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Diet quality in the early years

A good way to represent 'health' in a picture is to use a mosaic. From far away you can see the whole image, but up close you see that the image is made up of many tiles.

This example shows the complex nature of health; it is the result of many 'tiles' including good nutrition, physical activity and environment.

For children, putting together the tiles is even more complex, as many decisions are made by parents and health status has to be developed and maintained. This GFVN issue shows the complexity of building positive and healthy eating habits, balancing genetic background (the tiles) and the environment (the glue).

The result of this complex mosaic is not only better nutritional status, but, as stated in the article by Anett Nyaradi and colleagues, a much higher level of academic achievement. The study finds that good nutrition until at least 17 years of age is essential for academic performance.

Obviously, the earlier we focus on nutrition, the better the result in terms of quality of life and embedding positive behaviours. This concept is examined in the paper written by Martine Padilla. It is demonstrated that widening the foods offered during pregnancy, weaning and subsequent ages, can modify children's food preferences.

The battle to develop healthy eating habits cannot end in the home environment. The paper by Roohi Kharofa examines best practice at meal times in care centers to promote healthy food consumption. Once again the role modeling of significant adults and exposure to healthy foods are essential in promoting positive eating habits.

In the end, even though we have already glued many tiles onto the mosaic to promote health for our children, we still have to work patiently to make sure that the glue sets, to bring out the beautiful picture. All this work for the most wonderful result: the health of our children.

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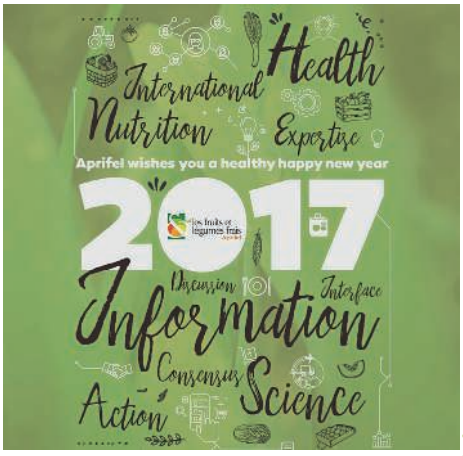

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October 2013 : Meg Bruening; Valter Cordeiro Barbosa Filho and colleagues, Alba M. Santaliestra-Pasías and colleagues; Kate A Levin (Behavioral risk factors in adolescents)

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Better diet quality may benefit children's cognitive and academic performance

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Cognitive development is influenced by many factors, including nutrition. There is an increasing body of literature that suggests a connection between improved nutrition and optimal brain function. Nutrients provide building blocks that play a critical role in cell proliferation, DNA synthesis, neurotransmitter and hormone metabolism, and are important constituents of enzyme systems in the brain[1]. Cognitive performance is a predictor of academic achievement. Higher educational attainment is associated with better jobs, higher income, higher socio-economic status, better health care access and housing, better lifestyle, nutrition and physical activity and is therefore of broad benefit for society as a whole[2].

The focus of these studies was to investigate the relationships between multiple dimension of dietary intakes, a comprehensive overall score and food components in early life (ages one, two and three), and various cognitive and educational outcomes at different developmental stages (cognitive development at ages 10 and 17; educational outcomes at grades five and seven) in a cohort of Western Australian children.

Diet in the early years of life influences cognitive outcomes at 10 years

Early childhood is believed to be a sensitive period for brain development. The main finding was that a higher diet score at age one was positively associated with cognitive outcomes (higher verbal and non-verbal skills) at age ten after adjusting for a range of sociodemographic characteristics. This association was attenuated at age two and three after adjustment for sociodemographic factors, suggesting a stronger influence of diet in the first year of life. Examining the components of the diet score, it was found that increased fruit consumption at age one was positively associated with cognitive performance at age ten, while increased soft drink consumption at age one was negatively associated with cognitive performance at age ten years. At two and three years of age, increased dairy consumption showed positive associations with later cognitive outcomes. These findings suggest that the promotion of a nutrient-dense diet for children during the early years is beneficial for cognitive development.

The relationship between nutrition in infancy and cognitive performance during adolescence

Much of the work previously published has focused on short-term associations between dietary factors and cognitive performance[1]. Therefore, this study represented a major progression in the field, as it was possible to extend the previous study by exploring whether the association between early diet and cognitive performance exists in the longer term, specifically in 17 year-old adolescents. In addition, in this study we investigated the long lasting effect of breastfeeding on the cognitive performance of adolescents. It was found that boys who had been breastfed for 4 months or longer performed better with respect to their psychomotor speed. However, there was no association between breastfeeding and cognitive performance in girls. A better quality diet at age one was also associated with a faster reaction time across the whole cohort (i.e. boys and girls combined). This study supports and strengthens previous findings concerning the importance of a high quality diet and breastfeeding during infancy in brain development.

