

Malnutrition

What is malnutrition?

Malnutrition is a nutrient deficiency state of protein, energy or micronutrients (vitamins and minerals).^[1] This causes measurable harm to body composition, function or clinical outcome.

Important information

Malnutrition is both a cause and a consequence of ill health. We tend to visualise malnutrition as solely affecting starving children in the developing world but it is common at home, particularly in elderly and hospitalised populations and massively increases a patient's vulnerability to disease. Reasonable opinion considers a healthy diet a basic human right.^[2]

NB: overnutrition and resulting obesity are sometimes included within the general definition of 'malnutrition' but for this see separate [Obesity in Adults](#) and [Obesity in Children](#) articles.

Protein-energy malnutrition (PEM)

There are two forms:

Kwashiorkor

- Fair-to-normal energy intake but inadequate protein.
- Associated with oedema and hepatomegaly.
- The word comes from the Ghanian language, Ga, and implies "the disease that the young child develops when displaced from his mother's breast by another child or pregnancy".

Marasmus

- Inadequate energy and protein intake.
- Associated with severe wasting.

Micronutrient deficiencies

Deficiencies in iron, iodine, vitamin A and zinc remain major public health problems in developing countries.^[3]

	Necessary for:	Causes of deficiency:	Manifestations of isolated deficiency:	Management and prevention:
Iron	Haemoglobin Myoglobin	Poor diet Elevated needs (eg, pregnancy, childhood) Parasitic infections	Anaemia and fatigue Impaired cognitive development Reduced growth	Foods rich in iron Iron-fortified weaning foods Low-dose supplements
Iodine	Thyroid hormones	Most diets worldwide are deficient unless fortified salt or seafood are available.	Goitre Hypothyroidism Growth restriction	Iodine supplementation Fortified salt Seafood
Vitamin A	Eyes Immune system	Diets poor in vegetables and animal products.	Night blindness Immune deficiency Increased childhood illness and death	Dark green leafy vegetables Animal products Fortification of oils/fats Supplementation
Zinc	Many enzymes Immune system	Diets based on refined cereals and lacking in animal products.	Immune deficiency Acrodermatitis Increased childhood illness and death	Zinc treatment for diarrhoea and malnutrition Improved diet

How common is malnutrition? (Epidemiology)

Globally, malnutrition is the most important risk factor for illness and death. It affects children and pregnant women disproportionately. It is the direct cause of about 300,000 deaths per annum and indirectly responsible for about half of all deaths in young children (malnutrition increases the risk of death from diarrhoea, lower respiratory tract infection, malaria and measles).^[3]

The World Health Organization (WHO) estimates that the current prevalence of malnutrition worldwide is 17.6% - with the vast majority living in developing countries in southern Asia and sub-Saharan Africa. An additional 29% will have stunted growth due to poor nutrition.

In the UK:^[4] ^[5]

- More than 3 million individuals are estimated to be at risk of malnutrition in the UK, of whom about 93% live in the community.
- Surveys have found that 28% of individuals on admission to hospital and 30-40% of those admitted to care homes in the previous six months were malnourished.
- Outpatient studies have shown that 16-20% of patients were malnourished and these were associated with more hospital admissions and longer length of stay.
- In sheltered housing, 10-14% of the tenants were found to be malnourished, with an overall estimated absolute prevalence of malnutrition which exceeded that in hospitals. In all cases, the majority of subjects were at high risk of malnutrition.

Risk factors

Malnutrition in children

- Young age (<5 years) - most vulnerable are premature babies and infants at time of weaning
- Children with co-existing chronic illnesses or developmental delay.
- Neglect by care-givers.

- Poverty and its complex relationships with:
 - Political and economic situation.
 - Education.
 - Sanitation.
 - Seasonal and climatic conditions.
 - Food production and security.
 - Cultural and religious traditions.
 - Prevalence of infectious diseases.
 - Availability and effectiveness of nutrition programmes and health services.

Malnutrition in elderly people ^[6]

- Living alone.
- Institutionalisation or hospitalisation.
- People with severe [learning difficulties](#) or mental health problems ([depression](#), [dementia](#)).
- Diseases that affect appetite, eating/swallowing or gastrointestinal function (gastric surgery, [malabsorption](#),
- Poor physical function - eg, caused by [stroke](#) and neurological disorders such as [motor neurone disease](#)).
- Catabolic states.

Malnutrition symptoms

Malnutrition in adults

Adults tend to lose weight, often insidiously. Oedema may mask weight loss.

BMI is a key measure (weight in kg divided by height in metres squared):

- 17-18.5 - mild malnutrition.
- 16-17 - moderate malnutrition.

- <16 – severe malnutrition.

Other features may include:

- Listlessness.
- Increasing fatigue.
- Cold sensitivity.
- Non-healing wounds and severe [decubitus ulcers](#).

Presentation in children ^[3]

WHO criteria for identifying children with severe malnutrition:

- Bipedal oedema.
- Visible severe wasting.
- Weight for height more than three standard deviations below the median of international reference population.

Protein energy malnutrition:

- Poor weight gain.
- Slowed linear growth.
- Behavioural changes – irritability, apathy, anxiety, attention deficit. Classically apathetic and quiet when lying in their bed but cry when picked up, with a typical monotonous bleat or loud groan.

