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Benefits of vegetables for weaning

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Abstract

Invited the BSF- British Nutrition Foundation in May (2016) to leading infant feeding experts to discuss and debate the strength of the evidence base on a 'vegetables first' approach to complementary feeding. Consensus was reached on the translation of the science into practical messages for parents/carers. In particular, it is known that familiarising infants with a variety of vegetables from the start of complementary feeding increases the likelihood that vegetables will be accepted throughout childhood, though currently in the UK vegetables tend not to be prioritised as first foods. Infant feeding guidance could include recommendations to offer tastes of a variety of vegetables when complementary feeding begins, as a first step in the transition from milk to solid foods, so that liking and acceptance are established during this early window of opportunity. This report describes the main themes emerging from the discussions and the specific messaging recommendations which could be included within infant feeding guidance.

Keywords: Infant feeding, benefits of vegetables, fruits, complementary feeding

Introduction

The 'early years' of childhood lay the foundations for health, growth and development (BNF 2013) [3] and, in terms of nutrition, the acquisition of eating behaviours that align with a healthy, varied diet is a critical feature of this period (Birch & Doub 2014) [4]. One of the most important eating behaviours to acquire during the early years is preference (liking) for foods that support good health. Consumers tend to eat those foods they like, so developing a preference for certain foods may have health benefits. For example, diets high in fruit and vegetables are associated in adulthood with reduced risk of cardiovascular disease, obesity, hypertension, stroke and some cancers (Boeing *et al.* 2012; Wang *et al.* 2014) [19].

Humans from birth tend to prefer sweet, salty and umami tastes over those that are bitter or sour (Schwartz *et al.* 2009) [17] and can quickly learn to like foods that are energy dense those that are low in energy density and without a sweet, salty or umami flavour profile. This describes the characteristics of many vegetables and, indeed, it is well known that vegetables are the type of food most commonly disliked by children and often the most difficult to encourage them to eat (Cooke & Wardle 2005) [6]. Food preferences are acquired through experience (Fildes *et al.* 2014) [11] and these tend to 'track' into later childhood (Coulthard *et al.* 2010; Grimm *et al.* 2014) [7, 12]. This means that, during the early years, there is potential for parents to provide their children with food experiences that can help them to accept and enjoy vegetables throughout childhood.

A recent narrative review of the scientific infant feeding literature highlighted that introducing 'vegetables first, frequently and in variety' during complementary feeding (*i.e.* when foods other than milk are first introduced – commonly referred to as weaning) can increase acceptance of vegetables during this period and into later childhood (Chambers 2016) [8]. On 5 May 2016, the British Nutrition Foundation (BNF) invited leading infant feeding experts to discuss and debate the strength of the evidence base and to see whether consensus could be reached on the translation of the science into practical messages for parents/carers. The event was chaired by Professor Marion Hetherington (University of Leeds, UK) and attendees provided expertise from several different disciplines, including psychology, dietetics, nutrition, policy development and paediatrics. The main themes emerging from the round-table discussions are described below.

Complementary feeding as a sensitive period for food preference development

Attendees were in agreement that the complementary feeding period is a 'window of opportunity' for acclimatising infants to the taste of a wide variety of foods because, during the first year of life, infants are receptive to all five basic tastes to differing extents, preferring those that are sweet and salty (Schwartz *et al.* 2009) ^[17], but willing to consume most new foods (Schwartz *et al.* 2011) ^[18]. It was highlighted that, after the first year, infants typically become more neophobic or 'fussy' and tend to be more selective about what they will eat, and variety in the diet can decrease (Dovey *et al.* 2008) ^[10]. There was consensus that during the early complementary feeding period, it is imperative to capitalise on the willingness of infants to try new foods, such as vegetables, by exposing them to a wide variety of foods in order to 'educate the palate' (Schwartz *et al.* 2013). It was also noted that some infants are likely to accept some foods, particularly fruit and vegetables, more readily than others, due to genetic factors (Fildes *et al.* 2014) ^[11]. This is an important message to communicate to parents to alleviate anxiety during this transitional feeding period.

The Department of Health (DH) recommends that complementary feeding should start at around 6 months of age (DH 2011). Some organisations recommend that it is appropriate to start complementary feeding between 4 and 6 months of age, when the infant is showing signs they are ready for solid foods (such as the ability to stay sitting up and to coordinate hand and mouth movements (Butte *et al.* 2004) ^[2]). The round-table group considered potential issues with introducing solid foods after 6 months, including evidence suggesting that it might increase the risk of developing certain allergies (Perkin *et al.* 2016) ^[15] and low iron levels (Agostoni *et al.* 2008) ^[1], and that part of the 'window of opportunity' for acquiring a broad repertoire of food preferences may be missed (Coulthard *et al.* 2014) ^[9]. With a focus on food acclimatisation rather than nutrition *per se* (*i.e.* 'tiny tastes' of small quantities of food that do not compromise breastfeeding), it was agreed that the 4–6 month period can be an appropriate time to introduce *tastes* of solid foods, if the foods are of the appropriate type, texture and amount for the developmental age of the infant. However, while the majority of infants in the UK are weaned before 6 months of age (McAndrew *et al.* 2012) ^[13], it was recognised that any advice should be consistent with the DH recommendation to introduce solid foods at around 6 months. The group considered how the idea of early food acclimatisation aligns with French, Swedish and Dutch approaches to early complementary feeding, which is to provide infants with plenty of opportunity to experience different foods, including vegetables, with an emphasis on 'tiny tastes' and 'educating the palate' (Schwartz *et al.*, 2013).

