Update: Microbiome, Nutrition and Health

Control centre: the intestinal microbiome

Nutrition and cognitive development

Proteins and growth

Allergy therapy: Interview with Prof. Carl-Peter Bauer

Malnutrition and long-term consequences

Latest news about Crohn’s disease
Dear readers,

The infant microbiome and consequently nutrition, especially in the first 1000 days of the infant’s life, has been gaining new interest due to the latest research and study results. These findings are essentially being driven at the moment by findings about the human oligosaccharides (HMO), whose function is presently at the focus of science and sheds light on the processes in the infant gut.

The early colonisation with positive bacteria, the balance between positive and negative effects, significantly influenced by the diet, evidently has long-term health implications – which last across childhood and adolescence and beyond. But even infection protection appears to be significantly enhanced due to this. This also results in new perspectives for the nutritional illnesses, a complex ongoing theme in paediatric practice. What is currently being discussed is also a direct link between the intestinal microbiome and the development of the infant’s brain. What consequences can the infant’s diet have on the formation of cognitive abilities? Which effect can certain nutrients have on health? That remains to be seen. We are presenting some fascinating studies and analyses in this issue, and detailed descriptions of the individual aspects can be found on the website of the Nestlé Nutrition Institute.

I hope you enjoy your journey through the latest research findings,

Dr. med. Mike Poßner
Medical Director Europe
Nestlé Nutrition Institute

Would you like more information about the discussed topics? The extensive source references to the articles of this issue can be found on the website.

**Setting the course for**

Various research approaches commit themselves to functions and possible disorders of the infant intestinal microbiome. It is evidently an important control centre for development and health, the impact of which goes way beyond childhood. To what extent does nutrition influence this impact – and how can it be optimised?

**Microbiome and exclusive breastfeeding**

The CHILD Study is a prospective longitudinal cohort study, which guides almost 3,500 families across Canada right from the process of pregnancy to early childhood. In this study, the extent to which genetic and environmental factors influence the development and health of the child is being investigated. One focal point of the study is the connection between breastfeeding with the characteristics of the intestinal microbiome and their long-term outcome.

The latest analysis of the data of 2,553 infants demonstrated a dose-dependent inverse association between breastfeeding and body mass index (BMI) at 1 year of age. 1) Supplementing the diet with an infant formula in the 6th month has reduced the effect of breastfeeding, while the implementation of the supplementary diet had no significant effect. The study also revealed that infants, who received expressed breast milk in the first 3 months, had a higher BMI after 1 year than the breast-fed infants.

Evidently, there is also a connection between asthma risk and breastfeeding. Amongst the infants, whose mothers are suffering from asthma, exclusive breastfeeding was related to a reduced risk of wheezing within the first year of the infant’s life by 62%. The effect of breastfeeding on obesity and asthma is possibly related to the effects of breastfeeding on the intestinal microbiome of the infant.

Several components of breast milk, including microbiota and HMO, contribute to the positive effects of breastfeeding. The relative incidence of bifidobacteria was the highest in exclusively breast-fed infants and the lowest in the infants, who were not breast-fed. Other factors of breastfeeding, such as self-regulation and the intense mother-child bonding, can probably affect the results as well.

**CHILD Study Inverse connection of breastfeeding and BMI**

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*adjusted according to maternal age, BMI before pregnancy, ethnicity, education, smoking, method of birth, parity, infant sex, gestational age

**References**

Azad MB et al, 2019

**Literature sources**

Various research approaches commit themselves to functions and possible disorders of the infant intestinal microbiome. It is evidently an important control centre for development and health, the impact of which goes way beyond childhood. To what extent does nutrition influence this impact – and how can it be optimised?
Impact factors on the microbiome

Breast milk contains a complex community of bacteria, which can help in enhancing the gut microbiota of the infant. The determinants for the composition of milk microbiota are still not very well known.

A study with 393 mother-children pairs from the Canadian CHILD cohort showed that the milk microbiome at 3-4 months postpartum was dominated by Proteobacteria and Firmicutes and had discrete compositional patterns. The composition and diversity were associated with:

- sex of the infant
- maternal BMI
- parity
- mode of delivery
- breastfeeding practices and
- other milk components.

