Malnutrition in developing countries

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Abstract

Although uncommon in industrialized countries, malnutrition in children remains a scourge in many developing countries. It was estimated that, in 2012, 26% of the world's children were stunted and almost 3% were severely wasted. Forty-five percent of all deaths in children aged under 5 years were attributable to the simple fact that they were underweight. Malnutrition occurs most commonly in Southern Asia and sub Saharan Africa. The effective management of severe acute malnutrition (SAM) is a huge challenge in low resource healthcare settings. More effective prevention and treatment of malnutrition is needed urgently.

Keywords kwashiorkor; malnutrition; nutrition disorder; wasting

Nutrition disorders: a leading cause of ill health in the world today

Millennium Developmental Goal 4 aims for a global reduction in under five mortality of two thirds between 1990 and 2015 and a remarkable 50% reduction has been achieved so far. However, most of the estimated 6.3 million deaths in under fives in 2013 were preventable. Under five mortality remains high in sub Saharan Africa (92/1000 live births) and Southern Asia (55/1000 live births), compared with developed countries (6/1000 live births). Outside the neonatal period, the most common primary causes of death are pneumonia and diarrhoea (Figure 1). However, researchers estimate that in 2011, 45% of all deaths were attributable to underlying undernutrition, including growth restriction in-utero, wasting, stunting, micronutrient deficiencies and suboptimum breastfeeding. As a result, significant further reductions in under five mortality will only be achieved with improved prevention and management of malnutrition.

The inner circle represents the 45% of all under five deaths attributable to undernutrition.

Other group 1 conditions are communicable, maternal, perinatal and nutritional causes.

However, the problem is not a simple one. The 21st century has thrown up some paradoxes in nutritional health. Alongside undernutrition we have seen childhood obesity double globally from 1990 to 2011 with alarming increases in developing as well as developed countries. It was estimated that, in 2011, obesity occurred in 7% of under fives globally, with 7% in Africa, 5% in Asia and 15% in developed countries. Current WHO policy to prevent a further increase in childhood obesity also includes developing countries.

The co-existence of underweight and overweight in the same communities, even in the same households, has been termed a "double burden" of disease. Survey data from Egypt (2006–2010) revealed a 12.6% prevalence of underweight in adolescents (average age 13.2 years), while overweight prevalence was as high as 31.4%. The expression "triple burden" adds micronutrient deficiencies which occur both in underweight and overweight children and is referred to as "hidden hunger". Obesity and its long term adverse outcomes are discussed elsewhere in this journal. This article focuses on undernutrition. Stunting is addressed under the heading "prevention".

Definitions and diagnosis

Anthropometry refers to measurement of body size and proportions. Most countries have endorsed the WHO 2006 child growth standards. Anthropometric indices compare a child's size to mean values using standard deviations or "Z-scores" (Table 1). In the resource limited settings where malnutrition is common, accurate measurement of weight and height may be a challenge. Mid-upper arm circumference (MUAC) is easier to measure and interpret. MUAC is similar in boys and girls and is relatively constant from 6 months to 5 years avoiding the requirement to calculate exact age. WHO recommends MUAC as a screening tool for severe acute malnutrition (SAM) in the community. SAM is diagnosed in children with severe wasting and/or nutritional oedema (pitting oedema of both feet) with no identifiable cause such as nephrotic syndrome.

All degrees of undernutrition impact negatively on health and the Integrated Management of Childhood Illness requires healthcare workers to assess the nutritional status of every attending child. Although the risk of death is greatest in SAM (odds ratio 9.4 compared to non-malnourished children), because of the large numbers affected, most malnutrition-associated deaths occur in children with mild and moderate malnutrition. Failure to identify undernutrition misses an opportunity to prevent long-term morbidity impacting on quality of life, development, educational achievement and economic prospects in adult life.

Epidemiology

Malnutrition remains prevalent in under fives in resource-poor countries. In 2013, 51 million children had at least moderate wasting (global prevalence of almost 8%) and 17 million were severely wasted (global prevalence almost 3%) with the highest prevalence in Asia (71%) and Africa (28%). Over a quarter of the world's under fives (161 million) were stunted, with highest prevalences in Southern Asia (56%) and Africa (36%).

Clinical presentation

There are two well recognized clinical syndromes of SAM: marasmus and kwashiorkor. Children with marasmus (Figure 2) have visible severe wasting with an "old man" face, emaciated limbs, clearly visible ribs, buttock wasting, minimal adipose tissue and are often irritable. They may exhibit clinical signs of micronutrient deficiencies, skin and hair changes and infection.

