ENCYCLOPEDIA
on Early Childhood
Development



Breastfeeding

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Synthesis

How important is it?

Breastfeeding is widely recognized as the recommended method of infant feeding worldwide. The World Health Organization (WHO) has identified exclusive breastfeeding as the optimal feeding regime for children. Exclusive breastfeeding refers to feeding the infant only breast milk—nothing else, not even water—for six months, followed by continued breastfeeding with appropriate complementary feeding up to and beyond two years of age.[1]

Breastfeeding has a positive impact on the infant, mother, parents and the health-care system; it also reduces the costs to society of raising healthy children who reach their full potential. For infants, breastfeeding can affect nutrition, growth and development, and offer protection from infection, allergies and some chronic diseases.

What do we know?

Breastfeeding has been shown to have a positive effect on the physical health of children, as well as their early behaviour and relationship with parents. Even long after breastfeeding has stopped, its influence can be seen in the child's emotional, intellectual and physical development.

To date, research has provided clear support for the nutritional and health benefits of breastfeeding. Breastfeeding has a major impact on rates of disease and death, particularly in developing countries. It protects against gastrointestinal and respiratory infections and is associated with a reduced incidence of childhood-onset chronic diseases, such as diabetes, celiac disease, Crohn's disease and some childhood malignancies. It also protects against allergies, with immunological protection continuing as long as the child is breastfed.

Breastfeeding can affect the early behaviour of infants and have a positive impact on the parents as well. Breastfeeding can result in closer parent-child relationships. Compared to formula-fed infants, breastfed infants may be more alert, cry less, and be better able to engage in interactions with their parents. Mothers who breastfeed have lower levels of perceived stress and negative mood and higher levels of maternal attachment; they also tend to see their children as more reinforcing compared to mothers who formula feed.

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Breastfeeding has been found to affect several aspects of children's development. Specifically, it has been shown to improve children's vision, an indication of breastfeeding's positive effect on the development of the central nervous system. Research indicates that breastfeeding also affects motor development: children who are breastfed show an earlier ability to crawl and perform the "pincer grip," after adjusting for potential confounding variables.

Breastfeeding plays a significant role in the social and emotional development of children as well. Research shows that children who have been breastfed are more outgoing, socially secure and more advanced on the developmental scales. Being breastfed exclusively for at least four months has been shown to have a positive effect on children's intellectual development, even when controlled for mothers' demographic variables.

Some positive effects associated with breastfeeding continue throughout a child's development, even after the feeding practice has ended. For instance, it has been consistently associated with prevention of childhood/adolescence obesity, a condition that can harm the child's self-esteem and socio-emotional development.

What can be done?

Investing in breastfeeding promotion is likely to lead not only to improved physical health but also to improved intellectual and psycho-emotional outcomes for children. Clinical services and public-health policies that promote exclusive breastfeeding for the first six months of life are likely to yield important benefits for early child development.

For breastfeeding practices to improve, there needs to be support at every level: supportive frameworks should exist within public policy, law, the health-care system, communities, families and friends.

At the highest level, we should develop a national policy that follows the WHO Code of Marketing (International Code of Marketing of Breast-milk Substitutes), which prohibits the marketing of breast milk substitutes on television, radio, or in print materials, as well as the distribution of free formula samples. There is also a need to fund further research on the impact of breastfeeding on psychosocial child development.

The legal system also has a role to play by supporting the WHO Code and through labour laws that promote working conditions consistent with six months of exclusive breastfeeding (such as

longer periods of paid leave, as well as child care and breast milk facilities at work).

Health-care facilities are in a unique position to teach new mothers good breastfeeding techniques. To help mothers initiate and maintain breastfeeding, health facilities where birthing takes place should adopt WHO and UNICEF's "Ten Steps to Successful Breastfeeding" as part of the International Baby-Friendly Hospital Initiative. In addition, well-trained, experienced peer-counsellors could carry mothers through the perceived problems of the first few weeks.

Breastfeeding promotions, both within the health-care sector and in the community as a whole, are also important. The most effective ones are comprehensive, combining prenatal group discussions with postnatal home visits.

At the broadest level, women need the social support of friends and family; we need to progress to a point where breastfeeding is accepted as a social norm and a part of life.

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Influence of Breastfeeding on Psychosocial Development

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Introduction

There is conclusive evidence that breastfeeding protects children against gastrointestinal and respiratory infections.[1] This obviously has major implications for child development, as children who become ill more frequently are unlikely to have optimal physical, intellectual and psycho-emotional development. However, relatively less is known about the possible influence of breastfeeding on the psychosocial development of children through its direct effects on brain development and through its association with preventing the onset of obesity, a major psycho-emotional risk factor for children and a major risk factor for debilitating chronic diseases such as cardiovascular disease and type 2 diabetes. Thus, the objective of this review is to summarize the evidence available in these areas. This review will not focus on the maternal-infant bonding hypothesis, as most studies in this area have serious methodological shortcomings that preclude drawing inferences and useful recommendations.[2]

Subject Relevance

Breastfeeding can influence the psychosocial development of children through different routes. First, breast milk contains bioactive substances such as long-chain poly-unsaturated fatty acids (PUFAs) that are crucial for brain development. Indeed, two PUFA derivatives known as arachidonic acid (AA) and docosahexaenoic acid (DHA) play crucial roles in the proper growth, development and maintenance of the brain.[3] In most parts of the world, infant formulas are still not fortified with these PUFAs. Thus, it is not surprising that breastfeeding has been consistently associated with improved central nervous system development, as indicated by improved visual acuity in relationship to formula-fed infants.[4] Second, both biological properties and differences in maternal-infant interactions during the feeding process can lead to improved motor and intellectual development outcomes.[5,6] Third, breastfeeding appears to be protective against the onset of childhood obesity,[7] a condition that has enormous psychosocial consequences for

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children. Given the implications of adequate physical and intellectual development for both individual and societal productivity and growth, this topic is of immense public-health significance.

Key Research Questions

This review concentrates on addressing the following five questions:

1. Is there a link between breastfeeding and intellectual development?
2. Does breastfeeding influence the motor development of children?
3. Can breastfeeding be used as an intervention to address the childhood obesity epidemic?
4. What are the possible mechanisms explaining these relationships?
5. What are the implications of these findings for public-health policies?

Key Research Results

Breastfeeding and IQ

Anderson et al.[8] conducted a meta-analysis (n=11 observational studies) to examine the impact of breastfeeding on cognitive development after adjusting for socio-economic confounders, including the level of maternal education. The unadjusted benefit in cognitive function (or Intelligence Quotient [IQ]) attributed to breastfeeding was 5.32 points (95% CI: 4.51-6.14). After adjusting for socio-economic confounders, the adjusted benefit in cognitive function declined to 3.16 points but it was still statistically significant (95% CI: 2.35-3.98). The age of cognitive testing ranged from six months to 15 years. These cognitive differences between breastfed and formula-fed infants were detected as early as two to 23 months of age and remained stable at subsequent ages. An interesting finding from this meta-analysis is that premature infants appeared to benefit more intellectually from breastfeeding than normal birth weight infants (5.18 points (95% CI: 3.59-6.77) vs. 2.66 points (95% CI:2.15-3.17)). These findings are very consistent with those from Lucas et al.[9] who randomly assigned premature babies to be tube-fed formula or human milk. Findings are also consistent with the multi-country randomized trial conducted by

O'Connor et al.[10] who found that supplementing infant formula with PUFAs (AA and DHA) was clearly beneficial for the visual and mental development of infants born prematurely, but not for infants born at term. The biological plausibility of this finding is high, as DHA and AA accretion in the fetus occurs until the last trimester of pregnancy.[8,10]

Breastfeeding and motor development

Although studies have consistently shown a positive relationship between breastfeeding and intellectual development, few studies have examined the association between infant feeding method and motor development. This is perhaps because in well-nourished populations, infants' motor development has not been identified as a useful predictor of intellectual function later in life. However, in malnourished populations motor development may be a useful predictor of subsequent human function.[5] A study conducted in Denmark[6] found a positive relationship between breastfeeding duration and an earlier ability to crawl and perform the "pincer grip" after adjusting for potential confounding variables. Data derived from two randomized trials with primiparous women from Honduras, one based on low birth weight and the other on normal birth weight infants, show that infants who were exclusively breastfed for six months (vs. four months) began to crawl earlier.[5] In addition, the normal birth weight trial showed that babies who were exclusively breastfed for six months were significantly more likely to be walking by one year compared with those who were exclusively breastfed for four months (60% vs. 39%).