The mode of breastfeeding proved to be one of the key determinants of milk microbiota composition. On the other hand, providing pumped breast milk showed enrichment of potential pathogens and depletion of bifidobacteria. Overall, this study offered an insight into the composition and essential determinants of the human milk microbiota composition, with potential implications for infant health and development.

**Influence factors of breast milk on the microbiome**

- Breastfeeding
- Exclusivity
- Mode of breastfeeding
- Preterm birth
- Birth weight
- Sex
- Antibiotics
- Mode of delivery
- Siblings
- Early stages
- Infant
- Milk
- HMO
- Fatty acids
- Hormones
- Ethnic affiliation
- BMI
- Age
- Nutrition

Significant connection

Moossavi S et al., 2019
According to the current notion, the application of one or multiple probiotic bacterial strains is a potential microbiome modelling treatment. The authors also offer an overview and the assessment of the relevant specialist publications.

A great biodiversity of microorganisms within the microbiome is increasingly being considered as a measure of a healthy microbiome. In the initial days of the infant’s life after birth, the intestinal microbiome is characterised by a low diversity, which consists of the diversity similar to that of an adult only at the age of 2 to 3 years. A reduced diversity of microbial colonisation is often related to illnesses.

Probiotics are understood to be non-pathogenic, living bacteria, which survive the gastrointestinal passage in sufficient numbers and contribute to improving or maintaining one’s health. The majority belongs to the group of lactic acid bacteria, including lactobacillus and bifidobacteria.

A uniform, probiotic mode of action is not currently known, but a variety of health-promoting interaction mechanisms of the microbiome, which consequently seem “probiotic”, have been described. The prophylactic administration of probiotics for chronic diseases could therefore be of great importance. For some disorders of the gastrointestinal tract, probiotics represent a potential therapeutic intervention. In many cases, however, the effectiveness of the probiotics appears to depend on the bacterial strain used, the dose and the disease entity.

The authors’ conclusion:
In several cases, probiotics represent a harmless treatment option, which might not be promising in all cases, however. Advancements in microbiome research and a better understanding of the interaction of individual microorganisms and molecular mechanisms of action will enhance the indication of probiotic intervention in the future.

Infants receive bioactive components through breastfeeding, which form your microbiome and are simultaneously influenced by microbial factors of breast milk and by the surface of the breast. More recent studies have suggested the possibility of an entero-mammary pathway of the microbial transfer, which opens up the possibility of a modulation of the infant intestinal microbiome through probiotic nutritional supplementation of the mother.

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Breast milk samples were analysed, which were collected 10 days and 3 months postpartum from women, who participated in the placebo-controlled Trondheim study “Probiotics in the Prevention of Allergy among Children”. The women received a fermented milk, which was supplemented with Lactobacillus rhamnosus GG, Lactobacillus acidophilus La-5, and Bifidobacterium animalis ssp. lactis Bb-12. The application took place daily from 4 weeks before the expected date of delivery to 3 months after the birth. In total, 472 breast milk samples were analysed for the administered bacteria, and the microbiome transferred during breastfeeding was analysed for 142 samples.

It was found that breastfeeding is unlikely to be a significant source of L. rhamnosus GG, L. acidophilus La-5, and B. animalis ssp. lactis Bb-12 for infants in the probiotic arm of the trial. Furthermore, maternal supplementation did not significantly affect the overall composition of the breast milk microbiota transferred during breastfeeding. Samples collected at 3 months postpartum had a statistically significant lower presence and relative abundance of the Staphylococcus genus. These samples also had a greater number of observed species and diversity, including more operational taxonomic units from the Rothia, Veillonella, Granulicatella, and Methylbacterium genera.
Oligosaccharides (HMO) are a primary component of breast milk and play an important role in protecting the infant against infections. Preterm infants are particularly susceptible, but have a better outcome if they are fed breast milk.

Randomised placebo-controlled trials with HMO supplementation indicate that 2′FL is related to the immune protection of infants and 2′FL together with Lacto-N-neotetraose (LNnT) is related to a protection of the lower respiratory tract against infections and a reduction of the necessity of the use of antibiotics. Disialyllacto-N-tetraose (DSLNT) and 2′FL have turned out to prevent necrotizing enterocolitis (NEC) in rat models. In preterm infants, who develop NEC, DSLNT was present in lower concentration in the milk of their mothers. DSLNT could therefore be used as a marker for the probability of NEC development.

