



PROJECT FINAL REPORT

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Final publishable summary report

1. Executive summary

The collaborative project HabEat had the aim of better understanding the formation of eating habits through two distinct approaches, epidemiological on one side and experimental on the other.

Epidemiological data from 18000 mother-child pairs followed from birth to at least 4-years of age from four large European cohorts (ALSPAC in the UK, EDEN in France, Europrevall in Greece and Generation XXI in Portugal) were analysed. The experimental part of the project comprised two sections. The first one primarily focused on key learning mechanisms, and concerned children from the beginning of complementary feeding (around 6 months) to 3-years of age. The second aimed at studying different strategies for increasing vegetable consumption beyond 3 and up to 6 -years of age. In total, 18 studies involving, nearly 2000 children between 6 months and 6 years of age were conducted.

By analysing the data from the four birth cohorts, HabEat found evidence that breastfeeding may facilitate the consumption of vegetables and fruit and a greater variety of healthy foods in early childhood. However, no consistent association between the timing of complementary feeding and later child's diet was found. Moreover, no consistent association was found between early feeding practices (breastfeeding duration and age of complementary feeding) and growth or adiposity indices across the cohorts among 4-5 years old children

Results from a randomized controlled trial showed that introducing a variety of vegetables (pureed or mashed) at the beginning of the complementary feeding period facilitates the acceptance of novel vegetables in the short and medium terms.

Across all experiments conducted, it was demonstrated that repeated exposure was the most effective technique for promoting the intake of a novel vegetable and that no significant, additional benefit to amount eaten was derived from adding seasoning, sweetness, offering dips, or increasing energy content. However, giving already known vegetables repeatedly to children between 3 and 6 years of age was not efficient for increasing their consumption. In fact, it appears difficult to increase vegetable intake of an already familiar vegetable in children in this age range. One strategy that seems to help is to let the child choose between two vegetables.

Both data from cohorts and experimental studies demonstrate that some children had eating difficulties and in particular are fussy eaters, meaning that they are reluctant to eat familiar food or avoid novel foods (food neophobia) and are highly selective about the range of foods they will accept. Results from the French EDEN cohort suggest that the main determinants of fruit and vegetable liking at 5 years were food neophobia (negatively) and to a lesser extent fruit and vegetable intake at 3 years (positively). Furthermore, maternal fruit and vegetable intake during pregnancy and early feeding practices were related to fruit and vegetables intake at 3 years but not directly to vegetable liking at 5 years. Moreover, results of analyses performed on three of the cohorts (ALSPAC, EDEN and Generation XXI) showed that children with eating difficulties, food refusal/neophobia and difficulties in establishing a daily eating routine, as reported by their mothers, presented lower fruit and vegetable intake and less dietary variety at 4-5 years of age than those without eating difficulties. The experimental studies showed that repeated exposure may be successful in increasing vegetable intake even in children who are fussy eaters.

HabEat experiments also revealed that, on average, as early as 3 years of age children compensated for only half of the energy (calories) from an energy-dense preload of food offered before a lunch and when offered palatable foods after a lunch, they ate extra equivalent to a quarter of the energy that they had consumed during their lunch.

The scientific results of this project have been translated into recommendations addressed to stakeholders. Moreover, a guide for parents was elaborated on the basis of the project's results and of prior data.



2. Summary description of project context and objectives

Recent surveys have shown that the diets of young children in many European countries are not ideal, in particular because they contain not enough fruit and vegetables. Different intervention studies based on nutritional information show that it is difficult to modify food behaviours in children, teenagers and even more in adults. Studies so far have shown the importance of the early years in later food behaviour. Nevertheless, the more favourable periods for the acquisition of these long-term healthy food behaviours during early childhood are not known precisely. Different learning mechanisms (conditioning, simple exposure, imitation, social interactions in particular within the family) are known to be involved in food preference formation. However, the impact of these learning mechanisms has only been examined within a few weeks following an experiment and thus does not provide a real understanding as to the long-term impact of these mechanisms on food preference development. Moreover, the individual differences in response to different learning strategies have not been studied. Beyond the understanding of learning mechanisms involved in food preference formation, it is unknown if the most efficient ways of learning are also the most efficient means to modify habits. It is therefore important to assess strategies to modify preferences. In order to increase the chance that children, later in childhood and even in adulthood, will have an adequate diet, early learning mechanisms must be understood better. This understanding will provide parents and caregivers with information about how children learn to accept foods and to eat the appropriate quantity of food.

In this context, HabEat aimed to enable a better understanding of how food habits are formed (and can also be changed) in infants and young children. This was done by combining epidemiologic studies based on existing human cohorts from 4 countries and experimental work carried out in six countries so as to collaboratively identify:

- the critical periods in the formation/breaking of food habits,
- the key learning processes, their relative impact in the short, mid and long term and their importance according to the different critical periods,
- the most effective strategies for breaking habits, i.e. for changing from poor to healthy habits,
- individual differences in acquisition of learning and individual characteristics predicting changes.

Furthermore, the project worked hand-in-hand with a board of stakeholder advisors (including industry, health professionals) to produce guidelines on the recommendations that will be communicated to childcare professionals and parents from different target groups (especially those most at risk) in different EU regions. HabEat has proposed strategies to policy makers for promoting the formation of good food habits for infants and children, and strategies for habit breaking.



3. Description of the main S&T results/foregrounds

3.1 Key result no 1: Tools to assess parental feeding practices, child's food habits and food liking

Workpackage: WP1 - Identification of critical periods and critical factors in the development of food habits

Research aims and background

Food habits developed in early childhood persist into adulthood. Thus, early food habit formation can have a long lasting role in eating behaviours. Investigating food habit development during the first years of life permits the identification of key factors in their formation and the development of interventions to improve food habits. Many tools have been developed to understand eating behaviour formation, but their psychometric properties were not always assessed or published. For this reason we first conducted a literature review to identify validated tools and second we developed tools to fill the gaps identified in the literature.

Our review of the literature (de Lauzon-Guillain et al, 2012) highlighted gaps in the methods to measure parental feeding practices, child's eating behaviour, and child's food liking. To fill these gaps, tools have been developed and validated in three countries: France, Portugal and Greece.

Results and applications

For the literature review, two electronic literature databases (Medline, Psycinfo) were used to search for documents in any language from the year of database inception until March 17, 2010. A total of 3,445 documents were retrieved from the electronic database search, of which 169 met the inclusion criteria. Ninety-two papers described tools or provided information on their reliability; some of them described more than one tool. We identified 15 tools on child's eating behaviour, 18 tools on parental feeding practices, ten food frequency questionnaires (FFQs), four food liking questionnaires and four food liking tests. However, many of them did not meet all validity criteria. Three main gaps were identified: 1/ tools focusing on parental attention to child's hunger and satiety cues throughout infancy and early childhood, as well as the degree of autonomy allowed to children in feeding events among children younger than two years; 2/ tools focusing on food avoidance and food approach in children aged 12-24 months; 3/ food liking questionnaires or tests based on the sensorial quality of foods rather than their nutritional quality. We acknowledge that, due to cultural differences in diet across countries, developing questionnaires or tests on food intake and liking that could be used across several countries is a challenge. As the development of a tool addressing the 2nd gap was already ongoing in another research group, we aimed to fill gaps 1 and 3.

The new tools were developed and validated. The first tool, on parental feeding practices and child's self-regulation of food intake is a self-reported questionnaire designed for parents of children aged 1 to 5 years. The second tool, on children's food liking, is a test that must be performed by children of 5-years or older during a face-to-face interview with a trained interviewer. For the questionnaire validation, parents of 1 to 5-year-old children were recruited in schools and nurseries in the three countries and asked to complete the questionnaire about their feeding practices, the child's capacity to regulate his/her food consumption, and the child's height and weight. A subsample of parents was asked to complete the questionnaire a second time with a 3-week delay to assess test-retest repeatability. For the liking test, 5-year-old children were interviewed individually via kindergartens in each country. They were asked to rate how much they liked a large range of foods presented in pictures (different fruits, meats, desserts etc.). For this food liking test, it was necessary to take into account the cultural differences between the three countries. Although these countries belong to the European community, foods consumed in each country differ (for instance, 'ratatouille' may only be relevant in France) and thus the food list was adapted to each country.



A subsample of children was interviewed a second time 3 weeks later to assess test-retest repeatability in each country. Using Structural Equation Modelling, the validity and consistency of most of the dimensions of the questionnaire were tested, as well as some food dimensions of the test of liking. These were found to be adequate. Test-retest analysis confirmed the repeatability of the questionnaire and the liking test. All together the results highlighted the reliability of these tools.

Significance and benefits

There are limited data in young children on ability to control for their food intake (i.e., eating in the absence of hunger, and caloric compensation) in young children, and most of the data are based on laboratory paradigms. This questionnaire is a new attempt to assess simultaneously these two behaviours using one tool, and furthermore it provides an opportunity to determine their links with different parental practices.

Concerning the liking test, most of the studies reported in the literature are based on maternal reported data. Here, children's liking for different foods was assessed directly by the children themselves; thus avoiding any potential parental misreporting.

These tools can now be used in longitudinal, epidemiological or clinical studies in medical/psychological research.

Successful applications

The first version of the food liking test was used successfully in the EDEN mother-child cohort, and an internet version is under development for use in the Elfe¹ cohort.

References

- This key result was related to Deliverables D4, D5, and D14
- One paper has been published:
de Lauzon-Guillain B, Oliveira A, Charles M A, Grammatikaki E, Jones L, Rigal N, Lopes C, Manios Y, Moreira P, Emmett P, Monnery-Patris S (2012). A review of methods to assess parental feeding practices and preschool children's eating behavior: the need for further development of tools. *Journal of the Academy of Nutrition and Dietetics*, 112(10), 1578-1602.
- One paper is in preparation:
Monnery-Patris S, Peteuil A, Chabanet C, Rigal N, Issanchou S. Psychometric validation of a French questionnaire to assess child's self-regulation abilities and related parental practices.

