



Feeding infants and young children. From guidelines to practice-conclusions and future directions[☆]

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ARTICLE INFO

Article history:

Received 12 July 2011

Accepted 13 July 2011

Available online 22 July 2011

Keywords:

Infant feeding

Healthy eating

Learning

Food preferences

Eating habits

ABSTRACT

Infant feeding is a challenging and intricate process. Food intake is shaped by prior experience of flavours derived from the maternal diet *in utero* and via human milk, by ongoing experience of foods eaten during the first years of life including the variety, types and frequency of foods offered. The ways in which parents interact with their children including the way foods are presented, the emotional context they cultivate and the feeding practices they use can influence their children's eating habits, either positively or negatively. There is a mismatch between what government guidelines advise parents in relation to the “when, what and how” to feed children including during the weaning period and what parents actually do. Acquisition of food preferences and the establishment of eating habits in the early years form part of an ongoing, complex developmental process, however there is a gap between experimental evidence on best practice in infant feeding and what parents receive as advice about feeding. It is timely, therefore, to translate these findings into solutions for parents. Practical support for infant feeding should be evidence based, parent-focused and contingent on the needs of the developing child since infant feeding sets the foundation of healthy eating habits for life.

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Introduction

The main aim of the expert workshop leading to this Special Issue was to review current evidence of how early infant feeding can lead to healthy eating habits and to identify priorities for future research. Whilst the main focus was the weaning period, research on taste exposure through prenatal and breastfeeding experience was also considered alongside later experience in early childhood. In particular, feeding guidelines, sensitive periods, prenatal (taste), postnatal exposure to foods (visual, taste, texture, flavour), parenting styles, feeding practices and the experience of mothers during the weaning period were explored with an emphasis on learning which approaches are most effective to develop healthy eating habits. Key themes which have emerged from this

endeavour include the importance of the interaction between the child and its environment (including what foods, how these are offered and when) and the gap between what is known through research and what is advocated in government guidelines on infant feeding. In this concluding article, an overview is provided of the key messages from the Special Issue together with proposals for crossing the divide between evidence and implementation.

The interaction between child and environment

At the beginning of life, the human newborn is equipped to feed, to experience complex sensory cues and to indicate a preference among different tastes (Steiner, 1979). As early as the 15th week of gestation intact taste buds have developed and contact with amniotic fluid ensures at least some experience of volatile compounds derived from the mother's diet. It is not clear at what point flavour is experienced but it is known that premature infants respond to taste (Lipsett, 1977) and that exposure *in utero* influences later flavour preferences (see Cooke & Fildes, 2011). Compounds from the maternal diet infuse the amniotic fluid and it makes good adaptive sense for the developing foetus to experience these dietary components and to form a preference for these postnatally. According to Leathwood and Maier (2005) exposure to the maternal diet and preference for these foods confers biological advantage since “The simple fact that she survived long enough and was fit enough to reproduce and suckle

[☆] The workshop was funded by EU FP7 Marie Curie IAPP 230637 “VIVA: V is for Vegetable – Applying Learning theory to increase liking and intake of vegetables”. The authors wish to thank the EU for its support of this project and all the experts who contributed to the success of the workshop. All authors of this article have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that: Carel M.J.L. Vereijken and Hugo Weenen are employees of Danone Research – Centre for Specialised Nutrition. No other relationships or activities have influenced the submitted work.

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her child shows that her food choices must at least have been adequate, if not positively good” (page 135).

Beyond this very early exposure, experience of a variety of flavours (combining odour and taste) can be transmitted to the infant through breast milk, providing “chemical continuity” from the *in utero* environment. Exposure to flavour in this early period influences later food preferences. Thus breast fed infants show greater preferences for novel vegetables than formula fed infants (Sullivan & Birch, 1994), preferences of breastfed infants reflect what the mother has eaten (Hausner, Nicklaus, Issanchou, Mølgaard, & Møller, 2010; Mennella, Jagnow, & Beauchamp, 2001) and early experience with a flavoured formula milk influences preferences for that flavour later in life (e.g. Haller, Rummel, Henneberg, Pollmer, & Köster, 1999). It has also been shown that foods offered during the first two years of life predict food preferences later in childhood (Coulthard, Harris, & Emmett, 2010; Skinner, Carruth, Bounds, Ziegler, & Reidy, 2002) and in adolescence (Nicklaus, Boggio, Chabanet, & Issanchou, 2004).