Fucosyltransferase-2 (FUT2) is responsible for binding fucose to core oligosaccharides via a α-1.2 linkage, which generates HMO such as 2′-Fucosyllactose (2′FL) or Lacto-N-Fucopentaose-I (LNFP-I). If FUT2 is inactive, such HMO are not present in the milk. Fucosyltransferase-3 (FUT3), binds fucose to the key oligosaccharides via a α-1.4 linkage and forms oligosaccharides such as LNFP-II and, together with other, fucosyltransferase HMO via α-1.3 linkages. If FUT3 is inactive, the HMO with α-1.4 connections are not present in the milk. This results in four primary milk groups with different HMO compositions depending on the activity of the enzymes FUT2 and FUT3:

- Milk group 1, in which both enzymes are active
- Milk group 2, in which the FUT3 is active but not FUT2
- Milk group 3, in which the FUT2 is active but not FUT3
- Milk group 4, in which both enzymes are inactive

In general, milk group 1 seems to be the most common one, milk group 4 rare, but the distribution of the milk groups in different populations varies according to the genetic background. Based on the HMO composition of different milk samples, there are also indications that other sub-groups could exist.

The trial investigated whether the HMO composition of breast milk of mothers of extremely young preterm infants (< 32 week of pregnancy, < 1500 g birth weight) differs from that of mothers of term babies. For this purpose, 22 different HMO in 500 milk samples of 25 mothers of preterm infants and of 28 mothers of term infants were analysed. In the same postpartum age, the concentrations of most HMO were similar.

In the same post-menstrual age, however, the concentrations of a series of HMO in the milk of mothers of preterm infants differs significantly from the concentrations in the milk of mothers of full-term infants. The biggest differences were seen in around 40 weeks after the birth (post-menstrual age), when the milk of the mothers of infants born close to the expected delivery date contained the highest concentrations of HMO. As regards their possible clinical effects, these findings require further investigations.
Calorie intake and composition of the diet have a massive and long-lasting impact on cognition and emotion, especially in critical development phases. The neural mechanisms of these effects are not yet clear, though.

Apart from genetic conditions, the interaction of specific environmental challenges, which occur in specific phases of development, appears to play a significant role in cerebral development. A brain dysfunction mostly occurs simultaneously with metabolic disorders (e.g. obesity) and/or malnutrition.

The negative health implications, including cognitive and mood-related dysfunctions, indicate a strong indication between these elements.

Infant nutrition and stress levels can lead to a life-long cognitive dysfunction, but early dietary interventions (e.g. with essential micronutrients) can prevent these deficits. Furthermore, the intake of a fat-rich diet facilitates an enhanced neuroinflammatory reaction of the hippocampus to a minor immune challenge, which causes memory problems. A low intake of polyunsaturated omega-3 fatty acids can also contribute to depression by affecting endocannabinoids and inflammation pathways in specific regions of the brain, which lead to synaptic phagocytosis due to microglia in the hippocampus and contribute to memory loss. The consumption of fruits and vegetables with high polyphenol content could prevent age-related cognitive impairment by counteracting oxidative stress and inflammations.

Poor nutrition during the prenatal period and during early childhood can lead to long-term changes in the metabolism and the central functions, including cognitive impairments and accelerated aging of the brain. Maternal gestational diabetes and even the consumption of junk food in non-diabetic patients can cause modifications in the brain of the offspring, so that a taste for foods rich in fat and sugar develops. Also, the first introduction of solid food to infants and the high consumption of fatty foods and sweetened beverages in childhood can accelerate weight gain and lead to long-term metabolic complications. On the other hand, some food supplements can have a positive impact on cognition, as can be observed in the supplementation of baby food with long-chain omega-3 PUFAs for the enhancement of cognition in infants.

Early life stress (ES) changes the structure and function of the brain permanently, which leads to an increased susceptibility to the development of emotional and cognitive disorders. In fact, ES is related to an increased susceptibility to metabolic disorders such as obesity, which mostly accompany cognitive impairments.

Both ES as well as an unfavourable early dietary background later lead to strikingly similar cognitive impairments, which indicate that metabolic factors and dietary elements could be responsible for some of the ES effects on the structure and function of the brain.
HMOs can be the most important mediators for the positive effects of breastfeeding on the development of the nervous system and the associated brain functions in adulthood. The hypothesis is confirmed by studies conducted on mice.