Breastfeeding and childhood obesity

Dewey[7] has recently reviewed the literature on this topic and concluded that breastfeeding is likely to be associated with a reduction in the risk of child obesity to a moderate extent. Dewey reviewed 11 observational studies with adequate sample sizes and with children's obesity data beyond three years of age. Only one of the studies was longitudinal and all were conducted in industrialized nations in North America, Europe, Australia and New Zealand. Of these 11 studies, eight showed an inverse relationship between breastfeeding and child obesity after controlling for potential confounders. The three studies where such an association was not documented lacked data on the exclusivity of breastfeeding. Since Dewey's review was published, two additional studies have been published with somewhat inconsistent results,[11,12] although both studies lacked a clear definition of exclusive breastfeeding. These two studies highlight the need for more research in developing country populations and among ethnic minorities in developed countries. Although much work remains to be done in this area, particularly regarding the need

for well-designed longitudinal studies that allow for a clear description of different breastfeeding modalities, the preponderance of the epidemiological evidence strongly suggests a link between breastfeeding and the prevention of obesity in childhood and adolescence. The biological plausibility of these findings is also strong. First, individuals who were breastfed have a leptin profile that may promote adequate appetite regulation and less fat deposition. With regards to appetite regulation, Pérez-Escamilla et al.[13] showed that Honduran babies adjusted their milk intake volume in inverse proportion to the energy density of their mother's breast milk. It has also been proposed that the reason that the milk fat content toward the end of the feeding episode (i.e. "hind milk") is higher than at the start ("fore milk") of the episode is that it signals to the baby that the feeding episode is coming to an end. Obviously, formula-fed babies are not exposed to such "physiological signalling," as the fat concentration in formula remains constant throughout the feeding episode. A corollary of this is that among formula-fed babies, it is the caretaker and not the infant who controls the child's caloric intake. Second, breastfed babies gain less weight than formula-fed infants during the first year of life. Third, formula-fed babies have higher insulin levels circulating in their bloodstream as a result of the higher protein content in infant formula, which in turn may stimulate a higher deposition of fat stores. Fourth, it is possible that breast milk influences the development of a taste receptors profile that can foster a preference for lower energy diets later in life. We are still far from having conclusive evidence regarding the biological mechanism(s) that may explain a link between breastfeeding and the prevention of obesity. Clearly, these research efforts will require the establishment and funding of strong multidisciplinary partnerships involving biological, medical, public-health and behavioural researchers.

Conclusions

There is substantial evidence to support a possible link between breastfeeding and the psychosocial development of children. Breastfeeding has consistently been associated with improved cognitive scores and is likely to be able to prevent the onset of childhood/adolescent obesity, a condition that can seriously harm the child's self-esteem and overall psychosocial development. The biological plausibility of the intellectual development findings is high as: a) human milk contains bioactive compounds that are not typically present in infant formulas and are essential for optimal central nervous system development; and b) the mother-infant interaction during the feeding process can be substantially different for breastfed and formula-fed infants. Likewise, the obesity prevention findings are plausible, as individuals who were

breastfed babies may have been “programmed” early in life to be able to regulate their appetite better and have more optimal fat deposition patterns.

Implications

The findings summarized in this review have major policy implications, as they strongly suggest that investing in breastfeeding promotion is likely to lead not only to improved physical health but also to improved intellectual and psycho-emotional outcomes. Findings also indicate the need for funding further research in this area. In particular, we need to conduct well-designed longitudinal studies to find out if breastfed babies actually end up: a) performing better in school; b) having better psychosocial development, including improved self-esteem, and less aggressive behaviours; and c) being more productive members of society, and if so, how much of this effect is related to brain stimulation vs. morbidity prevention effects of breastfeeding. Furthermore, we need to improve our understanding of whether breastfeeding leads to better infant motor development, and if so, what are the implications for human function later in life. Once we answer these questions, then we will truly have a complete appreciation of the findings included in this review.

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Breastfeeding and Child Psychosocial Development

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Introduction

The effects of breastfeeding on children's development have important implications for both public-health policies and for the design of targeted early intervention strategies to improve the developmental outcomes of children at risk as a result of biological (e.g., prematurity) or social adversity (e.g., poverty). To date, research has provided clear support for the nutritional and health benefits of breastfeeding for the mother and child,[1] with appropriate cautions noted for women who are ill or on medication. There is also evidence of consistently positive effects of breastfeeding on intellectual development.[2-4] Less well studied is the relationship between breastfeeding and child psychosocial development.

Subject

Most research concerned with the psychosocial effects of breastfeeding is based on observational studies due to the ethical challenges of randomly assigning mothers to either breastfeeding or formula feeding groups. Thus, for these studies there is a clear reliance on either matching or statistical adjustment for the effects of other factors correlated with feeding method that may also influence child outcomes such as maternal IQ and/or parenting style. This body of research has focused on the following:

1. Comparisons between breast- and bottle-feeding mother-infant dyads on a range of maternal and infant measures, such as maternal stress, well-being, parenting behaviour, the quality of early mother-infant interactions and infant self-regulation and behaviour.
2. Examining differences in maternal mood, infant state, and dyadic interactions between breast- or formula-fed groups.
3. Examining linkages between the extent of breastfeeding and children's longer-term psychosocial outcomes, including attachment to parents, behavioural adjustment and

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mental health.

4. Adjusting these linkages for confounding factors correlated with both the decision to breastfeed and child outcomes.

In addition to the above, there has been one prospective study that has used a cluster randomization design.[5,6] This study known as PROBIT (Promotion of Breastfeeding Intervention Trial) recruited Belarusian mothers who gave birth at either a UNICEF Baby-Friendly Hospital that actively promoted breastfeeding (intervention group) or a hospital/clinic where usual care procedures were in place (control group). Their infants were then studied prospectively across a number of outcomes.

Problems

The key problems in this area of investigation are as follows:

1. Separating the effects of breastfeeding from other potential confounding factors associated with breastfeeding. Specifically, the decision of whether or not to breastfeed is related to socioeconomic status (SES), maternal mental health, education, attachment history and nurturance. These factors are also related to child development outcomes. Therefore, determining the unique effects of breastfeeding on child psychosocial outcomes has been difficult and not always adequately done.
2. Nutrition and health factors such as alcohol use and medication can reduce the quality of mothers' breast milk and adversely affect infant neurological state and mother-infant interactions. Therefore, controlling for breast milk quality is also important. Few studies have included such measures or controls.
3. Consideration is not always given to the effects of breastfeeding duration or the use of combined feeding methods on later psychosocial outcomes.
4. Considerable variability exists in the psychosocial outcomes studied and the length of developmental follow-up.
5. Finally and importantly, there is a need for more studies examining the mechanisms or pathways by which breastfeeding may influence children's short- and long-term psychosocial adjustment.

Research Context

Early research in this area was based predominantly on samples of mothers and infants living in developed countries. However, more recent studies have extended this work to developed and developing countries.[1] Research designs have included both cross-sectional and longitudinal approaches. Cross-sectional studies have used both retrospective and concurrent reports of maternal breastfeeding. With a few exceptions, longitudinal studies have tended to be of short duration. In both longitudinal and cross-sectional studies, outcome measures have included maternal interviews or reports, child interviews, and direct observations of feeding, play and other interactions between mothers and their infants. Longitudinal studies have included educational outcomes and parent or teacher completed screening measures of child emotional and behavioural problems. As noted above, ethical standards have meant that random assignment to feeding groups is rarely possible, making other methodological and analytical steps necessary to ensure that research outcomes are accurately attributed to the relevant factors under study.[7]

Key Research Questions

The key research questions in this area are as follows:

1. Does breastfeeding contribute to children's psychosocial adjustment both in the short and long term? Psychosocial outcomes of interest include the formation of a secure and close infant-mother attachment relationship, and child social and behavioural adjustment.
2. What are the mechanisms and pathways by which breastfeeding might influence child psychosocial outcomes?

