

## **Breastfeeding during infancy and its effects on Lifelong Health of an individual:**

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### **Abstract**

The role and importance of nutrition in early postnatal life, bears an influence on lifelong vulnerability to poor health, it is an important part of current research. We need to be able to define optimal patterns of infant feeding, not just to support growth and development in infancy, but also as determinants of later health. To date, much of the focus on the long-term effects of infant nutrition on has been on milk feeding, to compare breast and formula feeding and to evaluate the effects of exclusivity, timing and duration of feeding different types of milk in infancy; other aspects of infant feeding such as age at introduction of solid foods and type of weaning diet have received less attention, and relatively little is known about their links to later health. There are some methodological challenges ahead, although significant progress has already been made, and further progress is envisaged in the future. In particular, the opportunity to bring together epidemiological studies and new mechanistic insights, that will help to identify key aspects of infant nutrition and their causal effects, offer great promise both in moving this field forward as well as the potential for health benefits for future generations.

**Keywords:** infancy, infant nutrition, breastfeeding, weaning, dietary patterns

### **Introduction**

Proper nutrition in early life has its influence on lifelong health. But perhaps the key aspect of this legacy is the value now placed on ensuring that the nutrition of mothers and young children is prioritised, because this is essential not only for their own health but also for that of future generations. This short review, based on a presentation at the Commemorative Meeting in October 2015, addresses the role and importance of nutrition in early postnatal life as an influence on infant and adult health. It considers some recent developments in our understanding, where future research in infant nutrition may be going, as well as some of the methodological challenges that face researchers in the field. Although interest in infant nutrition has increased hugely in recent decades, there is still much to be learnt about optimal patterns of feeding in early life.

### **Infant Growth**

Postnatal growth velocity is greatest in infancy – occurring at a time when the infant is entirely dependent on others to meet its nutrient needs. Infants are vulnerable, and it is well known that inadequate nutrition and restriction of growth at this stage can result in permanent stunting, as well as having potential for long-lasting deficits in neurological function. Although growth monitoring has been used routinely for decades, we do not yet have a complete understanding of what is optimal in terms of patterns of early growth. For example, while poor growth in infancy is recognised as a cause for concern, rapid weight gain has been linked to later obesity as well as a number of risk factors for cardiovascular

disease. To date, there have been few studies of childhood growth in relation to adult health outcomes. Some of the most important insights regarding optimal pathways of growth have therefore come from follow-up of men and women born in Helsinki, Finland between 1934-44. Their childhood growth, hospital admission and mortality records can be linked, allowing description of the patterns of growth that characterised the men and women who later developed coronary heart disease (CHD) and type 2 diabetes. For example, when compared with other men, those with CHD grew poorly in infancy, and had a low body weight and were short at 2 years of age - but the period of poor early growth was followed by relatively rapid weight gain in childhood. Deleterious outcomes associated with this pattern of growth have also been described in a study of young Indian adults; impaired glucose tolerance and diabetes in adult life was more common among men and women who were thin in infancy but who had accelerated gains in body mass index after the age of two years.

Although further evidence is needed to define the pathways of growth in prenatal and postnatal life that are associated with lifelong health in contemporary populations, significant progress has been made in establishing infant growth standards in the past decade. A key message from this work is that for such infants, their patterns of early growth are similar, across a range of ethnicity and cultural backgrounds. The pattern of growth described is seen as a better representation of how infants *should* grow, compared with the growth reference used in the past.

### **Milk Feeding during Infancy: Types**

To date, the focus of much infant nutrition research on has been on milk feeding, to compare breast and formula feeding, and to evaluate the effects of exclusivity, timing and duration of feeding different types of milk in infancy. Breast milk composition is known to be very variable, differing in nutrient content within feeds, across the period of lactation, as well as between women. More recently, an important development has been the wider recognition of the complexity of the composition of breast milk, particularly in terms of its content of a diverse range of bioactive components, that include anti-microbial and anti-inflammatory factors, enzymes, hormones and growth factors. These bioactive components affect the infant's immune status, with short-term protective effects in relation to infection, as well as facilitating immune development and maturation. These effects have led to description of breast milk as a 'communication vehicle' between the mother's immune system and the infant. The consequences of not breastfeeding have been extensively documented, with lower rates of gastrointestinal and respiratory infections found in breastfed infants (when compared with other infants), both in developed and developing settings. Importantly, promotion, protection and support of breastfeeding has been identified as one of the interventions with the greatest potential to prevent mortality in young children in countries that have a high burden of maternal and child under nutrition.

