Population differences in body size, shape, and growth rate

A 1976 view

Differences between populations in the size and shape of adults are due to differences in their gene pools, in their environments, and in the interactions between the two. Differences in size and shape between children of different populations have the same causes, but with the added complications caused by variations in rate of maturation. Thus, two populations may reach an average identical adult size, but the children of one population may be larger than those of the other simply because they have a faster tempo of growth, enter puberty earlier, and cease growing earlier.

Differences in tempo of growth are themselves subject to both genetic and environmental influences. Indeed one of the first effects of an environmental insult such as malnutrition is a slowing down of the overall rate of growth. How could it be otherwise, one might ask? Children did not evolve in Hampstead Garden Suburb but in communities like the villages on the Gambia river studied by McGregor, Billewicz, and Thomson (1961) or the New Guinea Highlands documented by Malcolm (1971). For evolving man famine is normal and no species whose growth blunders on when food supply is suspended stands a chance of survival. Children store fat during the first year; when famine, infection, and maladaptive cultural custom hit them they both use this fat for fuel and slow down their growth. (Very likely a single integrated mechanism controls both effects. In starvation the somatomedin level in the blood drops and the growth hormone level rises. The first diminishes bone growth, the second causes fat catabolism; and probably, though not yet certainly, it is the fall of somatomedin which itself is responsible for the rise in growth hormone.)

When conditions improve, the familiar catch-up phenomenon occurs. The previously starved children grow faster than well-nourished controls, satisfying some accumulated urge to grow, the nature of which is still entirely obscure. The urge gradually dies away, and when it is gone the child has either fully caught up (as in children badly starved for surgical reasons but then fully 'rehabilitated') or has lost for ever a part of the possibility for growth inherent in his genotype.

Since different populations are subject to such different environmental insults (starvation in one, force-feeding in another) it is hard to determine to what degree the genotypic possibilities differ. We know from twin and family studies in well-nourished populations that within such populations enormous genotypical variation in size, shape, and tempo of growth exists. But only quite recently has it become possible to compare growth between, for example, different ethnic groups growing up under similar conditions. We have also much better controlled studies of groups of a single genotypic population growing up under bad conditions and under good conditions. Amirhakimi's (1974) study of the growth of poor children in Iranian villages compared with rich children in Shiraz is an example, and Farquharson in this issue addresses a similar question in Nepal. In Africa, Margaret Janes's study (1970, 1974) of privileged and slum-dwelling Nigerians is notable, and for Asian children, we have the studies of Francis Chang and his colleagues in Hong Kong (Chang *et al.*, 1963). Iranians when well-nourished are as tall and heavy as British children, age for age; and Nigerians likewise. Chinese however, are not.

This last finding is reinforced by recent data from Japan (cited in Eveleth and Tanner, 1976). In the 1950s Greulich and others showed that Japanese born and reared in California grew to be taller than Japanese in Japan. Since then, however, environmental and social conditions in Japan have changed rapidly and present-day Japanese children are as large in Tokyo as in Los Angeles. In neither case, however, do they have the relatively long legs of the European child, let alone the very long legs of the African. Body shape is much more resistant to environmental pressure than is body size. Even in size, however, it seems likely that genotypic differences exist between Asians (that is Chinese, Japanese, and Indo-Malays) and Europeans. No such differences exist between Europeans and Africans. Recent studies in the United States, where it is possible to find African-descended groups living under identical conditions to European-descended ones, show that the children of African origin are as tall or taller than present-

day British children. The boys closely resemble London boys throughout their growth; the girls are a little taller but only because they have a faster tempo, with menarche on average at 12.5 years as opposed to 13.0 in London. In adulthood the average stature is practically the same.

We have now an enormous amount of data on age at menarche in different populations, for it is a very easy thing to study, requiring only two simple questions put to all girls aged 9–16 in the population: What was your date of birth, and have you begun to menstruate? Thanks largely to the International Biological Programme, a world-wide co-operative study during 1964–1974 of all kinds of biological problems, we also have extensive data on children's growth throughout the world. The Human Adaptability Project, of which Professor J. S. Weiner of the School of Hygiene and Tropical Medicine was Convener, had nine main research themes, one of which concerned growth and physique. The results of the IBP are beginning to be published (some 30 volumes are anticipated in English alone) and the volume *World Wide Variation in Human Growth* by Dr. Phyllis Eveleth and the present writer has just appeared. In it will be found a vast collection of data, which supply the bibliographic background for the statements above.

The question of genotypic variation between populations is practically important, as well as theoretically interesting. Can one use a single growth standard for all populations in the world, or do different populations need different standards? The answer, as usual, depends on precisely what question one is asking. If we want to follow only growth in height, then the same standards are fairly adequate for Europeans and Africans and their descendants in America and elsewhere. If we want to ask questions about body proportions (with the object of diagnosing hypochondroplasia for example, or Klinefelter's syndrome), then different standards must be used. If we want to measure the height growth of Chinese or Japanese then it seems that European standards will not do. Differences are small at first but become gradually greater and especially at adolescence the Asian growth pattern, with early menarche, early height spurt and short legs, differs too much for a European standard to be adequate.

In underdeveloped countries a different problem arises; should the standards be those of the best-off portion of the population or should they be drawn from the same type of random sample that is appropriate in the developed nations? To the writer's mind, the answer is clear enough; the best-

off group should be used. Surveys made every 5 or 7 years in all parts of the country are then able to monitor with some accuracy the success or failure of the social system. Few countries have instituted truly national plans on these lines; a model is provided by Cuba, where a large and genuinely national sample of persons from birth to 20 has been surveyed with meticulous care (Jordan *et al.*, 1975) as a beginning to continuous and detailed monitoring.

There is, all the same, one argument against using 'best-off' standards. The best-off in most countries grow up earlier and end up taller. Is early maturation and large size advantageous? Did we evolve to be adapted to continuous high calorie input or to cope with intermittent feeding? A small peasant can get a living from his soil better than a large peasant, for he requires less food. In a rural nonindustrialized economy there is an optimal body size for efficient energy cycling; too small and too big are both bad, just as for survival in newborns. Growth is indeed a fine yardstick of the health of individuals and populations, perhaps the best there is. But it remains so only as long as we view our standards as a sensitive balance to be adjusted if conditions change, and not an immutable ceiling to which we should all eat our way.

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