The sialylated HMO appear to be particularly responsible for these positive effects, but there is still a lack of understanding about the effective mechanisms of this long-term programming impact of sialylated HMO. In this animal testing, a dysfunctional mutation of the St6gal1 gene was used, which leads to an absence of 6’Sia in milk. This resulted in cognitive impairments.

This applies to cognitive abilities in the adult phase of a non-breastfed infant. The animals were divided into two groups: one receiving milk with 6’Sia (mutant pups; milk group) and the other receiving milk without 6’Sia (mutant pups receiving milk with 6’Sia; WT pups receiving milk without 6’Sia; milk + mutant group).

After the animals had reached adulthood (day 65 after birth), their spatial memory, and their recognition and attention capabilities were evaluated. Additionally, an analysis of the caecal microbiota composition and function was carried out.

This trial confirms the results of a previous trial, which reported a declined spatial memory, lowered recognition and attention capabilities in the milk group and in the milk + mutant group. The findings did not demonstrate any effect on the diversity of the microbiome.

The trial underlines the relation between the presence of 6’Sia in the diet of infants before weaning and the improvement of the mnemonic functions in adults.

Essential nutrients for the brain

What is the effect of nutrition on the structure and function of the infant’s brain? And which specific nutrients promote development, potentially even in the long term?

A growing number of scientific findings indicate a close interrelation between nutrition and cognitive development. Infant nutrition – but probably also the nutrition in childhood and adolescence – evidently has substantial importance in the growth and function of the infant’s brain. Malnutrition and poor nutrition are also related to an increased risk of mental as well as physical health.

Adequate availability of certain nutrients is a prerequisite for the infant’s development, as animal models and observational studies have proven. Especially the following, so-called critical nutrients are extremely essential:

**Iron**

An inadequate intake of iron during pregnancy and early childhood leads to long-term developmental impairments. This applies to cognitive abilities as well. Generally, the intake initially takes place through breast milk or, if breastfeeding is not possible, through infant formula. At the age of 4 to 6 months, this supply ceases to be enough and must be supplemented by iron acquired from supplementary food. The effect of a subsequent iron supplementation in the initial years of an infant’s life is being discussed.

**Iodine**

Iodine deficiency during pregnancy, e.g. due to hypothyroxinaemia, restricts the development of the central nervous system. This has been proven by a number of studies. An appropriate supplementation is therefore advisable. Iodine continues to play an important role in healthy development even after birth.

**Folic acid**

An inadequate intake of folic acid during pregnancy can have a negative impact on the development of the unborn infant. The occurrence of neural tube defects and abnormalities is essentially related to a folic acid deficiency, as demonstrated by several studies. Even here, an early diagnosis and supplementation, preferably starting even before pregnancy, is necessary.

**LC-PUFA**

Long-chain, unsaturated fatty acids (LC-PUFAs = long-chain polyunsaturated fatty acids) have long since been recognised as having positive consequences for infant development. This particularly applies to an intake of docosahexaenoic acid (DHA) and arachidonic acid (AA) in early childhood. They also seem to have an effect on visual acuity and cognitive development.

**Vitamin B12**

A deficiency of the essential vitamin B12 during pregnancy and early childhood leads to a sometimes irreversible cognitive developmental delay. Poor vitamin B12 status as a baby affects the mental capabilities at the age of 5 years, as confirmed in a study by the University of Bergen involving 500 children from Nepal.

Although the phase of the “first 1000 days” (from the time of conception to the end of the 2nd year of the infant’s life) has tremendous significance for the cognitive development, subsequent deficiencies or malnutrition influence the capabilities of the infant’s brain as well. For this reason, it is necessary to continue to ensure a balanced, healthy diet. Helpful guidelines regarding the same can be found in “Nutrition plan for the first year of the infant’s life” or in the “Optimised mixed diet” programme for children and adolescents by the Research Institute of Child Nutrition.
An excessively high protein intake in infancy is related to an increased risk of adiposity in childhood. Infant formula with reduced protein content could be a solution.

Infants, who are fed conventional infant formula, consume more protein than breast-fed infants, since the content is not suited to the age and requirements of the infant. Epidemiological studies have shown that excessively high intakes of protein during childhood are related to an increased risk of obesity in childhood.

