SMALL TALK

PAEDIATRIC NUTRITION UPDATE INTENDED FOR HEALTHCARE PROFESSIONALS ONLY | SPRING 2021

SPOTLIGHT ON **FALTERING GROWTH**

- ESPGHAN position paper: micronutrient status in sick children
- Nutritional management of childhood cancer
- Dietetic priorities in anorexia nervosa
- Picky eating in children

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WELCOME

to our Faltering Growth edition of Small Talk

We've all experienced some significant changes in both our professional and personal lives over the last year. For some people, this may have created more opportunities for professional development and education, whilst for others there may simply have been other priorities. Whatever your situation, we aim to support you in your continued learning with our latest Small Talk, the dedicated educational resource for paediatric healthcare professionals.

This edition features an overview of the recent ESPGHAN position paper on the assessment and interpretation of micronutrient status in sick children by the lead author, Prof. Konstantinos Gerasimidis. We also bring you a comprehensive review of the nutritional management of childhood cancer by James Evans and Breeana Gardiner, whilst Graeme O'Connor takes a look at the challenges of inpatient management of eating disorders, and Chris Smith unravels the complexities of picky eating.

As always, we provide a summary of the latest literature and research in our popular Up$_2$ Date section, a range of case studies, and a selection of key educational events for your diary.

Best wishes

Emma

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NUTRICIA
LIFE-TRANSFORMING NUTRITION

Assessment and interpretation of micronutrient status in sick children. **A summary of the position paper from the ESPGHAN Committee on Nutrition**

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INTRODUCTION

Vitamins and trace elements play a critical role in maintenance of whole body function. Micronutrient deficiencies lead to loss of homeostasis, impaired function and disease onset[1]. In disease, in addition to a low dietary intake, deficiencies in vitamins and trace elements can be the outcome of malabsorption, excessive losses, increased requirements, impaired metabolism and, less often, drug-nutrient interactions[1-7]. In contemporary medicine, the clinical practitioner is required to assess micronutrient status to:

a) Confirm clinical symptoms of deficiencies or toxicity

b) Screen patients at risk of deficiencies or toxicity and refer them for further diagnostic investigations

c) Prevent under- or over-supplementation and the possible effects these may have on health and disease

d) Supplement and potentially improve the clinical outcomes of patients

e) Reduce costs from unnecessary usage of healthcare resources to assess micronutrient status, and from unnecessary interventions to correct non-existing deficiencies.

In June 2020, the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) published a position paper on the assessment and interpretation of vitamin and trace element status (VTE) in sick children[8]. In this paper, the authors describe the various approaches available to healthcare professionals to assess micronutrient status, critically discuss their advantages and limitations, and make recommendations for routine clinical paediatric practice. In this Small Talk article, we provide a summary of this societal paper.

MICRONUTRIENT ASSESSMENT METHODS

There are three main approaches (**Figure 1**) to assess the micronutrient status of an individual or group in-vivo.

CLINICAL EXAMINATION

Guides with practical advice on how to perform clinical examination for micronutrient deficiencies have been published previously[9]. Clinical symptoms of micronutrient deficiencies in visible regions of the body (e.g. skin, nails, eyes) are usually present when body stores are substantially depleted. Consequently, clinical examination is an insensitive method to identify early deterioration of a patient's micronutrient status or to detect subclinical deficiencies. While certain clinical signs are specific to a single or very few micronutrient deficiencies (e.g. rickets in vitamin D deficiency), for other micronutrients deficiency signs are subtle and often difficult to distinguish from non-nutrient related factors and conditions. It is therefore important to confirm findings from nutrition-associated clinical assessment with laboratory biomarkers and dietary assessment as described below. Monitoring of clinical signs following dietary intervention or supplementation will confirm the initial diagnosis and also determine whether any intervention applied has corrected the micronutrient-related problem.

ASSESSMENT OF DIETARY INTAKE

Principles of dietary assessment

Dietary assessment accepts that a nutrient intake above a certain reference value meets the needs of the body. In disease, this assumes that nutrient absorption, metabolism and losses are comparable to those of healthy people, upon whom the dietary references values (DRV) have been developed. However, assumptions like these are often invalid for conditions where the physiological metabolism of micronutrients has been altered or bypassed. Prime examples are the onset of cytopaenia secondary to copper deficiency in children receiving exclusive jejunal feeding[10], faecal loss of fat soluble vitamins in children with cystic fibrosis and pancreatic insufficiency[11], and antagonism of folate metabolism in children receiving immunosuppression with methotrexate[12].

DIETARY ASSESSMENT

Pros
- Non-invasive
- Detect early store depletion

Cons
- Inaccurate/imprecise in per subject estimations
- Prone to self-reporting bias
- Assumes same requirements as in health
- Time consuming
- Increases patient burden
- Incomplete food composition databases
- Needs dietitian
- Requires dietary analysis software

CLINICAL EXAMINATION

Pros
- Non-invasive
- Quick to perform

Cons
- Insensitive for early depletion
- Often unspecific
- Requires clinician with appropriate training

LABORATORY BIOMARKERS

Pros
- 'Objective' marker of body store adequacy
- Less prone to user error
- Assess current and long-term stores

Cons
- Often invasive
- Some need laborious assays
- Reference intervals for children not always available
- Some reference intervals are based on selective populations
- Several affected by systemic inflammatory response
- Some affected by abnormal liver/kidney function
- Need specialised lab

Figure 1. Advantages and disadvantages of mainstream approaches to assess micronutrient status in paediatric patients

Dietary references values

In dietary assessment an individual's intake is compared against a DRV. The DRV for micronutrients cover the requirements of 97.5% of individuals within a population and serve as the basis for dietary assessment and diet planning. For sick children, either the DRVs established for healthy children are used or, in the absence of evidence, inflated adjustments for micronutrients are often applied to account for disease effects on body requirements, with the caveat that most of these adjustments are based on theoretical premises.

Dietary assessment methodology

Dietary assessment is only useful in assessing the micronutrient status of a patient when dietary intake data are collected and analysed appropriately. There are several caveats to consider with the use of dietary assessment methods or tools to estimate intakes of micronutrients in individuals. Methods developed to describe nutrient intakes of large populations in nutritional epidemiology, such as food frequency questionnaires or 24-hour past dietary recalls[13], at best provide mean group estimates or offer ranking of micronutrient intakes[14]. Use of such nutritional epidemiology methods for assessment of micronutrient status in individual patients should be discouraged, or done with extra caution, and always complemented with other micronutrient assessment methods. "Reference methods" of dietary assessment, such as weighed food diaries, may be more accurate methods to estimate micronutrient intake but require meticulous recording of weighed food over a long period of time (7 days or longer) to capture inter-daily variation in micronutrient intake. Diet recording over long periods increases burden and misreporting, and individuals often distort their habitual diet during the recording period[15].

Accuracy of dietary analysis also depends on the availability and completeness of food composition databases, meaning assessments using foods which lack detailed nutritional composition data may underestimate micronutrient intakes. This might be particularly relevant for medical foods used extensively in the dietary management of children with chronic illness, such as gluten free products in coeliac disease and low protein foods for the management of children with phenylketonuria[16].

Biochemical markers

Measurement of a micronutrient biomarker is the most common method in use in clinical practice to assess the body status of an individual patient. This is done by either directly measuring the concentration of the micronutrient or their derivatives and binding proteins in biological fluids, mainly blood. Functional biomarkers provide an indirect assessment of the adequacy of body micronutrients by measurement of a metabolite, enzymatic reaction activity, or a hormone, highly dependent to a certain micronutrient (e.g. diminished erythrocyte transketolase activity as a marker of thiamine deficiency). Functional markers are useful in cases when direct measurements of micronutrients in biological samples are not reliable markers of body micronutrient status. Measurements of micronutrient concentrations intracellularly in erythrocytes are more representative of long-term or tissue stores, as opposed to measurements in plasma which are influenced by recent changes in intake. However, not all micronutrient measurements in erythrocytes are reliable biomarkers of body status.

Micronutrient reference intervals

There are limitations regarding the use and interpretation of micronutrient biomarkers. These include the lack of robust blood micronutrient reference intervals in paediatrics, which means that often adult standards are adopted or adapted for use. Also, some of the currently available references are based on the prevailing levels in the generally healthy population, rather than the optimal ones, as with the WHO growth centile charts[17-23]. This is particularly important, as developing micronutrient reference intervals based on population distribution data in areas where micronutrient deficiency is a public health concern[24-26] may mask cases of true deficiencies and underestimate the proportion of subjects who need supplementation or nutritional support. Until high quality internationally agreed references are developed, clinical practitioners should still use their local laboratory micronutrient reference intervals but also take into consideration the issues highlighted in this paper.

Effect of illness and inflammatory response

Suboptimal intake is perhaps the main cause of low circulating levels of micronutrients in healthy individuals. In illness, a highly complex system regulates redistribution of micronutrients in the body[27]. This includes redistribution of micronutrients between tissues and body fluid compartments, changes in synthesis and loss of nutrient-carrier protein, including serum albumin and lipoproteins, as well as increased urinary excretion[1]. As a result of these inevitable effects, the blood concentration of several micronutrients will be affected, regardless of the actual body stores (**Figure 2**).

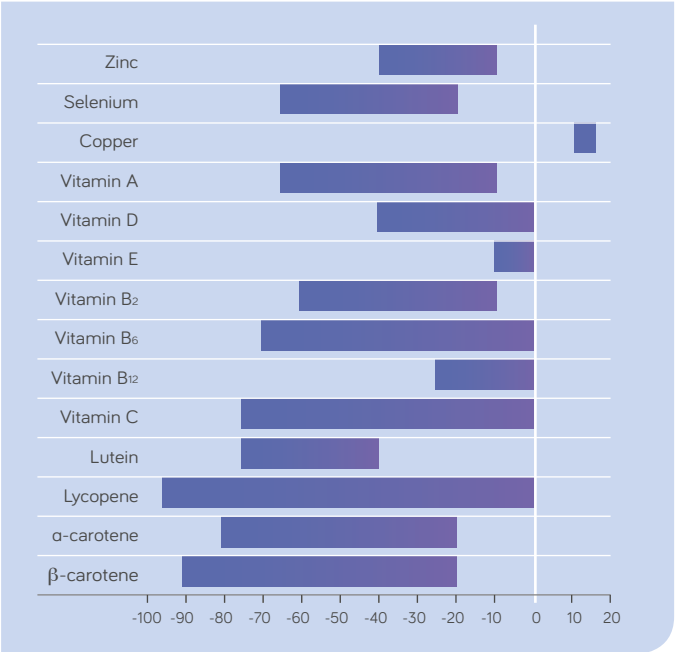

Figure 2. Magnitude of the effect of systemic inflammatory response (% change) on plasma micronutrient concentration as reported in previous research[31]

This appears to apply mainly in the case of micronutrient levels in plasma, while the intracellular concentration of micronutrients in erythrocytes remains the same or less affected[28-30]. For selenium and vitamins B_6 and C, this effect occurs with only slightly increased C-reactive protein concentrations of 5 to 10 mg/L. The important implication of this evidence is that it is difficult to differentiate between a true deficiency and an epiphenomenon of the systemic inflammatory response when a sick child has low plasma concentrations of a micronutrient. It is therefore possible that the concentration of the nutritional biomarker may reflect the activity of the disease, rather than the actual micronutrient status of a patient, in the presence of inflammatory response[27].