3.2 Key result no 2 - Early feeding practices and food habits in childhood

Workpackage: WP1 - Identification of critical periods and critical factors in the development of food habits

Research aims and background

Food habits and food liking have been shown to take shape early in life and track through to adulthood and intervention studies show that it is difficult to modify food behaviours both in adults and children. In many countries, fruit and vegetable intake and healthy dietary variety in children remain below recommendations. The long-term effects of early feeding practices on these dietary behaviours are not clearly understood. We aimed to examine whether early feeding practices, such as breastfeeding duration and timing of complementary feeding, influence later fruit and vegetable intake and variety of healthy foods in the diet of preschool children. Well-researched evidence is

¹ ELFE (Etude Longitudinales depuis l'enFance) is the first French National birth cohort. Recruitment started at birth in 2011. A small pilot cohort recruited in 2007 is also followed to test the different questionnaires for the national cohort. The internet version of the food liking test will be tested in the pilot cohort when the children are 9 years.



needed to provide a firm base for infant and child feeding guidelines and using comparable data from four different European countries in parallel analyses will ensure that our findings are widely applicable.

Results and applications

Birth cohorts from France (EDEN), the UK (ALSPAC), Portugal (Generation XXI) and Greece (EuroPrevall) with comparable data on breastfeeding initiation and duration, age at which complementary feeding had started and early childhood diet were studied. Parallel analyses with identical statistical models were performed in each country. Fruit and vegetable intake and healthy dietary variety were assessed by food frequency questionnaires completed by parents when their child was 2 to 5 years of age.

There were differences in early feeding practices across the four cohorts with longer breastfeeding duration (i.e. ≥ 6 months) in Portugal (more than 50%) compared to the UK (around 35%), France (25%) and Greece (30%). Timing of complementary feeding (foods other than milk) varied across the cohorts: in UK, mainly between 3 and 4 months of age, in Portugal at around 4 months, in Greece at around 5 months, and in France there was no peak age for introduction to complementary foods. Fruit and vegetable intake in childhood varied across the four cohorts with an average intake of less than one vegetable per day in Greece at 2 years and more than three vegetables per day in Portugal at 4 years. For dietary variety, if following all the healthy eating guidelines a score of 5.0 is the maximum, in the cohorts mean scores ranged from 2.3 in the UK (at 2 years) to 3.8 in Portugal (at 4 years).

Never or short breastfeeding duration (< 3 months) was quite consistently related to lower fruit and vegetable intake (< 1 serving/day) and to lower variety scores in young children in all four cohorts. Results were adjusted for infant's age and gender, and maternal age, education level, smoking during pregnancy and in France and the UK for mothers own fruit and vegetable intake. Moreover, results from UK indicated that this association could persist through childhood. This is consistent with the hypothesis that early sensory exposure through breastfeeding enhances later acceptance of fruit and vegetables.

The results on complementary feeding were not consistent across the cohorts and highlighted the need to go beyond the timing of complementary feeding. Previous results from the UK and preliminary results from France suggested that other aspects of complementary feeding have to be taken into account, such as food variety during the complementary feeding period and use of homemade vs. ready-prepared baby foods.

Significance and benefits

We were able to carry out parallel analyses using comparable data in four different countries with varying duration of breastfeeding and timing of complementary feeding. This work has allowed us to conclude that never or short duration of breastfeeding but not timing of complementary feeding are associated with a less healthy diet in early childhood. This was shown both in lower fruit and vegetable intake and lower scores for healthy dietary variety. The similar results in the four countries suggest that these findings are applicable in general populations. They strengthen evidence for the benefits of breastfeeding. It is likely that children who eat few fruits and vegetables and have a poor dietary variety in early childhood will continue to do so even into adulthood and this type of diet is associated with the development of chronic diseases in later life.

Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- This key result was reported in Deliverable D16.



- One paper has been published:
de Lauzon-Guillain B, Jones L, Oliveira A, Moschonis G, Betoko A, Lopes C, Moreira P, Manios Y, Papadopoulou NG, Emmett P, Charles MA (2013). The influence of early feeding practices on fruit and vegetable intake among preschool children in 4 European birth cohorts. *American Journal of Clinical Nutrition*, 98, 804-812.
- One paper has been submitted:
Jones L, Moschonis G, Oliveira A, de Lauzon-Guillain B, Manios Y, Lopes C, Moreira P, Charles MA, Emmett P. The influence of early feeding practices on healthy diet variety score among preschool children in four European birth cohorts.

3.3 Key result no 3 - Child's eating behaviour and child's food habits

Workpackage: WP1 - Identification of critical periods and critical factors in the development of food habits

Research aims and background

As infants and toddlers grow, problematic eating behaviours may develop. Children displaying these feeding problems are likely to avoid particular foods or food groups, which could result in a limited food selection and lack of dietary variety, and a negative impact on essential nutrients intake. Most infants overcome the typical difficulties of these periods and their feeding style matures through practice and repeated exposure to new experiences, but some children fail to develop the skills necessary to cope with developmental demands and face persistent problems with eating.

From previous literature, feeding problems may develop even in healthy young children and compromise their future health. Previous research has also documented a negative effect of feeding problems on dietary habits; fewer studies have documented their relation with dietary variety, most of these have been conducted in children older than 5 years, and most of the studies conducted so far are cross-sectional.

In order to compare results across different populations, and to evaluate these relations from a prospective approach, the objective of this study was to relate eating behaviours at different age frames (4-6, 12-15, 24 and 48-54 months) with fruit and vegetable intake and dietary variety at 4-5 years of age in three European birth cohorts (Generation XXI from Portugal, ALSPAC from the UK and EDEN from France).

A better understanding of these early feeding problems may help define strategies to increase fruit and vegetables intake and overall dietary quality in children.

Results and applications

Eating behaviours were assessed at 4-6, 12-15, 24 and 48-54 months, based on mother's perception of feeding difficulties, child's poor eating (eating small quantities at each meal, not eating enough or need to be stimulated to eat), food refusal, and difficulties in the establishment of daily food routines. The association of these eating behaviours with fruit and vegetables intake and healthy dietary variety, assessed by food frequency questionnaires completed by parents when their child was 4-5 years of age, were studied. Parallel analyses with identical statistical models were performed in each country: Portugal (Generation XXI), the UK (ALSPAC) and France (EDEN).

Feeding problems in infants and toddlers were frequently reported by mothers from the three European birth cohorts (varying from 3% to 66%). Children who were more difficult to feed were less likely to have fruit intake above 1 serving/day than those with no difficulty. This association was consistent across cohorts and age groups. Similarly, children presenting with food refusal or higher food neophobia scores and those with difficulties in establishing a daily routine, particularly at 24 and 48-60 months, had lower fruit intake at 4-5 years of age. The associations with vegetable



intake were very similar, but slightly stronger; particularly when feeding difficulties were reported at 12 months of age and thereafter.

Children whose parents reported feeding difficulties at 4-6, 12-15 and 24 months also presented with a lower variety score at 4-5 years of age than those without difficulty. The associations of variety score with food refusal/neophobia and difficulties in establishing a daily routine were in the same direction, and increased if the problems occurred after 12 months of age.

Efforts to improve dietary quality in early childhood should incorporate strategies aimed at reducing these problematic eating behaviours.

Significance and benefits

We carried out parallel analysis, from a prospective approach, using comparable data in three different countries. This work allowed us to conclude that feeding problems in infants and toddlers were frequently reported by mothers in all three countries. Furthermore they were consistently associated prospectively with lower fruit and vegetable intake, as well as less dietary variety at 4-5 years of age. The similar results in the three birth cohorts suggest that these findings are applicable in general populations. They strengthen evidence for the benefits of strategies aimed at reducing problematic eating behaviours in early life, since the presence of feeding difficulties will be likely to compromise dietary habits of young children.

Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- This key result was reported in Deliverable D16.
- One paper was submitted to Journal of Pediatrics (US) and is under revision.
Oliveira A, de Lauzon-Guillain B, Jones L, Emmett P, Moreira P, Ramos E, Charles MA, Lopes C. Birth weight and eating behaviors of young children from three European birth cohorts.
- One paper is under revision by co-authors:
Oliveira A, Jones L, Lauzon-Guillain B, Emmett P, Moreira P, Charles MA, Lopes C. Are problematic eating behaviours associated with fruit and vegetables intake and dietary variety of 4-5 years-old children? A prospective analysis in three European birth cohorts.

3.4 Key result no 4 - Early determinants of child's food liking

Workpackage: WP1 - Identification of critical periods and critical factors in the development of food habits

Research aims and background

Several studies show that child's eating habits often do not fit with current nutritional recommendations, especially for fruit and vegetables intake. It is possible that eating habits, which are related to later food liking, could be modifiable in early childhood. Consequently, identifying determinants of food liking would be useful to improve child's diets (in terms of quality and frequency). Many hypotheses have been put forward on the potential determinants of fruit and vegetables liking. However, very few studies have explored jointly early maternal determinants and those relating to the child.

In this context, the aim of this longitudinal study was to examine in a global model, the influence of maternal fruit and vegetable intake, infant feeding patterns, parental feeding practices, child's fruit



and vegetables intake, and child's food neophobia on fruit and vegetables liking among children aged 5 years.

1142 children from the EDEN mother-child cohort completed a liking test based on food photographs administered during the 5-y clinical exam by trained staff.

