The concept that patterns of growth in early life may influence, or program, long-term health, has been a focus of much recent research. In particular, the impact of catch-up growth (the higher than expected rate of growth seen following recovery from illness or starvation [1]) or growth acceleration (upward centile crossing for weight or length [2]) on later health has generated considerable interest. This pattern of growth is most commonly seen postnatally in infants with low birthweight (LBW), a problem affecting >20 million newborns a year globally. However, whether catch-up growth should be actively promoted in such infants (e.g. by encouraging a higher plane of nutrition) is an area of considerable debate.

The fact that ‘catch-up growth’ occurs in animal species as diverse as mammals, birds, and fish, as well as humans, suggests that this pattern of growth must have a survival advantage. However, the observation that animals or humans do not usually grow as fast as they are capable of (e.g. as seen during catch-up growth) suggests that faster growth must also have a biological cost. There is, therefore, a trade-off in order to optimize growth trajectories between short-term gains and long-term costs [3]. The short-term advantages of postnatal growth in infants with LBW is well recognized and include, for example, a lower risk of hospitalization in those born in poorer environments. However, the long-term costs of this pattern of growth are now becoming increasingly apparent.

Evidence for the adverse long-term effects of faster postnatal growth first emerged in animal models from the 1930s and has now been confirmed in many epidemiological studies in humans. Faster postnatal growth is associated with later risk of obesity, diabetes and cardiovascular disease [4]. This effect is seen in infants born preterm or at term, infants born appropriate weight or small for gestational age (SGA), and in developed and developing countries. Importantly, follow-up of randomized
studies supports a causal link between infant growth and later risk of metabolic disease. For instance, term SGA infants randomly assigned to nutrient-enriched formulas (that increased infant weight gain) had higher diastolic blood pressure at age 6–8 years and, in 2 trials, 18–38% greater fat mass at age 5–8 years than controls [as reviewed in Singhal 4]. Interestingly, differences in fat mass or blood pressure between randomized groups in childhood were related to the rate of weight gain in infancy, suggesting a ‘dose-response’ association between early growth and later cardiovascular risk. Overall, these studies suggest a large effect size. For example, >20% of later obesity risk may be explained by the rate of infant weight gain, and the relative risk of later obesity associated with more rapid weight gain in infancy ranges from 1.2 to as high as 5.7 [as reviewed in Singhal 4].

Based on the risks and benefits, the optimal pattern of postnatal growth is likely to differ in different populations. In infants born prematurely, faster postnatal growth predisposes to cardiovascular risk factors, but improves long-term cognitive function. So, on balance, the current policy is to promote faster growth by increasing nutrient intake (e.g. using higher-nutrient preterm formulas). Whether the same policy should apply to the larger preterm infant is currently unknown. Similarly, in infants from impoverished environments, the short-term benefits of faster postnatal growth may outweigh any long-term disadvantages. Whether similar considerations apply to LBW infants from countries in transition is uncertain. For term infants born SGA from developed countries, promoting catch-up growth by nutritional supplementation has few advantages for short- or long-term health [5]. The present review considers the programming effects of faster postnatal growth in such infants focusing on the underlying biology and clinical impact.

References