The Changing Face of Paediatric Nutrition

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Improvements in our understanding of the impact nutrition has on disease progression and childhood development, together with medical technological advances, mean that paediatric nutrition continues to evolve as an essential component in the medical management of disease.

Introduction

Over the last decade, multiple changes to the face of paediatric nutrition have occurred due to:

- Early screening to identify and diagnose new disorders
- Medical and surgical technological advancements
- The development of novel dietetic treatment modalities.

Identification of the genotype for cystic fibrosis (CF) has led to national new-born screening, with earlier interventions and better patient outcomes. The increasing ability to diagnose more inherited metabolic disorders earlier leads to improved survival rates and quality of life, but necessitates more highly modified and tailored dietary regimens. Ketogenic diets are now recommended for the effective management of epilepsy to limit seizure frequency for intractable epilepsies.[1]

The current picture

In 2012, 3.8 million UK children were in extreme poverty[2] and the UK charity 'Magic Breakfast' reports that over 500,000 children go to school hungry every day.[3] Some areas of the UK have seen the return of rickets attributed to dietary calcium and vitamin D deficiency.[4, 5] The incidence of food allergy has increased to between 6% and 8% of children under three years of age,[6] with children following restricted diets, often without access to dietetic support.

There has been an increase in awareness of childhood malnutrition and the impact on clinical and quality of life outcomes. The National Institute for Health and Care Excellence (NICE) defines malnutrition as a *'state in which a deficiency of nutrients such as energy, protein, vitamins and minerals causes measurable adverse effects on body composition, function or clinical outcome'*.[7]

Malnutrition in hospitalised children has a reported prevalence of up to 30%,[8] magnified for those with underlying disease and co-morbidity.[9] Malnutrition continues to present challenges, yet is overshadowed by the focus on obesity. The total cost of treating malnutrition in the UK is estimated at £13 billion;[10] it deserves more emphasis to prevent its occurrence.

What we now understand

Early nutrition and foetal programming: foundations for later life

Since Barker first proposed the concept of 'foetal programming',[11] the list of poor health outcomes associated with malnutrition in early development has increased. Inadequate foetal nutrition has been found to increase the risk of obesity, cardiovascular disease, kidney disease and Type 2 diabetes in later life and to have profound, long-lasting cognitive effects.[12] Low birth weight has been correlated with the development of childhood asthma.[13] Malnutrition during foetal and infant development leads to stunting, wasting and micronutrient deficiencies and is associated with nearly 3.1 million child deaths annually.[14]

The impact of malnutrition on growth and development

Inadequate childhood nutrition may lead to developmental delay and disease progression. Children with chronic malnutrition become stunted (low height-for-age) requiring increased protein and energy intakes to achieve their growth potential.[15, 16] Malnutrition predisposes to delayed motor and cognitive development, including learning and memory deficits, lower IQ and school achievement, and behavioural problems in childhood and adolescence.[15, 16]

Micronutrient deficiencies (zinc, iron and vitamin A) can lead to immune suppression and weakened immune function, resulting in an increase in inflammatory and infectious diseases.[5, 17] Gastrointestinal inflammatory disorders or infections increase the risk of secondary malabsorption of sugars and fats. Iron, magnesium and zinc deficiencies can lead to altered taste and anorexia and reduced oral intake.[5, 17]

Disease-related malnutrition

In 1990, a study amongst UK hospitalised children found 16% to be severely stunted, 14% wasted and 20% at risk of severe malnutrition.[18] Malnutrition is often exacerbated during hospital admissions. Pichler showed the prevalence of malnutrition rose from 27% (13% severe) on admission to 32% (21% severe) by discharge.[8]

Several studies[19-21] demonstrate that disease-related malnutrition in children is associated with poorer outcomes, including:

- Prolonged length of hospital stay
- Increased morbidity and mortality
- Increased infections and use of antibiotics
- Increased cost
- Decreased quality of life.

Malnutrition and some chronic diseases in children are intrinsically linked. In cardiac disease, renal disease and malignancy, nutritional requirements are higher.[22] Neurological impairment and cerebral palsy causing poor oral-motor function will impair the consumption of a sufficient oral diet,[23, 24] with behavioural feeding difficulties reported in 20% of children with motor disability.[25]

Children at risk of becoming malnourished should be identified and an appropriate multi-disciplinary team (MDT) plan for nutrition support developed.

