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Management of acute moderate and severe childhood malnutrition

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Acute childhood malnutrition affects about a tenth of the world's children under 5 years of age, particularly those living in circumstances of extreme poverty in the developing world.^{1,2} Malnutrition is typically the result of an inadequate diet and is one of the most common diagnoses in children in health facilities in sub-Saharan Africa and south Asia. Acute childhood malnutrition leads to greater risk of death or disability from common paediatric illnesses such as pneumonia and diarrhoeal disease, and it shapes long term health by compromising physical and intellectual development.³ The condition carries a case fatality rate of 5-60%.^{4,5} This review describes how best to manage cases of acute childhood malnutrition in light of recent changes in standard recommendations.

What is acute malnutrition?

In acute malnutrition, the amount of one or more macronutrients available to body tissues is inadequate to sustain optimal function. Macronutrient deficiency may result from inadequate diet, poor absorption of ingested nutrients, or the presence of a chronic inflammatory condition that increases requirements for nutrients while promoting a nutrient wasting, catabolic state.

How is acute malnutrition diagnosed and categorised?

Anthropometry

Nutritional status is assessed with the weight for height z score, which compares a child's weight to that of a healthy reference population of children of the same height or length and is expressed in units of standard deviations from the mean of the reference population. Recently the World Health Organization redefined

normal child anthropometry, considering a diversity of ethnicities and recognising that optimal infant feeding includes exclusive breastfeeding for the first six months of life.

In peripheral health facilities or in the community, where height is not easily measured, the circumference of the upper arm can be used in place of the weight for height z score to identify malnutrition. It changes little between the ages of 6 months and 5 years and is a measure of lean body mass. Prospective studies in Asia found that an upper arm circumference of <110 mm was the single best anthropometric predictor of death from malnutrition within 6 months.⁶ A measurement <110 mm is also used to define severe malnutrition.⁷ Using arm circumference will identify a different population as severely malnourished than will using the weight for height z score. When arm circumference is used, the population designated as malnourished is generally larger by 1.3. Conversely, 10% of the children identified as severely malnourished by the weight for height z score are not classified as such when arm circumference is used.

Oedema

Nutritional oedema is a physical finding of severe malnutrition. It presents bilaterally on the dorsum of the hands and feet. Children with nutritional oedema do not have primary renal, hepatic, or cardiac disease, and they do not have ascites. Nutritional oedema is generally associated with monotonous, maize based diets in populations facing food insecurity.

Categorisation

Acute malnutrition is differentiated as moderate or severe. Moderate malnutrition is defined as a weight for height z score between 2 and 3 standard deviations (SD) below the mean.⁸ Severe malnutrition is defined as the weight for height z score more than 3 SD below the mean, or an arm circumference <110 mm, or the presence of nutritional oedema. Moderate or severe malnutrition without nutritional oedema is termed marasmus, and malnutrition identified as severe due to the presence of oedema is termed kwashiorkor.

SOURCES AND SELECTION CRITERIA

We searched Medline for the terms "moderate malnutrition", "severe malnutrition", "supplementary feeding", and "therapeutic feeding", limiting the search to children. We utilised a personal archive of references, specifically concerning recent recommendations or changes in the standards of care. This article relies on evidence we have drawn from involvement in the international community that generates the latest research in care for malnourished children.

Box 1 Clinical features associated with complicated malnutrition

- Fever related to systemic infection, typically Gram negative coliforms such as *Escherichia coli* and *Klebsiella pneumoniae*
- Respiratory distress
- Heart failure
- Electrolyte derangements, including hypophosphataemia, hypokalaemia, hypoglycaemia
- Marked anorexia
- Anaemia
- Profuse diarrhoea
- Shock

Kwashiorkor is associated with a higher mortality rate than marasmus.

Severe malnutrition may also be categorised as uncomplicated or complicated (box 1). The most common complication is systemic bacterial infection.