There have been several efforts to overcome the limitations of interpretating body micronutrient concentration measurements in the presence of ongoing inflammatory response, but currently there is no accepted consensus. As several of the micronutrients circulate in the blood bound to nutrient-carrier proteins, a commonly used approach to account for the effect of the systemic inflammatory response is to correct for their plasma levels. For example, vitamin K, which is transferred primarily bound to chylomicrons, will decline as a secondary effect of the acute phase response on lipoprotein metabolism[32]. Plasma vitamin K concentrations are therefore unlikely to be a reliable measure of status during inflammation. Instead, the plasma vitamin K: triglyceride ratio[32] or other biomarkers, such as the undercarboxylated serum vitamin K-dependent proteins (PIVKA-II)[33], provide more reliable measurement of vitamin K status. The observation that the erythrocyte levels of certain micronutrients remain unaffected by the systemic inflammatory response[28-30, 34,35] means that they have the potential to be used as surrogate biomarkers of micronutrient body stores, for example, as seen with the erythrocyte concentrations of selenium, B_2 and B_6[36]. However, the same principle does not apply across all trace elements such as erythrocyte zinc. The long half-life of the erythrocytes also limits the use of erythrocyte micronutrient biomarker concentrations for the assessment of acute deficiencies or recent supplementation[37]. Beyond the effect of the systemic inflammatory response on blood biomarkers, conditions affecting normal liver and renal function can perturb the concentration of micronutrients, regardless of actual body stores. Therefore, interpretation of biomarkers of micronutrient in blood should be done in the context of the clinical condition[17,38].

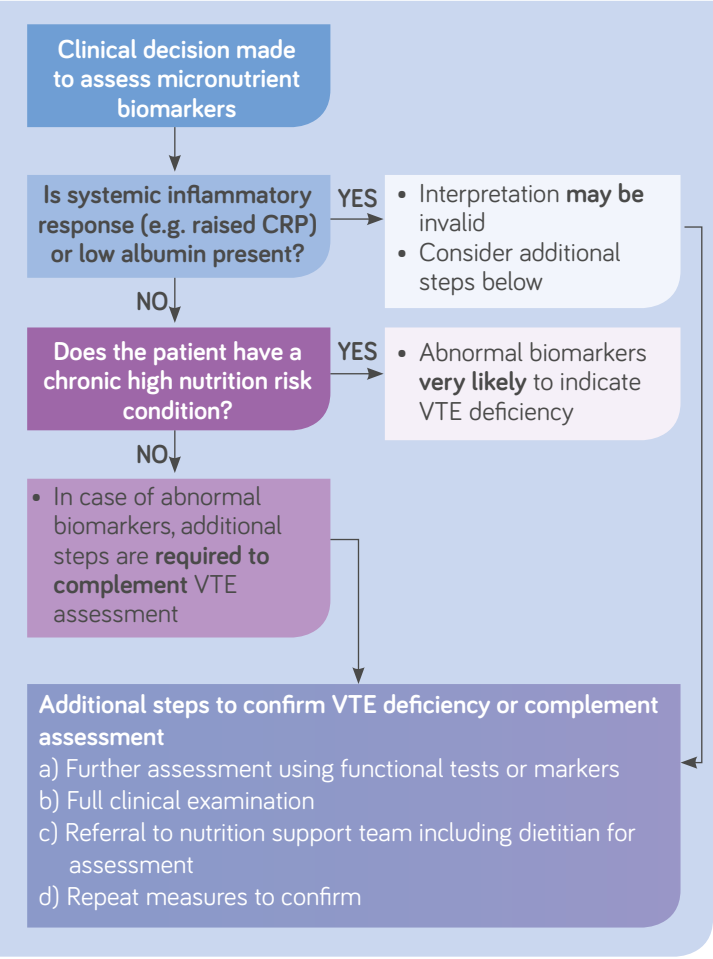

Figure 3. A decision tree to evaluate micronutrient status stores using laboratory biomarkers

Table 1. Recommendation of the ESPGHAN Committee of Nutrition on Assessment and Interpretation of Micronutrient Status in Sick Children

	Recommendations of the ESPGHAN Committee of Nutrition on Assessment and Interpretation of Micronutrition Status in Sick Children
1.	Routine screening for micronutrient status is justifiable only in groups of patients with chronic conditions at high nutrition risk and in individuals on long-term exclusion diets. Clinical teams should conduct audit and adapt practice accordingly.
2.	Micronutrient biomarkers should be interpreted in relation to the overall clinical condition and history of the individual patient.
3.	The use of a multimodal approach, including clinical examinations, dietary assessment and biomarkers, including functional markers, is the optimal method to ascertain the micronutrient status of individual patients.
4.	Systemic markers of inflammation (e.g. CRP) and serum albumin should be measured alongside plasma micronutrient concentrations, particularly where the disease state may result in a systemic inflammatory response.
5.	Dietary assessment methods developed for use in nutritional epidemiology (e.g. FFQ) should not be used to diagnose micronutrient deficiences in individual patients and especially in isolation of other methods.
6.	In the presence of inflammatory conditions, micronutrient measurements in plasma should be replaced by biomarkers not affected by the systemic inflammatory response or delayed until inflammatory state is resolved.
7.	Manufacturers of medical food products should be encouraged to report data on the composition of all micronutrients.

CONCLUSION

Based on the issues raised within this position paper, the Committee on Nutrition of ESPGHAN made recommendations for routine clinical practice (**Table 1**) and proposed a decision tree to evaluate micronutrient status stores using laboratory biomarkers (**Figure 3**).

FOR A FULL REFERENCE LIST, PLEASE SEE **PAGE 29**

Introduction to the **nutritional management of childhood cancer**

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TYPES OF CANCER SEEN IN CHILDHOOD

In the UK, about 1,600 children (≤15 years) are diagnosed with cancer each year, equating to one in every 450 children[1]. The survival rate for children's cancer has doubled since the 1960s. To date, 82% survive children's cancer for five or more years in developed countries. However, survival for children's cancer varies considerably depending on diagnosis[2].

Although there are 76 types of children's cancer, these can be divided into 12 main groups. Some groups are more common than others. **Table 1** outlines the most common childhood cancers and 5-year survival rates.

Table 1. Most common childhood cancers in groups and 5-year survival[1,2]

Most common childhood cancers (% cases of cancer diagnosed in UK children each year)	Examples	5-year survival rate
Leukaemia (30%)	- B-cell ALL, T-cell ALL, infant ALL, AML, CML	88%
Brain and spinal, and other CNS and intracranial tumours (20%)	- Medulloblastoma, pPNET, glioma, ependymoma	72%
Lymphoma (10%)	- Hodgkin's and non-Hodgkin's lymphomas	93%
Other groups including (make up to 40%): - Sympathetic nervous system tumours - Soft tissue sarcomas - Renal tumours - Bone tumours - Others including: - Carcinoma and malignant melanoma; germ cell and gonadal tumours; retinoblastoma; hepatic tumours	- Neuroblastoma - Rhabdomyosarcoma - Wilms' tumour - Osteosarcoma, Ewing's sarcoma	67% 67-70% 90% 65%

ALL, acute lymphoblastic leukaemia; AML, acute myeloid leukaemia; CML, chronic myeloid leukaemia; CNS, central nervous system; pPNET, peripheral primitive neuroectodermal tumour

Treatments vary depending on diagnosis, staging and cytogenetics, and can include chemotherapy, radiotherapy (including proton beam), surgery, bone marrow transplant (allogeneic or autologous) and immunotherapy.

As children are surviving and living into adulthood, the late effects and long-term consequences of treatment are becoming more apparent. The optimisation of nutritional status, both during treatment and beyond, is absolutely essential to promote the best outcomes for children and young people.

NUTRITIONAL CHALLENGES

When a child or young person is diagnosed with cancer, there are a number of factors that can impact on their nutritional status and increase their risk of malnutrition. These factors are outlined in **Table 2.**

Table 2. Nutritional challenges in childhood cancer[3-5]

Side effect	Example
Treatment	**Direct:** • Nausea and vomiting • Appetite suppression/anorexia • Mucositis - pain and inflammation of gastrointestinal tract lining • Changes in taste and smell/dry mouth • Constipation/diarrhoea • Mechanical gut issues • Graft versus host disease (bone marrow transplant only) **Indirect:** • Nil by mouth/fasting for procedures • Fluid restriction • Long-term hospitalisation
Metabolic	• Cancer cachexia - progressive muscle wasting of lean tissues • Frequent gastrointestinal dysfunction due to cancer therapy induced toxicity, metabolic and hormonal alterations • Other organ damage - renal, hepatic, cardiac
Psychological	• Tension and anxiety around feeding/parent–children interaction • Learned food aversion • Unfamiliar environments and no access to home-cooked meals • Disliking hospital foods • Emotional impact of having cancer • Anticipatory nausea and vomiting

Malnutrition

It is estimated that without nutritional intervention up to 50% of children treated for cancer are likely to become malnourished[6]. However, the incidence varies due to the lack of consensus regarding the definition of malnutrition in this cohort and the different types of paediatric malignancies studied. A recent systematic review estimated the prevalence to be between 0-10% for leukaemia, 20-50% for neuroblastoma and 0-30% for other solid tumours in developed countries[7].

The consequences of malnutrition are serious, with children who are underweight at diagnosis having poorer outcomes compared to those adequately nourished at diagnosis.

Malnutrition can:

- contribute to a reduced tolerance to intensive therapy and drug dose alteration[8]
- increase risk of drug toxicity[9]
- increase length of hospital stay[10]
- increase the risk of infection and complications[11]
- contribute to poorer quality of life[12]
- be an independent risk factor for graft-versus-host disease and mortality in bone marrow transplant[13,14].

Overweight and obesity

Obesity is also emerging as a commonly reported problem in children being treated for cancer. Studies suggest overweight and obesity may increase the risk of treatment related toxicity and mortality[15]. A recent systematic review found unhealthy weight gain occurs early in treatment and towards the end of treatment in ALL, and that these weight increases are maintained beyond treatment completion[16]. The potential causes for these findings may include:

- lengthy treatment protocol: 2-3 years
- difficultly in reversing unhealthy eating habits and sedentary behaviours after treatment completion[17]
- prolonged use of corticosteroids[18]
- chemotherapeutic agents (such as anthracyclines and vincristine) leading to impaired cardiovascular fitness and muscle strength[19].

Preventing early onset obesity is a priority for improving care and outcomes for children being treated with cancer, particularly ALL, when considering that changes in body composition and increased fat mass during treatment extend into survivorship[20,21].

IDENTIFYING NUTRITION RISK

The level of the child's nutritional risk with cancer is associated with their diagnosis (**Table 3**), stage of the disease (either as a result of the underlying disease and/or the anticipated toxicity from the current treatment protocol), as well as their nutritional status prior to diagnosis[22,23].

The only validated screening tool for children and young people with cancer is the nutrition screening tool for childhood cancer (SCAN)[25]. Other screening tools, such as a modified version of the Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP)[26], are available and used in the UK in the childhood cancer setting, although they have not been validated or audited.

Table 3. Nutrition risk and diagnosis[24]

HIGH NUTRITIONAL RISK
Advanced disease during initial intense treatment
High risk neuroblastoma
Stage III and IV Wilms' tumour
High risk rhabdomyosarcoma
Ewing's sarcoma/pPNET
Osteosarcoma
Medulloblastoma/CNS PNET
Diencephalic tumour
Nasopharyngeal tumour
B-cell NHL
AML
Some ALL Infants and teenagers Regimen B and C Patients relapsed ALL
Bone marrow transplant patients Allogeneic Autologous
LOW NUTRITIONAL RISK
ALL regimen A patients
Non metastatic solid tumours
Retinoblastoma
Hodgkin's disease
Germ cell tumours
Advanced disease in remission during maintenance treatment
HIGH RISK OF FAT ACCUMULATION
ALL patients on corticosteroids
Craniopharyngioma
Other malignancies with large or prolonged does of corticosteroids
Total body or cranial irradiation

pPNET, peripheral primitive neuroectodermal tumour; CNS PNET, central nervous system primitive neuroectodermal tumour; NHL, non-Hodgkin's lymphoma; AML, acute myeloid leukaemia; ALL, acute lymphoblastic leukaemia.

DIETETIC ASSESSMENT

There is no simple method to accurately identify poor nutritional status in childhood cancer[27]. In practice, assessment of nutritional risk should use a combination of the following factors.