Results and applications

Children's fruit and vegetable liking at 5 years was associated moderately but positively with their fruit and vegetables intake at 3 years. However, it was negatively associated with the intensity of food neophobia in the child. In turn, children's fruit and vegetable intake at 3 years was positively associated with maternal fruit and vegetable intake, as well as with some early feeding practices during the first year (positively with a pattern characterized by long breastfeeding duration, late introduction to complementary feeding and use of home-made foods, and negatively with a pattern characterized by use of ready-prepared adult foods). The two main determinants of child fruit and vegetable liking at 5 years are the intensity of food neophobia and child's intake at 3 years. "Child control" at 2 years also showed a small negative association with fruit and vegetable liking at 5 years. Furthermore, our results show that maternal intake is associated with infant feeding patterns over the first year and there was evidence of an association with parental restriction and control practices at 2 years. The results suggest that there is a direct link between maternal fruit and vegetable intake, infant feeding practices and child fruit and vegetable intake at 3 years and through this pathway to fruit and vegetable liking at 5 years.

Significance and benefits

These results underline the need to act on the determinants of food neophobia and fruit and vegetables intake so as to increase fruit and vegetables liking among young children and in the long-term among adults.

The originality of our study is in our ability to consider the complex and temporal relationships between the determinants of food liking and at the same time to assess food liking directly in an interview with the child.

References

- This key result was reported in Deliverable D16.
- One paper is under revision by co-authors:
Yuan WL, Rigal N, Monnery-Patris S, Chabanet C, Charles MA, de Lauzon-Guillain B. Early exposures and food liking in 5-y old children from the EDEN mother-child cohort.

3.5 Key result no 5 - Early feeding practices, child's food habits and growth/adiposity in young children

Workpackage: WP1 - Identification of critical periods and critical factors in the development of food habits

Research aims and background

Healthy growth but also overweight in children have been consistently reported to have their origins in early life. The current work aimed to examine the association between early feeding practices and growth and adiposity indices in preschool children from four European countries and extended to adolescents in the United Kingdom (UK).

The current work used available data from four European birth cohorts: ALSPAC (UK), EDEN (France), EuroPrevall (Greece) and Generation XXI (Portugal). Comparable data available in the four cohorts on anthropometric and body composition indices collected among 4-5 year old children were used in parallel analyses. Furthermore, body fat mass data (based on Dual Energy x-ray absorptiometry: DXA) on 9 and 13 year-old children and adolescents were available in



ALSPAC. Associations between early feeding practices (breastfeeding and timing of complementary feeding) and growth or adiposity indices (height z-score, BMI z-score, overweight/obesity and body fat mass levels) were tested using multiple linear or logistic regressions separately in each cohort, after adjustment for potential family socio-demographic, dietary and perinatal confounders.

Results and applications

Very few significant associations were found between breastfeeding duration or age of complementary feeding, and growth or adiposity indices. Moreover, associations were inconsistent across cohorts. For example, when stature (WHO height-for-age z-score) was examined as an outcome, 4 year-old children in ALSPAC who were never breastfed and those breastfed between 1 and 3 months of age were found to have higher height z-scores compared to children breastfed for more than 6 months of age whereas opposite associations were found in EDEN and no associations were found in Generation XXI and EuroPrevall. Relationships with other outcomes (BMI z-scores, overweight/obesity and body fat mass) were equally inconclusive.

Significance and benefits

In conclusion, the findings of the current work showed that early feeding practices (any breastfeeding and age of introduction of complementary feeding) are not consistently associated with height and BMI z-scores, overweight/obesity and body fat mass in preschool children from four European countries and in UK adolescents.

References

- This key result was reported in Deliverable D23.

3.6 Key result no 6 - The TASTE Study: the impact of exposure to early variety on vegetable acceptance

Workpackage: WP2 - Exploring key learning mechanisms and individual variations

Research aims and background

European children eat too few vegetables and preferences for these foods are low. Since food preferences influence intake, it is important to develop early life interventions to increase liking for vegetables. Emerging evidence has pointed to the potential benefits of introducing vegetables early in the weaning process, exposing infants to a variety of vegetable flavours early in life, repeating taste exposures on multiple occasions and the need for persistence despite infants' negative facial responses. This study aimed to investigate whether these findings have real-world application by testing a parent-led intervention to increase infants' vegetable acceptance.

Research suggests infants introduced to the taste of individual vegetables early during the process of introducing complementary foods, like and consume more of them both in the short and longer-term. The experience of tasting many different flavours leads to greater acceptance of unfamiliar foods and may reduce pickiness. This randomized control trial TASTE compared a home-based intervention comprising guidance on introducing a variety of single vegetables in the first weeks of complementary feeding with what constituted 'usual care', in three European countries (the UK, Greece and Portugal).

Results and applications

While no main effect of the intervention on children's intake of a novel vegetable was found in the three countries combined, UK Intervention infants ate significantly more of an unfamiliar vegetable and were rated by both mothers and researchers as liking the vegetable more than infants in the 'usual care' group one month after the introduction of solid foods. A positive trend towards higher consumption of the novel vegetable in the intervention group was observed in the Greek sample,



but the sample size for this outcome was smaller in Greece and thus was likely under-powered to detect significant group differences at the individual country level. This is supported by the similar intervention effect sizes observed in the Greek and UK samples. No effect of the intervention was observed in Portugal, where vegetable consumption is higher and vegetables are already commonly given to infants as first foods. These findings suggest that repeated exposure to a variety of vegetables at weaning can work to increase vegetable acceptance in the short-term, in countries where vegetables are not typically provided as first foods. However, the longer term impact of the intervention is less clear with no significant group differences in the primary outcome (intake of a novel vegetable) observed in any of the three countries six months post-intervention.

The TASTE intervention was received positively by parents who particularly welcomed the simple, prescriptive, and unambiguous nature of the instructions at an often anxiety-provoking stage of infant development. This intervention is straightforward, requiring parents simply to select single vegetables as their child's first foods and to offer them on a daily rotation, persisting even when their child appears to dislike a food. The advice would be easy to disseminate to parents during an infants' first months when frequent contact with health professionals is typical and parents are actively seeking advice about weaning.

Significance and benefits

This is the first study to have translated research findings into an easily disseminable intervention comprising simple, practical guidance to parents for introducing a variety of single vegetables as first foods in the home setting. It is also the first to include a no-treatment group ('usual care') in which mothers receive the 'usual care' available in their country. The differences in outcome observed across the three study sites is in itself a novel finding and may be partly explained by cultural variations in typical complementary feeding practices in the three participating countries. The higher levels of vegetable acceptance among Portuguese 'usual care' infants suggests less need for intervention in this country, where current practices already include early and varied vegetable introduction. In contrast the intervention successfully changed early feeding practices among Greek and UK intervention families, where fruit and baby cereals are typical first foods. The positive short term outcomes observed in the UK and Greece indicate the potential benefits of this intervention, especially when targeted appropriately. The advice trialled in the TASTE study offers a clearer and potentially more unified approach towards introducing solids than is currently available in many European countries.

Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- This key result was presented in Deliverable D12.
- One paper is in preparation:
Fildes A, Moschonis G, Lopes C, Moreira P, Oliveira A, Mavrogianni C, Manios Y, Beeken R, Wardle J, Cooke L. The TASTE study: A randomised control trial of parental advice for increasing vegetable acceptance in infancy.



3.7 Key result no 7 - Repeated exposure is a powerful mechanism to increase children's intake of a novel vegetable

Workpackage: WP2 - Exploring key learning mechanisms and individual variations and WP3 - Exploring new strategies for breaking habits and individual variations in responsiveness to these strategies

Research aims and background

Because children's vegetable intake is below the recommendations, it is important to find strategies that increase children's vegetable intake. Repeated exposure to vegetables has been shown to be a promising strategy to increase intake and liking of vegetables. Especially among infants, this strategy seems to be very successful. Previous studies have also shown that repeated exposure can be effective in young children, aged two to six years. In these studies however, small tastings of vegetables were used for the exposure sessions and intake increased significantly, but was still relatively small (16-35 grams compared to the daily recommendation of 100-150 grams).

Research has shown that there are various influences which might determine vegetable liking and might determine how much of a new or familiar food is accepted. Adding familiar and liked flavours such as sweetness or dips (flavour-flavour learning), increasing energy content using maltodextrin or oil (flavour-nutrient learning) or using different shapes of a vegetable may all influence the learning process.

Repeated exposure has been tested across many of the experimental studies performed in WP2, as well as in WP3 (Task T3.2) of the HabEat project and compared to other mechanisms based on learning by experience.

Results and applications

The studies across WP2 and WP3 showed that repeated exposure to a plain vegetable is an effective strategy to increase intake and liking of an unfamiliar vegetable among infants and young children. Large increases in vegetable intake were observed, and this was also true for children aged 3-5 years (Task 3.2). This task also showed that repeated exposure (twice a week) to a familiar vegetable was not effective in increasing children's vegetable intake.

WP2 showed that increasing energy content or adding familiar and liked flavours to the vegetables is not necessary for this learning effect among children aged 4 months to 4 years (see key result 8). An additional study conducted in the UK both confirmed and extended the findings from WP2.2. Repeated exposure to a novel vegetable increased intake of a novel vegetable in pre-school children. Moreover, intake of the control vegetable to which the children were not repeatedly exposed increased significantly from pre to post-intervention. This increase might be due to generalisation effects, in that the intervention vegetables shared similar taste and textural properties. However, it is difficult in this instance to rule out the possibility that the children became familiar with the experimental procedure and environment, and that they learned to expect to consume vegetable puree in this setting.

The two studies within Task 3.2 showed that using different shapes of vegetables can influence children's intake. Although the increases in intake over the seven exposures did not vary by experimental group (sticks, triangles, grated) in a study conducted in Denmark among children aged 3 to 5 years, the highest intake was achieved in the group receiving sticks. In addition, a study conducted in the Netherlands showed that 4-6-year-old children preferred carrot slices over carrot sticks for six out of ten sessions. In the Danish study, the generalisation of the learning effect to other vegetables was evaluated but no evidence for generalisation effects was observed. This may be explained by the fact that the overlap in sensory properties between the different vegetables used in the study was relatively small according to sensory evaluation performed by an adult panel.