Good quality diet in the early years may have a positive effect on academic achievement

Cognitive capacity is strongly associated with academic achievement; however, little attention has been paid to the direct influence of diet on academic performance. Associations between quality of diet and cognitive performance were identified in the previously presented studies. In this study, it was explored whether associations also exist with respect to the relationship between diet and academic attainment. More specifically, the aim of this study was to examine the associations between diet during the sensitive early years of life and academic performance with respect to mathematics, reading, writing and spelling scores in ten (grade five) and 12 year old (grade seven) children. It was found that a higher (i.e. better quality) diet score at age one was an independent predictor for higher scores in mathematics, reading, writing and spelling at grades five and seven. Significant associations were also found between a higher diet score at age two years and academic scores for mathematics, writing and spelling at grade seven. Regarding specific food groups, higher fruit consumption at age one year and higher dairy consumption at ages one, two and three years were consistently associated with higher academic scores. These findings are consistent with the findings of the previous studies presented in this thesis and support the view that a good quality diet during the early years of life is important with respect to both cognitive and academic performance in childhood and adolescence.

Possible Mechanism

During the early years, significant and rapid brain growth occurs and by the age of two years the brain reaches 80% of its adult weight and 50% of its synaptic density, indicating a sensitive periods of neurocognitive development in the early years of life[3].

The studies showed that a better quality diet (reflected by a higher diet score) and some specific 'healthy food' components of the diet such as dairy products and fruit are associated with better cognitive and academic performance. The relatively high micronutrient content of these foods is likely to play a role in improved brain development and subsequently cognition. Micronutrients that have been linked to cognitive performance include B12 vitamin, folate, zinc, iron, iodine and omega-3 fatty acids[1].

Based on: *Nyaradi A, Li J, Hickling S, Whitehouse AJO, Foster JK, Oddy WH. Diet in the early years of life influences cognitive outcomes at ten years: a prospective cohort study. Acta Paediatrica. 2013;102(12):1165-73.*

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Acceptance of fruit and vegetables during childhood: the impact of genetics, early experiences and the environment

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Research is in progress regarding low consumption of fruits and vegetables (FVs) by very young children. Two studies in the United States show that 1/3 of children aged 6-9 months and 1/5 of children aged 9-12 months never eat FVs. According to American recommendations, FVs should account for an increasing share of children's diet from the age of 2 years. For children aged under 2 years, this is more problematic, as babies eat only the foods they like.

Genetically, so-called fussy children consume low levels of FVs

FVs are among the foods most commonly rejected by so-called fussy children. Fussy behaviour reaches its peak at around 20 months of age, and disappears between 5 and 8 years of age. Food neophobia, which is characterised by the refusal of unknown foods, is also linked to low acceptance of FVs. It has a strong genetic base (72-78%) in early childhood. The hypothesis that neophobia and fussy behaviour have the same genetic origin, and that this interacts with children's taste for FVs, has been made[1]. This hypothesis was tested using data from the British twin cohort Gemini (2660 children under 3 years old). There was a significant negative correlation between 'being a fussy eater' and taste for FVs, particularly for monozygotic twins. Shared genes contributed to the observed phenotypic correlations; thus, if one twin had a high rating for 'fussy eating', the other twin tended to have a low rating for FVs. These results show that being fussy and taste for FVs are common hereditary traits among young children.

Infants do not naturally accept fruit and vegetables

The B-24 project (US Department of Health and Human Services) evaluates the scientific evidence regarding children aged under 2 years[2]. One finding is that babies are naturally able to detect foods that are energy- and nutrient-dense, and they avoid potentially toxic items that have a bitter taste, such as some FVs. A preference for sweet and salty flavours and an aversion towards bitter tastes dominates during childhood and adolescence. The perception of bitterness is extremely variable from one individual to another, and is linked to genetic differences in infants.

How can acceptance be improved? Children may not accept a food item due to an innate dislike, or because they were not introduced to that food during a 'sensitive' period for becoming familiar with it. What role might breastfeeding and weaning foods play, given that they are infants' early experiences of taste and textures[3,4].

• **Give pregnant and breastfeeding women FVs**. The senses underlying the perception of flavour are malleable and can be modified by the initial experience. It is now known that volatile food substances are transferred to amniotic fluid and to breast milk. A wide range of the flavours ingested by the mother (e.g. fruits, vegetables, alcohol, spices) are transferred to her amniotic fluid and/or milk. In a randomised clinical trial, pregnant women who intended to breastfeed were given carrot juice to drink. Once their breastfed infants had moved on to solid foods, the acceptance of plain cereals compared to carrot-flavoured cereals was tested. Infants who had experienced the flavour of carrots in their mother's amniotic fluid or breast milk responded more favourably. Not only breastfeeding provide an initial advantage to babies in their acceptance of FVs when these foods are part of their mother's diet, but the continuity in flavour helps with the transition to solid food. Breastfeeding thus has a certain advantage over infant formula.

• **Expose children to FVs.** As with children, infants eat more FVs to which they have been exposed on several occasions. Infants who were repeatedly exposed to different vegetables not only ate more of the vegetables to which they had been exposed, but they also ate more new vegetables than infants exposed to a single vegetable.

