Patterns of Growth in Early Childhood and Infectious Disease and Nutritional Determinants

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The physical growth of young children in low- and middle-income countries (LMIC) is generally reduced compared to that expected in the World Health Organization Child Growth Standards (fig. 1) [1]. Children in these countries have a height for age that from birth starts slightly below the standard and then declines steeply to nearly two standard deviations below by 24 months of age [2]. This decline is greatest for children in South Asia and sub-Saharan Africa. The pattern for weight for length differs markedly by region. Children in Africa dip below the standard in the first 24 months and then go back to the expected level for the remainder of their childhood. Children in South Asia start life at three quarters of a standard deviation below the standard and decline to more than one standard deviation below standard, where they remain for the remainder of their childhood. Children in Latin America have a higher weight for length compared to the standard, indicating more overweight and obesity.

The deviations in growth as reflected by both height for age and weight for length have serious consequences for child mortality, development, adult stature and health [3]. The determinants of these patterns of growth faltering include intergenerational factors, such as maternal height (<160 cm), short birth interval (<2 years) and conditions in pregnancy, including maternal underweight (body mass index <18.5) and anemia (hemoglobin <110 g/l). These factors contribute to fetal growth restriction and premature delivery, which put many infants on a different growth trajectory. Fetal growth restriction as assessed by the newborn being small for gestational age (SGA) is particularly important [3]. Babies who are SGA have an elevated risk of death and surviving children an increased risk of stunted linear growth. It has been estimated that a fifth of stunted growth (reduced length for age compared to the growth standard) in children can be attributed to being born SGA. In some regions this may be more than a third.

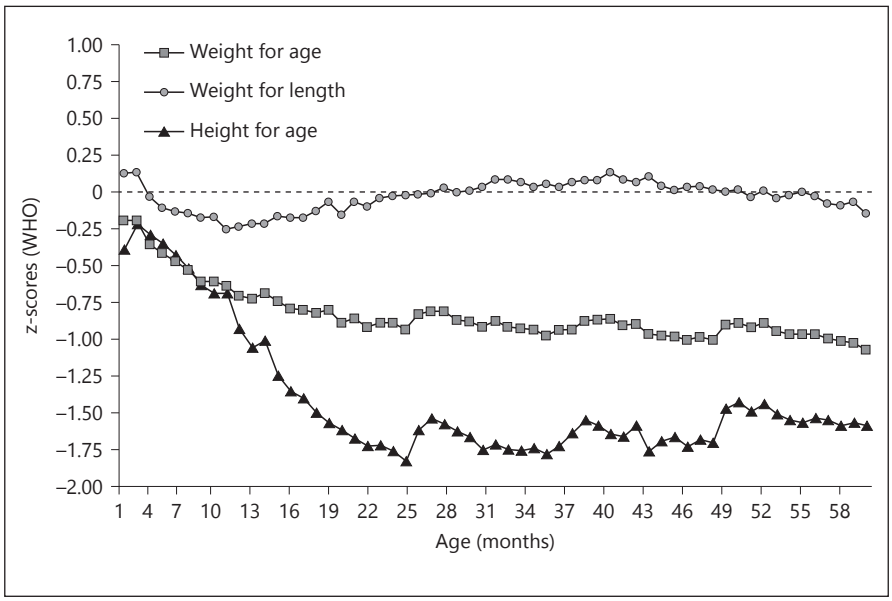

Fig. 1. Mean anthropometric z-scores according to age (1–59 months) for all 54 studies relative to the WHO standard. Reproduced with permission from *Pediatrics* [2] by the American Academy of Pediatrics.

Dietary factors, especially consumption of complementary foods of insufficient quality, have a paramount role in growth faltering in the critical period of infancy. Diets that are inadequate in calories, protein, essential fatty acids and micronutrients (essential vitamins and minerals) can result in poor growth. Breast milk is an important source of nutrients in the first months and years of life. Current recommendations are that babies be fed only breast milk for the first 6 months of life and that breastfeeding be continued along with complementary foods to at least the second birthday. Introduction of liquids or foods in the first 6 months can lead to a diet of reduced nutritional quality and exposure to microbes, which can cause diarrhea and possibly environmental dysfunction. Failure to continue to provide breast milk in the second half of infancy and feeding complementary foods of poor energy density and quality contribute to the faltering of both linear growth and weight gain in LMIC from 6 to about 24 months of age.

Observational studies of the determinants of stunting have shown significant relationships with reported food intake, as well as other indicators such as dietary diversity, reflecting the adequacy of intake of vitamins and minerals. Of particular importance among these is zinc because a zinc-deficient diet is associated with reduced linear growth.

Exposure to microbes after birth resulting in diarrhea and febrile infectious diseases and poor quality diet further compromise growth. Diarrhea episodes have been estimated to cause 20% of linear growth faltering [4]. Determinants of growth faltering after birth vary by setting and are not independent of each other. For example, the adverse effects of diarrhea on growth may be mitigated by a high-quality diet. In addition to the effects of infectious diseases, subclinical enteric infections can result in intestinal dysfunction with adverse effects on nutrition and growth [5].

References

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