Significance and benefits

Parents and caretakers should offer children unfamiliar vegetables (in their plain form) repeatedly for tasting, in order to encourage children to learn to like these new vegetables. The advantages of this strategy are that it can be used for children of various ages (infants to young children) and it can be implemented easily by parents, caregivers, day cares and primary schools.

Concerning the generalisation of learning from one vegetable to another vegetable, there are conflicting results in both the literature and the HabEat results. However, HabEat results seem to indicate that generalisation of learning could occur when the sensory properties of a novel vegetable are very close to the sensory properties of the 'learned' vegetable. It may be that generalization of learning is only seen under certain circumstances, but this remains to be determined by future studies. If the general rule is that generalisation does not easily occur, partly because vegetables are very different from each other, then, this implies that for optimal learning, children need to learn to like each vegetable, but that a variety of vegetables should be introduced so that the child's repertoire of liked vegetables is increased.

Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- This key result is related to Deliverables D7, D10 and D17.
- Several papers are already published:
 - Ahern SM, Caton SJ, Blundell P, Hetherington MM (2014). The root of the problem: increasing root vegetable intake in preschool children by repeated exposure and flavour flavour learning. *Appetite*, 80, 154-160.
 - Caton SJ, Ahern SM, Remy E, Nicklaus S, Blundell P, Hetherington MM (2013). Repetition counts: repeated exposure increases intake of a novel vegetable in UK pre-school children compared to flavour-flavour and flavour-nutrient learning. *British Journal of Nutrition* 109, 2089-2097.
 - de Wild V, de Graaf C, Jager G (2013). Effectiveness of flavour nutrient learning and mere exposure as mechanisms to increase toddler's intake and preference for green vegetables. *Appetite* 64, 89-96.
 - Hausner H, Olsen A, Møller P (2012). Mere exposure and flavour-flavour learning increase 2-3 year-old children's acceptance of a novel vegetable. *Appetite* 58, 1152-1159.
 - Remy E, Issanchou S, Chabanet C, Nicklaus S (2013) Repeated exposure of infants at complementary feeding to a vegetable puree increases acceptance as effectively as flavor-flavor learning and more effectively than flavor-nutrient learning. *Journal of Nutrition* 143, 1194-1200.
- One paper is accepted and available on-line:
 - de Wild V, de Graaf C, Jager G (2014). Efficacy of repeated exposure and flavour-flavour learning as mechanisms to increase preschooler's vegetable intake and acceptance. *Pediatric Obesity*, Epub ahead of print, doi: 10.1111/ijpo.244.
- One paper is under revision:
 - Bouhlal S, Issanchou S, Chabanet C, Nicklaus S. An experimental comparison of the effect of repeated exposure and conditioning with salt or spice on vegetable acceptance in toddlers: 'Just a pinch of salt'. *Appetite*, in revision.



3.8 Key result no 8 - Adding flavour or energy is unnecessary to promote intake of vegetables

Workpackage: WP2 - Exploring key learning mechanisms and individual variations

Research aims and background

The aim of several experiments within the HabEat project was to evaluate the benefits, if any, of manipulating the sensory features or energy density of vegetables in order to promote liking and intake. Vegetables may be disliked because they are high in water content and therefore are low in energy density. As children are growing they have increasing energy needs and children tend to prefer fruits and vegetables which are higher in energy density than those which are high in water content and therefore low in energy density. Providing additional energy to vegetables might also produce positive post-ingestive consequences and in learning about vegetables this benefit might enhance acceptance. Also vegetables tend to be bitter in taste and thus disliked due to the 'innate' rejection of bitterness. Within the HabEat project, several experiments tested whether increasing energy content, or altering the flavour of vegetable by adding sweetness, seasoning or dips would promote liking and intake of novel vegetables. Thus, novel vegetable crisps (freeze dried parsnip, beetroot) were offered with a plain creamy dip or tomato ketchup, a novel vegetable puree (salsify) had seasoning added (salt or salt plus nutmeg), a novel vegetable puree (artichoke) was presented with added flavour (sugar) or energy (oil) and novel green vegetable soups (endive and spinach) were developed with added energy (maltodextrin) or no added energy. Several experimental studies were conducted with children aged from 6 months to 48 months to test whether and to what extent sensory or energy manipulations could enhance intake and liking of a novel vegetable.

Results and applications

Initially, novel vegetables were identified within and across countries from a survey asking parents in each country about types of vegetables consumed (see Ahern et al., 2013). This ensured that children were exposed to novel vegetables which were eaten rarely or not at all in their country. This was done so that sensory and energy manipulations could be conducted without being confounded by familiarity and that the same vegetables could be used in each country. Intake was compared with a familiar vegetable (carrot) in several studies. Across all experiments conducted, it was demonstrated that repeated exposure was the most effective technique for promoting the intake of a novel vegetable and that no significant, additional benefit to amount eaten was derived from adding seasoning, sweetness, offering dips, or increasing energy content. For example, increasing energy content of the artichoke puree actually produced the lowest increase in intake compared to the basic artichoke puree (Hausner et al 2012, Caton et al 2013, Remy et al 2013) and adding sweetness enhanced intake of that version compared to the plain version among children exposed ten times to the sweet purée (Hausner et al 2012). Also, exposure to the endive or spinach soup enhanced intake but irrespective of the energy content although liking for the soups increased only for the versions paired with energy. Thus, preschool children liked the soup with added energy more than the low energy version but this did not increase intake (de Wild et al 2013). When seasoning was added to salsify, preschool children ate more of the target vegetable when offered plain compared to the seasoned versions (Bouhlal et al, in revision) and increased intake was observed 6 months after exposure. When freeze dried novel vegetables were offered with dip (plain or ketchup) a significant increase was found regardless of dip provision and the increased intake was also observed 6 months after exposure. Overall, four separate experiments demonstrated convincingly that repeated exposure to a basic form of vegetable was sufficient to increase novel vegetable intake in different forms (soup, crisp, puree), in one study increasing energy content enhanced liking for that soup and in one study adding sweetness induced a higher intake of the sweet version compared to the plain version. Thus, increasing energy content could be beneficial for increasing liking but not intake and adding sweetness could limit later intake of plain vegetables if children come to expect the sweet flavour with the vegetable.



Significance and benefits

The variety of techniques applied across different age groups and studies yielded a similar outcome. Therefore, the benefit of these studies was to provide strong evidence that repeated exposure is sufficient to encourage children to consume a novel vegetable whether in soup, crisp, or pureed form. The significance of these findings is that mothers and other caregivers can provide vegetables in their plain, unadulterated form and this will be enough to promote intake in most children. However, some seasoning or sweetness might facilitate acceptance of a new vegetable in some children. Increasing energy might influence liking through flavour-nutrient learning. The technique of repeated exposure does not require the addition of any other ingredients above and beyond regular preparation techniques and is the method most likely to be endorsed in public health messages.

Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- This key result was reported within Deliverable D7.
- Several papers are already published:
 - Ahern SM, Caton SJ, Nicklaus S, Møller P, Hausner H, Hetherington MM (2013). Eating a Rainbow: Introducing vegetables in the first years of life in 3 European countries. *Appetite*, 71, 48-56.
 - Ahern SM, Caton SJ, Blundell P, Hetherington MM (2014). The root of the problem: increasing root vegetable intake in preschool children by repeated exposure and flavour flavour learning. *Appetite*, 80, 154-160.
 - Caton SJ, Ahern SM, Remy E, Nicklaus S, Blundell P, Hetherington MM (2013). Repetition counts: repeated exposure increases intake of a novel vegetable in UK pre-school children compared to flavour-flavour and flavour-nutrient learning. *British Journal of Nutrition* 109, 2089-2097.
 - de Wild V, de Graaf C, Jager G (2013). Effectiveness of flavour nutrient learning and mere exposure as mechanisms to increase toddler's intake and preference for green vegetables. *Appetite* 64, 89-96.
 - Hausner H, Olsen A, Møller P (2012). Mere exposure and flavour-flavour learning increase 2-3 year-old children's acceptance of a novel vegetable. *Appetite* 58, 1152-1159.
 - Remy E, Issanchou S, Chabanet C, Nicklaus S (2013) Repeated exposure of infants at complementary feeding to a vegetable puree increases acceptance as effectively as flavor-flavor learning and more effectively than flavor-nutrient learning. *Journal of Nutrition* 143, 1194-1200.
- One paper is accepted and available on-line:
 - de Wild V, de Graaf C, Jager G. Efficacy of repeated exposure and flavour-flavour learning to increase preschooler's vegetable intake and acceptance. *Pediatric Obesity*, Epub ahead of print, doi: 10.1111/ijpo.244.
- One paper is under revision:
 - Bouhlal S, Issanchou S, Chabanet C, Nicklaus S. An experimental comparison of the effect of repeated exposure and conditioning with salt or spice on vegetable acceptance in toddlers: 'Just a pinch of salt'. *Appetite*, in revision.



3.9 Key result no 9 - Individual differences in learning to eat a novel vegetable

Workpackage: WP2 - Exploring key learning mechanisms and individual variations

Research aims and background

Amongst the different learning strategies based on learning by experience, repeated exposure (also named 'mere exposure') is the simplest and most convenient method to enhance vegetable intake in children. However, the efficiency of learning can depend not only on the strategy used by the mother but could differ greatly between children. Despite this fact, there are a limited number of studies examining individual differences between children along the course of a learning intervention and trying to relate these identified eating patterns to characteristics of the child. These child characteristics include age, body mass index (BMI), eating behaviour traits, such as satiety responsiveness, food enjoyment, food responsiveness, food fussiness (reluctance to eat or avoidance of novel foods (food neophobia), or high selectivity about the range of foods accepted). Background factors such as early food history (breastfeeding duration, and timing of introduction of complementary foods) may also be important.

