Poor growth

There is no consensus on a definition of failure to thrive (FTT) [1, 2]. The most common definition used in practice is 'weight decline on the centile lines', or 'falling below the third centile'. Raynor and Rudolf compared the values of 5 anthropometric methods (median weight for age, median weight for height, median weight/median height for age, BMI, thrive index) and found none of the methods superior in predicting problems. They concluded that weight alone, was the simplest remains the more reasonable marker of FTT [3].

Fewer than 5% of children identified with FTT have organic disease [4]. Equally, less than 5 – 10% of children with FTT are due to 'neglect' issues. A meta-analysis [5] of cohort studies and RCTs involving children identified with FTT before age 2 years, with growth, development or behaviour measured at 3 years of age, showed a 3-point reduction in IQ in children who had earlier failed to thrive.

Historically, FTT was 'diagnosed' either as 'organic' or 'non-organic'. Any identified organic problem would be treated and if no organic cause was found the child was classified with 'non-organic' FTT. The view that children could consume adequate calories yet fail to grow if in neglectful or emotionally negative environments is long-standing but has now been discredited. The earlier studies of children in orphanages and the association of FTT with emotional deprivation has since challenged and it was identified that infants didn't gain weight due to inadequate nutrition [6].

For those children without a medical reason for FTT, some do re-establish good growth rates with nutrition intervention, but for others poor weight gain persists. [6]. This group includes children classified as 'fussy' eaters, oral-motor problems, poor appetite regulation, hypersensitivity, aversions to certain textures, and /or behavioural problems associated with mealtimes. Feeding problems and concern about child growth are known to impact negatively on the parent-child relationship [6].

Concern about catch-up growth in undernourished children predisposing them to chronic illness later in life are increasing [7]. Most of the available evidence suggests this is not likely to be a concern in children under 2 years despite severe malnutrition and rapid catch up growth [8]. This scenario differs from the cases of individual children's 'catch up' following acute or chronic illness and a return to their previous growth trajectory.

Population growth assessment

For growth assessment of groups of children, and for research purposes, the number of children above or below a given reference point is used to identify population prevalence data. Z-scores are useful for these purposes. Z-scores describe the distance from the median in terms of standard deviations and are comparable between different age groups and allow comparison across children at different growth lines. The 'normal' population range is from -2 to +2 standard deviation z-scores with the median z-score being zero. For example, cut-points can be defined to classify population prevalence of malnutrition, stunting, wasting and overweight; usually below -2 and above +2 z-scores respectively [9].

Population-level malnutrition

In the analysis of population growth data, preference is given to the use of standard deviation (SD) z-scores and population distributions. Cut-offs (for example -2SD) are used for comparison of prevalence and for screening of populations [9]. The disadvantage of using centiles for cut-offs is that the number at extreme degrees of risk cannot be quantified as centiles below the 3rd or above the 97th centile are not usually defined.

The WHO defines 'underweight' (severe acute malnutrition) as a weight-for-age of three SD below the median WHO growth standard, the presence of bilateral pitting oedema, or a mid-upper arm circumference less than 110mm in children aged 1 – 5 years [10]. Severe acute malnutrition (SAM) affects approximately 3% of children under 5 and is associated with several hundred thousand child deaths each year [11]. Moderate acute malnutrition (MAM) is defined as a weight-for-age between -3 and -2 z-scores below the median of the WHO child growth standards [12], and is associated with an increased risk of mortality [13]. MAM may progress to severe acute malnutrition (SAM) (severe wasting and/or oedema) or severe stunting (height-for-age less than -3 z-scores), which are both life-threatening conditions.

'Wasting' (low weight for height) refers to a deficit in tissue and fat mass compared with the amount expected in a child the same height or length, and may result either from failure to gain weight or from weight loss. If can develop rapidly, but under favourable conditions can be restored rapidly. [9] Rates of wasting are used to classify populations at risk; for example greater than 15% of children under 5 years wasting indicate 'very high' levels of malnutrition, and warrant emergency response.

