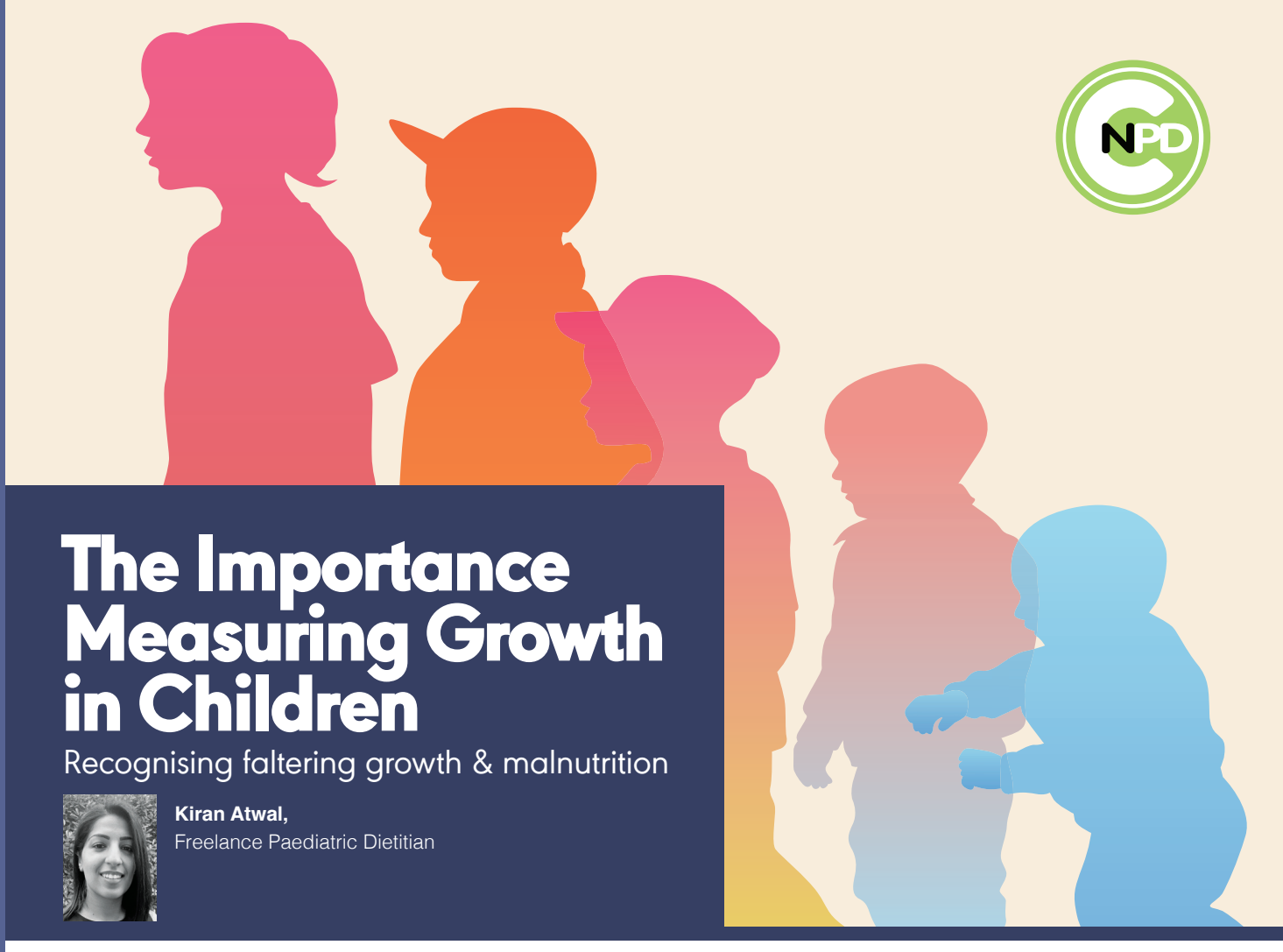

The Importance Measuring Growth in Children

Recognising faltering growth & malnutrition

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Nutrition plays a major role in child development which influences future health risk.[1, 2] Childhood malnutrition can result in increased infections, health complications, hospital utilisation and chronic diseases in adult life.[2, 3] Studies have suggested that poor growth outcomes in children are reversible, however some cognitive and behavioural impairments may be long-term.[4, 5]