The current study was designed to investigate this question: what individual characteristics predict patterns of a novel vegetable intake over time?

Data from three investigations, in the UK, Denmark and France, using the same target vegetable, and following the same procedure were combined. For the intervention, children were assigned to one of three learning conditions: repeated exposure (they receive a basic artichoke puree), flavour-flavour learning (basic artichoke puree with added sweetness) or flavour-nutrient learning (basic artichoke puree with added energy).

Knowing the individual differences which predict later success in interventions to promote vegetable acceptance would be extremely useful for developing public health interventions which could take account of traits inherent to the child.

Results and applications

Children were classified into one of four categories of eaters. Children whose increase in intake during exposure was significant and greater than 2g per exposure were categorised as "learners". Children who consumed the majority of what was offered (> 75g) over the first five exposures were categorised as "plate-clearers". Children who consumed very little (< 10g) at each exposure were classified as "non-eaters" and all other children were assigned to the category "others". Most children, 40%, in our sample were characterised as "learners", 16% of the children were classified as "non-eaters", 21% as "plate-clearers", and 23% were classified as "others" since their pattern did not fit any of the other categories in a systematic way. One logistic regression was conducted to discriminate "non-eaters" from "learners", and one to discriminate "non-eaters" from "plate-clearers". The only significant predictor to discriminate "non-eaters" from "learners" was food fussiness, although also age approached significance. That is, children who scored higher on food fussiness were more likely to be "non-eaters" than "learners", and younger children had a tendency toward being "learners" rather than "non-eaters". The only significant predictor to discriminate "plate-clearers" from "non-eaters" was age, although food fussiness approached significance. Younger children were more likely to be "plate-clearers" than older children and children with higher food fussiness scores tended to be "non-eaters".

"Non-eaters" were significantly older (\approx 28 months) than "learners" and "others" (\approx 20 months), "plate-clearers" were the youngest (\approx 12 months).

Satiety responsiveness, which was positively correlated with age, was also higher for "non-eaters" and lower for "plate-clearers". Food fussiness was positively correlated with age and differed significantly between the categories of eaters. It was higher for "non-eaters" and lower for "plate-clearers" and "others". There was no difference between the categories of eaters in terms of enjoyment of food and food responsiveness. Categories of eaters did not differ on BMI, or on the early food history, i.e. on total breastfeeding duration, and on timing of introduction of



complementary foods. Children who were in the flavour-nutrient learning condition were more likely to be in the “other” eating category, and less likely to be “learners”.

Significance and benefits

To our knowledge, this is the first study to investigate individual differences in response to novel vegetable exposure. Despite the fact that repeated exposure might be effective for most children, this is not the case for more than 15% of the children. Thus, recommendations to improve vegetable intake in children should take account of these individual differences. Therefore, alternative methods that focus on encouraging initial tastes of the target food might be needed for the fussier and older pre-school children. These techniques could be based on adding some liked seasoning, sauce or sweetness that might facilitate acceptance of a new vegetable in these children (see key result 8). It is also important that parents are encouraged to be persistent and patient but they must avoid pressurising their child.

Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- This key result was presented in Deliverable D13.
- One paper has been accepted:
Caton SJ, Blundell P, Ahern SM, Nekitsing C, Olsen AM, Møller P, Hausner H, Remy E, Nicklaus S, Chabanet C, Issanchou S, Hetherington MM (2014). Learning to eat vegetables in early life: the role of timing, age and individual eating traits. PLoS One, 9(5): e97609: <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0097609>

3.10 Key result no 10 - Earlier the better – experience of novel vegetables in early life promotes intake more successfully than experience later in childhood

Workpackage: WP2 - Exploring key learning mechanisms and individual variations

Research aims and background

Characteristics of the child, the caregiver (predominantly mothers) and their feeding practices influence food habit formation. However, it is not clear how these factors might interact to predict willingness to accept a novel vegetable and learning to accept this food over time. Thus, it is important, given the obvious overlap between these features that they are tested simultaneously. Within HabEat WP2 studies different experiments were based on a similar design. All included measurement of intake of a novel vegetable at pre-intervention (initial intake) and along the course of an intervention period during which children were supposed to learn to eat the vegetable by experience, i.e. through repeated exposure. The different learning strategies were based on learning by experience; they varied from repeated exposure (also named ‘mere exposure’), flavour-flavour learning (by adding familiar flavours such as sweetness), or flavour-nutrient learning (by increasing energy content using maltodextrin or oil). Therefore, questionnaire and intake data which were collected across 4 countries and five experiments (518 children aged between 4 – 46 months) from the UK, Denmark, France and the Netherlands were available and could be used to address this question. The data were analysed using structural equation modelling (SEM). The models were developed based on previous literature to predict initial acceptance of a novel vegetable as well as the slope of change in intake over time as a proxy of food preference formation. Therefore, structural equation models were developed using: i) child age and child eating behaviour traits, i.e. satiety responsiveness, food enjoyment, food responsiveness, food fussiness (reluctance to eat or avoidance of novel foods (food neophobia) or high selectivity about



the range of foods accepted), ii) maternal food neophobia, maternal vegetable intake and maternal education and, iii) breastfeeding and timing of complementary feeding as feeding practices.

Results and applications

As noted in the key-result 8, the most successful strategy to increase novel vegetable intake was repeated exposure.

It was found that food fussiness and satiety responsiveness can be combined in a construct named “food avoidance”. Food avoidance was higher for older children and was the best predictor of both initial intake and learning velocity. The effect was negative for the initial vegetable intake: the higher the avoidance, the lower the initial intake of a novel vegetable. On the contrary, the effect was positive on learning velocity: children who scored high in food avoidance showed a bigger increase in intake during the intervention. When food avoidance was taken into account, age had a positive effect for initial vegetable intake and a negative effect for learning. None of the other variables had a direct effect on initial vegetable intake or on learning velocity.

Maternal food neophobia was significantly linked with her own vegetable intake: the more mothers were neophobic, the less frequently they ate vegetables, but there was no significant association with child responses. Moreover, maternal vegetable intake had no significant association with child responses. Thus, characteristics of the child were more potent predictors of intake than maternal characteristics.

Mothers’ education was positively associated with timing of complementary feeding and timing of complementary feeding was negatively associated with child vegetable intake; thus, mother education only influenced indirectly child vegetable intake rather than having a direct effect.

Significance and benefits

To our knowledge, this is the first attempt to model the predictors of success in learning to eat vegetables. Across studies, older children were more likely to have high scores on food avoidance. Moreover, it appears that food avoidance may mediate the association between age and vegetable intake. Overall, intakes of children aged 4 years and under were mainly driven by their own eating traits.

A novel finding in this study is that food avoidant children demonstrated a steeper gradient of intake in learning to like a novel vegetable than less food avoidant children. So, initially they eat a little, but they increase their intake more over time. Thus, repeated exposure is successful even in children who are fussy eaters. However, older children being more food avoidant, are more likely to eat very little at the first exposure perhaps prompting their mothers to decide that they do not like the food and thus that it will not be worth offering it again.

Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- This key result was presented in Deliverable D15.
- A publication based on this is in development.



3.11 Key result no 11 - The effect of imitation of an idol or teacher on children's vegetable intake

Workpackage: WP3 - Exploring new strategies for breaking habits and individual variations in responsiveness to these strategies

Research aims and background

Despite the health benefits of eating vegetables, children's vegetable consumption is below that recommended across Europe. Therefore, new strategies are needed to increase their vegetable intake. Research has shown that observational learning (role modelling) plays an important role in shaping children's food choice behaviour. Children learn about food via observing other people's food intake behaviour - such as parents, peers, idols and teachers - and children are likely to imitate the behaviour. This has been studied for new or unfamiliar food products, but less is known about the effect of role modelling on children's intake of a relatively familiar vegetable. Only one study showed an increased acceptance for previously less liked vegetables in children who were exposed to children who had a high preference for that target vegetable.

Furthermore, pressuring children to eat vegetables has been shown to result in a reluctance to eat vegetables. Restriction of unhealthy foods, however, seems to increase the preference and intake of that food when it becomes available. It is not known whether restriction can be applied to vegetables to increase vegetable liking and intake.

Therefore, the effect of convivial eating and positive restriction on children's vegetable intake and vegetable choice was investigated in two countries (Greece and The Netherlands) via four studies. Raw carrot was the target vegetable. In two studies, a cartoon character or TV stars ('idols') acted as the role model (on video), whereas in the other two, the children's own teacher acted as the role model. The term positive restriction refers to the act where the role model consumes carrots, whereas the children do not receive carrots at that moment. The term convivial eating refers to the act where the role model and the children eat carrots together. Choice tests - during which children could choose one vegetable out of four (including raw carrot) - were included to assess vegetable preference.

Results and applications

Imitation of a video idol or teacher did not lead to increased vegetable intake among 3-6-year-old children. In the Greek idol imitation study, carrot intake was highest in the positive-restriction group and lowest in the control group, which could point to a promising role for positive restriction. However, a difference in baseline consumption - which was not assessed prior to the study - cannot be ruled out. Furthermore, the other three studies within this task did also not show a significant effect of positive restriction.

A strong and consistent finding was that children's vegetable consumption was higher during the choice tests (about 60-80 grams) than during the convivial eating sessions (about 25-40 grams), which may have been due to a positive effect of having a choice, an easier-to-chew effect or a preference effect.

The long-term measures showed increased vegetable intake for some groups, which may indicate that there was a delayed effect of the intervention. But taking all the results together and the fact that some control groups increased their intake as well, it seems more likely that this is an age effect. When children of this age become 8-9 months older, they simply eat more.