Recent Research Results

Evidence suggests that a number of maternal and infant factors are associated with both the decision to breastfeed and the duration of breastfeeding. These factors vary a lot by setting, and especially between developed and developing countries. In developed countries, women who choose not to breastfeed and who breastfeed for a shorter length of time tend to be younger, less well educated, single mothers, are poorer, and to report lower levels of breastfeeding support.[1,8,9] In contrast, in developing countries, poorer women were more likely to breastfeed, and to breastfeed for longer periods of time.[1,10]

Additional reasons for deciding not to breastfeed can include concern about the quality and quantity of breast milk, and partner and family support, which are common across developed and

developing countries.[10,11] Women who decide not to breastfeed are also more likely to have smoked during their pregnancy, be primiparous mothers (i.e., having their first child), and to have a child born low birth weight or with complex health issues such as cystic fibrosis.[9,12] Prenatal and post-natal stressful experiences may also reduce the duration of breastfeeding.[13] Finally, several studies suggest that mother's who return to work within the first 6 months postpartum or anticipate an early return to full-time employment, are less likely to breastfeed. When they do, they are also more likely to feed their babies for a shorter length of time.[14-16] Hospital policies and staff practices that support breastfeeding, as well as social support from fathers, grandmothers and other breastfeeding mothers, can help alleviate misgivings and improve breastfeeding duration and quality.[16-18]

These findings clearly indicate that infant breastfeeding is a selective process, that varies depending on a number of individual, family and community factors. Thus it is important to understand how these individual and contextual barriers to breastfeeding can be addressed.[1] Furthermore, from a research perspective, it is important that these pre-existing differences between breast and formula feeding mothers and infant be taken into account by researchers when testing associations between breast milk feeding exposure and child psychosocial outcomes. It is also important to be careful to distinguish between those factors that are confounders, and those that might best be viewed as mediators or explanatory factors involved in accounting for observed associations between breastfeeding exposure and outcome, such as the quality of the subsequent mother-infant relationship. Although most studies reviewed have attempted to control statistically for some of these differences, very few have controlled extensively for an adequate range of potential confounding factors.

Findings from short-term outcome studies suggest that breastfeeding may have some psychosocial benefits for both mother and infant, as well as for their developing relationship. However, effect sizes tend to be small, with care experiences in both groups being very much within the normal range. Mothers who breastfeed have been found to report lower levels of perceived stress and negative mood, higher levels of maternal attachment, and tend to perceive their infants more positively than mothers who formula-feed.[9,19-21] There is evidence to suggest that breastfeeding mothers may also spend more time in emotional care and be more sensitive to infant emotional distress cues than bottle-feeding mothers.[22,23] Relatedly, a small fMRI study of 17 mothers in the first postpartum month, found that breastfeeding mothers showed greater activation in brain areas involved in empathy and bonding than formula-feeding mothers when listening to their own infant's cry.[24] These brain areas included the superior frontal gyrus, insula,

precuneus, striatum and amygdala. Greater activation in the right superior frontal gyrus and amygdala were further correlated with higher levels of maternal sensitive behaviour in a mother-infant interaction at 3 to 4 months. This is consistent with other studies demonstrating a link between breastfeeding and maternal sensitivity.[25,26,27] For example, in a longitudinal study of more than 1300 families in the USA, mothers who breast fed were observed to be more sensitive to their babies at 6, 15, 24 and 36 months.[27] Importantly, this difference persisted after statistical control for the effects of maternal mental health, the quality of the home environment in terms of infant health and stimulation and socioeconomic status. Finally, after breastfeeding, mothers also report reductions in negative mood compared to mood levels prior to breastfeeding.[20]

In terms of early infant behaviour, there is some suggestion that in the first few weeks of life breastfed babies may be characterized by improved alertness[28,29] and other aspects of neurobehavioural functioning.[30] For example, Hart et al.[30] found that one-week-old breastfed infants obtained significantly higher scores on the orientation and motor scales on the Brazelton Neonatal Behavioural Assessment Scale. In addition, they also tended have better self-regulation, fewer abnormal reflexes and fewer signs of withdrawal than formula-fed infants. Additional support for the possible self-regulatory benefits associated with breastfeeding is also provided by a short-term follow-up study of 158 infants.[31] This study found that between the ages of 13 and 52 weeks, breastfed babies consistently cried for shorter periods of time than formula-fed babies.

However, perhaps the most important question concerning the psychosocial benefits of breastfeeding concerns the longer term impacts on a child’s relationships with their mother/family, as well as their behavioural and socio-emotional wellbeing. At present, findings are mixed, with several studies suggesting some limited psychosocial benefits and others not. In with respect to the quality of mother-infant relations, a prospective longitudinal study of around 1000 young New Zealanders found a small but significant association between breastfeeding duration and adolescents' perceptions of maternal care, with a longer duration of breastfeeding being associated with increased adolescent perceptions of maternal nurturance.[9] This association persisted after statistical control for a wide range of the selection factors noted above. Another study of 2,900 Australian infants assessed at ages 1, 2 3, 5, 8, 10, and 14 years found that infants breastfed for 6 months or longer, had lower externalizing, internalizing, and total behaviour problem scores throughout childhood and into adolescence than never breastfed and infants fed for less than 6 months.[8] These differences remained after statistical control for the presence of both biological parents in the home, low income and other factors associated with poor mental health.

These findings stand in contrast to other observational and experimental studies that have failed to observe any positive effects of breastfeeding on children's longer-term socio-emotional adjustment.[6,32] For example, in a sample of more than 1000 breastfeeding mothers and children from Project VIVA who were followed from before birth into middle childhood (mean age 7.7 years), no associations were found between breastfeeding duration (exclusive in the first 6 months and non-exclusive in the first 12 months) and parent and teacher ratings of child behaviour scores after statistical control for maternal mental health, maternal intelligence, socio-demographic characteristics and early child care.[32] Similarly, no differences in emotional, conduct, hyperactivity, peer or prosocial behaviour scores on the Strength and Difficulties Questionnaire at age 6.5 years were found between infants whose mothers in the intervention and control arms of the large PROBIT cluster randomized controlled trial of breastfeeding promotion. Given the relatively young ages of children at follow-up assessment, longer term evaluations of these cohorts will be important to see if these findings remain as children enter the more behaviourally challenging late middle childhood and adolescent years when emotional and behavioural problems often become more pronounced. But in general, there is limited and no clear evidence that breastfed babies are at lower risk of developing behaviour or mental health problems in later life.

Mechanisms

Several possible mechanisms may account for possible links between breastfeeding and child developmental outcomes. First, breastfeeding is associated with a reduced risk of childhood illnesses including asthma, ear infections, diarrhea, respiratory disease, and dental carries, as well as improved immune function. Thus it is possible that caring for a healthier baby may offer greater opportunities for positive mother-infant interaction, and in turn a closer relationship. Relatedly for mothers, breastfeeding can have positive health benefits, including anti-inflammatory effects, increased sleep, decreased stress and possibly better mood, thus potentially helping to support parent engagement and care.[33] Second, it is also possible that the positive effects on child cognitive development may play a role. Third, maternal sensitivity and a closer early mother-infant bond as a consequence of increased mother infant contact associated with breastfeeding may also in part explain infant neurobehavioural outcomes in the short, and possibly longer term. Fourth, higher quality maternal interactions have been shown to improve brain development at 5, 10 and 24 months.[34] Fifth, there is growing evidence to suggest that the beneficial effects of exclusive breastfeeding may be moderated by the infant's genome,[35,36] and the metabolism of the fatty acids in maternal breast milk.[37] For example, Krol et al.[36] showed that

infants exclusively breastfed for a longer duration (above the 50th percentile) showed a heightened sensitivity and interest in a happy visual stimulus (eyes) than infants exclusively breastfed for a shorter duration (below the 50th percentile). The authors hypothesized that the mechanism of action was through the effect of breastfeeding on the mother and infant's oxytocin system, a neurohormone implicated in attachment and bonding that increases the salience of affective stimuli.[38] In a further study, children born to mothers characterized by higher levels of omega-3 fatty acid and docosahexaenoic acid early in pregnancy have been shown to be at lower risk of emotional, behaviour and peer problems at age 5-6, although these results were not specific to breastfeeding.[35] These findings highlight a number of interesting possible mechanisms. However, further research and replication is clearly needed.