Anthropometry

Evaluating nutritional status is a key component of supportive care in childhood cancer. Weight and height remain the most commonly used methods[28]. However, weight and weight-related indices, e.g. body mass index (BMI), can be unreliable in children with solid tumours and those receiving hyperhydration with chemotherapy, masking losses in fat and fat-free mass. Up to 40% of childhood cancer patients have had malnutrition misdiagnosed when using weight and BMI alone[29]. Various accompanying methods can be used to assess a child's nutritional status and each brings its own limitations (**Table 4**).

Table 4. Anthropometric measurements

Anthropometric measure	Comments and limitations
Weight	Unreliable in children with solid tumours, ascites and hyperhydration
Height	Some lack of growth in height is observed in children undergoing cancer treatment
BMI	Unreliable in children with solid tumours
Weight loss ≥5% relative to pre-illness weight	May constitute acute malnutrition[5], interpret with caution as weight loss may be due to tumour shrinkage or resection
Mid upper arm circumference	Captures fat and fat-free mass, being less affected by hydration or tumour mass. Useful in children with solid tumours as independent of tumour shrinkage
Triceps skinfold thickness	Reliable for assessing fat mass in paediatric oncology[30]. Can be painful and not routinely used in practice

Biochemistry

Assessment of full blood count will identify the child's current level of neutropenia, thrombocytopenia and haemoglobin levels. Urea and electrolytes and liver function tests will identify any kidney and liver impairment that may have resulted from chemotherapy, antibiotics or other medicines used. Nutritional bloods, particularly vitamin D, may also be worth checking at diagnosis and regularly throughout treatment. Bone morbidity in children with cancer, especially those who receive steroids, is increasingly recognised as a short and long-term problem[31].

Clinical observations

Clinical assessment should include: the child's diagnosis, stage of disease, treatment protocol and current stage within their protocol. This will identify the treatment intensity, modalities, expected side effects (**Table 2**), and impact these might have on the child's ability to consume adequate nutrition. Treatment is often given in cycles, with days spent receiving treatment followed by a few weeks break, before the cycle repeats. Knowledge of treatment protocols can help predict what side effects might occur at specific times. Children should be encouraged to make the most of their eating at times free from the majority of side effects. Awareness of the child's medications is essential, e.g. ensuring anti-emetics are optimised may help improve tolerance of enteral tube feeds.

Nutritional requirements

For children with cancers associated with low nutritional risk, the aim should be to meet the estimated average requirement for energy and reference nutrient intake for protein, vitamins and minerals[32,33]. Children requiring catch up growth, or with increased gastrointestinal losses, may have increased requirements[33]. Furthermore, children with solid tumours are seen to have increased basal metabolic rate at diagnosis and possibly during the first phase of oncologic treatment[34], which should be considered when determining energy requirements. In all cases, requirements for energy should be reviewed regularly, especially in patients at risk of fat accumulation such as those taking steroids. Fluid requirements can be met through a combination of oral, enteral and intravenous fluids and/or nutrition.

DIETETIC INTERVENTIONS

The aims of nutritional support are to reverse any malnutrition seen at diagnosis, prevent future malnutrition associated with treatment and promote normal weight gain and growth[35].

Oral feeding strategies

Throughout treatment, advice to promote positive feeding practices is needed, including: maintenance of as normal a feeding regime as possible, family involvement at mealtimes, normal weaning progression, avoidance of force feeding, use of high energy foods, fortification strategies and a 'little and often' approach to eating[36]. Some hospitals have facilities to prepare food at ward level, with meals 'cooked to order' according to the preference of the child.

Oral nutritional supplements

In practice, many children become unable to consume adequate nutrition orally due to treatment side effects and require oral nutritional supplements (ONS). Milk-based and low volume energy supplements, taken alone or added to food/drinks, may be more acceptable options[37]. 'Compact' style supplements may also be useful in children who struggle to take larger volumes orally. Adding ONS to foods and drinks the child would normally consume, including breakfast cereals and puddings and making ice lollies, may also aid compliance.

Enteral nutrition

Enteral tube feeding should be initiated early in children with diagnoses that pose a high nutritional risk. Enteral nutrition has been shown to: prevent nutritional decline during treatment[38], improve nutritional status and energy intake during intensive treatment with minimal complications[39,40], and reduce parental anxiety[41]. The Royal College of Nursing provides criteria for starting enteral feeding[42]:

- weight two centiles below height centile
- percentage weight for height <90% of the ideal
- decrease in current percentiles for weight (or height) of two centiles
- total weight loss ≥5% since diagnosis
- reduced oral intake of <70% of estimated requirements for >5 days.

Nasogastric tubes are commonly used in this population but placement can be traumatic for children[43]. It can be useful to co-ordinate insertion with other procedures requiring general anaesthetic. Where long-term nutrition support is expected, gastrostomy feeding may be preferential. It is shown to reverse early weight loss and is associated with only minor complications, despite the immunocompromised state of these children[40,44]. In children with intractable vomiting jejunal feeding may be required.

Generally, an age-appropriate, polymeric enteral feed will be tolerated by children with a functioning gastrointestinal tract. High energy versions can be used if catch up growth is required, or the child is fluid restricted. Fibre containing feeds should be used in those with constipation; a possible side effect of vincristine chemotherapy.

However, children with cancer commonly develop gastrointestinal symptoms, including diarrhoea, abdominal pain and vomiting, related both to the treatment as well as the underlying diagnosis. Chemotherapy frequently induces intestinal mucositis and inflammation, villus atrophy and down-regulation of the enterocyte-specific gene expression, all of which negatively impact on nutrient absorption[45,46]. Therefore, there may be a role for the use of extensively hydrolysed protein and amino acid feeds if these gastrointestinal symptoms occur. In the first instance, changing from a polymeric to an extensively hydrolysed protein feed may improve tolerance. Amino acid feeds may be needed if hydrolysed options are not tolerated, for example in severe mucositis. However, evidence for either extensively hydrolysed or amino acid feeds alleviating these symptoms and improving nutrient absorption is limited.

Children prone to vomiting often tolerate cyclical feeding regimens of 4-5 hours continuous feeds with 1-2 hours break repeated over the day. During periods of intensive treatment continuous 20-24 hour feeds may be required. At home, in between treatments, bolus feeds should be tolerated.

Parenteral nutrition

Given its associations with metabolic and infectious complications[47], careful consideration should be given before parenteral nutrition is commenced. Appropriate indications for parenteral nutrition may include[48]:

- severe mucositis
- neutropenic enterocolitis (typhlitis)
- ileus or intestinal obstruction
- enteral tube and oral feeding meeting <50% energy requirements for 3-5 days and unable to advance enteral feeds due to severe vomiting, diarrhoea or mucositis.

There is limited evidence from individual trials to suggest parenteral nutrition is more effective than enteral nutrition in well-nourished children and young people with cancer undergoing chemotherapy[35]. Trophic amounts of enteral nutrition should be administered alongside parenteral nutrition, if possible, to preserve the integrity of the gut mucosa[49].

NUTRITIONAL MANAGEMENT OF TREATMENT SIDE EFFECTS

Strategies to nutritionally manage common side effects of cancer treatment are shown in **Table 5**.

FOOD SAFETY

The neutropenic state encountered during cancer treatment puts children at risk of food-borne infections. It is advisable that children follow food safety advice and avoid the following foods[36]:

- raw or lightly cooked eggs
- soft, ripened or blue-veined cheeses, e.g. Brie, Camembert, Stilton
- pâté
- raw shellfish
- raw and undercooked meat.

FOR A FULL REFERENCE LIST, PLEASE SEE **PAGE 30**

Good food hygiene practices are also important, such as washing hands before preparing and eating food, and not reheating rice. Before eating at restaurants, it would be advisable to check the food hygiene rating on the Food Standards Agency website.

Table 5. Nutritional strategies to manage treatment side effects

Side effect	Nutritional management
Nausea and vomiting	Ensure anti-emetics are maximised Avoid strong smells, encourage cold or room temperature foods (e.g. toast, yoghurt, cereal) Small meals/snacks given frequently over the day Sipping fizzy drinks Avoid greasy foods Consider continuous or intermittent tube feeding If ongoing problems, consider jejunal feeding
Taste changes	Savoury and salty foods may be preferred over sweet foods[50] Identify foods the child enjoys and offer these (trial and error) Have a selection of quick and easy foods readily available Use herbs, spices and sauces to flavour foods Red meat may have a metallic taste; try chicken, fish, cheese or beans instead
Anorexia	'Little and often' approach to eating Achievable meal sizes Have a selection of foods the child likes readily available so a preferred food can be given at the right time Food fortification Low volume, 'compact' oral nutritional supplements may be beneficial
Mucositis	Good oral hygiene, use of mouth sprays for mucosal protection Encourage soft, moist foods (e.g. extra gravy and sauces) Avoid hot food and drinks, salty, acidic and spicy foods (e.g. fruit juices and fizzy drinks), rough or sticky foods (e.g. crisps, bread) Moderate mucositis: continuous enteral feeding regimens and hydrolysed feeds may aid tolerance Severe mucositis: gut rest and parenteral nutrition may be needed
Constipation	Laxatives Encourage high fibre diet and adequate fluids Fibre containing enteral feeds
Diarrhoea	Determine cause first – antibiotics may be the culprit Enteral feed and/or diet manipulation should be considered (e.g. lactose or milk free products and continuous enteral feeding) Gut rest and parenteral nutrition may be needed in severe cases

RESOURCES

- Children's Cancer and Leukaemia Group information guide to eating well: https://www.cclg.org.uk/publications/All-publications/Helping-your-child-to-eat-well-during-cancer-treatment/HELPYEAT
- Trekstock (young adult cancer support) nutrition guide: https://www.trekstock.com/Handlers/Download.ashx?IDMF=87df37b3-b196-4ff6-96e0-623ceeb72bab
- Food Standards Agency food hygiene ratings: https://ratings.food.gov.uk
- NHS food safety advice: https://www.nhs.uk/conditions/pregnancy-and-baby/food-safety-hygiene/?tabname=im-pregnant

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kcal 300
Protein 7.1 g
Fibre 3 g

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Fortini Compact Multi Fibre is a Food for Special Medical Purposes for the dietary management of disease related malnutrition and growth failure in children from one year onwards, and must be used under medical supervision.

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NUTRICIA
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The use of Fortini Compact Multi Fibre as a flexible solution to poor growth and tolerance in enteral feeding

Cheryl Baig, Specialist Paediatric Dietitian, Mid Yorkshire NHS Trust

BACKGROUND

X was a 2-year-old ex premature male, born at 26 weeks on the 9th centile for weight, and diagnosed with Cerebral Palsy secondary to prematurity, global development delay, and visual and hearing impairment. He was referred to paediatric dietetics for poor growth (weight dropped to 0.4th-2nd centile and height was 25th-50th centile) and constipation. His mum was a single parent, with limited support around her.

On first assessment, X was seen to be fed a normal diet with no reported difficulties; however, poor fluid intake was noted and Movicol was helping with the constipation. A food first approach was offered initially and a mixture of Fortini Multi Fibre (1.5kcal/ml) and Fortini Creamy Fruit (1.5kcal/100g) were prescribed to support nutritional intake and promote growth.

Initially, weight increased to the 9th centile over 6 months. However, when X started nursery, he picked up recurrent illnesses, such as colds and vomiting bugs. Subsequently his oral intake and acceptance of oral nutritional supplements became variable and his weight dropped to the 2nd centile. Further oral nutritional supplement options were explored, such as shots and powders, but these had limited impact on growth.