Food preferences developed in the early years track across the life-course

The experts agreed that food preferences acquired during the early years can 'track' into later childhood (*i.e.* food likes and dislikes developed in the early years predict food likes and dislikes in later years) but noted that this evidence base is mostly observational (as is the case for most life-course research) and follow-up periods do not tend to cover later childhood (>7 years) (Coulthard *et al.* 2009), and the *Infant Feeding Practices Study II* (Grimm *et al.* 2014) ^[12], as well as smaller cohorts (Foterek *et al.* 2015). The group also highlighted research indicating that early familiarisation with

protein hydrolysate formulas, which have a particularly bitter taste, is associated with later acceptance for bitter foods, including vegetables and fruit (Mennella & Beauchamp 2002) ^[5]. Recently, Maier-Nöth and colleagues (2016) have published experimental data demonstrating a link between introducing a variety of vegetables at the onset of complementary feeding (Maier *et al.* 2008) ^[14] with acceptance of these foods in early life and over the longer term (up to 6 years of age). Overall, round-table attendees agreed that messages based on the idea of food preference 'tracking' could be powerful, as establishing preferences for healthier foods early offers parents the opportunity to reduce the likelihood that their child will resist eating these foods in later childhood, which is a common concern amongst parents/carers.

Ways of introducing vegetables during complementary feeding

Round-table discussions centred on the following ways of introducing vegetables during complementary feeding as there is both experimental and observational evidence that these can increase children's vegetable acceptance in the short and longer term: repeated exposure to vegetables, offering a wide variety of vegetables and introducing vegetables as first foods. The paper by Chambers (2016) ^[8] described some of the studies in this evidence base but the round-table participants agreed that a systematic research review is necessary to ensure that all relevant papers are captured and to assess the quality of the studies using standardised criteria.

It was agreed that there is good evidence that repeated exposure to the pure/distinct taste of a vegetable during complementary feeding (on at least eight occasions) can help infants learn to accept that vegetable, both immediately and in later childhood (Hetherington *et al.* 2015). Participants debated whether mixing or 'masking' vegetables with other foods, a common way of preparing infant meals, enhances or reduces the positive effects of exposure on the development of acceptance for the masked vegetable (Remy *et al.* 2013) ^[16]. Further research is required to explore whether specific combinations of foods and the prominence of the individual vegetable flavours (and visual characteristics) produce different outcomes for preference and intake. There is some evidence from a small sample of mothers that mixing vegetable flavours (purees of cooked vegetable) with milk or baby rice can increase infants' initial acceptance of vegetables and help bridge the transition from a diet of milk to the introduction of pure vegetable flavours (Hetherington *et al.* 2015).

Offering a variety of vegetables during the complementary feeding period was considered to be an effective way to increase acceptance of vegetables and other new foods in the short and longer term (in other words, this approach can make infants more 'versatile') (Nöth *et al.* 2016), though it was acknowledged that the evidence base is limited to small experimental studies. The group agreed that the most compelling evidence comes from a series of studies by Maier-Nöth (nee Maier) and colleagues (Maier *et al.*, 2008) ^[14], the first of which showed that offering a high variety of vegetables, compared to no or low vegetable variety, for 10 days at the beginning of complementary feeding increased acceptance of other new foods, including vegetables, immediately after the intervention. When this cohort was retested at 6 years of age in a laboratory setting, the group who had received a high variety of vegetables during early complementary feeding consumed more vegetables and reported liking them more than the no and low variety groups,

although it was noted that there was a dip in vegetable acceptance during the notorious 'fussy' period (tested at 15 months and 3 years) and vegetable exposure at home during the 6-year study period was not controlled for in the study.

Studies that have specifically tested the benefits of introducing a variety of vegetable tastes exclusively for the first 2 weeks of complementary feeding were discussed and it was agreed that this approach can increase vegetable acceptance in the short and longer term (up to 12 months), though it was noted that this new area of research currently consists of only a handful of published, peer-reviewed papers (Barends *et al.* 2013). Discussions at this point turned to the practical implications of recommending vegetable exclusivity at the initiation of complementary feeding. The group all agreed that it is imperative to provide context to this message as the appropriateness of this approach will be dependent on the infant's age and stage. This is because at 6 months of age, infants' iron stores, accumulated during gestation, begin to deplete and consumption of iron-rich foods, such as red meat, eggs and pulses, is required as breast milk is a poor source of iron (Fewtrell *et al.* 2007). Thus, introducing a variety of vegetable tastes exclusively for the first few weeks of complementary feeding is a suitable message for parents introducing solid foods between 4 and 6 months, but for those who adhere to DH's advice to start at around 6 months, it should be advised that iron-rich foods are provided as well.