Conclusion

Evidence supports a link between breastfeeding and positive mother-infant and neurobehavioural outcomes in the short term. However, the extent to which these early and relatively subtle differences translate into long term differences in psychosocial functioning is less clear. Breastfed infants may be more alert, cry less, and be better able to engage in interactions with their parents than formula-fed infants. Breastfeeding may also have some stress-reducing properties for mothers and assist parenting confidence. Further research is needed to clarify the longer-term benefits of breastfeeding, and potentially with behavioural rather than just questionnaire screening measures. The mechanisms by which these associations arise have not been fully established. However, maternal sensitivity and attachment fostered through breastfeeding is one possibility. Another explanation could be that associations between breastfeeding and improved mother-child relations may, at least in part, reflect improvements in child cognitive functioning and/or physical health associated with breastfeeding.

Implications for Policy and Services

1. There is ample justification for the value of breastfeeding from studies of the nutritional and cognitive advantages associated with breastfeeding, as well as the psychosocial benefits. Increasingly, this information is being incorporated into strategies to promote breastfeeding.
2. Although some research is establishing a relationship between breastfeeding and improved psychosocial functioning, a large number of parent and family factors have also been shown to predict child psychosocial maladjustment. These include teenage motherhood, maternal

educational under-achievement, poverty, parental antisocial behaviour and other mental-health problems, prenatal stress and maternal health, family violence, child abuse and parenting difficulties. Therefore, in order to reduce rates of behavioural and mental health problems among children and youth, broad based community and family intervention strategies, that encourage breastfeeding amongst other strategies, are likely be the most effective approaches.

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Nutrition and Its Impact on Psychosocial Child Development: Perspective on Preterm Infants

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Introduction

Early nutrition, both the amount and the quality of nutrients, is increasingly recognized as having a major influence on the growth and development of preterm infants. Importantly, inadequate early nutrition may profoundly impact preterm infants' neurodevelopment causing impairments in educational and cognitive competency throughout childhood and young adulthood.[1,2] This paper will highlight new research that links specific aspects of nutrition in early life with benefits for early growth and brain function in preterm infants.

Subject

While breastfeeding is associated with optimal neurodevelopment and mother's own milk is universally recommended for preterm infants,[3-5] mothers may elect not to breastfeed or their milk supply is insufficient to meet the baby's needs. If mother's milk is not available, preterm infants are usually fed with commercial formula designed to meet their nutritional needs. However, donor human milk is now being advocated as a substitute for infant formula for in-hospital feeding,[4,6] potentially providing another source of the special components of human milk that are associated with benefits to neurodevelopment.

Problems

Research has consistently found that preterm infants who are fed their mother's milk early in life have greater visual acuity, language skills and developmental outcomes (up to 24 months of age) than do a comparable group of infants fed cow milk-based infant formula or even donor human milk.[3,4,7,8] Further research is necessary to define the specific nutrient(s) and/or socio-environmental factors related to feeding practices that may explain the observed developmental advantages associated with feeding mother's milk.

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Research Context

Due to ethical constraints, there are no randomized controlled trials (RCT) comparing the neurodevelopmental outcomes in preterm infants fed mother's milk versus formula or mixed feeding. However, reviews of prospective and retrospective data are consistent with an overall beneficial effect of mother's milk on brain development and cognitive functioning into childhood compared to infant formula.[4,9] Since required processing of donor milk renders it different to mother's milk, a separate assessment of the effect of donor milk compared to mother's milk on neurodevelopmental outcomes is needed.

Over the past two decades, research has focused on long-chain polyunsaturated fatty acids (LCPUFA), particularly docosahexaenoic acid (DHA) and arachidonic acid (AA), as the factors in mother's milk responsible for neurodevelopmental benefits. DHA and AA play a key role in the structure and function of retinal (eye) and neural (brain) tissues. Preterm birth disrupts the most significant accretion of DHA and AA that occurs during the second and third trimester. Thus, preterm infants must receive these fatty acids in their diet after birth due to insufficient endogenous synthesis.[10] Studies on the effect of LCPUFA on neurodevelopmental outcomes have had inconsistent results due to many variations in study design. Despite current standard practice in many countries that infant formula products contain DHA and AA, cognitive, language and motor advantages still appear to be greater in infants fed mother's milk compared to formula supplemented with LCPUFA.

Key Research Questions

The key research question is whether feeding preterm infants their mother's own milk benefits neurobehavioural development, which in turn, affects intellectual programming and social behaviour; and if so, by what mechanism (nutrients and/or feeding behaviour). If nutrients unique to human milk are found to confer neurobehavioural benefits, then the sequential research question is which (if any) of these factors are inactivated or destroyed during the processing (heating, freezing, thawing) of donor milk. Accordingly, it must be determined whether components labile to processing can be added back to donor milk or infant formula in amounts that will support the same developmental benefits as in fresh mother's own milk.

Recent Research Results

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Mother's milk: The observed positive benefits of breastfeeding compared to formula feeding on short-term visual and developmental outcomes are summarized in several reviews.[4,7,9,11] Persistent beneficial effects of mother's milk during the early postnatal period on cognitive functioning are apparent for preterm infants up to 18,[8] 24[3] and 30 months of age.[12] A dose-response effect for mother's milk has been described in preterm infants, where each 10 mL/kg/day increase in mother's milk results in a 0.59 point increase in the Mental Developmental Index (MDI), a 0.56 point increase in the Psychomotor Developmental Index and the total behaviour percentile score increased by 0.99 points.[12] However, sometimes it is difficult to compare findings across studies due to differences between studies in partial and exclusive breastfeeding, use of fortified and unfortified human milk, differences in the type of cognitive assessments and the age at which they were conducted.

Donor milk: Fresh mother's own milk contains many components that may directly or indirectly facilitate the growth and development of the nervous system.[4] Awareness of the benefits of mother's milk has led to the increased use of donor milk. However, recent studies revealed that donor milk does not confer benefits to neurodevelopment compared to formula in preterm infants. In a recent Canadian RCT (n=363), donor milk-fed preterm infants did not achieve higher cognitive composite scores at 18 months' corrected age compared to formula-fed infants.[5] Furthermore, language and motor composite scores were not different between donor milk and formula-fed infants. Pooled data from a Cochrane systematic review of 9 studies (n=1070) also supports the fact that donor milk does not confer any neurodevelopmental advantage over formula.[13]

LCPUFA supplements: Evidence is inconsistent regarding whether LCPUFA supplementation in early life provides a cognitive advantage in infancy and later childhood. On the positive side, preterm infants who received mother's milk supplemented with DHA and AA compared to mother's milk alone from birth to 9 weeks of age had better recognition memory and higher problem-solving scores at 6 months of age.[14] Further, breastfed preterm infants with higher circulating DHA levels at 4 weeks of age had improvements in psychomotor development at 5 years of age.[15] In contrast, in a large multi-centre RCT (n=657) in Australia, the MDI at 18 months corrected age did not differ in infants supplemented with DHA versus those receiving a standard diet.[16] In the same cohort at 7 years of age (n=604), DHA supplementation did not result in any improvements in overall IQ scores.[17] Interestingly, in a subgroup analyses girls in the high-DHA group showed improvements in the MDI scores at 18 months of age[16] but at 7

years of age had poorer parent-reported executive function and behaviour.[17] Thus, LCPUFA supplementation may accelerate the pace of neurodevelopment in preterm infants without offering any significant advantage in overall developmental outcome, as suggested by a recent systematic review and meta-analysis of 11 RCTs and 2272 participants.[18]

Research Gaps

The specific factor(s) in fresh mother's own milk that confers a developmental advantage for preterm infants remains to be identified. If it is not a specific neurotrophic factor in human milk that contributes to improvements in neurodevelopmental outcomes, thought should be given to how the nutrition source (mother's own milk, donor milk, formula) may be influencing other neonatal morbidities[19] (i.e., extended periods of parenteral nutrition, sepsis, necrotising enterocolitis, bronchopulmonary dysplasia, etc.) that could interfere with neurodevelopment.