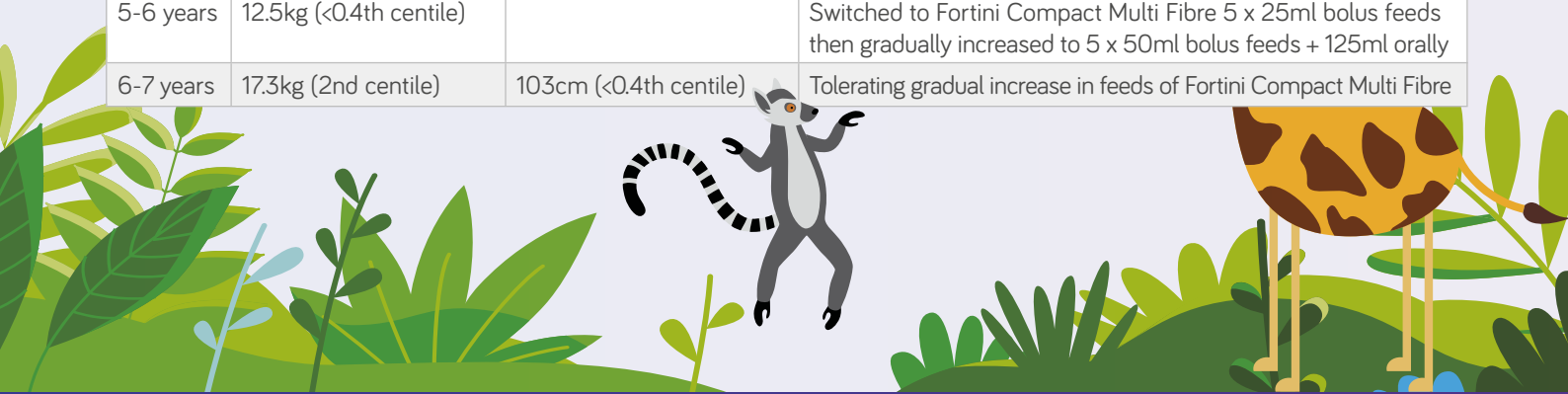
Discussions around gastrostomy feeding started 18 months after referral to paediatric dietetics due to ongoing poor growth, and concerns from other health professionals around weight and nutrition. At this point, weight had dropped below the 2nd centile, but mum was very anxious and reluctant for gastrostomy tube insertion.

Following hip surgery, oral intake reduced further and X's weight fell below the 0.4th centile. Due to his Cerebral Palsy and being in a wheelchair, height measurements were difficult to obtain as his condition worsened, but this did falter over time to below the 0.4th centile along with weight. Requirements were estimated at approx. 1390kcal and 19.7g protein, leaving a 400-600kcal and 10-5g protein deficit. X was referred for gastrostomy and this was inserted at 4 years old, despite mum's reluctance. Following insertion, mum became more anxious and did not want to use a feeding pump and equipment; therefore, a gravity bolus regime of 2 x 100ml Fortini Multi Fibre using 60ml syringes was agreed to supplement his oral diet, providing 300kcal and 6.6g protein. As Fortini Multi Fibre was already being prescribed for oral use it was felt that this would be a suitable choice of feed, as it would minimise changes for mum and could be given orally, which mum found more acceptable. It was also easily decanted from the 200ml bottle into 60ml syringes, so provided a practical option for use both in and out of the home.

Feeds were later increased to 3 x 100ml Fortini Multi Fibre, which provided 450kcal and 10g protein, but X struggled to tolerate this volume. He was vomiting post feeds, resulting in some weight loss. Despite the difficulties with feeds, X was reported to have small regular fortified meals throughout the day without difficulties.

Table 1. Anthropometry chart

Age	Weight	Length	Phase
Birth	800g (9th centile)		
2 years	9.4kg (0.4th-2nd centile)	83cm (25th-50th centile)	Referred to paediatric dietitians
2.5 years	10.3kg (9th centile)		Food fortification advice Fortini Multi Fibre 200ml OD Fortini Creamy Fruit pot 100g OD
3 years	11.1kg (2nd centile)		Recurrent illness
3.5 years	11.4kg (0.4th-2nd centile)		Discussions around gastrostomy
4 years	11.5kg (<0.4th centile)		Hip surgery
4.5 years	11.5kg (<0.4th centile)	95cm (0.4th centile)	Gastrostomy inserted 2 x 100ml Fortini Multi Fibre, then increased to 3 x 100ml Fortini Multi Fibre with tolerance problems
5-6 years	12.5kg (<0.4th centile)		Switched to Fortini Compact Multi Fibre 5 x 25ml bolus feeds then gradually increased to 5 x 50ml bolus feeds + 125ml orally
6-7 years	17.3kg (2nd centile)	103cm (<0.4th centile)	Tolerating gradual increase in feeds of Fortini Compact Multi Fibre



MANAGEMENT

At 5 years old, X struggled with increased feeds. Without a feeding pump as an option to deliver slower feeds, Fortini Compact Multi Fibre (2.4kcal/ml) was trialled as it offered a similar amount of calories and protein in a smaller volume. It was also a familiar product to both X and mum that could be used in the same way and was suitable for a paediatric patient.

A bolus feeding regime of 5 x 25ml Fortini Compact Multi Fibre was agreed, with a view to increasing volumes gradually depending on tolerance. The small volume bolus feeds were quick and easy for mum to bolus after meals and snacks, which felt more acceptable to her. This could also be offered orally, mixed into food or as a drink, with minimal impact on dietary intake; so it offered flexibility as well. Initially this provided 300kcal and 7.1g protein.

DISCUSSION

The compact feed was well tolerated, enabling increased volumes which were built up gradually to a total of 3 x 125ml bottles per day, given as 5 x 50ml gravity bolus feeds after meals and snacks. The remaining 125ml was to be given orally or used to fortify meals and snacks. This provided 900kcal and 21.3g protein which, at this point, was approx. 60% of total energy requirements and met protein requirements. At around 6 years of age, weight improved quickly from below the 0.4th to 2nd centile within 6 months (see **Table 1**). This feeding plan provided a flexible and convenient way of delivering nutrition both in and out of the home environment, in addition to addressing mum's concerns, giving her the choice to feed both orally and via gastrostomy. The use of the compact feed improved tolerance as it was able to meet requirements in smaller volumes.

Fortini Compact Multi Fibre can provide a low volume and flexible option for paediatric enteral feeding, being suitable for both oral and tube feeding, and is suitable for both pump and gravity bolus feeding. With 300kcal and 7.1g protein per 125ml bottle, it can help to meet nutritional requirements alongside the oral diet with minimal impact on intake. When delivered in small, regular feeds, Fortini Compact Multi Fibre can improve tolerance in those who struggle with larger volumes of feed and reduce feeding durations. It provides flexibility in being able to offer a wide range of feeding options that can be tailored to different environments, times of day, or medical changes. With the option to deliver feed without lots of feeding equipment, it can be perceived as more acceptable for families, which can improve compliance with dietary advice resulting in improved health outcomes.

Diary Dates

EAP 2021 Congress & Mastercourse
22-25 April
Virtual congress

KetoCollege
25-27 May
Felbridge, West Sussex

6th World Congress of Pediatric Gastroenterology, Hepatology and Nutrition (hybrid meeting)
2-5 June
Vienna, Austria

British Inherited Metabolic Diseases Group (BIMDG) Annual Symposium
24-25 June
Manchester

EAACI Hybrid Congress
10-12 July
Krakow

8th International Conference on Nutrition & Growth
26-28 August
Lisbon, Portugal

BSACI Annual Conference
7-9 October
Harrogate

7th Global Symposium for Medical Ketogenic Dietary Therapies
19-23 October
Brighton

Nutricia Paediatric Expert Meeting
w/c 8 November
Location TBC

14th International Congress of Inborn Errors of Metabolism (ICIEM)
21-23 November
Hybrid meeting

BAPEN Conference
30 November - 1 December
Brighton

Practical dietetic management **for when a young person is admitted to a general paediatric ward with a possible eating disorder**

Dr Graeme O'Connor Specialist Paediatric Intensive Care Dietitian at Great Ormond Street Hospital for Children

INTRODUCTION

Young people presenting to accident and emergency with malnutrition are at risk of medical and psychiatric complications. Invariably, the definitive diagnosis is unknown at this time. Among the eating disorders, anorexia nervosa (AN) carries the highest risk[1] and will require nutritional as well as psychological intervention.

The cause of medical complications can be due to both the amount and rapidity of weight loss, coupled with compensatory behaviours (vomiting, laxative abuse, diuretic abuse, diet tablets and compulsive exercise). Therefore, it is essential to have efficient and timely medical and psychiatric assessment and commence management without procrastination.

Diagnostic features of an eating disorder are[2]:

- Refusal to maintain body weight or failure to gain weight during a period of growth
- Intense fear of gaining weight
- Disturbed body perception
- Undue influence of body weight or shape on self-esteem
- Denial of seriousness of current low body weight
- Secondary amenorrhoea in girls post-menarche.

ADMISSION GUIDANCE

Junior MARSIPAN (management of severe inpatients with anorexia nervosa) provides a risk assessment framework in Guidance One regarding when to admit. Psychiatric or medical admission should be considered if any of the following criteria are met[3]:

- Dehydration and refusal to eat or drink: reduced urine output, dry mouth, decreased skin turgor, sunken eyes, tachypnoea, tachycardia
- Percentage median BMI <70% (approx. below 0.4th BMI centile)
- Rapid recent loss of weight of 1kg or more/week for 2 consecutive weeks
- Increased aggression resulting in either the patient and/or family being at risk of harm.

DEFINING MALNUTRITION

Weight and BMI can be used to track changes in the individual, but any comparison of weight against population norms needs to take account of height, gender and age. In adolescents, the World Health Organization recommended that the severity of wasting could be assessed by BMI for age in 10–18 year olds (<5th centile)[4,5]. More recently, a United Nations Administrative Committee on Coordination (Sub-Committee on Nutrition) report defined severe malnutrition in adolescents requiring therapeutic intervention as <70% weight for height or BMI, plus either bilateral pitting oedema (nutritional), inability to stand, or apparent dehydration. Several studies have shown that low mid-upper arm circumference (MUAC <115mm) and/or weight for height <70%, or weight for height Z-score ≤3 each predicts a high risk of mortality[7].

MEDICAL TEAM'S RELUCTANCE TO MANAGE ANOREXIA NERVOSA

The risk of death in 'acute' malnutrition is closely related to its severity, assessed anthropometrically. It is for this reason that severely malnourished patients should be treated as an inpatient. Sadly, this is often side-lined, as medical teams may be unable, or lack skills, to manage the behavioural issues that accompany the severe medical symptoms linked with anorexia nervosa, and patients are often discharged too early.

Behavioural indicators of an eating disorder include: denial of physical symptoms, resisting weighing and examination, covering the body, being secretive or evasive, having increased energy levels (and in some cases agitation), and getting angry or distressed when asked about eating problems.

Conversely, the young person may be overly compliant in a bid to be discharged, further complicating the assessment and management process.

DIAGNOSIS

When an eating disorder is identified and organic diseases (e.g. brain tumour and inflammatory bowel diseases) have been ruled out, direct challenge or confrontation is unlikely to be helpful at this acute stage.

Reasonable aims for the initial consultations:

- Feedback findings from physical examination, including degree of underweight with emphasise on the associated complications: bone health, anaemia and neurological development.
- Highlight the risks associated with refeeding (refeeding syndrome). Stipulate the importance of not overeating in a bid to get discharged.
- Establish weight monitoring, plus a plan to follow if weight falls.
- Discussion of a refeeding plan – this is non-negotiable. It is a fact delivery exercise, as opposed to collaboration with the patient.

NUTRITIONAL ASSESSMENT

Acquiring an accurate diet history from young people with an eating disorder has the added barrier of intentional over- and underestimation of intake; therefore, it is essential to have input from families. This can be an inflammatory consultation and may need to be performed without the young person. The nutritional assessment should expand on the history of food restriction and other self-imposed nutritional 'rules'.