In the last few years, new technologies have been developed in the field of protein research, which are enhancing the biological quality of proteins in infant formula. It has therefore become possible to develop infant formula with less but high-quality protein.

In a recently concluded study, an infant formula with low protein content (1.61 g/100 kcal) was compared with a standard infant formula (protein content 2.15 g/100 kcal). Infants with overweight or obese mothers were examined in the study. The nutrition study was started at the age of 3 months, the infant formula was fed until the age of 1 year.

- The infants in both infant formula groups showed a growth classified as normal.
- Infants, who were fed the infant formula with less proteins which were consequently within the WHO standards, showed slower weight gain than the infants from the other group.
- The growth-slowing effect was particularly pronounced in infants with obese mothers and in infants with an already extremely fast degree of growth.

A study with infant formula with less protein (1.6 g/100 kcal) fed to infants with normal-weighing mothers also showed a slightly lower effect on the growth after 3 months.

The infants had similar protein accumulation between the 3rd and the 6th month, irrespective of the protein content.

Biomarkers (insulin and IGF-1) in infants, who were fed formula with low protein content, differ from those who were fed formula with higher protein content. 6 year old infants, who were fed formula with low protein content in the first year of the life, showed a lower risk of infant overweight. At 5 years of age, their BMI is similar to breast-fed infants.

The reduction of protein content in infant formula can significantly contribute to the prevention of obesity. Of key importance here is the fact that infant formula with lower but high-quality protein content promotes normal growth and is appropriate for all healthy term infants.

**Infant nutrition: Less protein = less overweight?**

Infant nutrition is considered to be the most important factor for the effective prevention of obesity in childhood. It was investigated whether the reduction of protein in the infant formula lowers the BMI and the prevalence of obesity at the age of 6 years.

A high protein intake is related to quicker weight gain in infancy. The Childhood Obesity Project was carried out as a European multi-centric, double-blind, randomised clinical trial, which included infants, who were born between October 2002 and July 2004. Infants, who were fed infant formula (n = 1,090) received a high-protein (HP) or low-protein (LP) infant formula within the then recommended quantities in the first year of life. Breast-fed infants (n = 588) were enrolled as a reference group. The weight and height of 448 (41%) infants at the age of 6 years was measured.

HP infants has a significantly higher BMI at the age of 6 years. The risk of becoming obese was 2.43 times higher in the HP group than in the LP group. There was a tendency towards a higher weight in HP infants, but no differences in height between the intervention groups. Other anthropometric measurements were similar in the LP and the breast-fed groups.

**Infant formula with a lower protein content reduces the average BMI and the risk of obesity during the school age. Avoiding infant formula that leads to an excessive intake of protein could contribute to a reduction of obesity in childhood.**
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Allergy prevention

Prevention of allergies through the microbiome

The most frequently examined microbiota are the bacteria in the human digestive tract. Its composition and diversity plays a significant role in human health.

Intestinal bacteria helps to regulate metabolism and the immune system and offers protection against the colonisation by pathogens. The human microbiome is influenced by multiple factors, including: The method of childbirth (vaginal vs. C-section), breastfeeding, nutrition, presence of siblings and pets, exposure to antibiotics and other medication.

Microbial species, which promote atopic reactions or tolerance, have been characterised. Specific microbiota presumably functions through different metabolic pathways for enhancing intestinal health, which optimally control the developing immune system.

A better understanding of the factors, which influence the healthy microbiome, can lead to specific strategies of early intervention and disease prevention.

eHF diet without animal enzymes?

The protein hydrolysis of an extensively hydrolysed diet (eHF) is usually carried out through the use of pancreas enzymes from pigs. Since they could seem unsuitable due to religious (e.g. halal or kosher diet) or cultural reasons (e.g. strict vegetarian or vegan diet), an eHF with non-animal enzymes (trial diet) has been developed.

For infants, who were fed an infant formula, an eHF is recommended as the first-line treatment of a cow’s milk allergy (CMA).

The American Academy of Pediatrics (AAP) defines an eHF as “hypoallergenic” if at least 90 per cent of the infants with CMA tolerate it under double-blind, placebo-controlled conditions. The control formula was a whey-based eHF with enzymes from porcine pancreas (Althéra®). Taste and appearance of both eHFs could not be distinguished from each other.