Conclusions

Studies published to date provide evidence that mother's own milk confers a developmental advantage when compared to infant formula in preterm infants, but it is not likely that LCPUFA are solely responsible for this benefit. It is absolutely essential for brain and retinal development that preterm infants receive target amounts of LCPUFA (comparable to in utero accretion rates), but there is no strong evidence to support dietary supplementation with high levels of LCPUFA to improve cognitive, language or motor functioning.

Given that some studies have reported no difference in neurodevelopmental outcomes between donor milk and formula (with/without LCPUFA), it is possible that the beneficial effects of human milk are specific to mother's own fresh milk. A consensus on whether donor milk confers any neurodevelopmental advantage over formula is needed, and if it can be considered comparable to mother's own milk.

Implications for Policy and Services

Despite lack of supporting evidence, pregnant and breastfeeding mothers are increasingly encouraged to supplement their diet with LCPUFA to optimize brain development in their offspring. Clear guidelines that detail sufficient, but not excessive, intakes need to be established and communicated to mothers. Recent results suggest that high levels of omega-3 LCPUFA in the perinatal period may even have a negative impact on behaviour[17] and respiratory health in

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preterm infants.[20] Other long-term morbidities potentially associated with LCPUFA supplementation may not be apparent yet given that many of the LCPUFA supplementation trials over the past decade have not had lengthy follow-up periods.

Development of infant nutrition products specifically for preterm infants should consider the influence of specific nutrients on neurodevelopment and not just somatic growth. In order to adequately assess the efficacy of the macronutrient balance, micronutrient levels and other neurotrophic ingredients on neurodevelopmental outcomes, tests are needed that are more sensitive to diet-induced alteration in behavioural and cognitive functions, both in early life and at school age.

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Programs to Protect, Support and Promote Breastfeeding

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Introduction

The importance of breastfeeding is widely acknowledged and referred to in several other papers in the Encyclopedia on Early Childhood Development. Dewey (Nutrition: Facilitating improved nutrition for pregnant and lactating women, and children 0-5 years of age) cites some of the best literature on the relationship between breastfeeding and maternal and child health, including the available evidence for the impact of breastfeeding on child development.[1]

The impact of breastfeeding on early childhood development is being increasingly recognized. For example, the United Nations Children's Fund, UNICEF, includes breastfeeding under the broader department dealing with Early Child Development. The World Health Organization (WHO) defines optimal breastfeeding as exclusive breastfeeding for six months, followed by continued breastfeeding with appropriate complementary feeding up to and beyond two years of age.

Subject

How can breastfeeding best be protected, supported and promoted? These are complex concepts and the steps required to implement them are even more complex. In theory,[2] the establishment of systems to protect existing breastfeeding practice deserves priority, from both the human rights and economic perspectives. Second, priority should go to providing the social, economic, work-place, nutritional, lactation-management and "moral" support women need to meet their breastfeeding objectives. Only once such mechanisms are in place is it rational and defensible to "promote" breastfeeding to help convince women to increase the duration and intensity of their breastfeeding.

Of course, this is viewing "promotion" from a narrow perspective. Information on both the benefits and the successful practice of breastfeeding should always be provided as each

generation of new mothers comes of age and requires such information. Indeed, this is obligatory in countries that have ratified the International Convention on the Rights of the Child.[3] There is also increasing agreement that such information should actually not take as its point of departure artificial feeding as the norm, and thus should provide health workers and mothers not with a "breast is best" message, but with objective evidence of the harm and risks inherent in feeding infants less than optimally. (It should be pointed out that such evidence is far from complete, especially regarding breastfeeding in economically well-off circumstances for periods longer than a year or in such circumstances, exclusively for more than four months.)

Problems

Though a traditional practice everywhere, and nearly universal for long periods of time in low-income countries (and, for shorter periods, in most of Scandinavia and parts of Canada (SPC)), breastfeeding in the modern world is not automatic. Many ideas and practices associated with modern life seem to work against it. Thus continuing efforts to protect, support and promote breastfeeding may be required, at least until it becomes the social norm.

Research Context and Recent Research Results

The concept of exclusive breastfeeding is new and the practice (giving breast milk and nothing else, not even water, to an infant from birth until six months of age) is not traditional anywhere. The theory and first experimental evidence that breastfed infants did not need additional water were first described by Almroth in 1978.[4] After several studies confirmed this theory, the WHO produced an update in 1997 warning health-care professionals not to give breastfed infants water and teas. Based on a systematic review,[5] the WHO also recommended six months of exclusive breastfeeding. Thus, there has been little time to research the health implications of longer periods of exclusive breastfeeding (rare almost everywhere except for SPC), nor the methods of promoting and supporting this practice beyond the early weeks of life.

Best Practices

Protection

Probably the first "code of marketing" to protect breastfeeding from commercial forces was promulgated in the United States;[6] unfortunately, it is not respected by North American formula manufacturers who do not market other products through medical professions. The International

Code of Marketing of Breast-Milk Substitutes[7] and later relevant World Health Assembly Resolutions continue to be the backbone of efforts to protect breastfeeding throughout most of the world, in spite of continued milk company promotional activities.[8] This unique Code is the basis for comprehensive marketing laws in more than 20 countries and less comprehensive laws in over twice that many. Due to the bad publicity they risk, most international companies abstain from consumer advertising in most other countries as well.

As for other products, marketing activities of commercial infant foods would not be undertaken if they did not lead to rising sales. Proving their impact has been difficult and few studies have even been attempted. Women's recollection of having heard advertisements (controlling statistically for levels of brand familiarity, among other things) was associated with a shorter period of exclusive/predominant breastfeeding in St. Vincent.[9] The use of commercial discharge packs in the U.S. has also been associated with shorter periods of exclusive/predominant breastfeeding.[10]

It is by definition impossible to evaluate the impact of ongoing worldwide efforts to monitor and uphold the Code by the WHO, UNICEF and NGO networks, particularly the International Baby Food Action Network (IBFAN) and the World Alliance for Breastfeeding Action and its core partners.

Support

At the broadest level, women need the support of society as a whole, acceptance for breastfeeding as being a social norm, a part of life and a normal extension of the reproductive process after pregnancy. This kind of social norm was lost in most of the wealthier countries of the world, but has now been restored in SPC. Much of the rest of Europe and North America is currently making efforts to promote the restoration of their earlier breastfeeding cultures. However, without some of the support measures described below, success seems unlikely.

While it is "natural," breastfeeding is not instinctive on the part of the mother. Though several breastfeeding behaviours are instinctive for infants, a small proportion of infants or mothers get part of it wrong without help. A body of evidence has been built up for how best breastfeeding counselling and "lactation management" should take place, and several international courses (including one available from WHO[11]) and an international program for certification (International Board of Lactation Consultant Examiners[12]) have been established.

Every health facility should have staff members or consultants available who possess the requisite lactation management knowledge and skills. Such knowledge and skills are not included in the basic training of any health professionals, although midwifery training in some countries may come close.

Furthermore, health facilities where birthing takes place should adopt WHO and UNICEF's "Ten Steps to Successful Breastfeeding" as part of the International Baby-Friendly Hospital Initiative. The changes required in hospital practice are well documented scientifically, particularly the importance of early initiation of breastfeeding, avoidance of unnecessary supplementation with glucose and other substances, and rooming in (babies sleeping with their mothers rather than in a "nursery").[13]

The International Labour Organisation (ILO) has passed three Maternity Protection Conventions, the latest, Convention 183 of 2000, with Recommendation 195.[14] Only nine countries have ratified it so far (mid-2004).[14] A long period of paid leave (R195 recommends 18 weeks but SPC offer much longer periods) is no doubt the best way to give working women the opportunity for exclusive breastfeeding. Offering child care and breast milk expressing facilities at the workplace is another. The problem remains especially acute throughout the world for women working in the informal sector, who often have no maternity protection whatsoever and can even lose their jobs when pregnant.