Advances in nutrition support: feeds and feeding techniques

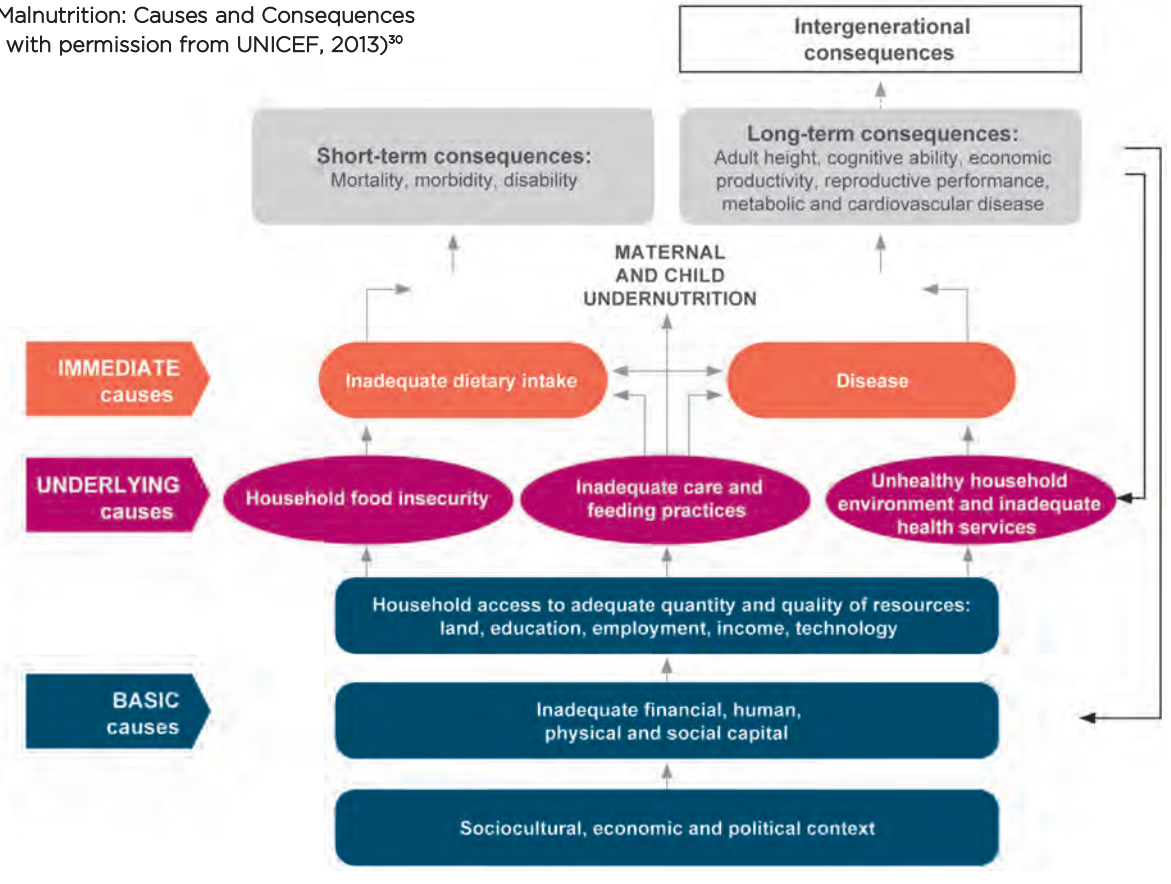
Screening is essential for the early identification of malnutrition and its subsequent proactive management. Nutrition screening tools, such as the 'Screening Tool for the Assessment of Malnutrition in Paediatrics', have the potential to identify children 'at risk' of malnutrition.[26] Anthropometric measurements and the use of growth centile charts provide the gold standard in nutritional assessment and monitoring. Ongoing education is needed to ensure screening tools are used correctly, with the outcomes recorded and an action plan followed. Future research is needed to develop a simple way of collecting auditable data and identifying outcomes that can be solely attributed to nutritional status.

Food and food fortification should be the first-line approach in the management and prevention of malnutrition, with interventions individually tailored to match disease-specific nutritional requirements. Commercially available oral nutritional supplements (ONS), used appropriately, can play an important role in helping to meet increased nutritional requirements and recent advances in the range and palatability of ONS may aid compliance. To prevent flavour fatigue, frequent changes to products (type, taste, flavour) should be considered. Anthropometry with compliance to dietary advice and ONS must be monitored to ensure clinical effectiveness.