79 children (2 months - 8 years) with CMA from 12 locations in the USA were recorded from 4.2015-4.2017. The diagnosis of an IgE-mediated CMA was confirmed by an allergic reaction to cow’s milk within 6 months and milk-specific serum IgE > 0.7 kUA/L or a prick test (SPT) > 5mm. Persons sensitive to cow’s milk were recorded as well, with >95 per cent predictive diagnoses. In a double-blind, placebo-controlled food provocation, they were fed one of both formulas in a randomised manner.

The trial formula without porcine enzymes was well tolerated by > 90 per cent of patients with CMA and corresponds to the AAP regulations. Minor differences based on peptide distribution resulted in no deviation. This data strongly supports the suitability of the tested formula for consumption by children with CMA.
**Allergy or intolerance?**

Lactose intolerance is often confused for patients and parents with a cow’s milk allergy (CMA). A better understanding of the differences between these conditions could limit misunderstandings in the diagnostic approach and in their management.

Lactose intolerance is primarily related to a syndrome with different symptoms due to the consumption of foods containing lactose. It is the most frequently occurring forms of food intolerance and occurs if the lactase activity is reduced. Depending on the severity of the symptoms, patients can acquire lactose intolerance in varying degrees, depending on the type of lactose consumed. If the lactose cannot be digested by the body, it gets fermented by the intestinal microbiome. This leads to symptoms such as stomach ache, flatulence and diarrhoea in individually differing severity of clinical manifestations.

These gastrointestinal symptoms can resemble those of a cow’s milk allergy, though, which results in the danger of a misdiagnosis. But there are crucial differences between lactose intolerance and cow’s milk allergy.

**Cow’s milk allergy or lactose intolerance?**

Lactose intolerance is one of the most frequently occurring types of food intolerance and is often mistaken for a cow’s milk allergy.

Lactose intolerance is the result of inadequate digestion of lactose – of the most important carbohydrate in mammalian milk. The fermentation of undigested lactose can cause gastrointestinal symptoms similar to that of a cow’s milk allergy.

When must one limit one’s lactose intake?

Unnecessarily foregoing lactose in the diet of infants and young children is disadvantageous for the development of a healthy gut microbiome.

A better knowledge of the differences between lactose intolerance and cow’s milk allergy can contribute to the minimisation of misunderstandings with respect to the diagnosis and treatment of these disorders.
In case of a diagnosed cow’s milk allergy (CMA), an extensively hydrolysed diet is the first choice; the expert associations have reached an agreement of the recommendations for the same. A German investigation shows another picture of the treatment management.

CMA manifests with heterogeneous and non-specific symptoms such as gastrointestinal, dermatological and/or respiratory disorders. In Europe, the incidence in children ≤ 3 years is between 1 to 7 per cent. Extensively hydrolysed formulas (eHFs) and amino acid-based formulas (AAFs) are special medical formulas for children. The latest guidelines recommend eHFs as the first choice for most of the children with CMA, AAFs should be reserved for patients with severe, life-threatening symptoms or for those who can tolerate eHFs.

A secondary data analysis was carried out for the assessment of the adherence of guidelines for the CMA diet management. The basis was the cost reimbursement data of the company health insurance funds in Germany from the 3rd quarter of 2007 to the 1st quarter of 2015.

A study population (N=564) was determined algorithmically. It was demonstrated that the initial prescription of eHFs are, contrary to the guidelines, significantly lower than that of AAFs.

The majority of CMA patients does not switch the treatment (91% to 96%). In the children being treated with eHFs, the treatment lasted an for an average of 36 weeks (median: 28 weeks), while for the children being treated with AAFs, it lasted for an average of 43 weeks (median: 30 weeks). In case of switch from eHF to AAF, the treatment duration was 45 weeks with an average of 13 weeks until the first switch in treatment. In case of switch from AAF to eHF, the treatment duration was 50 weeks with an average of 9 weeks until the first switch in treatment.

In contrast to the recommendations of the guidelines, eHF is prescribed for less than half of the CMA cases in infancy. This result shows that the awareness for the recommendations for the first choice of eHFs needs to be intensified.
Crohn’s disease: New treatment schema promises success

Exclusive enteral nutrition (EEN) is recommended for children with mild to moderately severe Crohn’s disease (CD), but the implementation of the same is challenging. EEN was compared with the CD exclusion diet (CDED), a whole-food diet coupled with partial enteral nutrition (PEN), designed to reduce exposure to dietary components.