Many studies have shown that various other kinds of support from the baby's father, family and friends are crucial in helping women achieve optimal breastfeeding patterns.[15] In addition, exclusive breastfeeding cannot be achieved in most countries without addressing the widespread myths that lead to the pressure placed on mothers[16] to follow various non-exclusive patterns of feeding that are normative all over the world.[17]

Seen as a whole, it is equally impossible to evaluate the impact of providing the many forms of support women need to achieve optimal breastfeeding patterns. Indeed, very few if any intentional national-level efforts have attempted to be comprehensive, with the possible exception of Brazil, which has, for more than 20 years, implemented a comprehensive range of efforts with undoubted impact on its breastfeeding rates – though much still remains to be done even there.[18,19,20]

Promotion

Evaluations have been performed of many ways of promoting breastfeeding, ranging from the provision of a simple brochure or verbal message to breastfeed, to integrated health-systems and community-based approaches. A review of 23 experimental and 31 quasi-experimental studies concluded that the most effective approaches to promoting breastfeeding through the health-care system were fairly comprehensive, combining prenatal group discussions with postnatal home visits.[21] Pugin et al[22] found that adding to several other interventions "prenatal group educational sessions emphasizing the skills necessary to initiate and maintain breastfeeding past the neonatal period" led to a significantly higher number of women still breastfeeding at six months.

A recent review for the U.K. National Health Service[23] examined evidence from two high-quality systematic reviews regarding interventions proven to increase the initiation of breastfeeding (and thus relevant mainly to areas where initiation is low). The review concluded that comprehensive approaches, both within and outside the health-care sector, were most likely to be effective, including use of the mass media and of peer counsellors.

It is difficult to "tease out" exactly which aspects of complex promotional programs have had an impact and which have not. De Oliveira et al.[21] found that "Small-scale short interventions, brief breastfeeding messages given amongst other topics and isolated use of printed matter all showed no effect. Most strategies with no or brief face-to-face interaction failed to produce significant results."

Peer counselling is the intervention that has attracted the most attention in recent years, perhaps in response to a few trials that have achieved dramatic impacts on exclusive breastfeeding rates in some developing countries.[24,25,26] In industrialized countries, outcomes of peer counsellor evaluations have been more mixed, as have reports from unpublished trials in developing countries. More research is needed to determine which characteristics of peer counsellors and of programs using them are most associated with Program success.

Conclusions

Optimal breastfeeding behaviours, although associated with enormous health benefits, especially in developing countries,[27] are demanding for mothers to implement and complex to promote programmatically. It seems unlikely that simplistic approaches that address only one aspect would be effective. Efforts need to address protection, support and promotion issues, both within

the health-care sector and in the community as a whole.

Comprehensive advice to policy-makers on policies and programs for achieving optimal infant feeding has been provided by WHO in the recently approved Global Strategy on Infant and Young Child Feeding.[28] Among other things, countries are advised to establish intersectoral breastfeeding committees and appoint a coordinator. Both resources and responsibility need to be allocated before the protection, support and promotion of breastfeeding can succeed.

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Supporting Breastfeeding/Early Childhood Social and Emotion Development

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Introduction

Babies were born to be breastfed. This is the tagline for the recently released universal campaign to promote breastfeeding. Breastfeeding is the best nutrition for all infants because of breast milk's unique properties.[1] It is more than just good nutrition[2] as it offers infection protection,[3] immunologic protection[3] and protection against allergies, but most important is its impact on physical[4] and mental development. Breastfeeding results in reduced incidence of common infections such as diarrhea, otitis media and pneumonia.[5] It is associated with a reduced incidence of childhood-onset diabetes, celiac disease, Crohn's disease and some childhood malignancies.[6] More recent work suggests that breastfed infants are less obese in infancy and later childhood.[7] Mothers who breastfeed have a more physiologic postpartum recovery and a lower incidence of breast and ovarian cancer, osteoporosis and obesity.[8]

The very process of breastfeeding brings a closeness and intimacy between mother and infant that enhances the bond between them.[9] The World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF), World Alliance for Breastfeeding Action (WABA), and the professional societies of pediatricians,[10] obstetricians and family physicians and the Institute of Medicine (IOM)[11] all embrace breastfeeding exclusively for six months. They further recommend continuing while adding weaning foods for the next six months and then as long thereafter as mother and child wish.[12]

Subject

Breastfeeding plays a significant role in the social and emotional development of the child. Over 40 years ago, Niles Newton published the first observations on the difference at age three between children who had been breastfed beyond six months and those who had been bottle-fed since birth.[13] The children who had been breastfed were more outgoing, socially secure and more advanced on the developmental scales. The mothers were matched for age, parity, education and

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social status. Subsequent studies by many investigators have established the fact that breastfeeding also affects intellectual development.[14-22]

Problems

Given the tremendous advantages of breastfeeding for both infant and mother, why do mothers not choose to breastfeed, or why do they discontinue breastfeeding before the recommended goals of six months of exclusive breastfeeding and at least another six months continued breastfeeding? The common explanation is a need to return to work or other activity outside the home, such as school.

Research Context

Studying breastfeeding behaviours or outcomes is difficult since it is not possible to randomly assign mothers and infants to treatment groups or to control the duration of the process. Critical to any study format for breastfeeding is the very definition of the process. Many studies looking at health outcomes have included infants with any breastfeeding, for example, a few days or weeks, in the same category with infants breastfeeding exclusively for six months, thus diluting the measurable impact. By breastfeeding, we mean exclusive breastfeeding with no other fluids or foods for the first six months. Partial breastfeeding is mostly breastfeeding but with the addition of occasional bottles of formula, water, juices or herbal teas. Other infants are given part breast milk and part formula, still others are given more formula than breast milk. For research purposes, these definitions have been established.[23]

Epidemiologic studies of large groups of children who have been breastfed with a comparison group of children who have been bottle-fed is a model applied to studies attempting to measure the developmental outcome of infants. Critical to the interpretation of these results are the demographic variables, such as maternal age, parity (the condition of a woman with respect to having borne viable offspring), race, socioeconomic status and education. The outcomes have predominantly measured illness as an endpoint or intellectual development. Equally important issues are social adjustment, interpersonal relationships and social maturation.

Mother-infant interaction is described by Newton in unrestricted breastfeeding.[13] The breast is used not only to assuage hunger but also to assuage all types of discomfort and fears. Distress signals are answered by mouth – nipple contact and body contact. In the older child, the whole body reacts to nursing. In animal studies when pups are rotated from mother to mother, there

were significant increases in emotionality and distress.[24]

Research Questions

Key questions that need clarification are the impact of being breastfed in terms of not only developmental milestones but psychological development, maturity, self-assuredness, assertiveness and behavioural adaptations as compared with the impact of being bottle-fed on these parameters.

The effect of breastfeeding on mothers is also an important question. Although it is said that mothers who breastfeed are not different, breastfeeding makes them different by the very relationship, physically and psychologically.[8,25,26]

Recent Research Results

Being breastfed exclusively for at least four months has been shown to have a positive effect on the intellectual development of children even when controlled for the demographic variables, especially socioeconomic status (SES) and education of the mother.[14-22] The nutrient advantages of human milk coupled with the mother-infant relationship provide the matrix for the child to reach his/her full intellectual potential.

Contrary to the belief that extended breastfeeding makes the children very dependent upon their mothers, it actually makes them more secure and allows for social growth.[27]

If the studies of intellectual development and visual and auditory acuity are examined more closely, there is some suggestion of social maturity or behavioural characteristics. In Horwood's long-range study that followed children from birth to 18 years or the completion of high school, breastfed children were rated as more cooperative and socially better students the longer they were breastfed.[17] When drop-out rates were calculated, the rate was higher among children who had been bottle-fed and lowest among those who had been breastfed equal to or longer than eight months, even when data were adjusted for maternal demographics.