Key questions to incorporate into the diet history[8]:

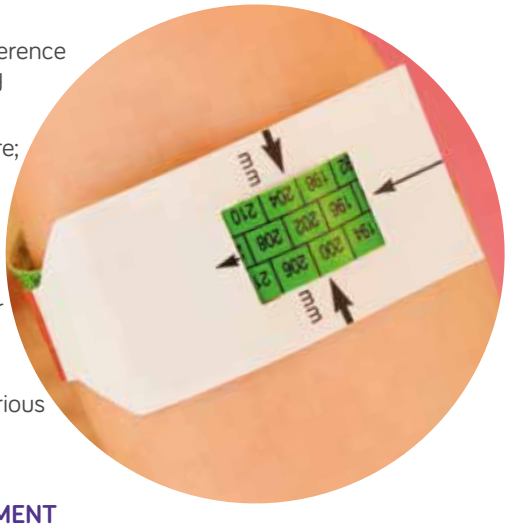
- You seem to have excluded fats/carbohydrates from your diet. Is there a reason for this?
- Have you been a vegetarian/vegan for long? What made you decide to change?
- Is there any reason why you do not eat after a certain time?
- Do you like the feeling of having an empty stomach? What do you do when you feel hungry?
- How many times a week do you miss a meal?
- If you miss a meal do you find it difficult to control the amount you eat at the next sitting?
- How often do you exercise a week? (Try to gain a sense of intensity and duration)
- When was the last time you ate out with friends/family?

NUTRITIONAL BLOODS

As part of the medical assessment, a detailed laboratory assessment should be performed to rule out any organic cause of weight loss and to obtain baseline biochemistry. Additional markers that should be monitored include vitamin B_{12}, folate, zinc, fat soluble vitamins A, D and E, and ferritin[3].

ANTHROPOMETRICS

As previously mentioned, weight and BMI can be used to track changes in an individual, but any comparison of weight against population norms needs to take account of height, gender and age. It is perfectly correct to use BMI centile charts and to report BMI centile in young people. However, for patients below the 0.4th BMI centile, there is a need to quantify the degree of underweight. Using %BMI (BMI/median BMI for age and gender) instantly provides information about a patient's nutritional status without the need to refer to a chart[3].



Mid upper arm circumference (MUAC) is a simple and effective additional anthropometric measure; its use can eliminate some of the methods employed by young people to mislead practitioners about their true weight, such as water loading and attaching weights to various parts of the body[9].

REFEEDING MANAGEMENT

If after a careful clinical history, examination and initial investigations, there is no obvious underlying physical illness other than malnutrition, then it is important not to delay refeeding.

Although infrequent, and rarely critical, refeeding syndrome is a serious potential complication of commencing feeding in young people who have experienced starvation and should be considered and monitored in such patients[10,11]. Refeeding syndrome is a physiological phenomenon driven by insulin, resulting in deranged biochemistry which leads to cardiovascular abnormalities[12]. As glycogen stores are depleted, gluconeogenesis is activated, utilising lipids and proteins as metabolic substrates to form glucose. However, gluconeogenesis has a limited capacity to support the body's energy requirements. Therefore, during this period of low serum insulin, hormone sensitive lipase is activated, which breaks down adipose tissue to form fatty acids and glycerol; the fatty acids are transported to the liver to be converted to ketones. Ketones now replace glucose as the body's major energy source during acute starvation[13].

At risk groups

Those most at risk of refeeding syndrome:

- very low body weight (in particular those <70-80% weight for height/median BMI)[14]
- acute starvation with rapid weight loss prior to commencement of nutrition
- previous history of refeeding syndrome
- electrolyte abnormalities prior to starting feeds
- low white blood cell count[14].

Commencing nutrition

The refeeding of malnourished patients needs to be closely monitored and must increase in controlled phases in order to avoid further weight loss (underfeeding syndrome). A worked example of a phased refeeding regimen is given in **Table 1**.

Oral thiamine (100-200mg/day) and a B vitamin complex should be administered during refeeding to ensure adequate metabolism of ingested carbohydrates. Supplementation should be continued until the meal plan is meeting the young person's micronutrients requirements. However, in practice, B vitamin supplementation usually occurs for 10 days[15].

Please refer to Junior MARSIPAN Guidelines[3] for details on electrolyte supplementation.

Table 1. Worked example of a phased refeeding regimen. 14-year-old girl with anorexia nervosa, weight = 30 kg.

Day (refeeding phase)	Target energy requirements and weight gain
Day 1 and 2 (primary phase)	It has not been possible to elicit an accurate reliable diet history **Start a meal plan:** at 40 kcal (165 kJ)/kg = 1200 kcal (4950 kJ)/day **Now calculate the secondary phase energy intake target:** BMR x 1.2 PAL (restricted to ward) [(17.686 x 30 kg) + 692.6] x 1.2 PAL = 1468 kcal (6140 kJ)/day
Day 3 and 4 (secondary phase energy intake target)	Increase meal plan by 200 kcal (820 kJ)/day until secondary phase requirements met = 1468 kcal (6140 kJ)/day Weight should increase as a result of hydration and glycogen store replenishment **Now calculate the tertiary phase energy intake target:** EAR for energy = 2342 kcal (9836 kJ)
Day 7 (tertiary phase energy intake target)	Increase meal plan by 200 kcal (820 kJ)/day until tertiary phase energy requirements met Halt energy increments and monitor weight gain From this point weight gain target: 0.6-1.0 kg/week (0.1 kg/day). If weight gain is <0.6 kg/week, increase meal plan by 300 kcal (1255 kJ) = 2650 kcal (11.07 MJ)/day
Progression	If sufficient weight gain is not achieved, continue to increase energy intake by 300 kcal (1255 kJ) every four days until weight gain target of 0.6-1.0 kg/week (0.1 kg/day) is achieved. Be mindful of compensatory behaviours (secret exercising/purging) if exceeding 3000 kcal (12.54 MJ)/ day whilst bed/ward bound

EAR, estimated average requirement for energy. PAL, physical activity level

MEAL PLANNING AND SUPERVISION

Once refeeding energy requirements have been calculated, it is advisable to link with catering to ascertain the ward menu for the next few days so a practical ward based meal plan can be devised, incorporating appropriate portions to correlate with energy requirements.

Invariably, the young person will find it too difficult to choose from the menu and it will need to be completed by the dietitian with the family, who can verify true food dislikes. This process of finalising the meal plan can be time-consuming, but it is essential the meal plan is watertight to minimise manipulation.

Meals and snacks should be provided under supervision, ideally by someone who can demonstrate empathy and understanding while setting firm boundaries about what is expected, e.g. how much is to be consumed in a set period of time. Time limits for eating, e.g. 15 minutes per snack and 30 minutes per meal, all need to be agreed. Support and supervision are recommended for one hour after each meal and have been shown to reduce the need for nasogastric feeding[15].

NASOGASTRIC TUBE FEEDING AND ORAL NUTRITIONAL SUPPORT (ONS)

Any actions to be taken if food is not eaten need to be agreed and documented in advance, e.g. volume of sip feed to be given instead of the incomplete meal. Individual circumstances will help to dictate the exact needs of the young person and any support that may be needed with respect to helping them eat the required amount of food:

- Nasogastric tube insertion should be considered if 80% of daily energy requirement is not met orally with food and/ or oral nutritional supplements (ONS)
- Bolus nasogastric tube feeds are preferable to continuous as they closely mimic normal physiology and reduce the individual's preoccupation with energy. However, continuous feeds may be considered in those with hypoglycaemia, upper gastrointestinal symptoms or malabsorption.
- Suitable enteral feeds include Tentrini 1kcal/ml and Paediasure 1kcal/ml.
- High energy feeds are a useful resource as they can significantly reduce volume and time (Fortisip Compact 2.4kcal/ ml; TwoCal HN).
- ONS can also help to meet the high energy requirements of pubertal adolescents.
- Avoid exclusive enteral nutrition from nasogastric tube feeding or ONS – ensure some degree of food or fluid intake is maintained.

FAMILY THERAPY

The process of referral to Child and Adolescent Mental Health Services (CAMHS) is essential once a diagnosis of an eating disorder is confirmed. Although inpatient treatments are generally effective for weight restoration of patients with AN, they are disruptive to family, social and educational life.

Therefore, intensive outpatient treatment using an evidence-based treatment approach should be sought by preference if the risks are manageable. Family based treatment can be summarised as an intensive outpatient treatment where parents play an active and positive role in promoting recovery in their adolescent child with AN. It has the strongest evidence base of available therapies. Parents are seen as a resource and play an active role in treatment, using their own methods to restore their malnourished adolescent's weight[16].

SUMMARY POINTS

- Anthropometric measurements to be taken including %BMI and MUAC.
- Request baseline nutritional bloods.
- A detailed nutritional history interspersed with questions pertaining to disordered eating.
- Devise a meal plan that aligns with refeeding energy requirements. ONS is a perfectly acceptable component to the meal plan (Fortisip Compact 2.4kcal/ ml; TwoCal HN).
- Nasogastric tube feeding should not be used as a treat but enforced when the meal plan is not being achieved.
- Avoid challenging anorexic cognitions or dietary rules at this acute stage. These will be addressed once under a specialist eating disorder dietitian and CAMHS team.
- Refeeding should be commenced at 40kcal/kg/day (or Basal Metabolic Rate) and increased daily by 200kcal until you achieve the Estimated Average Requirements.
- Give thiamin (100ml bd) and a B vitamin complex whilst establishing full nutrition.
- Ensure refeeding biochemistry is monitored throughout the refeeding process, correcting abnormalities as they arise (Junior MARSIPAN Guidelines).
- Team communication is paramount and it is essential to clearly document and discuss plans with the immediate medical team to avoid splitting. Be mindful of the manipulative nature of the disease but ensure to separate the patient from AN.
- Refer to CAMHS.

FOR A FULL REFERENCE LIST, PLEASE SEE **PAGE 31**

CPD Consideration Points

1 Identify what and when specific nutritional bloods should be monitored.

2 Identify an understanding of the common biochemical abnormalities seen in ED. For example: water loading; anaemia and purging behaviours.

3 Able to assess nutritional intake and risk factors to make a rational clinical decision to use supplements.

4 The dietitian should be able to choose the appropriate ONS for the patient and advise on use.

5 What are the risk factors for refeeding syndrome and how would you calculate estimated requirements?


The use of Nutrini Peptisorb in a **Paediatric Cardiology Intensive Care Unit**

Joanne Pena, Lead Paediatric Dietitian, **Andrea Moreno**, Specialist Paediatric Dietitian, The Great North Children's Hospital

THE PATIENT

A 19-month-old girl , patient Z, admitted to PICU with chronic heart failure, an acute decompensation, intestinal and hepatic impairment, poor left ventricular function and faltering growth.

DIET AND GROWTH HISTORY

Z was born at 37 weeks gestation on the 9th-25th centile for weight (birth weight: 2.92kg). During the first 15 months Z tracked nicely along the 9th centile for both weight and height. During the following 5 months, as heart failure symptoms increased, Z's weight centile dropped significantly to the 0.4th centile (**Table 1**).

Z was breast fed from birth and a complementary weaning diet was introduced at around 6 months of age. From 13 months, Z started developing heart failure symptoms, which had an impact on ability to feed orally. Therefore, food intake was reduced and Z tired more easily during breast feeds. Z's nutritional requirements at this point were calculated as: EAR= 80kcal/kg/d + 30% due to cardiac failure = 104kcal/kg/d, protein requirements 2-3g/kg/d.

Due to this, a high energy infant feed (1kcal/ml) was introduced for daytime feeds, and Z continued with up to 4 breast feeds per day and managed small amounts of complementary feeding. A daily paediatric multivitamin and mineral supplement was introduced.

Gradually, Z's oral intake decreased, and a nasogastric feeding tube was inserted when around 15 months old to provide top up feeds. This remained in-situ until admission at 19 months old.

PICU ADMISSION

Z remained on high inotrope support and was ventilated over several weeks. For the first few weeks Z required parenteral nutrition (PN), and Z's requirements were calculated as BMR + 30% = 75kcal/kg/d, protein requirements 2-3g/kg/d. Z was unable to tolerate enteral feeds and was deemed to be at risk of bowel ischaemia, due to poor cardiovascular function, high lactate levels and high inotrope support. Trophic feeds with EBM were provided to maintain gut integrity. During this period weight gain was achieved as nutritional requirements were being met by PN (**Table 1**).

Unsuccessful attempts to increase enteral feed volume followed but retching and vomiting episodes prevented any significant increase in volume. The feed was changed to a peptide-based feed, Nutrini Peptisorb (1kcal/ml, extensively hydrolysed, 50% MCT feed), which was better tolerated. However, full feed volume was not met due to vomiting episodes. Some weight loss was observed in this period (**Table 1**).