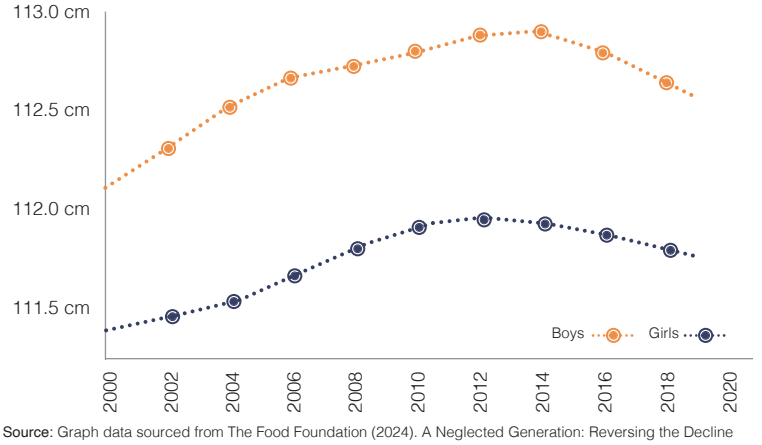
The issue of poor growth is often not thought of in high-income countries, such as the UK, but this year's Food Foundation Report highlighted the stark outlook on children's health. The average height of 5-year-olds has fallen since 2013 (see Figure 1) and is troublingly lower than in counterparts in other areas of Europe. On the other end of the spectrum, obesity in older children has continued to rise since 2006. These outcomes can be attributed to numerous environmental, socio-economic and political factors (i.e. reduced funding for children's services and inflation [the latter giving way to rising food costs and food insecurity]).[6]

Defining malnutrition & faltering growth

Malnutrition can be defined as *'a state in which a deficiency of nutrients such as energy, protein, vitamins and minerals cause measurable adverse effects on body composition, function or clinical outcome'*.[7] The double burden of malnutrition is a growing phenomenon, which is the coexistence of undernutrition (i.e. micronutrient deficiencies, underweight, stunting and wasting) and overweight/obesity and diet-related chronic diseases.[8] This article focuses on undernutrition.

Growth is more commonly measured in children. The failure to achieve the expected growth for length/height, weight and/or head circumference at a normal rate for age, at any time from birth to 18 years, is termed faltering growth.[9]

Figure 1: Food Foundation Report 2024: Average Height of Children Aged 5 in the UK[6]



Source: Graph data sourced from The Food Foundation (2024). A Neglected Generation: Reversing the Decline in Children's Health in the UK. Accessed online: https://foodfoundation.org.uk/sites/default/files/2024-06/TFF_Children%27s%20Health%20Report.pdf (Aug 2024).

Identification & clinical indicators

Faltering growth is measured relative to birth weight and can be identified using National Institute for Health and Care Excellence (NICE) recommendations as follows:[10]

- Drop across ≥1 weight centile space, if birthweight <9th centile
- Drop across ≥2 weight centile spaces, if birthweight is between the 9th and 91st centiles
- Drop across ≥3 weight centile spaces, if birthweight >91st centile
- When current weight <2nd centile for age, whatever the birthweight.

Other recommendations, such as the World Health Organization (WHO), define faltering growth as a fall in the weight-for-age z-score of ≥1.0.[11] Gender- and age-specific growth charts must be used to plot measurements against expected growth rates.[12] If concerns about weight are present based on these criteria, length (in <2 years) or height (in >2 years) should also be measured and compared for discrepancies. The mid-parental centile can be calculated using the accompanying 'parental height calculator' on the UK-WHO growth chart for children 2–18 years.[12] If the child's length/height is more than two centile spaces below the mid-parental centile, this could suggest either undernutrition or a growth disorder.[10]

In a child aged over 2 years, the body mass index (BMI) centile should also be determined using the accompanying BMI centile 'look-up chart' located on the UK-WHO growth chart. The accretion of weight and length/height varies over different stages of development and to body fatness (e.g. during puberty) and must be interpreted relative to the average child of the same gender and age. If the BMI is below the 2nd centile, this may reflect either undernutrition or a small build, but if it's below the 0.4th centile, this suggests probable undernutrition.[10]

Though growth charts provide the most reliable format for assessing the risk of faltering growth, **Figure 2** lists the physical signs and symptoms that are commonly reported in children with malnutrition.[13] Ongoing weight loss, increased fluid loss, increased requirements, low dietary intake and high-risk medical conditions were ranked in a survey as the most important clinical indicators of children with disease-associated malnutrition.[14]