Although the underlying mechanisms are not fully understood, there is now evidence that epigenetic changes occur in early postnatal life. A range of bioactive constituents in breast milk have been shown to induce changes in DNA methylation and it is possible that lack of exposure to these constituents in formula-fed infants could lead to differences in the regulation of epigenetic processes, gene transcription and/or protein synthesis, when compared with breastfed infants - with long-term consequences for health. This will be key

to our ability to gauge the potential for future strategies to promote, protect and support breastfeeding, not only to prevent infection in infancy, but also to promote lifelong health.

Particular attention has been focused on possible programmed effects of differences in types and patterns of milk feeding on regulation of energy balance in later life, and in the possibility that breastfeeding promotion could be used as part of efforts to prevent obesity. Alongside consideration of compositional differences and molecular mechanisms, there may be other differences between breastfed and formula-fed infants that are also important in this respect. One possible explanation is that breastfed infants are able to control the amount of milk they consume, learning effective self-regulation of energy intake, which remains with them in later life. Consistent with this possibility is the finding of a recent study in which early introduction of solid foods was associated with greater odds of later obesity in formula-fed infants but not breastfed infants, suggesting that breastfed infants were able to reduce their milk consumption when given solid foods. It is also possible that the mode of feeding is important, as compared with breastfed infants, those who are bottle-fed are relatively more passive in the feeding process, and also may be encouraged to empty the bottle at each feed – both of these factors might undermine the infant's ability to regulate its milk consumption.

### **The break off**

In comparison to evidence on milk feeding, the process of weaning – that is the gradual transition from a milk-based diet to a diet based on solid foods - is not well described. The age at introduction of solid foods and the type of first solid food are often documented, but the assessment of food and nutrient intake during weaning is less common. This could reflect the challenge of assessing intake in very young children, but additionally, as dietary patterns and intakes are changing rapidly in late infancy, it may be difficult to determine the timing and key exposures that need to be characterised. At present, there is therefore limited evidence to enable an understanding of possible long-term effects of variation in weaning practice on adult health outcomes<sup>4</sup>, although younger cohorts established in recent decades will start to provide these data in the near future.

### **Introduction of solid foods: Age of intake**

The recommended age at which solid foods should be introduced has changed over time, and continues to be widely debated. Energy requirements in infancy are considered to have been overestimated in the past and no deficits in growth have been demonstrated among infants who are exclusively breastfed for six months in developing or developed countries. Both early and late introduction of solid foods have been linked to poorer health outcomes in individual studies, although so far the evidence is incomplete and/or inconsistent. For example, early age of introduction of solid foods has been associated with obesity risk, but this is not consistent with findings of recent systematic reviews.

### **Diet quality in infancy and its weaning practice**

Very little is known about long-term health effects resulting from qualitative differences in the weaning diet. What is known is that even within populations there may be huge variations in feeding practice in infancy, including differences in the solid foods fed, the rate of transition from milk to solid foods, the degree of dietary diversity, portion sizes, and

balance of family and commercial infant foods. These differences have significant implications for nutrient intake in late infancy and potentially, could be important influences on growth and development at this stage but additionally, an essential component of future work will be to develop the evidence base substantially to include infants from diverse backgrounds, beyond developed settings, for whom feeding patterns may be very different.

### **Looking Forward**

Much has been achieved in recent decades to advance understanding of the importance of differences in infant feeding practice, not just as an influence on growth and development in infancy, but also their effects on long-term physiology and function. However, there are gaps in the evidence and new, contemporary data are needed to enable us to move beyond explanation of historical data from the past, to understand and predict health outcomes in future generations. To deliver on this ambition, there are some particular issues and challenges that future studies will need to address.

New developments in the analysis of breast milk, together with better understanding of the mechanisms that underpin programmed changes in physiology and function, will provide a much clearer understanding of the key dietary exposures that need to be assessed in infancy. This will inform the design of assessment methods to enable the characterisation of dietary intake, and hopefully, provide opportunity for a move towards common methodologies that can be used across settings in the future. In parallel with such developments, it will be essential to determine whether there are aspects of infant feeding that could be assessed very simply that would provide useful information on the key dietary exposures.

### **Conclusion**

Understanding the role and importance of nutrition in early postnatal life as an influence on such vulnerability is an important part of current research - to enable the definition of optimal feeding patterns in early life, not just to support growth and development in infancy, but also as a long-term determinant of health. Whilst there are some methodological challenges ahead, significant progress has already been made, and further progress is envisaged in the future. In particular, the opportunity to bring together epidemiological studies and new mechanistic insights, that will help to identify key aspects of infant nutrition and their causal effects, offer great promise both in moving this field forward as well as the potential for health benefits for future generations.

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