Z's nutritional requirements for enteral feeds at this point were calculated as: EAR = 81 kcal/kg/d + 30% due to cardiac failure = 103kcal/kg/d, protein requirements 2-3g/kg/d.

A decision to try post-pyloric feeding was made and a nasojejunal feeding tube was inserted. The feed, Nutrini Peptisorb, was successfully increased to the target volume (120ml/kg/d) and PN fully discontinued. Z's weight at this point was 7.9kg (0.4th–2nd centile, **Table 1**). Z continued tolerating Nutrini Peptisorb for several weeks and a weight gain, to 9kg (25th centile) was achieved (**Table 1**).

Table 1. Patient Z anthropometry and feeding regime

Age	Weight	Length	Phase
Birth	2.92kg (9th-25th centile)	Not available	
11 months	7.84kg (9th centile)		Start supplementing with high energy formula
15 months	7.9kg (2nd-9th centile)	72cm (9th centile)	Start NG feeding
19 months	7.61kg (0.4th centile)	78cm (9th centile)	PICU admission - start of PN
20 months	8.7kg (2nd-9th centile)		Reduction of PN and commencement of NG feeds of Nutrini Peptisorb (fluid restriction to 90ml/kg)
20 months	7.9kg (0.4th centile)	80cm (9th-25th centile)	Start of NJ feeding due to vomiting, exclusive Nutrini Peptisorb (fluid allowance 120ml/kg)
21 months	9kg (9th centile)		Good weight gain, however, fluid allowance reduced to 90ml/kg due to deterioration
22 months	8.5kg (2nd centile)		Introduction of Nutrini Peptisorb Energy (50:50 mix) with Nutrini Peptisorb
23 months	9.9kg (9th-25th centile)		Good weight gain, continues on previous mix
24 months	10.79kg (25th centile)		Further weight gain, re-started Nutrini Peptisorb exclusively
25 months	11.3kg (50th centile)		Continues gaining weight on 90ml/kg of Nutrini Peptisorb

Due to changes in Z's medical condition, fluid allowance was reduced which led to a reduction in feed volume (90ml/kg/d). Hence, Z was no longer meeting nutritional requirements and weight loss was again observed, reducing to 8.5kg (**Table 1**).

Nutrini Peptisorb Energy was then introduced and Z's feeding regime was changed to ½ Nutrini Peptisorb and ½ Nutrini Peptisorb Energy (1.5kcal/ml, extensively hydrolysed, 50% MCT feed), averaging 1.25kcal/ml. The addition of the high energy feed meant Z could meet requirements in a smaller feed volume, whilst continuing to tolerate it. This feed provided Z with 112kcal/kg/d, 95ml/kg/d and 2.8g/kg/d of protein, meeting calculated requirements.

Patient Z remained on this feed for 2 months, thriving and increasing weight up to 10.79kg (25th centile, **Table 1**).

CURRENT FEEDING REGIME

As Z was gaining weight rapidly, her feed was returned to Nutrini Peptisorb exclusively, and volumes were optimised for weight. Z is currently on Nutrini Peptisorb @ 50 ml/h x 20h. Providing: 90kcal/kg/d, 90ml/kg/d, 2.5g/kg/d of protein, meeting above Z's calculated requirements.

DISCUSSION

This case illustrates that Nutrini Peptisorb and Nutrini Peptisorb Energy are well tolerated in a cardiothoracic paediatric intensive care unit.

Paediatric patients with heart failure may have poor feed tolerance, which can lead to difficulties achieving target feed volumes and optimal nutrition. From the experience in our unit, peptide-based feeds are often better tolerated in this complex patient group; as proven by this case study, where Nutrini Peptisorb and Nutrini Peptisorb Energy were well tolerated.

Heart failure and other cardiac conditions can lead to significant increases in energy requirements which can be difficult to meet. In this case study, the use of some Nutrini Peptisorb Energy helped to meet energy requirements when the fluid allowance was significantly decreased.

As Z becomes more stable, we aim to reintroduce gastric feeds gradually. Z will remain on a peptide-based feed throughout her PICU admission.

The spectrum of **picky eating in children**

Chris Smith Senior Paediatric Dietitian - Clinical Lead at Royal Alexandra Hospital for Children, Brighton

INTRODUCTION

"My child is a picky eater..." Data suggest health professionals working with children from across the globe hear this phrase on a regular basis[1]. As dietitians, our response may vary from exasperated sighs to nods of mutual understanding, but there is little doubt this situation is stressful and concerning for the families involved. Picky eating (PE) in children appears indiscriminate, impacting both sexes, across wide age categories and in otherwise healthy children, as well as in many disease specialities. As it seems likely most children will at some point either be perceived to have issues, or legitimately meet various criteria, it's appropriate that paediatric health professionals are armed with a broad understanding of the current evidence base.

Whilst some families may perceive PE as being of immediate and considerable concern, as health professionals we need to objectively assess the situation and, where appropriate, offer support, reassurance and evidence-based advice and interventions that best suit that individual.

This article aims to provide an overview of the literature whilst also signposting to relevant studies and providing practical management advice.

THE LITERATURE

The scientific data in this field are quite limited and very much in its infancy, mostly having been published in the last 20 years. Prior to this, PE likely still occurred but the scientific community paid little attention to it. The last 10 years has seen a clear acceleration in publications and, whilst this is useful, some fundamental limitations exist to this narrow literature base.

In stark contrast to the scientific data, there is a plethora of books, YouTube videos and social media articles widely available to the general public. This certainly suggests that most advice or information in the public sector is based mainly on experience and opinion rather than science.

DEFINITION

There is a large amount of confusion and inconsistency in defining PE. In recent decades many groups have proposed various definitions[2]; some firmly based in research and others designed for more practical use. Unfortunately, different definitions have led to confusion and terms are used interchangeably, such as picky, fussy, selective and faddy eating. Many argue it is best, therefore, to think of PE as an umbrella term with characteristics that include unwillingness to eat familiar foods or try new ones, rather than a diagnostic or clinical category. It may also be useful to consider that PE is on a spectrum with a more common "mild" form at one end and a rarer "severe" form at the other. The extreme forms of PE, such as avoidant/restrictive food intake disorder (ARFID), which can lead to somatic and/or psychosocial dysfunction[3], are not covered in this article.

KEY POINT
A universally agreed definition for PE does not exist.

PREVALENCE

The lack of a universal definition makes it difficult to assess or compare prevalence data, as concluded by groups looking at global prevalence[2]. This partly explains the wide range in prevalence reported, being between 5% to 59% of children. Data continue to be added, including reports of PE from previously unreported geographical areas such as the developing world. Three key points stand out when interpreting global prevalence data:

1. Huge ranges can be seen, not just between countries but within countries due to differing methodologies.
2. Different age ranges are used within the different criteria, so concluding peak prevalence and trajectories is difficult. Additionally, data are predominantly cross-sectional rather than longitudinal, but most studies suggest peak prevalence occurs around age 3-4 years[2].
3. PE is an international issue with new data highlighting occurrence in both developed and developing countries.

KEY POINT
PE appears to be a global issue with prevalence data ranging from 5-59%.

CAUSES

The causes of PE have been investigated by several groups[1,7]. Broadly speaking, they can be split into three categories, those related to:

1. the child
2. the care giver or parent
3. the childcare giver/parent interaction

Data from the Gemini twin birth cohort suggest there is a significant genetic influence on food fussiness (FF) and food neophobia (FN) during early life: FF heritability was 46% and FN was 58%[8]. However, a child who inherits "fussy" genes will not necessarily become a fussy toddler, with upbringing and experiences having a roughly equal impact on their eating habits. Genetic influence is relatively new and experiences and environment have been more widely investigated. Several recent large longitudinal studies are helping us to better understand causes. For example, data collected prospectively from 6000 children in the Avon Longitudinal Study of Parents and Children (ALSPAC), highlighted that the late introduction of lumpy foods (>9 months) was associated with increased likelihood of the child being very picky, and feeding ready-prepared food was predictive of PE behaviours[9]. Other considerations from the literature are highlighted in **Table 1** below.

Table 1. Causes of picky eating

FACTORS RELATED TO THE CHILD
- Reduced duration of breastfeeding (prevalence data in breast compared with bottle fed infants are inconsistent) - Late introduction of solids - Late or poor texture development - Child emotionality/temperament and sensory sensitivity - Genetics
FACTORS RELATED TO THE PARENT/CAREGIVER
- Maternal eating habits - healthy eating has been associated with lower prevalence - Pressure to eat - Anxiety and depression during pregnancy[10] - Parenting style
FACTORS RELATED TO CHILD/PARENT INTERACTION
- Poor/inappropriate feeding styles, e.g. force feeding arising from misperceptions of appropriate portions - Misperceived nutritional status - Neglect/social issues - Environmental factors

Many of these however are interrelated. This concept is supported by, and was the focus of, a group who undertook a systematic review of qualitative work in 2019 which illustrates the interconnected aspects of aetiology[7].

KEY POINT
The causes of picky eating are multifactorial, multidimensional and interrelated.

CONSEQUENCES

The overall consequences of mild to moderate PE are not well understood because of the major inconsistencies in the studies. However, three main areas of concern have emerged in the literature: growth, nutrients and behaviour.

Consequences for growth

The clinical impact of PE on the growth of children is still controversial and the literature is variable. Some show higher caloric intake in PE (hypothesised to be related to increased intake of higher calorie density preference foods (e.g. sugar and fat) some with isocaloric comparison, and some demonstrate lower caloric intakes[11]. To try to understand the impact of this, a systemic review looked at growth as the ultimate outcome of caloric intake. 17 studies showed no association of PE with weight, 11 found a negative association with BMI or BMI Z score, there were 6 with a positive association with underweight, 5 with negative association with overweight and 2 with a positive association with overweight[11]. Therefore, it appears that PE can have a multidirectional impact on weight status.

It is worth noting that the majority of studies on growth in PE are cross-sectional, making interpretation difficult, and there are very limited true longitudinal studies. One of the largest and most robust studies on longitudinal growth, published in 2019 by ALSPAC, concluded that mean heights, weights and BMIs of the “very PE” children were consistently above the 50th centiles of UK reference growth charts, suggesting there is no great need for concern regarding growth[12].

Several studies have used weight-for-age as a descriptor. Whilst BMI data would certainly be better, its limitations as a blunt marker of nutritional status are recognised. Body composition is emerging as a more robust, three-dimensional marker and its use in PE is increasing but the data in this area are currently limited to two studies[12,13].

Historically, undernutrition was the main concern with PE but overnutrition is now increasingly coming into focus. Teasing out the impact of PE on being overweight or obese, or the risk of developing these conditions, is difficult due to the huge number of influencing factors. However, obese or overweight status in PE does not necessarily result in nutritional adequacy and this is a key message for both families and health professionals.

Consequences for nutrient status

Studies suggest certain intakes of food groups are lower in PE, namely fruits, vegetables and meat. Macro- and micronutrient intakes were summarised in a review paper from 2018[14] and most researchers agree there is generally not a significant impact of PE on macronutrient intake. However, studies from the UK and China[15,16] found a tendency for lower protein intakes, although still within acceptable ranges. Additionally, fibre intakes may be lower, with one specific study identifying increased constipation as a possible consequence[17].

Several studies have shown key micronutrients to be lower in PE children, including iron and zinc. This is of particular importance as these two nutrients have key roles in brain development, the rate of which exceeds body weight growth between the ages of 2-6 years, during the time PE commonly peaks. Iron is involved in the structural development of the brain and myelination, contributing to cognitive development, whilst zinc as a neurosecretory factor. However, the majority of research into nutrient status is not of high quality and has received considerable criticism[18].