What is the first response in managing a malnourished child?

All organ systems have a reduced capacity to maintain homeostasis in malnutrition.⁹ Physiological changes due to severe malnutrition can be life threatening, and careful clinical evaluation of the child is critical. If the child presents in the context of a resource rich environment, where food insecurity secondary to poverty is unlikely, the clinician should consider which chronic condition or illness is causing the child to be malnourished. If the child presents in a resource poor setting, where food insecurity is commonplace, the diagnosis of malnutrition secondary to inadequate dietary intake should be the first consideration. The figure outlines a general management scheme.

Should the child be treated in a healthcare facility or at home?

The decision to treat in a hospital or at home is based primarily on a child's clinical presentation but also on the resources available to the child in each setting. Home based care is advised for uncomplicated malnutrition; complicated acute malnutrition requires facility based care. Generally 5-30% of the children presenting with malnutrition need to be cared for in a healthcare facility.^{10,11}

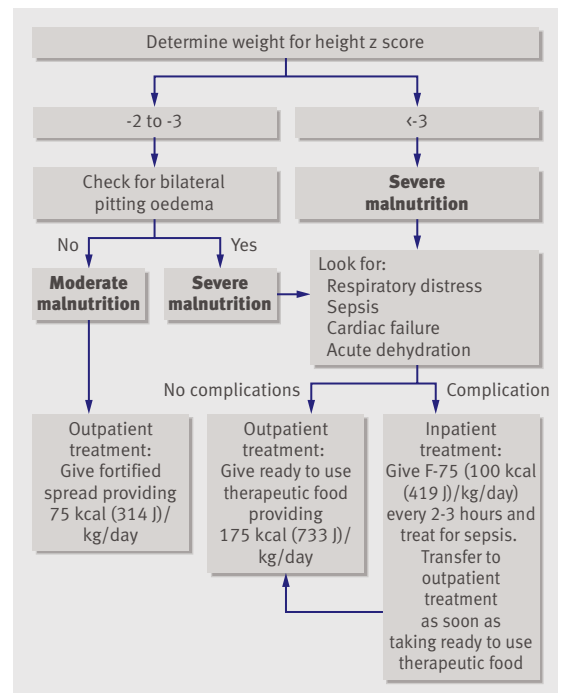
Controlled trials show that community based or home based management for children with uncomplicated acute severe malnutrition is associated with equal or superior outcomes than hospital care.^{12,13} A recent joint statement by the WHO, Unicef, and the World Food Programme advocates treating acute malnutrition in the community whenever possible.¹⁰ In the developing world children are often cared for in large, overcrowded wards, so the risk of nosocomial infection is great, and every effort should be made to give treatment outside of the facility.

To assess children's ability to respond to home based treatment, feed them a 30 g test dose of therapeutic food and judge their appetite.¹¹ Children who will consume therapeutic food in the ambulatory clinic are good candidates for home based treatment.

A child treated at home receives therapeutic food on enrollment and consumes the food at home. At regular intervals, the child and a caregiver return to the health facility for measurements to gauge the child's growth and to receive therapeutic food. Return visits stop when anthropometry and clinical assessment determine that the child has recovered.

How is acute moderate malnutrition managed?

Acute moderate malnutrition is treated by adding a nutrient rich supplemental food that provides the daily recommended dietary allowance of all micronutrients in addition to the child's habitual diet. The food typically used in the developing world is a cereal and legume blended flour that provides about half of the total energy requirement for catch-up growth, 75 kcal (314 J)/kg/day.¹⁴ However, the effectiveness of these flours is modest.¹⁵ Recently, ready to use fortified spreads have been successfully used to treat moderate malnutrition in Africa.¹⁶ A fortified spread is a lipid rich, water free, hygienic paste that does not support the growth of bacteria because water is absent. Peanut butter is the prototype lipid base; protein rich milk powder and micronutrient powder are embedded in the paste to add the appropriate protein and micronutrient content.¹⁷ Because of the high fat content, fortified spread has an energy density of 5.5 kcal/g. Malawian children with acute moderate malnutrition treated with ready to use fortified spread responded



Diagnosis and treatment of malnourished children

TIPS FOR NON-SPECIALISTS

Start appropriate therapeutic diets at the onset of care—food is medicine to malnourished children
Treat children outside of healthcare facilities whenever possible

UNANSWERED QUESTIONS

How can diets for children cared for in healthcare facilities be made more hygienic and digestible?

