Commentary: Early insights into height, leg length, proportionate growth and health

David Gunnell

Lifecourse epidemiology

The last ten years have seen the focus of chronic disease epidemiology shift from an almost exclusive interest in adult risk factors to a growing appreciation of the role of exposures acting at early stages of life. Leitch’s review of growth and health, based on a lecture given over half a century ago, is a timely reminder that the scientific rationale for recent interest in the early life origins of adult health is grounded in research dating back more than a hundred years. But more than this it offers elegant descriptions of confounding, gene-environment interactions, a sweeping dismissal of the eugenic movement and pointers to future avenues of research which have since led to a greater understanding of early life determinants of adult health.

One focus of Leitch’s paper concerns proportionate growth in animals and humans. Using examples from research into the growth of pigs and sheep, she suggests an animal’s adult body proportions may provide an indication of undernutrition during development. Poor feeding may permanently retard the development of the later developing body segments—their hindquarters, a theme she returns to in later writings. She goes on to use anecdotal observation and empirical research to extrapolate these findings to humans, stating: ‘High class fashion journals depict women with an extreme length of limb, and decorative art does the same for both men and women … When the artist wishes to depict the lower orders, as such, or the comic, he draws people with exaggeratedly short limbs and makes them fat.’

Healthy and attractive individuals, by implication, have long legs and their health may be derived from the effects of good childhood nutrition on ‘hindquarter’ growth. Leitch reports some early analyses of Boyd Orr’s Survey of Family Diet and Health in Pre-War Britain to support this idea. These suggest that leg length (crystal height) better predicts socioeconomic position than does overall height, furthermore, longer-legged children suffer less bronchitis than short-legged children.

The Boyd Orr cohort

To investigate the long-term impact of childhood nutrition on health Leitch suggests that ‘It would be of greatest interest to be able to trace accurately the further history of well- and ill-grown people in terms of living and dying and causes of death.’

In keeping with Leitch’s speculations, follow-up of the Boyd Orr cohort suggests that leg length is the component of stature generating these associations. Increases in childhood leg length, but not trunk length, are associated with decreased coronary heart disease mortality and increased cancer risk. The detailed diet records collected in Boyd Orr’s study allow a direct investigation into the role of diet in height-disease associations. Studies on the Boyd Orr cohort to date indicate that excess calorie intake may increase cancer risk whereas fruit intake may be protective. Few other studies have prospectively examined associations between the components of stature and adult mortality patterns. Alabans’ study of adult leg length and cancer incidence in the USA, however, offers some support for the notion that leg length is the component of stature associated with increased cancer risk. Further research is needed to confirm these findings and replicate observations concerning leg length and cardiovascular mortality. The biological mechanisms underlying height-disease associations are the focus of current research interest.

Growth and health

What has been learnt about proportionate growth in humans in the last 50 years? Whilst a considerable amount of research interest in the early part of the twentieth century focused on health in relation to body shape and proportion, attention in more recent years has focused on the role of body fat and fat distribution in adult chronic disease risk. A greater understanding of linear growth in the components of stature during childhood has been derived from a number of detailed longitudinal studies. These show that whilst leg length is the component of stature responsible for the greater part of pre-pubertal height...
increases, trunk growth is greater than leg length increases in puberty.22 Thus relatively long legs in childhood may provide an indication of better pre-pubertal nutrition and together with longitudinal findings,14–17 this suggests that childhood exposures may influence adult disease risk. Alternatively, rather than necessarily reflecting better nutrition, relatively long legs in childhood may reflect an increased tempo of growth and early puberty. If this is the case then factors setting growth trajectories in early life, rather than the child’s later environment, influence relative leg length,23 suggesting that childhood circumstances are less important than prenatal and infant exposures in influencing later health. Two lines of evidence point to leg length being a measure of childhood circumstances, independent of prenatal exposures. Firstly McMeekan’s animal studies described by Leitch show that poor feeding post-natally may permanently influence animals hindquarter development. Secondly, anthropometric markers of prenatal nutrition are equally strongly related to leg length and trunk length,24 whereas if prenatal exposures set the tempo of growth in childhood it might be expected that birth measures would be more strongly associated with leg length growth.

Leitch’s paper appears to have received relatively little attention when first published although some of the ideas she proposed were taken up by Dugald Baird when he gave the prestigious Cutter lecture in Harvard the following year.24 Her speculations pre-date a range of recent epidemiological investigations into early influences on adult health. The suggestion that leg length is a sensitive and specific marker of childhood conditions requires fuller investigation. Leitch would, no doubt, be intrigued by recent findings in this area.

Acknowledgements
The author would like to thank Professor George Davey Smith for comments and suggestions on this commentary.

References