Consequences for behaviour

The link between eating disorders (anorexia and overeating) in children and adolescents and these behaviors in adulthood is documented. However, there is little data on the association between PE in pre-school children and the development of behavioural issues in later life. Two recent studies have investigated a wide range of social and activity based behaviour developments in PE children. Groups from Taiwan and Iraq looked at physical impact and showed poorer levels of certain physical activities were more common in PE compared to non-PE[4,6]. In addition, both showed some suggestion that some aspects of learning development were poorer in the PE groups. These recently investigated aspects may provide some interesting context as more work is added. Again, drawing conclusions is hampered by inconsistent methodologies, inclusions and definitions.

KEY POINT

Obese or overweight status does not mean the diet is nutritionally adequate. However, evidence on the health consequences of PE appears to be generally reassuring but limitations in the data curb firmer conclusions.

PRINCIPLES OF MANAGEMENT

Whilst most descriptive and outcome data is very reassuring about PE, addressing parental concern is important. Giving superficial reassurance will leave families feeling unsatisfied and their concerns will remain. Therefore, a systematic approach to assessing the child is important to ensure that parents feel that we have acknowledged their concerns and to satisfy ourselves that there is no concerning clinical picture.

This should be done remembering three broad generic aims in this group:

1. To support appropriate growth and weight gain.
2. To improve eating patterns or behaviours to ensure the diet is adequate.
3. To provide reassurance where possible.

Assessment

Assessment should take the basis of the common ABCD approach investigation (Anthropometry, Biochemistry, Clinical and Dietary). Anthropometry measurements are essential and the importance of this was highlighted in a recent large study from China, where nearly a quarter of the PE children were reported by caregivers to be underweight[19]. However, when they were objectively assessed, the actual number of underweight children was less than 2%. This adds to previous evidence highlighting that parents of PE commonly perceive their children to be underweight and that a healthcare professional simply 'eye balling' the child is also highly inaccurate[20]. In the current Covid climate, taking anthropometric measurements may be more of a challenge but the importance of assessment remains the same.

Whilst PE alone is not a condition that would warrant biochemical investigation, if growth failure exists it can be considered. Biochemical markers are useful to identify any organic underlying issues and may highlight specific nutrients associated with PE behaviours, namely iron, zinc and vitamin D. The ESPGHAN position statement on assessment and interpretation of vitamins and trace elements provides a comprehensive tool for how these should be broadly assessed and interpreted[21] (see page 3).

The clinical situation should be assessed, and it is useful to consider the red flags highlighted in a recent publication[22].

RED FLAGS[22]

- Dysphagia
- Aspiration
- Apparent pain with feeding
- Vomiting and diarrhoea
- Developmental delay
- Chronic cardio-respiratory symptoms
- Growth failure
- Frank nutrient deficiencies
- Force feeding

1. Assessment of dietary Intake

Broadly speaking, dietary intake in all children can be assessed in three ways: food frequency questionnaires, food diaries and 24hr recall. However, they all have limitations in both research and clinical practice:

- reliance on memory is indisputably poor
- the use of protocols is known to induce false memory
- they cannot be independently verified.

Several questionnaires have recently been developed, such as the Finnish Children Healthy Eating Index (FCHEI)[23] and the Chinese Children Dietary Index[24]. Whilst both are robustly designed and developed, it must be remembered they were intended to assess overall diet quality among children in their respective countries and extrapolation to UK children will have limitations.

Regardless of how you assess dietary intake, a key principle to remember is that we need to assess not only what the child eats but also how they eat.

2. Assessment of dietary behaviours

A single question may not be sufficient to delineate between parental perception of PE and true PE, or to identify what contributing factors are at work. Therefore, tools that incorporate a broader range of situations or factors are likely to be more useful and may be more sensitive in identifying true PE and guiding future management.

Several validated tools to assess eating behaviours are available. The most commonly used in the PE literature is the Child Eating Behaviour Questionnaire (CEBQ)[25] but others, such as the Behavioural Paediatric Feeding Assessment Scale (BPFAS), have also been used widely across several groups[26-28]. As parents' perception of their child's eating behaviour has been identified as often inaccurate[29], filming 'at home mealtimes' can yield a huge array of information, although reviewing these may take time. It is also important to remember, as with any human behaviour, that it is highly complex and organic.

As well as understanding how the child eats, assessing the parents' style of feeding can be very useful too. Broadly, there are four main parenting styles when it comes to feeding that may play a role in the evolution of PE: responsive, controlling, indulgent and neglectful[30]. One of the quickest and crudest methods to classify parenting style is to ask "what do you do if your child won't eat?". It is likely that a responsive style parent or carer will wait for next meal, a controlling style will force, an indulgent will beg the child and prepare multiple different meals, and a neglectful parent will be vague. The data suggest the controlling parent style may be associated with the highest risk of impact on growth and, theoretically, be the least effective style at improving eating behaviours. Steering families towards a more responsive style to prevent PE is advised.

PRINCIPLES OF MANAGEMENT

Addressing behaviours

There are evidence-based interventions shown to help PE children make progress and widen their intakes. Some of these have become clearer as we have learnt more about how children learn about food. One of the largest PE studies, alongside a recent systematic review[31], generally conclude that modelling is perhaps one of the most influential strategies. The benefit of modelling was first identified about 45 years ago[32] and the evidence has grown since. A recent study[33] observed the most success when the parent was present and eating exactly the same food as the child; the food was more likely to be tried, more of it eaten and with less delay. Whilst this information is very practical in helping children increase their repertoire of difficult food groups, like vegetables, a fundamental problem remains, which is the poor intake of vegetables in most adults' diets (recent data from 28 countries suggests 40% of adults only eat one vegetable a day)[34].

Other recognised strategies to improve acceptance of foods include frequent exposure to new foods, subtle encouragement, familiarising children with foods through touch and play, and responsive feeding[9]. Education, including visual illustration of 'normal' intakes and portion sizes, can be very helpful in parents where perception of intake may be skewed. Data published in 2021 can be a very useful resource for this[35]. As feeding difficulties like PE take time to resolve and can be multifactorial, such strategies may be best implemented in progressive phases.

In summary, four key strategies should be considered:

- **Role modelling of food choices.**
- **Providing repeated exposure to a variety of foods.**
- **Offering age-appropriate textures/portion sizes.**
- **Practicing responsive feeding and using appropriate feeding techniques.**

Whilst most of these strategies are relatively simple, it does not mean they are easy to implement in practice. Families need to be supported to worry *less* about the possible nutritional intake so they can concentrate *more* on behaviour modification. This can be partially achieved by removing or minimising parents' or carers' sense of responsibility for weight gain or intake and is where the second part of an approach, a nutritional intervention or supplementation, may help.

Addressing nutritional deficits

The age range where PE most commonly occurs corresponds with significant growth and development. The importance of optimal intake of micro- and macronutrients during this time is increasingly being recognised. As dietitians, we prefer to use real foods to achieve requirements. This should still be our preference in PE but, realistically, establishing new foods quickly and consistently in the diet to fill an identified nutrient hole is unlikely to be successful. This remains our ultimate goal, but it will take time and other approaches may be needed more urgently.

The choice of oral nutritional supplement (ONS) should start with identifying the requirement - is it one nutrient or multiple nutrients that need addressing, is there a macronutrient imbalance, is fibre low, or are additional calories required? This will affect our choice of either complete ONS, single or multiple vitamin supplements.

The data on dietary interventions in PE is limited. A randomised controlled intervention trial in 92 children from Taiwan and Philippines with PE and low weight for height found improved growth parameters in those receiving ONS with counselling compared to those with counselling only[36]. Importantly, this study found that serum iron and zinc levels were also improved in the study group, although they were not statistically significant. Another more recent study in China found that the addition of a ONS to nutritional counselling resulted in better growth recovery[37]. Encouragingly, both found the liquid nutrition was readily accepted and well tolerated, which is important in this context. Most recently, a UK industry neutral group also reported some additional benefit[38].

CONCLUSION

PE is inconsistently and unclearly defined in the literature. However, work in this area is increasing around the world, suggesting it is a global issue. The limited data we have appear to suggest significant negative impact is rare over the long term.

Different opinions exist on optimal management but there is agreement that a systematic assessment is the cornerstone, allowing reassurance or intervention as indicated.

FOR A FULL REFERENCE LIST, PLEASE SEE **PAGE 32**

Use of Cow & Gate Nutriprem Protein Supplement **in a preterm infant**

Rachel Pountney Neonatal & Paediatric Dietitian

THE PATIENT

X is a preterm male infant born at 27+2 weeks gestation with a birth weight of 1.12kg (50th centile) and OFC of 25.8cm (50th centile). X was diagnosed with respiratory distress syndrome, patent ductus arteriosus, hyperglycaemia requiring insulin therapy, hypertriglyceridaemia treated with parenteral fat restriction, and necrotising enterocolitis (NEC) managed conservatively.

FEEDING MANAGEMENT

Nutritional requirements were calculated using ESPGHAN[1] recommendations of 110-135kcals/kg/day and 3.5-4.0g/kg/day protein, as birth weight was >1kg. Once X was over 1.8kg, requirements were considered to be transitioning towards term requirements, based on SACN[2], of 96-120kcals/kg/day and 2.6g/kg/day protein.

Parenteral nutrition (PN) was commenced on day 0 of life with trophic enteral feeds introduced on day 1. Hypertriglyceridaemia resulted in the lipid portion of the PN being limited. The aim was to increment enteral feeds at 30ml/kg/day until full feeds of 150ml/kg/day expressed breast milk (EBM) were achieved. Unfortunately, enteral feeds were frequently stopped due to large green bilious aspirates, abdominal distension, increasing oxygen requirements and significant apnoeas, resulting in delayed achievement of enteral feeds.

On day 17, enteral feeds had reached 120ml/kg/day EBM. However, due to longline sepsis, PN was discontinued earlier than anticipated, compromising nutritional intake. Full enteral feeds of 165ml/kg/day EBM were achieved on day 22 and breast milk fortifier (BMF) commenced. On day 24, feeds were incremented to 180ml/kg/day fortified EBM, aiming to replenish protein deficits incurred in the first 3 weeks of life.

X was treated conservatively for NEC on day 31, giving PN as the sole source of nutrition. Post NEC, feed intolerance persisted but PN continued to supplement enteral feeds to ensure nutritional requirements were met. Once enteral feeds were tolerated at 150ml/kg/day EBM, PN was discontinued.

Despite lack of evidence linking BMF with NEC[3], fortifier was not reintroduced due to the possibility of further feed intolerance. This resulted in poor nutrition and concerns regarding neurological outcomes. Poor weight gain was observed, and urea levels decreased to 0.8mg/dL further indicating inadequate nutrition. To improve nutritional intake, feeds were increased on day 56 to 165ml/kg/day EBM, however, the additional protein provided was minimal.

Despite her desire to establish breastfeeding, X's mother was considering introducing some formula to improve protein intakes and weight gain. Evidence supports both the benefits of EBM for preterm infants, and the increased risk of NEC with formula introduction[4]. It was agreed as a multidisciplinary team to trial Nutriprem Protein Supplement to optimise protein status and overall growth, as breast milk alone was unlikely to meet X's requirements[3]. It was commencing Nutriprem Protein Supplement that gave X's mother the confidence to continue establishing breastfeeding. Feeds and nutritional intake are summarised in **Table 1**.

Table 1. Feeds and nutritional intake

Day	Feeds	Kcals/kg/day	Protein/kg/day
17	120ml/kg/day preterm EBM	79	1.8
22	165ml/kg/day EBM + Cow & Gate BMF	135	4.1
24	180ml/kg/day EBM + Cow & Gate BMF	147	4.5
47	150ml/kg/day EBM	99	1.9
56	165ml/kg/day EBM	108	2.1
64	165ml/kg/day EBM + Cow & Gate Nutriprem Protein Supplement	115	3.5

ANTHROPOMETRY

Weight and OFC at birth plotted on the 50th centile. Weight gain was established on the 9th centile from 2 weeks of life. Signs of malnutrition were observed at day 47; weight gain velocity slowed and faltered to the 2nd centile over a period of 2 weeks. No change in OFC was observed, indicating moderate rather than severe malnutrition.