The New Zealand investigators actually reported on the later psychologicaladjustments using measurements between the ages of 15 and 18 years.[17] Beginning from birth to one year, breastfeeding practices were carefully described in 999 mother-infant pairs. A sample of children 15 to 18 years of age were assessed using a range of psychosocial measures including parent-child relationships, juvenile delinquency, substance abuse and mental health. The children who

were breastfed longer (greater than four months) were more likely to report higher levels of parental attachment. They also perceived their mothers as being more caring and less overprotective of them compared to their bottle-fed peers. The subsequent rates of juvenile offending, substance use and mental health were factored with maternal age, education and SES. The authors concluded that extended breastfeeding is not associated with mental health risks but breastfeeding can result in closer parent-child relationships.[17] Doubt of the relationship between breastfeeding and cognitive development led to a meta-analysis of 20 studies. After adjustment for 15 appropriate key factors (including maternal age, education, race, ethnicity, SES, family size and childhood experiences), breastfeeding was associated with significantly higher scores for cognitive development than formula feeding. A difference of 3.16 points was measurable through 15 years.[17] A casual observation regarding reactions to such data demonstrates anger in individual mothers who protest that their bottle-fed infants turned out fine and went to college and graduate school. It is important to point out that a child with a genetic potential for an IQ of 150 will probably not notice a 3.4 point deficit. A child with a potential for an IQ of 100 would benefit from 3.4 points. In other words, breastfeeding allows an infant to reach his/her full potential.

In a study of a homogeneous (similar age, SES and education) population where mothers had a favourable environment and most infants were breastfed, the duration of breastfeeding clearly made a difference in cognitive development at 13 months and five years. The longer the breastfeeding continued, the higher the developmental scores.[15]

While there are no formal studies, it is apparent from a review of the child abuse literature that women who breastfeed their infants are not identified as abusing them. The question of infant feeding methods is an important parameter when evaluating a case of child abuse.

Conclusions

Breastfeeding makes a difference for the infant in issues of nutrition, growth and development, as well as protection from infection, allergy and some chronic diseases. The impact of breast milk and the process of being breastfed enhance intellectual development and the mother-infant relationship for the infant. The psychosocial development of the infant is more advanced the longer the child is breastfed during the first year of life. There are no data to measure the benefits of extended breastfeeding, although it is known that immunological protection continues as long as the child is breastfed.

Maternal benefits of breastfeeding have been established in the realm of better postpartum recovery and decreased risk of long-term obesity, osteoporosis and breast and ovarian cancer. The impact on mothering skills and attitudes has not been investigated since the work of Newton and Newton, 1950-1960.[13,24] The physical closeness of mother and infant in the process of breastfeeding allows eye-to-eye contact and precipitates characteristic behaviour described in the bonding process by Klaus and Kennell.[25] The physiologic process of let-down when the nipple is stimulated releases maternal oxytocin and prolactin, which enhance mothering behaviours in all species tested and in most species, both male and female.[13]

Implications

Implications of breastfeeding are important for the infant, mother, both parents, the health-care system and the costs to society of raising healthy children who reach their full potential.[28]

Encouraging women to breastfeed exclusively for six months, continue for the next six months while adding weaning foods and then as long thereafter as mother and infant choose should be standard advice, reflecting the recommendations of WHO, UNICEF, and the Innocenti Declaration.[29] The national policy should follow the WHO code of marketing, which forbids marketing of breast milk substitutes on television, radio or in print materials and prohibits the giving of free formula samples.

One of the most difficult hurdles for women is to continue breastfeeding once they leave the supportive environment of the hospital. The health-care system needs to provide a more substantive support system, beginning with well-trained experienced peer-counsellors to carry mothers through the perceived problems of the first few weeks. Having a baby changes one’s life, and current culture in modern cities just does not provide the network of support mothers need.

Not everything is known about breastfeeding’s impact on the mother and infant. Well-designed studies patterned after the early observations and projections of Niles Newton[13] would bring the process forward to greater understanding. Parenting is influenced by breastfeeding but needs to be understood in relationship to behaviour, social adaptation and social understanding of the infant.

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Breastfeeding Promotion and Early Child Development: Comments on Woodward and Liberty, Pérez-Escamilla, Lawrence, and Greiner

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Introduction

Breastfeeding has been reported to have a number of health advantages for both the mother and the child, some of which are more solidly established than others. The evidence that breastfeeding protects against gastrointestinal and respiratory infection is strong and consistent, with major implications for morbidity and even mortality, particularly in developing-country settings. Because these infections rarely have life-and-death consequences in industrialized countries, however, the major recent focus in such countries has been on the potential role of breastfeeding in protecting over the long term against adult chronic diseases (including obesity, coronary heart disease and both type 1 and type 2 diabetes), and specifically, its potentially beneficial effects on neurocognitive development and behaviour. Because of the practical and ethical difficulties in randomizing healthy human infants to be breastfed vs. formula-fed or to different durations or exclusivity of breastfeeding, the scientific evidence bearing on these outcomes is based almost exclusively on observational (non-experimental) studies. It is in this context that the papers by Woodward and Liberty, Pérez-Escamilla, Lawrence, and Greiner have attempted to review the available evidence. The first three of these four papers summarize the literature linking infant feeding to early child development, while the fourth focuses on health services and policies to protect, support and promote breastfeeding in developed-country settings.

Research and Conclusions

In their paper, Woodward and Liberty point out the difficulty of making causal inferences in observational studies due to potentially confounding differences in maternal mental health and “nurturance,” which can affect feeding choice and can also have causal influences on child

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development independent of infant feeding. Although the authors claim that random assignment of two different feeding groups has not been possible, such an experimental study has indeed been carried out by Lucas and his colleagues, who compared banked human milk, preterm formula and term formula given to preterm infants; the results indicate improved cognitive development in those who received banked breast milk.[1] The authors cite studies suggesting emotional benefits for the mother who breastfeeds, improved maternal-infant attachment, improved alertness and orientation of the infants, and reduced duration of crying (although the latter has not been supported by other studies). The authors point out the limited evidence bearing on long-term benefits for behaviour and mental health of the offspring. They also state that maternal alcohol and medication use reduce the quality of the breast milk and may thereby adversely affect infant behaviour, but to my knowledge, the doses ingested through this route have not been linked to such adverse effects.

Pérez-Escamilla briefly reviews the rather consistent finding of higher IQs in breastfed infants, even after adjusting for socioeconomic status (including maternal education). Although he emphasizes the potential etiologic role of long-chain polyunsaturated fatty acids (LCPUFAs) in explaining this effect, Cochrane reviews suggest the evidence is not so clear-cut, either in term[2] or preterm[3] infants. As Pérez-Escamilla points out, data regarding breastfeeding and motor development are few and even less conclusive. He concludes with a review of the evidence suggesting that breastfeeding has a long-term protective effect against obesity and speculates that such a protective effect may be due to improved appetite regulation resulting from the rising fat concentration during breastfeeding. Pérez-Escamilla concludes by calling for more research on some of the school/academic and long-term behavioural and psychosocial developmental outcomes in breastfed vs. formula-fed infants.

Lawrence reviews some of the same evidence bearing on breastfeeding and neurocognitive development and evidence from the long-term New Zealand cohort study suggesting an improved parent-child relationship. Like the authors of the previous two papers, Lawrence makes the claim that “it is not possible to randomly assign mothers and infants to treatment groups or to control the duration of the process.” In fact, however, Morrow et al.[4] in Mexico, Dewey and her colleagues in Honduras[5,6], and we in Belarus[7] have all managed to experimentally allocate groups of mothers and infants to experimental vs. control interventions that affect the duration and/or and exclusivity of breastfeeding. And as already mentioned, Lucas and his colleagues randomly assigned a group of preterm infants to banked human milk vs. preterm

formula vs. term formula.[1] Experimental designs are therefore possible in this domain and probably should be used more frequently in future investigations.