Unexpectedly, differences between school classes were observed regarding the intake patterns during the intervention period. This finding and the findings from the analyses when the data from both countries were combined, suggest that various individual, situational and cultural factors may have played a role. It is possible that different processes with contrary effects on children's vegetable intake occur simultaneously: such that role modelling effects of the video idol and teacher are positive, while peer modelling effects and boredom effects could be negative. Therefore, both situational and individual factors influence children's vegetable intake.



Significance and benefits

This study is the first to investigate the effect of positive restriction on children's vegetable intake and choice. Although the effect of positive restriction per se was difficult to assess, it appears to show some promise, however this should be explored in additional studies.

This is one of the few studies that focus on role modelling strategies to increase children's intake of relatively familiar vegetables. No increase in vegetable intake was observed as a result of these imitation strategies among children aged 3 to 6 years in a classroom setting. Since convivial eating and positive restriction are strategies that are relatively easy to apply, it would be worthwhile to explore their effect in other age groups and in other settings, such as the home.

Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- The results of these studies have been reported in Deliverables D11 and D17.
- One paper has been submitted in May 2014:
Zeinstra GG, Kooijman V, Kremer S. A majority of Dutch 4-6-year-old children are resistant to role modelling intervention in a classroom setting to increase carrot consumption: only 11% significantly increased their intake.

3.12 Key result no 12 - Effects of offering choice on 2-6 year-old children's vegetable intake

Workpackage: WP3 - Exploring new strategies for breaking habits and individual variations in responsiveness to these strategies

Research aims and background

It is a problem that children's intake of vegetables are consistently reported to fall far below recommendations. Therefore, many different approaches to increase their consumption are being investigated. Offering children a choice between several vegetable alternatives might hold potential for increasing vegetable intake. By offering a choice, a child's feeling of autonomy may be increased, which in turn may enhance intrinsic motivation, according to the self-determination theory. Only a few studies have investigated the influence of free choice on children's vegetable intake. These studies showed that children liked being able to choose, but the results regarding vegetable intake were not consistent.

Therefore, the effect of choice-offering on children's vegetable intake was investigated in three countries. In Denmark and Greece, a within-subject design was used for children aged 3-5 years in a school/nursery setting. The children participated in six vegetable eating sessions of which four were without choice and two were with choice. The Dutch choice study was executed in the home-setting with children aged 2-6 years. Fifty per cent of the Dutch children were offered no choice during dinner time meals, whereas the other 50% were offered a choice between two vegetables during the evening meals.

Results and applications

The Danish study provided opposing results depending on whether comparisons were made per vegetable type or across all three vegetables. For example, higher vegetable intake of 12 grams was found for the choice sessions (single vegetable) compared to the mean intake of a single vegetable at no-choice sessions. When comparisons were done per vegetable, no effect (sugar snaps and baby maize) or a negative effect (for carrots) on vegetable intake was found. The Greek results showed significantly higher intakes in the freedom of choice sessions compared to the no



choice sessions for three pairwise comparisons, whereas there was no difference in intake for the other five comparisons of choice session versus no-choice session. The Dutch study showed a positive trend for freedom of choice on vegetable intake when corrected for gender, age and vegetable liking prior to the intervention. Together the results indicate that choice-offering seems to have potential to positively contribute to children's vegetable intake, but the effect does not seem to be very robust. So, further investigation of optimising choice should be explored.

The results also indicate that certain groups may benefit more from choice-offering than others. Cultural and situational factors, the type of vegetable, age of the child and vegetable liking prior to the study seem to be moderating factors. These influencing factors may have also contributed to the somewhat inconsistent results.

Significance and benefits

The work in this task adds to the limited number of studies that have investigated the effect of choice-offering on children's vegetable intake. As it is a relatively simple strategy to apply, future research should aim to confirm and extend our findings; in particular to understand the conditions which favour or undermine any positive effect of offering choice.

It seems that offering a choice of vegetables may contribute to creating a positive atmosphere around eating vegetables, which could have a positive effect on general vegetable consumption. Alternatively, it may be that the effectiveness of choice-offering varies with age. Younger children may not be used to making food choices, and possibly with increasing age, children may increase their understanding and appreciation of having a choice. Therefore, studying the effect of choice in different age groups seems a valuable approach for future research.

Should choice-offering turn out to be an effective strategy for influencing intake, it is possible that it would have an effect in general and not be bound to specific types of stimuli. If this is true, offering choice could be used to increase intake of many types of healthy foods and possibly decrease intake of unhealthy foods (e.g. sweets) by offering choice for the healthy options and not for the unhealthy options.

Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- The results of these studies have been reported in Deliverables D11 and D17.
- One paper has been submitted in May 2014 and is under review:
de Wild V, de Graaf C, Boshuizen H, Jager G. Influence of choice on vegetable intake in children: an in-home study.

3.13 Key result no 13 - The VIK study: involving children in vegetable preparation

Workpackage: WP3 - Exploring new strategies for breaking habits and individual variations in responsiveness to these strategies

Research aims and background

Despite the health benefits of vegetables, children's vegetable consumption is below that recommended in many European countries. Research shows that it is a challenge to increase children's vegetable intake and new strategies are needed. Previous studies suggest that cooking sessions may be a promising strategy to increase children's vegetable consumption. By being involved in vegetable preparation, the child may become more familiar with the vegetable and familiarity is an important determinant for liking and intake. Furthermore, involvement in the preparation of vegetables might increase the child's feelings of autonomy, relatedness and



competence according to the self-determination theory, possibly leading to a more intrinsic motivation for eating vegetables.

Since eating habits and food preferences develop early in life, this study investigated the effect of involvement in vegetable preparation on vegetable consumption and vegetable choice in children aged from 4 to 6 years (The Netherlands). The results of this study can be applied easily at home or in a school event.

Children were randomly assigned to the intervention or control group. Fifty per cent of the children participated in an interactive vegetable preparation session (carrots) with an enthusiastic chef-cook prior to an evening meal, whereas the control group participated in a book-reading activity. The children received a typically Dutch meal consisting of mashed potatoes, cooked vegetables (children could choose between French beans or carrots) and sausages.

Results and applications

There were no significant differences in vegetable intake between the intervention and control group at any time point (baseline, after intervention, follow-up at 1 and 3 months). In addition, the measurements did not show any increase in children's evening meal vegetable intake (after intervention or follow-up at 1 and 3 months) or children's habitual daily vegetable intake (one-year follow-up). So, participation in one interactive vegetable preparation session with an enthusiastic chef-cook did not increase vegetable intake among children aged 4 to 6 years. When exploring children's vegetable choices during the dinners, there was some evidence that the cooking session maintained children's interest in the prepared vegetable. In comparison with baseline, control children choose carrots less often, whereas a similar number of intervention children choose carrots before and after the cooking session.

The fact that we did not find an increase in vegetable intake could be due to the large within-subject variability that was observed, the relatively young age group that was studied, the test setting, or the fact that parents were requested not to focus on the vegetables in the parent-child conversations during the meal.

It was interesting to see that involvement in food-related activities remained stable for the intervention group between baseline and the 3-month follow-up moment, and it slightly decreased in the control group. The intervention did not teach the parents about involving children in the meal preparation process, and nothing was mentioned about involvement in food-related activities during the study. Perhaps, merely looking at the children being involved in vegetable preparation (by the parents in the intervention group) may have prevented a similar drop in involvement over time to that seen in the control group.

Significance and benefits

A unique point of this study is that it investigated the effect of involvement in vegetable preparation per se in a young age group. In contrast to previous studies that found positive effects of cooking programs, our study showed that participating once in a vegetable preparation session together with an enthusiastic chef-cook did not increase children's intake of a relatively familiar vegetable in a restaurant setting. Nevertheless, our study showed some evidence for positive secondary outcomes: children's interest in the prepared vegetable may be maintained as well as their involvement in food-related activities. This suggests that preparing a vegetable may result in positive effects, which may partly be due to the positive context that is created by cooking together. Nevertheless, future research should substantiate whether or not it is possible to increase vegetable intake of 4 to 6-year-old children by involving them in vegetable preparation.

For future research, it is recommended to have multiple cooking sessions, to test this strategy also in a more familiar home setting and in different age groups, as the results we found may be age specific. In addition, it may be interesting to measure the verbal responses of the parents and the parent-child conversations during and after the vegetable preparation.



Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- The results of this study have been reported in Deliverables D11 and D17.

3.14 Key result no 14 - Control of food intake in preschool children: associated factors

Workpackage: WP3 - Exploring new strategies for breaking habits and individual variations in responsiveness to these strategies

Research aims and background

Infants have an innate ability to self-regulate energy intake with intake being driven primarily by responses to hunger and satiation cues. This ability to self-regulate energy intake tends to decrease with age. Between the ages of 3 and 6 years children may become less responsive to internal cues of hunger and satiation, and more responsive to external food cues, which may induce overeating and contribute to weight gain. Some parental feeding practices may promote overeating in children. Thus, it is important to better understand eating behaviours that may favour the development of overweight during childhood as this is linked with a higher risk of obesity at adult age and increased morbidity and mortality risks.

Thus, the aims of this series of studies were:

- (1) to measure caloric compensation (COMPX) and eating in the absence of hunger (EAH) in 3 to 6 year-old French children in their usual eating context
- (2) to link these measurements with individual characteristics (age, sex, adiposity) and maternal feeding practices
- (3) to develop an intervention targeted to children aged at least 4 years with either an initial score for eating in the absence of hunger (above) or for caloric compensation (below) the median. The aim was to help them focus on their internal cues of hunger and satiation to avoid overeating, and to evaluate the impact of the intervention on children's COMPX and EAH
- (4) to evaluate the evolution of COMPX and EAH over one year in children who had not received the intervention.

Results and applications

On average children compensated for only half of the energy (calories) from an energy-dense preload offered before a lunch. When offered palatable foods after a lunch, they ate extra equivalent to a quarter of the energy that they had consumed during their lunch. Children who were poor at compensating were not the same as those who ate the largest amount in the absence of hunger.