BIOCHEMISTRY

Urea was used as a marker of protein status from week 3 of life as it has been deemed a more practical approach to monitoring protein status when analysis of mother's breast milk is not feasible[5]. The addition of Nutriprem Protein Supplement on day 64 led to the improvement in blood urea levels (**Table 2**).

Table 2. Biochemistry from day 21 to 91

Day	21	28	33	40	47	51	56	70	77	91
Urea mg/dL	1.6	1.8	3.3	1.3	1.1	0.8	0.8	1.0	1.3	1.8

DISCUSSION

Meeting nutritional requirements, particularly for protein, had been challenging from birth due to metabolic imbalance and restricted calorie provision from PN. Protein was not utilised for growth and tissue generation and significant protein deficits accrued[6]. Suboptimal protein intake has a detrimental impact on neurological outcomes as well as growth[7].

Increasing enteral feed volumes was considered as a treatment option, but was less desirable due to the high volumes needed to provide adequate protein.

Additionally, preterm infants are at risk of gastro-oesophageal reflux disease (GORD) and, with the ongoing feed intolerance, it was felt high volumes could worsen symptoms, particularly desaturations and apnoeas[9].

Nutriprem Protein Supplement was added to feeds following reluctance to reintroduce BMF, as protein was the most desirable nutrient to improve growth. Mononutrient protein fortification has been shown to improve growth in preterm infants[8].

Unlike BMF, Nutriprem Protein Supplement does not contain additional key micronutrients needed by a preterm infant, risking deficiency[8]. X was supplemented with additional vitamin A and D, phosphate and iron, and bloods were closely monitored for adequacy. Intakes were calculated to range between term and preterm requirements and deemed appropriate through close monitoring in view of X's gestational age. Additional monitoring and subsequent supplementation would be desirable, including zinc, iodine, calcium and magnesium as needed. While evidence suggests that preterm infants exclusively breast fed achieve adequate catch-up growth at 2 years, it is clear that both under- and over-feeding should be avoided during this period[10]. Given the lack of clarity regarding optimum nutritional intake post-discharge, an individualised approach was adopted. Additional supplementation may not have been necessary post-discharge[11]; however, X was supplied with Nutriprem Protein Supplement short term (based on low blood urea at discharge), as arguably discontinuation may have been detrimental.

SUMMARY

Cow & Gate Nutriprem Protein Supplement was used, in place of BMF, to increase protein intake in a preterm infant with a history of feed intolerance and NEC with the following positive outcomes:

- Improved urea from 0.8mg/dL to 1.8mg/dL
- Improved weight gain from 2nd to 9th centile
- Maternal confidence maintained to establish breast feeding and avoid formula introduction.

FOR A FULL REFERENCE LIST, PLEASE SEE **PAGE 33**

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21-001. January 2021

Up$_2$ Date ...

ARTICLE SUMMARIES:

Nutrition during childhood cancer treatment: current understanding and a path for future research

Joffe L, Ladas EJ.

Lancet Child Adolesc Health 2020;**4**(6):465-75.

This comprehensive review describes the latest understanding of the role of nutritional status in paediatric cancer care. It covers the metabolic effects of cancer and cancer therapy and the influence of nutritional status on cancer outcomes, recognising that children with cancer are at high risk of undernutrition and overnutrition in both the short- and long-term. The importance of nutritional assessment throughout treatment and into survivorship is highlighted and nutritional interventions are considered in order to promote normal growth and development.

A detailed examination of future directions for research and clinical practice covers the influence of genomics and metabolomics and how biomarkers may enable a more individualised approach to nutritional management. The potential role of the microbiome in infection risk and treatment-related effects in cancer patients are also considered, as well as in the development of cancer.

Further research is needed to understand the underlying pathophysiology of malnutrition and the potential of new technologies to provide individualised intervention strategies to optimise clinical outcomes for paediatric patients.

Probiotics and preterm infants: a position paper by the European Society for Paediatric Gastroenterology Hepatology and Nutrition Committee on Nutrition and the European Society for Paediatric Gastroenterology Hepatology and Nutrition Working Group for Probiotics and Prebiotics

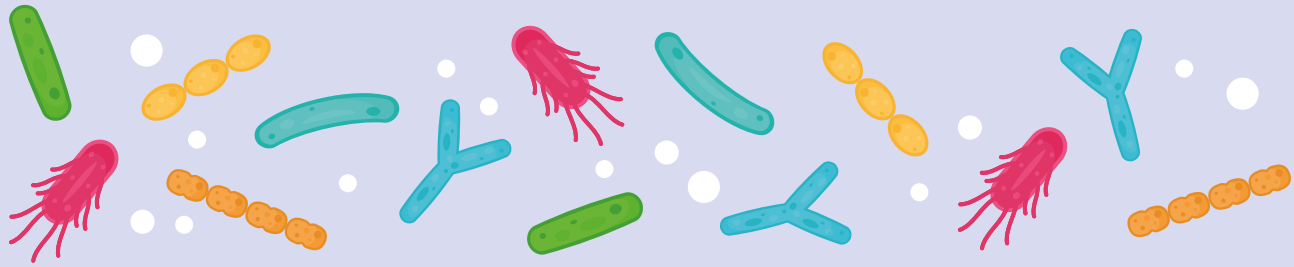
van der Akker CHP *et al.*

J Pediatr Gastroenterol Nutr 2020;**70**(5):664-80.

There has been a great deal of interest in the possibility of using probiotics in preterm infants to reduce morbidity and mortality, with randomised clinical trials taking place in over 10,000 preterm infants. Following a systematic review and network meta-analysis by the ESPGHAN Working Group for Probiotics and Prebiotics in 2018, this new position paper aimed to provide a guide for their possible use based on expert consensus. The panel addressed several key questions including: safety in preterm infants, which probiotic or combination of probiotics are most effective, at what dose and for how long?

Several safety recommendations were made by the panel (all based on a very low certainty of evidence) including the avoidance of strains that produce D-lactate and those that contain plasmids with transferable antibiotic resistance genes. Before commencing probiotics, clinicians should check with local microbiologists if they are able to routinely detect probiotic sepsis. Probiotic products used in preterm infants should be manufactured according to cGMP and certificates of compliance and analysis should be provided. Preterm infants are immunocompromised and often require indwelling catheters and nasogastric tubes, so product integrity is essential. Additionally, parents should be informed of both the benefits and risks of their use and this is best provided face-to-face and backed up with written communications.

The panel concluded with a conditional recommendation (with a low certainty of evidence and assuming all safety provisions are met) to provide either *Lactobacillus rhamnosus* GG ATCC53103 or a combination of *Bifidobacterium infantis* Bb-02, *Bifidobacterium lactis* Bb-12, and *Streptococcus thermophilus* TH-4 for the reduction of necrotising enterocolitis. The panel also provided recommended doses for each, but they concluded that there were insufficient data to recommend optimal start times or durations of treatment.



PUBLISHED ABSTRACTS:

Preterm's nutrition from hospital to solid foods: are we still navigating by sight?

Crippa BL *et al.*

Nutrients 2020;**12**(12):E3646. https://doi.org/10.3390/nu12123646

As preterm birth rates are globally increasing, together with research on preterms' peculiar needs, neonatologists are still facing the challenge of how to properly feed them. The need to strike a balance between excessive catch-up growth and extrauterine growth retardation, both leading to adverse outcomes, is made even more difficult by the broad range of preterms' needs. Although mother's fresh milk is undoubtedly the best nourishment, its availability during hospital stay is often lower than recommended, and its fortification at discharge is still an open issue. Formula milks are available as an alternative to breast milk. However, choosing the right formula requires a thorough evaluation of the infant's perinatal history and targets. Last but not least, adequate timing and initiation of weaning in premature babies are still a poorly explored matter. This narrative review aims at evaluating the multitude of issues to consider when feeding preterms in the three stages of their first life: in-hospital care, discharge, and, eventually, weaning. Given the current absence of internationally shared guidelines, understanding the potential pitfalls of preterms' nutrition could help us trace the right path for the right preterm.

Childhood fussy/picky eating behaviours: a systematic review and synthesis of qualitative studies

Wolstenholme H *et al.*

Int J Nehav Nutr Phys Act 2020;**17**(1):2. https://doi.org/10.1186/s12966-019-0899-x

Fussy/picky eating behaviours are common across childhood. Recent reviews of the fussy eating literature focus on quantitative research and do not adequately account for families' subjective experiences, perceptions and practices. This review aims to synthesise the increasing volume of qualitative work on fussy eating. A systematic search of relevant databases was carried out. Studies were included if they were qualitative, published since 2008, with a primary focus on families' experiences, perceptions and practices regarding fussy eating, food neophobia, or food refusal in children (aged one to young adult). Studies with clinical samples, or relating to children under one year were excluded. Ten studies were eligible for this review and were synthesised using meta-ethnography (developed by Noblit and Hare). This review provides a comprehensive description and definition of fussy eating behaviours. A conceptual model of the family experience of fussy eating was developed, illustrating relationships between child characteristics (including fussy eating behaviours), parent feeding beliefs, parent feeding practices, mealtime emotions and parent awareness of food preference development. Our synthesis identified two ways in which fussy eating relates to mealtime emotions (directly and via parent feeding practices) and three distinct categories of parent beliefs that relate to fussy eating (self-efficacy, attributions and beliefs about hunger regulation). The model proposes pathways which could be explored further in future qualitative and quantitative studies, and suggests that parent beliefs, emotions, and awareness should be targeted alongside parent feeding practices to increase effectiveness of interventions. The majority of studies included in this review focus on pre-school children and all report the parent perspective. Further research is required to understand the child's perspective, and experiences of fussy eating in later childhood.

Gut feelings: how microbiota might impact the development and course of anorexia nervosa

Seitz J *et al.*

Nutrients 2020;**12**(11):3295. https://doi.org/10.3390/nu12113295

Anorexia nervosa (AN) can probably be regarded as a "model" for studying the interaction of nutrition with the gut-brain axis, which has drawn increased attention from researchers and clinicians alike. The gut microbiota influences somatic effects, such as energy extraction from food and body weight gain, as well as appetite, gut permeability, inflammation and complex psychological behaviors, such as depression or anxiety, all of which play important roles in AN. As nutrition is one of the main factors that influence the gut microbiota, nutritional restriction and selective eating in AN are likely influencing factors; however, nutritional rehabilitation therapy is surprisingly understudied. Here, we review the general mechanisms of the interactions between nutrition, the gut microbiota and the host that may be relevant to AN, paying special attention to the gut-brain axis, and we present the first specific findings in patients with AN and corresponding animal models. In particular, nutritional interventions, including food selection, supplements, and pre-, pro- and synbiotics that have the potential to influence the gut microbiota, are important research targets to potentially support future AN therapy.

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The only EHF with a unique combination of pre- and probiotics (synbiotics) that work synergistically

Compared to non-synbiotic formulas†
Aptamil Pepti Syneo has been shown to support

IMPROVED symptom management[1–4]

- **reduction in abdominal discomfort and wind[1]**
- **reduction in atopic dermatitis severity[2‡,3]**
- **reduction in constipation[1,2] and dry stools[2]**

PLUS Modulates the gut microbiota[2] to support long-term health and immunity[5–8]

For further information visit **nutricia.co.uk**
or contact our Healthcare Professional
Helpline on **0800 996 1234**

IMPORTANT NOTICE: Breastfeeding is best. Aptamil Pepti Syneo is a food for special medical purposes for the dietary management of cow's milk allergy. It should only be used under medical supervision, after full consideration of the feeding options available including breastfeeding. Suitable for use as the sole source of nutrition for infants from birth, and/or as part of a balanced diet from 6 months. Refer to label for details.

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* GOS/FOS = Galacto-oligosaccharides and fructo-oligosaccharides.
† UK 4 week single split arm study[1,3–5]: infants with non-IgE mediated CMA, baseline non-synbiotic EHFs vs Aptamil Pepti Syneo.
12 week randomised controlled trial[2]: infants with atopic dermatitis, Aptamil Pepti Syneo vs Aptamil Pepti.
‡ subgroup of n=48 infants with IgE associated atopic dermatitis.

20-186. Accurate at date of publication December 2020.

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