Why are case fatality rates for kwashiorkor (severe malnutrition characterised by bilateral pitting oedema) higher than those for marasmus?

Does nutritional therapy in cases of concurrent HIV infection and acute malnutrition need to be modified, and, if so, how?

rapidly to supplemental feeding; most children recovered after four to six weeks of treatment.¹⁶

How is uncomplicated acute severe malnutrition managed?

The severely malnourished child with an adequate appetite is best managed at home with ready to use therapeutic food.^{12,13} This therapeutic food, nutritionally equivalent to the milk based therapeutic food F-100, contains ample amounts of micronutrients to meet the requirements for catch-up growth and replenishment of body stores. It is relatively new, and its effectiveness has been supported by several recent studies.^{12,13} Home based treatment with ready to use therapeutic food has been used successfully in severely malnourished children with nutritional oedema.¹¹ It should be given in quantities that provide 175 kcal (733 J)/kg/day.

How is complicated acute severe malnutrition managed?

The severely malnourished child with immediately life threatening complications should be stabilised in an inpatient facility. Treatment of severe malnutrition in the facility involves feeds of small amounts of liquid food every two hours. The recommended daily energy intake of 100 kcal/kg/day is provided by a milk based formula called F-75.¹⁸ The body of evidence supporting the use of these recommended practices and the standard F-75 therapy is based primarily on clinical judgment and expert opinion. To prevent hypoglycaemia, prompt feeding on admission is recommended.⁸ The liquid food should contain at least 3-4 mmol/kg/day potassium and 2 mmol/kg/day phosphorus to replace losses.⁸ Where the ambient temperature is below 15°C, malnourished children should be wrapped in blankets and kept close to caretakers' bodies to prevent hypothermia.

Once the child with complicated severe malnutrition has regained appetite and is no longer unstable, usually after a few days of treatment in a health facility, he or she is best managed as the child with uncomplicated severe malnutrition. At this point the child's diet is advanced to a high energy, high protein ready to use food. Rarely will a child make an abrupt transition from anorexia to an avid appetite, but the appetite will usually improve gradually over a few days. It is not necessary for the clinician to regulate dietary intake

during this transition as long as the child is consuming 100 kcal (419 J)/kg/day.

Sepsis and shock

Because sepsis occurs coincidentally in 15-60% of children with complicated severe malnutrition it is standard practice to give broad spectrum, parenteral antibiotics.¹⁹

Severely malnourished children should be carefully monitored for shock, which may be the result of cardiac failure, compromised capillary integrity as is seen in sepsis, or (less commonly) fluid losses. Diagnosing the cause of shock in the severely malnourished child is important, even in settings with severe resource constraints, because diagnosis will guide treatment and affect outcome. Supplemental oxygen is always appropriate when shock is diagnosed.