Finally, Greiner's paper focuses on clinical- and public-health policies that protect, support and promote breastfeeding. He appropriately emphasizes the importance of the World Health Assembly's International Code of Marketing of Breast Milk Substitutes and of political "climate," maternal employment policy and the WHO/UNICEF Baby-Friendly Hospital Initiative (BFHI). Unfortunately, Greiner fails to cite some of the best evidence available on this topic, i.e. evidence from randomized controlled trials and meta-analyses of randomized trials. Based on this evidence, some of the interventions he advocates are far better supported than others. The evidence favouring on-demand feeding, hospital rooming-in and postnatal support is strong.[8,9] On the other hand, trials of glucose or formula supplementation suggest no detrimental effect on breastfeeding duration.[10-12] Greiner correctly points out how difficult it is to "tease out" the precise components of complex promotional programs that have an impact. But countries like Norway and Sweden have shown what can be achieved with active enforcement of the international code, enlightened maternal-leave policies and widespread societal support for breastfeeding.

Implications for Services

Clinical services and public-health policies that favour the initiation, exclusivity and duration of breastfeeding are likely to yield important benefits for early child development. Benefits have been reported both in preterm and in healthy term infants, but whether they are due to biological components (e.g. LCPUFAs) in human milk or to the enhanced maternal-infant interaction accorded by breastfeeding is unclear. Although the magnitude of the beneficial effect is small at the individual level, the potential impact on the overall population of infants and young children is of major public-health importance. Countries like Norway and Sweden have shown that clinical and societal support for breastfeeding can yield enormous dividends.

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Breastfeeding and Its Impact on Child Psychosocial and Emotional Development: Comments on Woodward and Liberty, Greiner, Pérez-Escamilla, and Lawrence

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Introduction

Breastfeeding is the recommended method of infant feeding worldwide. While the nutritional and immunological advantages of breastfeeding are well documented,[1] consistent study results concerning the psychosocial benefits are more elusive. The pathways by which breastfeeding affects psychosocial and emotional development are difficult to disentangle and are not always uni-directional. Confounding variables, such as maternal education, are closely associated with the practice of breastfeeding, yet are also determinants of psychosocial development.[2,3] Environmental factors interact with biological determinants, modifying their observed effect on development. For example, Engle et al.[4] suggest that maternal vocalization patterns may differentially modulate the influence that child nutritional status has on cognitive development. Further, Pollitt postulated that not only do environmental factors (such as vocal stimulation) have a direct and modifying effect on children's development, the reverse is also true – a developmentally advanced child elicits more stimulation from a caregiver.[5]

Three of the four papers presented here discuss the research challenges in distinguishing the effect of breastfeeding on the social and emotional development of young children. These papers focus on maternal-infant attachment, social and behavioural adjustment, and cognitive development as indicators of psychosocial development. The fourth paper, by Greiner, discusses the social practices that will help optimal breastfeeding behaviours to become the social norm.

Research and Conclusions

Woodward and Liberty review many of the challenges of research on psychosocial development. There are a wide range of psychosocial outcomes that span from the neonatal period (e.g. early

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maternal-infant interactions) to later childhood and adolescence (e.g. behavioural adjustment). In addition, a variety of group comparisons can be made: breastfed versus bottle-fed, before versus after an episode of breastfeeding, or by duration or pattern of breastfeeding. Importantly, Woodward and Liberty identify as key research issues the distinction between short-term and long-term effects and the mechanism by which breastfeeding may influence psychosocial development. Woodward and Liberty demonstrate the complexity of the mechanistic pathway in their example of the influence of breastfeeding on maternal moods and the effect of the infant's feedback to the mother. However, the pathways for the different outcomes may each be unique.

Breastfeeding is a choice, not a behaviour that is randomly assigned to mothers. Women who choose to breastfeed are different from women who choose to bottle-feed their infant, and these other characteristics of the mother and her environment are confounding factors of the analysis. Although Woodward and Liberty discuss this analysis challenge, what appears to be missing is a recognition that the maternal characteristics associated with breastfeeding will vary depending on the culture studied. The maternal characteristics associated with breastfeeding (such as higher education and wealth) in resource-rich countries like Canada and the U.S. are not universal. In fact, in low-resource countries, breastfeeding is more common among the poor and less educated.[6] The unique cultural context has to be considered if we hope to understand the pathways through which breastfeeding influences psychosocial development.

The paper by Pérez-Escamilla approaches psychosocial development from a different perspective than Woodward and Liberty. This review emphasizes the effect breastfeeding has on three characteristics associated with the psychosocial development of the older child: infant cognitive and motor development, and childhood obesity. Pérez-Escamilla nicely demonstrates the strength of the evidence that supports the positive effect of breastfeeding on cognitive development. There is a statistically significant, consistent result among studies; a "need response" (premature infants, who have a greater physiological need, benefit more than normal-weight infants); a logical temporal sequence (i.e. the cause precedes the effect); and a biologically plausible relationship, based on the role of PUFAs (poly-unsaturated fatty acids) in visual and mental development.

Pérez-Escamilla provides examples of studies in which breastfeeding is associated with more advanced motor development in infants, as indicated by the early attainment of certain milestones, such as crawling. Pollitt suggested that delayed development in malnourished infants may give the appearance of the child being "young," and therefore elicit less stimulation from

the mother and the household environment.[7] However, the evidence that early motor development is associated with improved psychosocial development for well nourished children is not presented in the Pérez-Escamilla article.

The final paper on psychosocial development, by Lawrence, returns to early observational work by Newton.[8] In those studies 40 years ago, there was an ongoing discussion of the challenges of conducting research on breastfeeding. A primary concern then (and now) is the definition of breastfeeding. Lawrence also notes that breastfeeding occurs not only as a response to hunger, but also as a mechanism of decreasing a child's stress and discomfort, and therefore would be expected to play an important role in the child's psychosocial development. This is consistent with Peruvian mothers' description of breastfeeding as a means of providing the child with comfort, love, security and communication.[9] However, research is needed on how breastfeeding influences human characteristics that are more difficult to quantify: assertiveness, social maturity, self-assuredness. Lawrence reports on some measures of the benefits of breastfeeding on these characteristics, such as breastfed children being more cooperative and less likely to drop out of school, in studies on cognitive development, but they are limited. Well-designed studies that provide the richness of the Newton observational research are still needed.

The paper by Greiner stands out from the others because it looks at the societal features that need to be in place for successful promotion of breastfeeding. Although Greiner believes that there is a place for a general information campaign to educate each new generation of mothers, there is a need for a balanced approach that is informative about the risks of not optimally feeding an infant. Stating that breast is best is not sufficient. For breastfeeding practices to improve, there needs to be support at every level - through the legal system (e.g. to support the Code), through health facilities to teach new mothers good breastfeeding techniques, through labour laws designed to promote working conditions that are consistent with six months of exclusive breastfeeding, and through social support of friends and family. Intervention activities that do not work cooperatively to accomplish support at all levels meet with only limited success.

Implications for Services, Development and Policy

The first three papers provide evidence that breastfeeding is associated with some components of psychosocial development. All three authors also recognize that there is a paucity of good studies and serious challenges remain to understanding the mechanisms by which breastfeeding is influential. Whereas Pérez-Escamilla and Lawrence conclude that the benefits for psychosocial

development exist and should form part of the policy decision, Woodward and Liberty conclude that there is no substantive evidence and that the promotion of breastfeeding should be based solely on the nutritional and cognitive advantages. Woodward and Liberty's conclusion seems overly conservative. They present evidence of short-term benefits for the mother that would improve her ability to provide stimulation and good child care, as well as benefits for the infant (increased level of alertness, motor assessment self-regulation and less crying). Although there is little evidence of long-term benefits, the short-term benefits, as well as the absence of negative associations with breastfeeding, would seem to suggest that policy-makers can include breastfeeding as one of many social interventions to promote healthy psychosocial development in young children. There exists a wide range of behaviours and needs in every society. Services and policies should work to help all of society meet their potential. Thus, policies should be designed not only to reduce the number of extreme cases of mental illness but also to help all families to improve the psychosocial development of their children. Breastfeeding is not a panacea, but the literature would suggest that infants and children benefit in many ways when their mothers are able to optimally breastfeed. Society should find ways to support mothers so that this practice becomes universal.

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