Relationships between undernutrition, infection, and growth and development

Interactions between undernutrition, infection, and growth and development are complex, and are reviewed in this article. Anthropometry is a common means of nutritional assessment, but the relationship between food availability and anthropometric status is at best very loose, at least at the national level. This suggests that anthropometric assessment is less a measure of nutritional status than of the totality of environmental factors that influence growth, including infectious disease. The effects of diet, nutrition and infection on the nutritional status of a child can vary according to the disease ecology, the age of the child, patterns of feeding and types of food consumed. There are two possible ways in which this relationship can begin; one in which poor nutritional status leads to impaired immunocompetence and reduced resistance to infection, and the other in which exposure to infectious disease can lead to appetitive loss and anorexia, malabsorption, and elevated metabolism of energy and other nutrients. Once started, the interactions between these two major environmental stressors becomes increasingly complex, with the nature of the disease ecology influencing the balance of immunoparesis and adaptive immunity its effect on subsequent disease experience, and the extent, if any, of anorexia, fever, and malabsorption during infectious episodes which has an impact on nutritional status. Specific nutritional deficiencies can subsequently influence immune status and responsiveness, and adaptive immunity. In addition, cultural factors can influence patterns of disease management and sickness behaviour, which can in turn affect the incidence, severity and duration of infection, and their effects on nutritional status, while deficiencies of vitamins and trace elements can have major effects on immune responsiveness.

Introduction

In the less developed world, undernutrition and infection interact across the course of human growth and development, depressing the rate of growth which manifests itself in small body size in later childhood and into adult life. The interactions between undernutrition, infection, and growth and development are complex, numerous factors being involved in determining nutrient intakes and the patterns of infectious disease experienced by young children. In the first three months of life, weight velocities of children in developing countries are similar to those of western children (Offringa & Boersma, 1987). However, in many populations the process of ‘becoming small’ is more or less complete by the end of the second year of life. This is due to the combined stresses of low nutrient intakes and infection, associated with the weaning process. There is high infant mortality associated with the process of becoming small (Ulijaszek and Strickland, 1993). Small body size in children above the age of two years appears to carry little functional cost, at least until the onset of adolescence. Physical work capacity is closely related to muscle mass (Spurr, 1988), and shorter and lighter
adolescents and adults engaged in paid employment show poorer work performance than their larger peers (Spurr et al, 1977, Satyanarayana et al, 1980, Imminck et al, 1984). In this article, the relationships between undernutrition and infection during the course of growth and development are reviewed.

**Undernutrition and anthropometry**

Nutritional assessment is a means by which the health status of individuals or populations which is influenced by their intake and utilisation of nutrients can be determined. This involves the interpretation of information obtained from any of dietary, biochemical, anthropometric or clinical studies (Gibson, 1990). Anthropometric measures include height for age and weight for age relative to growth references such as those produced by the National Center for Health Statistics (1977) and adopted for international use by the World Health Organisation (World Health Organisation, 1983). The proportions of the young child population below some cut-off of these references have been used as retrospective measures of undernutrition-induced growth faltering and/or wasting. Although one anthropometric measure of current nutritional status is low weight for height relative to western references (Waterlow et al, 1977), the most widely used index in the developing world is low weight for age, which reflects both past and present exposure to the dual stresses of undernutrition and infection, at least in early life.

Table 1 gives the extent of wasting (children aged 0 to 5 years below 80% of National Center for Health Statistics (1977) 50th centile of weight for age) in Asia, Africa, and in Central and Latin America, in the period 1980-1987 (United Nations Children’s Fund, 1990). These data are far from complete, since no national figures are available for the extent of undernutrition in a number of countries, including China, Nigeria, Kenya, South Africa, Mexico and Argentina. Although the methods of ascertainment and the degree of reporting vary from country to country, making these data less than ideal, some interesting patterns and relationships are revealed. Overall, about 38% of children under five years of age in developing countries are undernourished, the greatest proportions being found in Asia (43%), the lowest in Central and Latin America (14%). However, the value for Asia is likely to be an overestimate, since data for the more modernised nations such as Malaysia, Taiwan, Japan and South Korea are not available, and it cannot be assumed that there is no undernutrition in those countries.

For the Asian countries reported, Bangladesh has the highest proportion of the under-fives population undernourished, followed by Vietnam and Indonesia. Although a lower proportion of under-fives is undernourished in India, the sheer size of the Indian population gives that country by far the greatest number of undernourished for the Asian countries for which national data is available. There is surprisingly little undernutrition in Laos and Kampuchea. Of the African countries, Mozambique, Niger and Tanzania have the greatest proportions of their under-fives populations undernourished, while Ethiopia, Tanzania and Sudan have the largest absolute numbers of undernourished children. The countries with the lowest prevalences of light-for-age children are Lesotho and Malawi, on the basis of national data collected between 1980 and 1987. In Central and Latin America, El Salvador has the highest proportion of undernourished children, while Brazil has by far the largest total number. Uruguay and Chile have both the lowest proportions of light-for-age children, and the lowest total numbers.