Clinicians are often concerned that their severely malnourished patients have hypovolaemic shock from intravascular fluid depletion since severely malnourished children often take oral fluids poorly, may have a few loose stools daily, and may have altered mental status. These symptoms may be seen in shock of any aetiology. Hypovolaemic shock is more likely when there are more than six stools per day or large volumes of watery stool. In these cases, oral rehydration should be given in the form of F-75 therapeutic food, in quantities estimated to replace losses. The standard oral rehydration solution recommended by WHO, with 90 mmol/l of sodium, increases the risk of heart failure because the cardiac muscle is thin and atrophied in a severely malnourished child.^{8,20}

Intravenous fluid infusions

Giving parenteral fluids to severely malnourished children is not recommended. This treatment has been identified as a risk factor for death, even after the severity of the clinical illness has been controlled for.²¹ Standard management recommendations direct that isotonic, parenteral fluids should be given only in cases of profuse watery diarrhoea and when the clinician is firmly convinced by clinical observations that hypovolaemic hypotensive shock is present.⁸ A case-control study from Bangladesh compared severely malnourished children with diarrhoea and signs of shock who were given standard treatment (100 ml/kg isotonic, parenteral fluids followed by oral rehydration solution) with those treated with reduced parental fluid therapy (30 ml/kg of isotonic, parenteral fluids followed by a low sodium oral rehydration solution) and found that the case fatality rate among the children who received reduced parental fluids was half the rate of those who received the standard treatment.²²

Blood transfusions

Malnourished children often have low haemoglobin, typically 60-100 g/l, although they rarely have acute blood loss. When in shock, malnourished children look pale. This may prompt the clinician to consider whether anaemia is the cause of their haemodynamic

ADDITIONAL EDUCATIONAL RESOURCES

World Health Organization. *Management of severe malnutrition: a manual for physicians and other senior health workers*. 1999. (<http://whqlibdoc.who.int/hq/1999/a57361.pdf>)—guidelines for health personnel

Community-based management of severe acute malnutrition: a joint statement by the World Health Organization, the World Food Programme, the United Nations System Standing Committee on Nutrition and the United Nations Children's Fund (www.who.int/nutrition/topics/Statement_community_based_man_sev_acute_mal_eng.pdf)—information on home based treatment and ready to use therapeutic food

SUMMARY POINTS

Children with severe malnutrition and evidence of systemic infection should be monitored for shock

Oral or parenteral fluid resuscitation should be reserved for those with profuse watery diarrhoea as evidence of hypovolaemia

Malnourished children should be tested promptly for HIV infection so that they can receive appropriate prophylaxis and treatments

compromise. In most cases, anaemia is not compromising oxygen delivery to body tissues, and a blood transfusion could exacerbate heart failure. Blood transfusions have been identified as a risk factor for death in children treated for severe malnutrition.²¹ The WHO recommends giving blood transfusions only when haemoglobin is under 40 g/l.⁸

How does a concurrent diagnosis of HIV infection affect management?

In sub-Saharan Africa, tens of thousands of severely malnourished children with HIV infection seek care every year. A study of 200 children presenting with malnutrition in a Zambian hospital found that 54% also had HIV infection.²³ Prompt diagnosis of HIV infection is necessary, because in some areas of the developing world starting antiretroviral therapy takes weeks.²⁴

HIV infected children are more likely to have systemic bacterial infection when doubly immunocompromised by malnutrition. Antibiotic coverage for sepsis must cover the most common bacteria found in these children; infection with enteric *Salmonella* species or *Salmonella typhimurium* is more common in malnourished children with HIV infection.²⁵ As HIV and tuberculosis are often coinfections, malnourished children with HIV infection will benefit from cotrimoxazole prophylaxis to prevent infection with *Pneumocystis jiroveci*.²⁶

What outcomes are expected?

Among uncomplicated moderately and severely malnourished children without chronic illness, home based treatment yields recovery rates of 85-90%.²⁷ The case fatality rates in these groups of children are less than 5%, more typically 1-2%. Among uncomplicated cases, 5-10% of children do not improve when treated at home, but they will usually reach and maintain a weight for height z score above -2 after medical evaluation and inpatient treatment. Complicated severe childhood malnutrition that needs inpatient treatment but is not associated with chronic illness can be successfully managed in 90% of cases.^{25,27} In children with HIV infection and severe malnutrition, careful management is associated with a case fatality rate of 15-25%.²⁴

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