A 12-week prospective controlled trial inflammatory bowel diseases (IBD) centres in Israel and Canada compared a CDED with 50% PEN diet for six weeks, followed by randomised CDED with 25% PEN for the next six weeks (Group 1) to EEN, or CDED with 25% PEN and reintroduction of a free diet for six weeks (Group 2). The PEN formula (“Modulen®, Nestlé Health”) was given orally in both groups.

78 children with mild or moderately severe luminal CD, defined by Pediatric Crohn’s disease Activity Index (PCDAI) ≥10 and ≤40 and evidence for active inflammation with elevated C-reactive protein, were enrolled. Patients were seen at the beginning of the trial and weeks 3, 6, and 12. A telephone conversation by a dietician was performed as well.

Primary endpoint: Development of dietary tolerance. No deviation from the diet until week 6, defined as termination of the study. Secondary endpoint: Remission (ITT cohort) at week 6 (PCDAI value < 10) and corticosteroid-free ITT sustained remission at week 12 (ITT).

Four patients from group 1 withdrew from the study and were only recorded for the primary outcome.

Results
- CDED+PEN was tolerated significantly better than EEN (97.5% or 73.6%).
- Both diets were equally effective in inducing remission and reducing inflammations at week 6.
- After 12 weeks, the sustained remission was significantly higher in the group that received CDED+PEN.
- Both diets showed similar changes in the faecal microbiome, which were connected to a remission at week 6, but returned to the original values in Group 2.

This data supports the use of CDED + PEN as a treatment to induce remission in children with luminal CD and mild to light activity.
Severe acute malnutrition is increasingly being observed in infants under 6 months of age and is often associated with a higher mortality rate in infants than in older infants and children. Apart from causal factors such as low birth weight, persistent diarrhoea and chronic underlying diseases or a disability, the development of severe acute malnutrition in infants under 6 months of age is caused by inadequate nutrition, especially due to inadequate breastfeeding practices.

There are essential physiological differences between toddlers and older children, which require modified management approaches or clinical interventions. The WHO has developed a number of recommendations for the identification and treatment of severe acute malnutrition in infants under the age of 6 months.

The most important WHO recommendations:
- Infants < 6 months of age with severe acute malnutrition should receive the same general medical care as infants > 6 months of age with severe acute malnutrition.
- Priority should be given to introducing or restoring an effective exclusive nursing period by the mother or other caregiver.
- Infants under the age of 6 months can be discharged from care if they are breastfeeding effectively or feeding well with replacement feeds, have gained sufficient weight and have a weight-for-length \( \geq -2 \) z-score according to the WHO Child Growth Standards median.

As part of the current children’s health report by the Techniker Krankenkasse, the occurrence of malnutrition in the analysis group was examined as well – with some surprising results.

The TK Children’s Health Report follows the TK’s Birth Report from 2017 with the caption “A routine data analysis on Caesarean section and preterm birth”. It examined the connection between maternal illnesses and diseases of the child related to the factors of Caesarean section and premature birth. Childhood overweight and obesity are health risks that can have long-term consequences. However, forms of malnutrition must also be taken into consideration – and treated.

Malnutrition is more common among children than obesity in the TK analysis group. The term does not refer to being underweight, but primarily dehydration and a lack of vitamin D, proteins and minerals.

Malnutrition is determined in almost 5 per cent of newborns. The value rises to around 7 per cent at the age of 1 year, drops to almost 5 per cent in the 2nd year of life, and to around 2 per cent in the following years. The prevalence in the analysis group was 18.7 per cent over the course of the entire investigation period.

A connection is demonstrated in preterm infants with a 30.5 per cent increased risk of malnutrition. This applies to girls and boys in equal measure. However, a link with a Caesarean section can be demonstrated with a 7 per cent higher probability in the first eight years of life.

A similar picture as that of malnutrition is also evident in the “symptoms of food intake” disease cluster. This concerns nutritional problems and improper nutrition, abnormal weight gain or loss.