These early years are crucial not only because of the effects of early taste exposure on later preferences, but also since this is the time when oro-motor skills develop and because there is a relatively high willingness to accept novel foods (Nicklaus, 2011). Various studies have shown the efficacy of practices which facilitate acceptance of unfamiliar foods including repeated, sustained exposure to foods and offering a variety of foods. Variety has been relatively well studied and includes variety within and across food groups, as well as variety of taste, texture and forms of foods (Nicklaus, 2011). Thus, parents should be encouraged to adopt some of these practices to enhance the development of healthy eating habits.

By the end of the second year infants begin to indicate a reluctance to try new foods (neophobia) and some show strongly avoidant behaviours (Cashdan, 1994; Pliner & Hobden, 1992). This behaviour may protect against accidental exposure to toxins at a time when infants are fully mobile and can explore their environment without the control of adult supervision. However, this constrains the period during which food acceptance can be easily optimized. There may be developmental stages of acceptance with sweet tastes preferred from birth to 4 m, a window for acceptance of new tastes between 4 and 6 m and then a sensitive period for solid textures from 6 to 12 m (Harris, 1993). Children who lack experience of solid foods during this time show problematic eating later in life (Mason, Harris & Blissett, 2005; Coulthard, Harris, & Emmett, 2009) especially in relation to experience of pieces or

“lumpy” foods (Northstone et al., 2001). From 12 to 24 m foods are recognized by appearance and by 24 m foods which were previously accepted (Harris, 2008) may be rejected on the basis of sight alone. Given the importance of appearance in these later stages, it is interesting to note the efficacy of visual exposure, for example in the form of picture books, in increasing willingness of 12–24 m children to taste unfamiliar fruits and vegetables presented in this way (Heath, Kennedy, & Houston-Price, 2011). At a time when neophobic responses emerge, familiarization through images displayed in a positive, narrative-based context could offer potential to minimize food rejection.

Parents face a limited time window in which to encourage and establish the foundations of healthy eating. Their willingness to engage with different strategies to achieve this may depend on their parenting style (the broad emotional context in which parenting occurs) and the specific feeding styles they adopt during the early years of eating habit development. Feeding styles which appear to be conducive to increasing the likelihood that foods such as fruits and vegetables are consumed are embodied by authoritative feeding which combines emotional warmth and responsiveness with high expectations of high dietary quality (Blissett, 2011). Further, children are more willing to eat fruits and vegetables if this is modeled by parents, if these foods are made freely available at home and if parents use encouragement rather than pressure to eat these foods (Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011).

To support healthy eating, governments provide guidance on feeding infants and this guidance can be categorized into the “when, what, how” framework (Schwartz et al., 2011; see Table 1). It is clear from the existing literature that across different cultural contexts, the timing of the introduction of solid foods varies and typically deviates from the guidance provided (Schiess et al., 2010; Caton, Ahern, & Hetherington, 2011). It is also evident that not all government agencies provide specific guidance on what foods to use at what stage, for example, giving advice on the introduction of lumpy foods, limiting salty and sweet foods and how variety might best be exploited to enhance acceptance and intake of new foods (see Schwartz et al. this issue).

Where do we go from here?

Children learn through experience of the internal and external environment. They learn over time to eat in age- and culturally appropriate ways. The challenge faced by the infant in the

Table 1
applying the “when, what, how” framework to the contributions from this Special Issue.

Period in child development	Topics covered			Schwartz et al. Weaning literature and feeding guidelines review	Cooke and Fildes Flavour exposure <i>in utero</i> and via milk	Nicklaus Feeding practices and sensory properties	Caton et al. Weaning practices and vegetable intake	Blissett Parenting styles and feeding practices	Heath et al. Visual exposure
Pre-weaning	What	Sensory	Flavour		x				
Weaning	When	Start and progress	Start weaning	x		x	x		
Weaning	What	Balance	Nutrients	x					
Weaning	What	Sensory	Taste	x		x			
Weaning	What	Sensory	Texture	x		x			
Weaning	What	Sensory	Appearance	x					x
Weaning	How	Procedure	Exposure	x		x			
Weaning	How	Procedure	Variety	x		x			
Weaning	How	Child	Self feeding	x			x		
Weaning	How	Child	Self regulation	x					
Weaning	How	Parent–child interaction	Parenting styles	x				x	
Weaning	How	Parent–child interaction	Parenting practices	x			x	x	x

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