The Subjective Global Nutritional Assessment (SGNA) (updated in 2022) is a method of assessing the degree of malnutrition in children and can be adopted: parameters measured include food intake, gastrointestinal symptoms, functional capacity, metabolic stress, and a nutrition-focused physical exam.[15]

Figure 2: Signs & symptoms commonly reported in children with malnutrition[13]

- Muscle and fat wasting, low skinfold thickness
- Thin, frail hair
- Visible or prominent bones (e.g. protruding chin in infants)
- Pale complexion (suggestive of iron deficiency)
- Poor sleep pattern
- Developmental delay (particularly communication skills in children and young people)
- Emotional and behavioural issues (ranging from withdrawal to passive, active to chaotic, with poor concentration)

Special considerations

Certain medical conditions can affect growth differently, and specific growth charts have been developed (where sufficient data is available) to enable accurate monitoring. For preterm infants, specific UK-WHO neonatal and infant close monitoring growth charts are available; specific growth charts also exist for some common conditions such as cerebral palsy, Down's syndrome, sickle cell, Williams syndrome and Turner syndrome.[16, 17]

Anthropometric measurements may be more challenging in children with neurological impairment due to the inability to weight-bear, scoliosis, or poor access to appropriate measuring equipment (such as hoist or seated scales) and trained personnel. Segmental or proxy measurements are useful and can be used instead.[18]

Mid-upper arm circumference (MUAC) is a relatively easy measure of growth (only requiring a measuring tape), which is closely linked to nutritional status and can be interpreted using guidance from the WHO and the United Nations Children's Fund. For infants and preschool children (aged 6–60 months) with a MUAC of <115 mm there is a high risk of death.[19, 20]

If height cannot be measured, ulna length, knee height or tibial length are alternative proxies to estimate linear growth. Predictive equations can be used to extrapolate estimated length/height from either proxy measure and plotted on relevant growth charts.[21-23] There are discrepancies in the literature on the best alternative height estimate.[24]

Some older children may experience gender dysphoria and may question their gender identity.[25] Various aspects of growth are influenced by several factors, some of which are sex-specific, and have a complex interplay.[26] Unfortunately, there are no clinical guidelines as to whether birth-assigned or gender-affirmed growth charts should be used in such children. Consideration of both sex-specific growth charts may be needed if the child is receiving gender-affirming treatment.[27]

Aetiology

The causes of malnutrition and faltering growth can be multifactorial in origin, either disease or non-disease-related, or both.[13] In disease, the effects of acute or chronic illness can include impaired nutrient absorption (as seen in cystic fibrosis); impaired utilisation (as seen in metabolic disease); increased nutrient loss (as seen in gastrointestinal surgery); impaired intake (as seen in cardiac disease); and increased nutrient requirements (as seen in preterm infants). Non-disease (behavioural and psycho-social) factors may include lack of caregiver knowledge about the child's dietary needs; behavioural problems (which may be linked to neglect and/or abuse); poor feeding practices (which may be linked to poverty); maternal postnatal depression or anxiety; social/cultural/religious beliefs.[10-13]

At risk groups

Recognising children from vulnerable backgrounds is critical as the risk of poorer healthcare service access is higher.[28] Vulnerable groups may include families who are seeking asylum, refugees, non-English speakers, travellers or those known to social care services. Evidence suggests between 5-10% of children known to social care services are identified with faltering growth, and BMI z-scores in refugees are lower than in non-refugee-matched counterparts.[13, 29]

Capturing such groups largely depends on the ability of primary care teams to provide services that can recognise and address engagement barriers. Where indicated, support should be built into subsequent care planning to engage these groups in regular monitoring and interactions with healthcare professionals (HCPs) as part of collaborative care between multiple disciplines to minimise service disengagement and worsening health outcomes.

Universal growth monitoring

Efforts to prevent poor growth outcomes begin with all children from birth. Every infant in the UK is given a Personal Child Health Record ('the red book') to record important information such as growth.[30] This forms part of national child health surveillance services, led by health visitors, which aim to monitor and detect early warning signs for concern in child development.[28] Measurement of growth is outlined regularly for infants due to rapid growth. Poor weight gain in the first 6–8 weeks of life has been linked to a stronger predictor of developmental delay than poor weight gain over the rest of the first year of life.[31]

Most infants and young children do not require measuring more frequently unless identified as at risk of malnutrition and/or faltering growth. In such cases, local pathways for management should be followed, or no more often than as follows:[10]

- Daily if <1 month
- Weekly between 1–6 months
- Fortnightly between 6–12 months
- Monthly from 1 year until 4 years of age.