The overall prevalence is 21.3 per cent. In infants, the proportion was around 7 per cent, also with the peak at 1 year (around 10%). Again, preterm infants (28.2%) and C-section infants (10.9%) are particularly affected by this. Boys have a significantly higher risk (12.9%) than girls (8.9%).
In the year 2012, the D-A-CH Nutrition Societies quadrupled their vitamin D intake recommendations per day, thus underlining the significance of these vitamins. The question, though, is whether the new recommendations for an increased vitamin D intake improve the widespread state of vitamin D deficiency in German children and adolescents.

Vitamin D is a key component in the growth and development of children and adolescents and affects a number of functions. Epidemiological and clinical studies across the world have shown that at least 25(OH)D blood values of ≥ 20.0 ng/ml (≥ 50.0 nmol/L), which have been defined as sufficient vitamin D values by several but not all international and national nutrition and children’s organisations, are often not achieved.

For a study spanning 6 years (January 2009 to December 2014) in Mülheim an der Ruhr, healthy children and adolescents (n=1,929, 1–17 years, median 11.0 years, 46.9% female) consulting a paediatric group practice were recruited. 75 per cent of the study participants were German or European (Caucasian) origin. The remaining had mostly Turkish roots, 2% showed a worldwide distribution.

The median 25(OH)D serum concentrations between 2009–2012 and 2013–2014 after increasing recommendations for vitamin D intake from 200 IU (5 µg) to 800 IU (20 µg), did not show a significant difference. The D-A-CH recommendations had no influence on vitamin D levels in children and adolescents. The prevalence of vitamin D deficiency has not changed compared to previous studies.

Guidelines should be drawn up to ultimately improve the health of the population. This requires the general population to be aware of the significance and implication of vitamin D deficiency. Efforts must be made to ensure at least the agreed minimum of around 1000 IU/day for healthy bones in young children and adolescents.
**Latest news regarding nutrition**

**Mommy the influencer**

The latest Nestlé trial “This is what Germany eats 2019” shows surprising results regarding the influence of parents on the eating behaviour – in spite of the digital competition. 68 per cent of parents with children between the age of 14 and 18 years think that when it comes to nutritional education, they have an extremely strong impact on their children. The children have astonishingly similar opinions. 80 per cent of the 14- to 18-year-olds declared that the parents shape their eating habits.

Mothers are often seen as role models. They increasingly seem to have started becoming aware of this. Since 65 per cent of mothers care a lot about their diet, 15 per cent more than ten years ago. What’s more, mothers are the ones who try out diets like flexitarian or low carb diets and introduce it the family.

Adolescents love using the internet, and lots of it – also for the purpose of educating themselves about nutrition. However, the Nestlé study shows that: Adolescents prefer to obtain advice and tips about diet and nutrition from their parents. 70 per cent of the 14- to 19-year-olds believe their parents or relatives the most. Friends and acquaintances take the second spot by a clear margin (34 per cent).

**Scarcity amid plenty**

Too much, too fat, so sweet, to salty – the problematic factors, which lead to an increased risk of overweight and obesity, are known. At least a significant part of the German population has considerably increased BMI values – in spite of this general superfluity, there are critical nutrients, the sufficient intake of which must be verified.

For the 13th German Nutrition Society (DGE) nutritional report, the nation-wide “German Health Interview and Examination Survey for Adults” (DEGS) has submitted representative data for the supplementation of vitamin D, folate, sodium, potassium and iodine. The data refers to clinical-chemical analyses of blood and urine samples for a reliable assessment of nutrient supply.

**The most significant facts:**

- The vitamin D consumption of the German population is overall insufficient. Around one-thirds of the population are deficient in serum concentrations of < 30 nmol/l 25-hydroxyvitamin D and only about 40% consume it in sufficient quantities.
- 86 % show an adequate intake of folate.
- Potassium intake is ensured as well.
- For 30% of the adults, the iodine consumption could still be better.
- Almost everyone consumes more than sufficient quantities of sodium. For 90 % of women and 93 % of men, the sodium intake is above the reference value. At an average of 9 or 10 g/day, they also seem to be consuming excess table salt.

The easiest way to achieve sufficient nutrient intake is through a balanced and wholesome diet in the form of a diversified diet, which majorly consists of plant-based (grains, vegetables, fruit) and a small portion of animal-based food (milk, fish, eggs and a little bit of meat).

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