'Stunting' signifies slowing in skeletal growth. Stunting is frequently found to be associated with poor overall economic conditions, especially mild to moderate chronic or repeated infections, as well as inadequate nutrition. [9] The prevalence of wasting in developing countries is greatest between 12 and 24 months of age, when dietary deficiencies are common and diarrhoeal diseases more frequent and tends to reduce later on. In contrast, the prevalence of stunting increases over time up to the age of 2 – 3 years. And little effect on the child's height over the age of 2.

A systematic review [8] from five longstanding prospective cohort studies from developing countries suggested that lower birth weight and undernutrition in childhood are risk factors for high glucose concentrations, high blood pressure, and high blood lipids once adult BMI and height are adjusted for, suggesting that rapid postnatal weight gain – especially after infancy – is linked to these conditions, which has led some to question the approach of 'Catch up' growth in these populations [7] although other evidence suggests that catch up growth before 2 years of age does not have the same longer-term implications. [8]

Using BMI to determine new cut-points to define thinness in children based on BMI, the WHO has defined 'thinness' as BMI at age 18 as <17. [14]. This same cut-off applied to the WHO data at age 18 gave mean BMI close to a z-score of -2. Therefore it matches existing criteria for wasting in children based on weight and height. For each dataset, centile curves were drawn to pass through the cutpoint BMI 17 at 18 years. Similar cut-points were derived based on BMI 16 and 18.5 (severe malnutrition). Practical application of this new research has identified some inconsistencies in the use of BMI using the WHO standards for older children [15].

References

1. Spencer, N.J., *Failure to think about failure to thrive.* Archives of Disease in Childhood, 2007. **92**(2): p. 95-96.
2. World Health Organization, *Issues in the assessment of nutritional status using anthropometry* Bulletin of the World Health Organization, 1994. **72**(2): p. 273-283.
3. Raynor, P. and M.C.J. Rudolf, *Anthropometric indices of failure to thrive.* Archives of Disease in Childhood, 2000. **82**(5): p. 364-365.
4. Wright, C.M., et al., *Effect of community based management in failure to thrive: randomised controlled trial.* BMJ, 1998. **317**(7158): p. 571-574.
5. Rudolf, M.C.J. and S. Logan, *What is the long term outcome for children who fail to thrive? A systematic review.* Archives of Disease in Childhood, 2005. **90**(9): p. 925-931.
6. Batchelor, J., *'Failure to thrive' revisited.* Child Abuse Review, 2008. **17**(3): p. 147-159.
7. Ruben, A.R., *Undernutrition and Obesity in Indigenous Children: Epidemiology, Prevention, and Treatment.* Pediatric Clinics of North America, 2009. **56**(6): p. 1285-1302.
8. Victora, C.G., et al., *Maternal and child undernutrition: consequences for adult health and human capital.* The Lancet, 2008. **371**(9609): p. 340-357.
9. World Health Organization, *Use and interpretation of anthropometric indicators of nutritional status* Bulletin of the World Health Organization, 1996. **64**(6): p. 929-941.
10. Collins, *Management of severe acute malnutrition in children.* The Lancet, 2006. **368**: p. 1992-2000.
11. Briend, A. and S. Collins, *Therapeutic nutrition for children with severe acute malnutrition: Summary of African experience.* Indian Pediatrics, 2010. **47**(8): p. 655-659.
12. World Health Organization, *WHO child growth standards and the identification of severe acute malnutrition in infant and children*. 2009.
13. Briend, A. and Z.W. Prinzo, *Dietary management of moderate malnutrition: time for a change.* Food Nutr Bull, 2009. **30**(3 Suppl): p. S265-6.
14. Cole, T.J., et al., *Body mass index cut offs to define thinness in children and adolescents: international survey.* BMJ, 2007. **335**(7612): p. 194.
15. Nash, A., et al., *Field testing of the 2006 World Health Organization growth charts from birth to 2 years: assessment of hospital undernutrition and overnutrition rates and the usefulness of BMI.* JPEN Journal of Parenteral & Enteral Nutrition, 2008. **32**(2): p. 145-153.