• **Mask the taste**. The two preferred tastes (sweet and salty) can mask bitter tastes from children. A clinical study on school-age children demonstrated that adding diluted solutions of sweetener to vegetables reduced the children's perception of bitterness and increased their taste for vegetables. For very young children, during repeated exposure to green beans or to peaches, only those who consumed peaches after the green beans seemed to like the taste of green beans after an 8-day exposure period: the sweet taste of the peaches masked the bitterness of the green beans, improving their palatability and taste.

• **Diversify early**. Some data appears to support the idea of sensitive periods for the introduction of complementary foods. At all stages, the more varied tastes and textures an infant experiences, the more likely he or she is to be willing to try new foods. This means that complementary foods should be given, altering the tastes frequently, and that the early introduction of complementary textured food (other than smooth purées) confers an advantage in terms of the acceptance of other more complex textures, such as those found in the majority of FVs[3].

Conclusion

Beginning very early on in life, sensory experiences can shape and alter food preferences. Children's rejection of some FVs, particularly bitter vegetables, can have a genetic origin, but can also be caused by environmental factors such as the mother's dietary habits. Breastfeeding and the early introduction of complementary foods are predictors of later acceptance of FVs.

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Are Mealtime Best Practice Guidelines for Child-Care Centers Associated with Energy, Vegetable, and Fruit Intake?

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The preschool years are a critical period for obesity prevention, as both eating habits and growth trajectories are established during this time. Data supports that children who become overweight/obese in early childhood have a five-fold increase of being overweight/obese adults[1]. A key environment for obesity prevention efforts is the child-care center. 61% of preschool age children (3 to 6 years)[2] are in child-care, where they spend an average of 33 hours per week[3] and consume up to two-thirds of their daily caloric intake[4].

Best practices for child-care mealtime environments that support obesity prevention are outlined by the Nutrition and Physical Activity Self-Assessment for Child Care program (NAP SACC)[5]. These best practices, listed below, were derived from experimental studies and expert opinion. Few studies prior to ours examined the use of these practices in real-world settings.

Recommended Child-Care Mealtime Best Practices

1. Staff serve meals family style (children self-serve)
2. Staff sit with children at meals
3. Staff eat the same food as children
4. Staff informally talk with children about healthy food
5. Staff encourage children to try a new/less favorite food
6. Staff help children determine if they are still hungry before serving seconds

Study Design

We sought to describe adherence to child-care mealtime best practices and to evaluate the association between practices and children's dietary intake. As such, we randomly chose 30 child-care centers in Hamilton County, Ohio to participate in an observational study of physical activity and nutrition environments in child care – the Preschool Eating and Activity Study (PEAS)[6]. Data collection occurred between November 2009 and January 2011. Eligible children were 36 to 72 months old. Two classrooms at each center were randomly chosen. Three observers were stationed in each classroom concurrently: two observers recorded the intake of three separate children during lunch while one observer recorded mealtime practices and teacher behaviors. General mixed linear models with child-care center as a random effect were used to evaluate the association between mealtime behaviors and children's dietary intake.

Adherence with Mealtime Best Practices

We found variable adherence with individual mealtime best practice recommendations. **Table 1** shows the frequency with which each best practice was observed in our study.

Table 1. Adherence with Mealtime Best Practices (% of lunches)

Mealtime Best Practices	%
1. Staff serve meals family style (children self-serve)	12
2. Staff sit with children at meals	29
3. Staff eat some of the same food as children	66
4. Staff informally talk with children about healthy food	33
5. Staff encourage children to try a new/less favorite food	77
6. Staff help children determine if they are still hungry before serving seconds	0

Dietary Outcomes Associated with Best Practices

Children consumed an average of 349 kcal, 0.4 servings of vegetables, and 0.5 servings of fruit at observed lunches.

Energy (total caloric) consumption: Staff sitting with children at lunch was associated with lower energy consumption (313 kcal vs. 368 kcal, p=0.04). Staff eating some of the same foods was associated with higher energy consumption (375 kcal vs. 309 kcal, p=0.008).

Fruit consumption: The best practice of staff encouraging children to try a new or less favorite food resulted in a mixed effect on fruit intake. Encouragement once led to a non-statistical increase in fruit consumption (0.5 to 0.7 servings). Repeat encouragement was associated with significantly lower fruit intake (0.7 to 0.4 servings; p trend = 0.008).

Vegetable consumption: Two mealtime best practices were associated with increased vegetable consumption: staff sitting with children at lunch (0.5 servings vs. 0.3 servings, p = 0.03) and staff eating some of the same foods (0.4 servings vs. 0.3 servings, p = 0.04).

Family style meal service and staff talking about healthy eating were not significantly associated with fruit, vegetable, or total energy intake.

Implications

Our study was the first direct observation of child-care mealtime environments and children's associated dietary intake in the United States. We demonstrated that adherence with individual mealtime best practices varies considerably and that few guidelines are associated with actual dietary outcomes. Given the large amount of time many children spend in child-care, targeting these facilities as areas for prevention efforts is key. Further research is needed in order to identify modifiable practices and behaviors that lead to positive dietary outcomes for children. This research is essential to improving child-care mealtime environments and helping shift the course of the childhood obesity epidemic.

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