EAH and COMPX did not vary with age or adiposity. EAH was higher in boys than in girls. The more mothers used food as reward, the more their children ate in the absence of hunger but surprisingly the better they compensated for calories.

This study provides evidence that caloric compensation and eating in the absence of hunger are two distinct eating behaviours.

We observed that at post-intervention the mean score of caloric compensation was higher than at pre-intervention. However, this increase was not different between the group that received the intervention and a control group of the same size and with similar characteristics as the intervention group.

Concerning EAH, there was no change between the pre- and the post-intervention whatever the group of children.

Thus, we were unable to demonstrate an effect of the intervention on children's behaviour in two challenging situations where they can overeat. In conclusion, it appears that it is not so easy to



teach children between 4 and 6 years of age to pay attention to their internal cues of hunger and satiation and to improve their ability to adjust their energy intake in challenging situations where overeating is possible.

In a longitudinal follow-up of COMPX and EAH scores, EAH was stable over 1 year but COMPX decreased, confirming alteration of food intake control with age.

Significance and benefits

This work documented for the first time the level of caloric compensation at a meal after a preload in French preschool children. Moreover, this work revealed that children who did not compensate for the energy from the preload were not necessarily the same children who ate in the absence of hunger, providing evidence that caloric compensation and eating in the absence of hunger are two distinct eating behaviours.

Moreover, the present study is the first longitudinal study on caloric compensation with such a high sample size ($n \approx 100$).

Successful applications

We have incorporated these results into a booklet and web-based guide to parents of infants and young children on how to help children to like vegetables and fruit.

References

- The results of this work have been reported in Deliverables D9, D17 and D18.
- One paper is at the final stage before submission:
Remy E, Issanchou S, Chabanet C, Boggio V, Nicklaus S. Evaluation of overeating in 3- to 6-year-old children by the measurements of eating in the absence of hunger and caloric compensation.
- Another paper is in preparation:
Remy E, Issanchou S, Chabanet C, Boggio V, Nicklaus S. Tracking of overeating. One-year deterioration in caloric compensation and stability in eating in the absence of hunger in preschool children.

3.15 Key result no 15 - A guide for parents of young children “Vegetables and fruit: help your child to like them”

Workpackage: WP4 – Recommendations, guidelines and communication

Research aims and background

HabEat has brought together researchers from 11² groups from six European countries and has applied a multidisciplinary approach (psychology, epidemiology, behavioural science and nutrition, sensory science) to investigate how key food habits are formed in infants and young children. A

² INRA: Institut National de la Recherche Agronomique
FBR-DLO: Food & Biobased Research (WUR) - Stichting DLO, the Netherlands
Inserm: Institut National de la Santé et de la Recherche Médicale, France
ULeeds: University of Leeds, UK
WUR: Wageningen University, the Netherlands
UCPH: Københavns Universitet, Denmark
UCL: University College London, UK
U.Porto: University of Porto, Portugal
HUA: Harokopio University, Greece
UNIBRIS: University of Bristol, UK
IT: INRA Transfert SA



combination of epidemiological studies, based on existing birth cohorts from four countries, and experimental work in six countries has been carried out with the aim of identifying:

- The critical periods in the formation/breaking of food habits;
- The key learning mechanisms, their relative impact in the short, medium and long term and their importance according to the different critical periods;
- The most effective strategies for breaking habits, i.e. for changing from poor to healthy habits;
- Individual reactions to the learning mechanisms and individual susceptibility to changes.

HabEat aimed to develop strategies to promote healthy food habits in infants and young children. These include interventions to facilitate habit breaking while taking into account individual differences in child eating behaviour and parental feeding strategies.

HabEat studies focused on fruit and even more on vegetable consumption because in most Western countries, large population groups, including children and adolescents, eat far less than the recommended amount. It is likely that promoting the adequate intake of fruit and vegetables early in life is particularly important in helping to reverse this trend, because health behaviours learned in childhood tend to track into adolescence and adulthood.

The project has worked hand-in-hand with stakeholder advisors (including industry and health professionals) to produce recommendations that childcare professionals, policy makers and parents from different target groups (especially those most at risk) in different EU regions will find helpful. Feed-back from stakeholders has been obtained via presentations and discussion groups held in the UK, Portugal, Poland, and France.

Results and applications

The guide for parents is based on the analysis of data from birth cohort studies and experimental work among infants, toddlers and children up to 6 years of age. These HabEat findings have been used in combination with evidence from previous literature to inform the contents of a booklet for parents aiming to guide them towards the promotion of healthy eating in their children starting in infancy.

The evidence-based recommendations from HabEat results which are included in the guide for parents are presented below.

Breastfeeding and complementary feeding

Breast milk is the best food for infants. Among its many advantages, HabEat found evidence that it may facilitate the consumption of vegetables and fruit and a greater variety of healthy foods in later childhood. This may be the result of exposure to flavours from the mother's diet changing the taste of the breast milk.

Recommendation: Continued efforts should be made to encourage breastfeeding.

The complementary feeding period is a 'window of opportunity' when an infant is particularly receptive to a variety of foods with different flavours and textures. It is important that infants are introduced to a variety of different vegetables in the complementary feeding period as HabEat found some evidence that this increases later acceptance of novel foods. Familiarity with many different vegetables is likely to lead to the consumption of a greater variety of vegetables and fruit, as the child grows.

HabEat has shown that introducing a variety of plain vegetables to infants can increase acceptance of a novel vegetable. HabEat has also shown that repeating the exposure to the same vegetable can increase acceptance of that vegetable. If it is refused at first it should be offered again after a few days. The number of tastings needed will depend on the age and eating temperament of the individual child and on the particular vegetable. As many as 8 exposures may be necessary and can be carried out in both home and childcare settings.

HabEat found that infants and younger children accept novel vegetables more readily than older children (2-6 years).



HabEat has shown that children (aged 4 to 36 months) who are less enthusiastic eaters needed more exposures to accept a novel vegetable. These children consumed less of the vegetable at the beginning but their intake increased with exposure.

Recommendation: Introduce plain vegetables as first foods in the complementary feeding period and use repeated exposure to a variety of vegetables to increase acceptance of vegetables.

Feeding young children (2-6 years of age)

Children are more likely to become neophobic and picky (refuse novel and familiar foods) between the ages of 2 and 6 years and at this stage it is more difficult to achieve acceptance of a novel vegetable. HabEat has shown that repeated exposure to a plain novel vegetable increases intake in children of this age.

Offering several different serving styles (sticks, grated, squares etc.) of vegetables may be effective in increasing intake, as this influenced liking and intake among young children in HabEat.

HabEat found that offering children more than one vegetable to choose may increase their intake of vegetables. Other HabEat studies have shown that offering the same (relatively familiar) vegetable twice per week may lead to boredom and diminish intake of that vegetable.

HabEat did not find evidence that, for children aged 4 to 6 years, helping to prepare vegetables on one occasion in a restaurant setting was effective in increasing their intake of a relatively familiar vegetable. Neither the child's teacher nor a cartoon character acting as a role model was effective in increasing intake of a relatively familiar vegetable in a class-room setting.

Recommendation: Use repeated exposure to a novel vegetable to help a child learn to enjoy the taste of that vegetable. When possible offer children a choice of two or more vegetables.

Children described by their parents as 'difficult eaters' were found by HabEat to eat less vegetables and fruit and a less varied diet at 4-5 years of age than children who were not described as difficult.

Recommendation: Parents should persist in offering children who are 'difficult eaters' a variety of tastes and textures to help them learn to like a range of foods.

Food intake regulation and parental feeding practices

HabEat found that parents who used 'Food as a reward' were more likely to have children (aged 3-6 years) who ate in the absence of hunger than parents who did not use this feeding strategy.

Recommendation: Foods should be offered to a child in response to their feelings of hunger, and not used as reward for a good behaviour or for any other reason.

HabEat found that when children (aged 3 to 6 years) ate a preload of energy-dense food less than one hour before a meal, they ate less during the meal. However, at the meal, children adjusted their food intake only partially for the energy ingested from the preload. Therefore, their overall average energy intake was higher with the preload than when only the meal was eaten.

HabEat found that when energy-dense foods were available freely after a meal, most children (aged 3 to 6 years) ate in the absence of hunger and consumed extra energy.

Recommendation: Avoid offering energy-dense snacks before or after meals. If children are hungry before a meal, vegetables could be offered as a snack/appetizer.

References

- The results of this work have been reported in the deliverable D19/20: <http://www.habeat.eu/publications.php>
- All HabEat partners – April 2014, A guide for parents of young children: "Vegetables and fruit: help your child to like them". ISBN: 2-7380-1349-X. All right reserved. Paper version.



- All HabEat partners – April 2014, A guide for parents of young children: “Vegetables and fruit: help your child to like them”. ISBN: 2-7380-1350-3. All right reserved. Electronic version: http://www.habeat.eu/media/file/BookletHabEat_Electronic%20version.pdf
- All HabEat partners – April 2014, Evidence-based recommendations for the formation of healthy habits in children from infancy to 6 years old. Electronic version: http://www.habeat.eu/media/file/Brochure_stakeholders.pdf

4. The potential impact and the main dissemination activities and exploitation of results

HabEat covered six EU countries with a good geographical spread in terms of variety of eating habits and food choice (UK, Denmark, the Netherlands, France, Portugal and Greece). Gathering data from cohorts from four countries (France, UK, Greece and Portugal) offered us the opportunity to have a large range of variety in feeding practices and eating experiences during the two first years of life and to examine the later impact (at 5 years and up to 13 years in one cohort) on food preferences and eating habits. The similar results obtained in the different birth cohorts from countries with different feeding practices, enabled us to suggest that these results are widely applicable. Conducting similar experiments in different European countries enabled us to highlight results which are independent of the countries and thus to demonstrate that learning strategies based on experience, such as the repeated exposure, are efficient with novel vegetables whatever the country and thus, whatever the environment. We were also able to observe that other learning strategies based on observation, such as imitation of a model, seem more sensitive to situational factors and thus, are more or less effective, even within a given country.