Enteral tube feeding was recognised over 30 years ago as an effective method for providing nutrition support for patients with a functioning gut but who were unable to consume an adequate oral diet. Initially feeds were made in hospital kitchens by blending milk, eggs and other nutritional powders which were invariably 'gravity' fed using wide bore nasogastric tubes. Feeds were high osmolality, of limited shelf life and carried a significant microbiological risk.[27]

The availability of commercially manufactured feed preparations precipitated the development of enteral tube feeding practices. Fine-bore nasogastric feeding tubes, which are more comfortable and less abrasive, are available. Gastrostomy and jejunostomy devices are surgically, endoscopically or radiologically sited for direct access of nutrients into the gastro-intestinal tract. Accurate and reliable portable pumps enable a range of feeding regimens (continuous/bolus) to improve tolerance and accommodate the child's lifestyle. A significant increase in the range

Figure 1: Malnutrition: Causes and Consequences (adapted with permission from UNICEF, 2013)[30]



of disease-specific commercially available paediatric feeds, which are quality controlled, microbiologically safe and nutritionally complete, helps meet the ever-changing clinical demands.

In practice, some infants and children previously managed with parenteral feeding regimens are now successfully maintained using highly modified enteral feeds:

- Whole protein, extensively hydrolysed protein, amino acid-based
- Nutrient dense, low energy
- Fibre enriched, low fibre
- Modular components – energy, protein
- Pre and probiotic
- Modified fats (MCT/LCT)
- Modified carbohydrate
- Disease-specific.

In 2011, approximately 16,000 UK children were managed at home on enteral tube feeds.[28]

Understanding the total picture

Advances in the understanding of malnutrition have facilitated positive changes in its management, for example, the importance of micronutrients in childhood development (vitamin D, vitamin A, zinc and iron) has led to routine childhood vitamin supplementation.[5, 29]

Poor parenting skills, educational and social deprivation can also precipitate malnutrition (see **Figure 1**).[30]

Patient experience and family-centred care are embedded in the National Service Framework for Children.[31] Nutritional support must be integrated and co-ordinated around the needs of the individual child and their family. Best practice for the management of faltering growth requires a multi-agency approach whereby health visitors, social workers and hospital specialists work together to support parents.[10]

Current challenges

The rise of allergic disease and food intolerance

Paediatric food allergies and intolerances have increased with an incidence of 6-8%.[32] The rise has been linked to the Western diet[33] and early weaning practices.[34]

Cows' milk allergy is the most common paediatric food allergy, affecting 5% of children.[35] The increasing prevalence, coupled with greater awareness, has led to pressure on paediatric dietetic services and healthcare budgets. There is a need for education to ensure feeds are prescribed appropriately for as long as necessary, based on regular monitoring and re-challenges.

The elimination of dietary allergens may result in dietary deficiency of energy, protein or micronutrients. Undiagnosed or poorly managed food allergies may result in decreased food intake and/or behavioural feeding difficulties. Primary care team education is needed with development of appropriate local care pathways and prescribing guidelines.[32]

Commissioners and providers need to work together to ensure access to appropriate education, support, monitoring and products.

Transition from paediatric to adult care

Transition for young adults with high-dependency nutritional needs can be problematic, including non-adherence or lack of follow-up increasing the risks of morbidity, mortality, and poor social and educational outcomes.[36]

Transition has become a challenge in CF, where survival into adulthood has increased considerably. National standards of CF care suggest a framework where MDTs from adult and paediatric centres work together in the transition process.[37] Network models supported by 'best practice tariffs' enable MDTs from specialised and local centres to provide structured education sessions and tailored care, e.g. CF and diabetes.

What does the future hold?

Hospital nutrition (food) and hydration standards[38] will be monitored as part of the Care Quality Commission inspections. Acute hospitals need to develop an overarching nutrition strategy with policies to include:

- Nutrition screening and action plans
- Auditable standards around menus and choice of food
- Standards for the provision of hospital food to meet nutritional requirements.

Unlike in the adult population, there are no guidelines to govern the provision of nutritional support for children. NICE guidelines for the management of faltering growth are to be published in 2017 and may address this gap.

Conclusion

We have come a long way in our understanding and management of paediatric nutrition and there are still many new challenges on the horizon:

- Metabolic syndrome and childhood obesity
- Rise in allergic disease
- Re-emergence of diseases once eradicated, e.g. rickets
- Increased screening, treatment and survival with more highly complex medical conditions
- The changing NHS.

Over the last two decades, it has become clear that maternal, foetal and childhood nutrition are crucial contributors to long-term adult development and the progression of disease. Many children with chronic diseases are malnourished yet, despite advances in paediatric nutrition, malnutrition is often unrecognised and continues to be an issue.

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