The Child Growth Foundation recommends growth monitoring for all children at every point of contact with any HCP to adequately detect faltering growth early and for intervention to have optimum effect.[32] National schedules in England, such as the National Child Measurement Programme, largely focus on trends in overweight and obesity, but also provide an opportunity to capture any concerns which should prompt input for those identified as underweight.[33]

Malnutrition screening in hospitalised children

Screening tools for the identification of malnutrition readily exist in adult healthcare, however, in paediatrics, there are no universally accepted tools. Screening considers holistic criteria, which generally include growth history, clinical status, aetiology, dietary (and nutrient) intake and functional status.[34] The European Society for Paediatric Gastroenterology Hepatology and Nutrition does recommend the use of nutritional screening in hospitalised children, as does the Royal College of Nursing.[35, 36] However, there is a lack of consensus on the clinical indicators and components of assessment for disease-related malnutrition in various screening tools that currently exist.

As such, routine clinical malnutrition screening in children using one of the many tools, such as the Paediatric Yorkhill Malnutrition Score (PYMS) and the Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP), has not been recommended.[13] Some settings may choose to implement one of these or local versions, though this is not routine practice. Research has developed screening tools, that demonstrate stronger outcomes (e.g. PeDiSMART or STRONGkids), but these are yet to be validated in larger studies on children from the UK.[37, 38] All HCPs should be aware of general risk factors and clinical features in their review of a child and subsequent local procedures.[14, 39]

Recommendations for child healthcare services & future research

Poor awareness of the role of nutrition in patient care, lack of local policy or guidelines to identify faltering growth and malnutrition, and lack of time have all been reported as common barriers to identification.[14] Several expert groups have summarised the conditions that favour good growth and prevent malnutrition in children (see **Figure 3**).[36, 37]

Figure 3: Recommendations for healthcare services to prevent malnutrition in children[40]

- Well-organised service with clear objectives as to the purpose of growth monitoring and nutritional assessment (policy, pathway and/or guideline[s] in place)
- Access to resources and equipment that support growth monitoring, such as growth charts, scales, stadiometers, measuring tapes, etc. and their maintenance
- Integration of growth monitoring and nutritional assessment with preventive and curative health services for management
- Integration of nutrition and growth education into all paediatric services, and induction of new staff (to create awareness of policy, pathway and/or guideline[s])
- Priority monitoring of children at high risk
- Trained and skilled healthcare professionals on standard operating procedures, such as anthropometric measurements, with good communication skills and knowledge to start a conversation about the importance of growth and nutrition in children (support from dietetics)
- Adequate time for staff nutrition counselling to parents and caregivers
- Skills and techniques provided to staff to promote behavioural change
- Regular supervision of healthcare professionals to maintain performance over time (including service audit against growth standards)
- Service delivered locally with good accessibility, at convenient times or being visited at home
- Development of key messages that are actionable, feasible, memorable and used at all points of contact

Implementation will largely depend on the commitment of staff, and the level of training and resources provided. A lack of equipment has specifically been identified as a barrier to the prevention and management of childhood malnutrition, therefore, adequate spending on resources should be prioritised.[14] Current research has not enhanced our understanding and management of optimal growth in children, and recommendations have been put forward in **Figure 4**.[38]

Conclusion

Growth is a key indicator of child health and development. Understanding faltering growth and malnutrition requires an understanding of the associated medical, psycho-social and behavioural risk factors. Growth assessment requires careful consideration of the multi-faceted variables and risks which may place a child in poorer outcomes. Regular surveillance of infant growth provides a gateway to malnutrition prevention but is only part of the puzzle. Current paediatric malnutrition screening tools are not universally adopted and lack consensus on the clinical features that are sensitive and specific to malnutrition identification, as no one tool has been acknowledged as superior. Education, more resources and robust local policy on high-quality nutrition and optimal growth as part of child healthcare services are vital to tackling the current state of child health in the UK.

Figure 4: Recommendations for future research on growth in children[41]

- Better understanding of some less-studied underlying causes (e.g. gut microbiome)
- Identification of cost-effective interventions that combat poor growth in under-privileged groups
- Better understanding of the alterations in body composition after catch-up growth in the short-term and the metabolic consequences in the long-term
- More high-quality, randomised controlled trials to further clarify optimal intervention strategies that focus on both longitudinal weight and height outcomes
- More focus on the causes, consequences and management of faltering in linear growth

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