The project has been promoted on the HabEat public website: <http://www.habeat.eu/files.php>, and on other websites and through articles in the Vitagora³ Newsletters published after interviews of the HabEat coordinator. The project aims were also been presented during an ECOG Satellite meeting “New Technologies and Innovations to Tackle Obesity” organized by the DG Research – European Commission on November 16, 2010 in Brussels, Belgium.

Seven HabEat eNewsletters were published and disseminated. The final list of diffusion contained 400 people from 24 different countries: Poland, Hungary, Czech Republic, Croatia, Latvia, Lithuania, Russia, Estonia, Serbia, Finland, UK, Ireland, Italy, The Netherlands, Portugal, Greece, Denmark, Belgium, France, Spain, Switzerland, Germany, Norway, Trinidad and Tobago and USA. These Newsletters are still available on the HabEat public website. Some of them report the discussions that took place during three stakeholder workshops organized during the course of the project.

The key findings from the three R&D workpackages were summarized and translated into recommendations within the workpackage ‘Recommendations, Guidelines and Communication’. The project has worked hand-in-hand with stakeholder advisors (including industry and health professionals) to produce recommendations addressed to childcare professionals, policy makers and parents of young children. Feed-back from stakeholders has been obtained throughout the project via the Stakeholders Advisory group who was invited to all HabEat meetings and workshops. Stakeholders were also consulted during the three stakeholder workshops held in two countries being represented within the consortium (the UK and Portugal), and one country (Poland) being not represented in the HabEat consortium. Thus, different European countries with different feeding and eating practices were targeted. Dissemination and exchanges with stakeholders, in

³ Vitagora is a cluster grouping together players from the food industry - both multinationals and small to medium-sized companies – and from academic research around the theme "Taste-Nutrition-Health" in order to pursue common goals concerning competitiveness, greater recognition and economic development. Vitagora is one of the HabEat stakeholder advisory board.



particular with child-health professionals, also took place during about 20 events organized by HabEat partners or where HabEat partners presented some results.

The results of this work are presented in a leaflet for stakeholders presenting recommendations based on HabEat findings and in a guide for parents of young children “Vegetables and fruit: help your child to like them” including recommendations based on HabEat findings and on evidence from the previous literature. Both the leaflet and the guide for parents were distributed to all participants of the final HabEat symposium. During the final symposium, the participants to the round-table discussions confirmed that the HabEat guideline documents are written in an accessible way and have covered useful key messages, phrased in a positive way instead of a negative one. It was also underlined that an added value of the guide for parents compared to previous documents is that a section explaining the rationale behind the recommendations is included. The electronic version of the stakeholder leaflet and of the guide for parents will enable a wide dissemination of the HabEat results and recommendations. Moreover, a section for parents was also developed on the HabEat public website in Danish, Dutch, English, French, Greek and Portuguese languages. It is planned to have a version of the guide for parents available on the web site in these different languages, and also in German; the translations in Dutch and Greek have already been done, the translations in French and German are in preparation. This will enable dissemination to a large number of parents from different European countries.

An opportunity has arisen to obtain funding to develop an 'App for Impact' to enhance the dissemination of the guide for parents. This App would be linked to the web version of the guide for parents which would provide the evidence-based information for the parents. The App would encourage parents and children to engage with eating vegetables and fruit regularly in their own and infant's diets and may be based on recording intake or on games that encourage intake. An application will be made through the University of Bristol, UK.

The HabEat final symposium presenting the final results and recommendations was recorded and the video of each presentation, of the round-table discussions and of the interviews of the different workpackage leaders is available on the HabEat web site:

<http://www.habeat.eu/page.php?a=habeat-symposium-09>.

Moreover, the proceedings of this final symposium are available on the HabEat website. Thus, dissemination of the HabEat results and of the recommendations based on these results will go beyond the 150 participants who attended the symposium. After the symposium around 100 French communications (press releases and media websites) promoted the HabEat results.

Thanks to the participation of the coordinator of the Health National Nutrition Programme (PNNS) at the French Ministry of Social Affairs and Health, responsible for the French National programme on nutrition and health (PNNS), it should be possible to introduce the findings from HabEat into the next version of the French Guidelines which are presently under revision.

HabEat results were presented through oral presentations (27), and posters (18) at national and international conferences. Results and practical implications have been presented to about 200 people in a HabEat workshop organized within the 20th International Congress of Nutrition held in Granada, Spain on the 19th September 2013. HabEat results will be presented in a workshop within the next EuroSense conference (European Conference on Sensory and Consumer) named “The sense of Life” that will be held next September, in Copenhagen, Denmark.

Results and key messages from the project were also presented at the final events of two other European funded projects: VIVA⁴ and ToyBox⁵.

HabEat researchers were also invited to present the project and some results during different European meetings:

⁴ VIVA was funded by a mobility programme to encourage knowledge transfer and exchange under the Marie Curie Industry Academia Partnerships and Pathways mechanism (EU FP7 Marie Curie IAPP 230637; RCN 90766).

⁵ ToyBox was funded by the European Commission Seventh Framework Programme (FP7-KBBE-2009-3) under grant agreement no245200.



- the Joint Programming Initiative Conference “A Healthy Diet for a Health Life” held on June 14, 2012 in the Hague, the Netherlands
- an EU–US Task Force on Biotechnology Research symposium on healthy food choices and nutrition-related purchasing behaviors organized jointly by the National Institutes of Health (NIH, USA) and the European Commission that took place in Brussels, Belgium on May 21-22, 2013. One workpackage leader of HabEat is a co-author of a report paper⁶ summarising this transdisciplinary approach to obesity and bringing together scientists from academia, government, and industry.
- a Member States meeting jointly with the Advisory Group on "Fruit and Vegetables" and the School Fruit Scheme Experts Group in Brussels, Belgium on May 20, 2014.

Thirteen peer reviewed articles have already been published in different journals targeting researchers from different disciplines. Moreover, participants of the HabEat project have been asked to write reviews for an e-book and for peer-reviewed journals. All the publications abstracts are available on the HabEat public website at the following link: <http://www.habeat.eu/publications.php>

In the leaflet for the stakeholders, a section on recommendations for future research was included.

Thus, we have had already a large dissemination of the results of the project. So, the knowledge brought by HabEat should favour actions aiming to promote better food behaviour in children which is important in the context of increasing childhood obesity prevalence, and of other diseases resulting from poor food habits learned at an early age.

Finally, it is worth mentioning that HabEat has contributed to the training and career developments of young scientists.

Two master students, Lindsey Bemmelmans and Martine Plandsoen, performed their thesis research at DLO. Wen Lun Yuan (INSERM) who was a research assistant on the project is now enrolled to her PhD at INRA. Chandani Nekitsing (ULeeds) who was a research assistant on the project is now enrolled to do her PhD at the University of Leeds. Audrey Peteuil (INRA) who was a research assistant on the project is now enrolled to do her PhD at the University of Burgundy.

Six PhD students were involved in the HabEat project:

- Sara Ahern (ULeeds) successfully defended her thesis in January 2014 and she now works as a postdoctoral fellow in Bradford Institute of Health,
- Aisha Betoko (INSERM) successfully defended her thesis in July 2013 and she now works as a postdoctoral fellow at the Johns Hopkins University,
- Sofia Bouhlal (INRA) successfully defended her thesis in December 2011 and she now works as a postdoctoral fellow at the National Institutes of Health (NIH),
- Alison Fildes (UCL) successfully defended her thesis in December 2013 and now works as a postdoctoral fellow at Queensland University of Technology, Australia,
- Eloise Remy (INRA) successfully defended her thesis in December 2013 and now works in a food company (Bonduelle, one of the HabEat stakeholder advisory board),
- Victoire de Wild (WUR) has planned to defend her thesis on September 2015.

Concerning the postdoctoral fellows involved in the HabEat project, Dr Samantha Caton (ULeeds) is now a lecturer at the SchARR, University of Sheffield in the Section on Public Health; Blandine de Lauzon-Guillain (INSERM) obtained a permanent position at INSERM in October 2011 and Annemarie Olsen (UCPH) got a position as a faculty member.

Finally, Sophie Nicklaus (INRA) has now been approved to supervise PhDs and got a promotion as a research director at INRA.

⁶ Fried KE, Rowe S, Bellows LL, Johnson SL, Hetherington MM, de Froidmont-Görtz I, Lammens V; Hubbard VS. Report of an EU–US symposium on understanding nutrition-related consumer behavior: strategies to promote a lifetime of healthy food choices. Accepted in Journal of Nutrition Education and Behavior.



5. Project information

Project logo



Project public website

The website address is the following: www.habeat.eu

- All HabEat partners – April 2014, A guide for parents of young children: “Vegetables and fruit: help your child to like them”. ISBN: 2-7380-1350-3. All right reserved. Electronic version: http://www.habeat.eu/media/file/BookletHabEat_Electronic%20version.pdf
- All HabEat partners – April 2014, Evidence-based recommendations for the formation of healthy habits in children from infancy to 6 years old. Electronic version: http://www.habeat.eu/media/file/Brochure_stakeholders.pdf
- All HabEat partners – April 2014, Parents section on the HabEat public website in Danish, Dutch, English, French, Greek and Portuguese languages: <http://www.habeat.eu/page.php?a=parents>
- The results of this work have been reported in Deliverable D19/20: <http://www.habeat.eu/publications.php>
- Symposium video and interviews: <http://www.habeat.eu/page.php?a=habeat-symposium-09>

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