Fruit

The UK recommendation to eat 5 A DAY does not distinguish between fruit and vegetables as studies demonstrating the health benefits of these foods have generally grouped them together; what appears to be most important to nutrient intakes is quantity and variety (Cooper *et al.* 2012; Bhupathiraju *et al.* 2013). In terms of food preference development, however, participants agreed that vegetables and fruit should not be 'lumped together' as fruits are typically well accepted from the start of complementary feeding, because of their sweet taste, while it is typically less easy to encourage vegetable consumption. Indeed, most of the research to date on infant food preference development has focussed on increasing acceptance of vegetables rather than fruit. The group noted that the distinction is not as simple as fruit or vegetable and that the flavour profile should be taken into account as some vegetables are sweet and usually well accepted from the outset (*e.g.* carrots) and some fruits are sour or astringent and less well accepted (*e.g.* plums). The focus should be, therefore, on the vegetables and fruits that are most difficult to encourage infants to accept, which are those without a predominant sweet flavour (*i.e.* many vegetables, some fruits). At the start of complementary feeding, parents are known to serve infants sweet fruit and vegetables more often than less sweet varieties and commercial baby foods can be sweet in flavour (Garcia *et al.* 2015). Therefore, a focus on less sweet vegetables (and fruits) during early complementary feeding, when infants are likely to accept foods of all flavours, was considered sensible. It was stressed that for infants aged 6 months and older, any focus on bitter vegetable and sour fruits should be in the context of a healthy, varied diet to avoid unduly neglecting other important foods (*e.g.* those that are iron-rich).

Current messaging and practices in relation to complementary feeding

The most comprehensive government resource for

parents/carers on complementary feeding, the NHS/*Start4life* 'Introducing Solid Foods' was discussed. It was noted that all fruit and vegetables recommended as appropriate first foods are sweet in flavour and no specific or detailed information is provided on ways to encourage infants to accept vegetables or on the importance of iron-rich foods. The Scientific Advisory Committee on Nutrition (SACN) Subgroup on Maternal and Child Nutrition (SMCN) is currently reviewing the literature on complementary feeding and it is expected that government guidance, including the 'Introducing Solid Foods' booklet, will be updated after the publication of their report.

Common parental concerns about complementary feeding were discussed to gain insight into the potential motives of UK parents who often prefer to offer baby rice and sweet fruits as first foods rather than vegetables. The experts highlighted that parents are likely to want their infant's first food experiences to be as positive as possible and that their own perceptions of 'tasty' foods will determine what foods are offered. Parents may also expect their child to dislike certain foods based on their own food preferences and so will not offer these foods from the outset. The misconceived idea that vegetables are difficult for infants to digest and can cause 'gassiness' or stomach pain sometimes also influences parents' decision-making. Parents may avoid offering less sweet vegetables because infants tend to eat less of these foods than sweeter varieties, causing concerns about wastage or infants consuming 'enough' food and being 'full up' and more likely to sleep for longer. Cultural and traditional practices are also likely to influence the foods that are offered during complementary feeding.

Conclusions

The acquisition of preferences for foods that comprise a healthy, varied diet is paramount during the early years. The complementary feeding period is a 'window of opportunity' to familiarise infants with a wide variety of foods because, at this stage, infants' openness to trying new foods is at its peak and familiar foods are likely to become preferred foods, with these acquired preferences 'tracking' into later childhood. The lack of sweet flavour and low energy density of many vegetables and some fruits means that these foods may be rejected by children and extra efforts may need to be put in place to help them accept these foods. The scientific literature indicates that repeated exposure to vegetables, offering a wide variety of vegetables and introducing vegetables as first foods during complementary feeding can increase vegetable acceptance in early life and in later childhood. Current infant feeding guidance and practices suggest that this type of approach is not typical in the UK and that there is scope to provide parents and healthcare professionals with practical advice on encouraging vegetable acceptance during complementary feeding. Participants considered what these new messages should be and emphasised that they are dependent of the infant's age and stage and their immediate need for iron-rich foods. A systematic review of the scientific literature on establishing acceptance of vegetables during complementary feeding was recommended as were more longitudinal randomised controlled trials, though the current evidence base was considered sufficient to begin to update resources and communicate practical messages to healthcare professionals and parents about introducing vegetables during complementary feeding. Opportunities to disseminate the messages were identified, with health visitors considered to play an important role.

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