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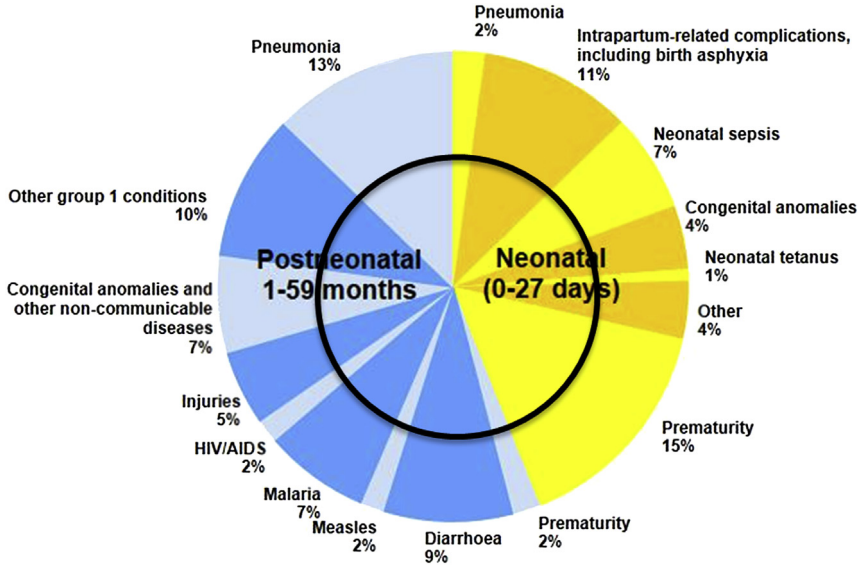

Figure 1 Global cause specific mortality in children under 5 years (adapted from Global Health Observatory http://www.who.int/gho/child_health/mortality/causes/en/).

Children with kwashiorkor (Figure 3), from the Ghanaian Kwa language meaning "the deposed child", present with oedema and may show other classical features including 'flaky paint' dermatitis with areas of hypo- and hyper-pigmentation, sparse depigmented hair and hepatomegaly; these children are typically described as apathetic. Children often present with clinical features of both syndromes: "marasmic kwashiorkor". MUAC is a more reliable index of wasting than weight for height in children with nutritional oedema.

Aetiology and pathophysiology

Malnutrition results from a combination of inadequate diet and infections which exacerbate energy and nutrient losses through anorexia, vomiting and diarrhoea. Wasting is a consequence of acute malnutrition whereas stunting results from longer-term adversity. Even in the absence of overt infection, microbial contamination of the gut can result in an environmental enteropathy that impairs digestion and nutrient uptake and may result in sepsis from bacterial translocation across the intestinal mucosa.

Although nutritional oedema of kwashiorkor was first described in the 1930s, the underlying pathological mechanism is still not fully understood. Similarity in the diet amongst children with marasmus and kwashiorkor, and animal studies of protein restriction, do not support the long-held assumption that oedema is a consequence of low plasma protein concentrations resulting from dietary protein deficiency. An alternative hypothesis that increased free radical exposure results in oedema through increased vascular permeability was not supported by the lack of effect of antioxidant dietary supplementation. Recent research raises the possibility of an inherited underexpression of heparin sulphate proteoglycan, a glycosaminoglycan which has a role in mucosal integrity, free fatty acid uptake and keratinocyte adhesion.

"Reductive adaptation", a response to malnutrition, describes the down regulation of the basal metabolic rate and catabolism of reserves of carbohydrate, protein and fat. One clinically important effect is a decrease in the number and function of Na–K pumps in cell membranes resulting in higher intracellular sodium and loss of potassium into the extracellular space and thence into the urine. The net effects are an increase in total body sodium, low plasma sodium and a depletion in total body potassium. Physiological processes such as heart rate, physical activity and growth are minimized, and the function of all the major organs is impaired. The kidneys are less able to excrete the extra sodium. Cardiac muscle atrophies and hypokalaemia contributes to poor contractility and reduced cardiac function. Hepatic glucose stores are depleted and gluconeogenesis impaired. In addition to environmental enteropathy, digestion and nutrient absorption is impaired by reduced production of acid and enzymes and

Agreed definitions for underweight, wasting & stunting based on anthropometric indices

Classification	Index used	Moderate	Severe
Underweight	Weight for age	<−2 Z-scores	<−3 Z-scores
Wasting	Weight for length/height	<−2 Z-scores	<−3 Z-scores
	Mid upper arm circumference (6–59 months)	<125 mm	<115 mm
Stunting	Length/Height for age	<−2 Z-scores	<−3 Z-scores

Table 1