Three clinical syndromes (note, mixed pictures may occur):

- Marasmus: ^[7]
 - Obvious loss of weight with gross reduction in muscle mass, especially from limb girdles. Subcutaneous fat virtually absent.
 - Thin, atrophic skin lies in folds.
 - Pinched face has appearance of old man or monkey.
 - [Alopecia](#) and brittle hair.
 - Sometimes, appearance of lanugo hair.

- Kwashiorkor:^[8]
 - Usually occurs in children aged 1-2 years with changing hair colour to red, grey or blonde.
 - Moon facies, swollen abdomen (pot belly), hepatomegaly and pitting oedema.
 - Dry, dark skin which splits where stretched over pressure areas, to reveal pale areas.
- Nutritional dwarfism:
 - Patient is small for age.
 - Face shape may be affected by size of teeth.

Other clinical features may include:^[9]

- Fever related to systemic infection (especially Gram-negative coliforms such as *Escherichia coli* and *Klebsiella pneumoniae*).
- Respiratory distress.
- Heart failure.
- Electrolyte abnormalities ([hypophosphataemia](#), [hypokalaemia](#), [hypoglycaemia](#)).
- Marked anorexia.
- Anaemia.
- Profuse diarrhoea.
- Shock.

Screening for malnutrition

Screening should assess BMI and percentage of unintentional weight loss and should consider the timescale of reduced nutritional intake and likelihood of this continuing in the future. Several screening tools exist to aid this assessment, including:

- The 'Malnutrition Universal Screening Tool' (MUST), which was developed by the Malnutrition Advisory Group, a standing committee of the British Association of Parenteral and Enteral Nutrition (BAPEN); it has been reviewed regularly since its launch in 2003. ^[10]
- The Mini Nutritional Assessment Short Form (MNA[®]-SF), which is a practical tool for identification of nutritional status. ^[11] ^[12]

Nutritional support should be considered for those:

- With a BMI <18.5.
- With unintentional weight loss of >10% over the previous 3–6 months.
- With a BMI <20 and unintentional weight loss of >5% over the previous 3–6 months.
- Who have eaten little or nothing for >5 days and who are unlikely not to for the following 5 days or longer.
- Who have poor absorption, high nutrient losses or increased nutritional needs.

Differential diagnosis

Elderly failure-to-thrive (weight loss >5% of baseline, decreased appetite, poor nutrition, inactivity) – consider in addition to malnutrition: ^[13]

- Impaired physical function (for example, infection, malignancy, renal or heart failure).
- Depression.
- Dementia.

Severe malnutrition – may all co-exist:

- Dehydration.
- Severe infection.
- Hypoglycaemia.
- Anaemia.

Investigations

Anthropometric assessment:^[9]

- Height and weight (height and weight for age and weight for height are sensitive markers in childhood and a z score, comparing an individual child to a healthy reference population, can be derived, expressed in units of standard deviations from the mean of the reference population):
 - Moderate malnutrition is defined as a weight for height z score between two and three standard deviations below the mean.
 - Severe malnutrition is defined as the weight for height z score more than three standard deviations below the mean.
- BMI (used mainly in adults).
- Mid upper arm diameter (over-diagnoses among younger children, under-diagnoses among older children):
 - An upper arm circumference <110 mm is also used to define severe malnutrition in children.
 - Asian prospective studies have found that an upper arm circumference of <110 mm was the best single anthropometric predictor of death from malnutrition within six months.
- Skin folds.

NB: standardised reference tables need to be appropriate for use with a particular ethnic group and may not be accurate for elderly populations.

For the investigation of malnourished children in developing countries, WHO recommends:

- Blood glucose
- FBC and film
- Urine MC&S
- Stool OC&P

- Serum albumin
- HIV test
- U&Es

NB: tuberculin skin testing is less reliable in the malnourished child.

Additional tests to assess nutritional status may include:

- Iron studies, folate, B12.
- Pre-albumin, transferrin, retinol-binding protein (better short-term indicators of protein status than albumin alone).
- TFTs.
- Coeliac serology.
- Calcium, phosphate, zinc.
- Vitamin levels - if deficiency is suspected.

Most accurate evidence of malnutrition in an elderly patient is hypocholesterolaemia and hypoalbuminaemia.^[13]

Malnutrition treatment and management

General measures for the elderly population in the UK

- General nutritional advice. Evidence suggests that dietary advice with or without oral nutritional supplements may improve weight, body composition and grip strength.^[14]
- Use of supplements - more effective than nutritional advice alone.^[15] Supplementation produces a small but consistent weight gain in older people. Mortality may be reduced in older people who are undernourished.^[16]
- Inability to shop/prepare meals - refer to social services, meals at home service, community dietician, local day centres.
- Factors such as increasing number of people present at meals,^[17] improving the palatability of meals and finding the optimal time of day and location of meals may also improve intake.

- Difficulty with feeding utensils - refer to occupational therapy to consider aids/equipment.
- Nausea - consider antiemetics.
- Oral pathology - treat if present.
- Dysphagia - investigate and refer to speech and language therapy. If not amenable to treatment, consider puréed food or thickened fluids.

Acute management of the severely malnourished^[9]

- Clinical assessment - check for co-existing dehydration, infection, anaemia, hypoglycaemia.
- Correct shock and dehydration and restore electrolyte balance. National Institute for Health and Care Excellence (NICE) guidelines state that electrolyte and fluid imbalances do not need to be corrected prior to feeding but should be done alongside.^[1] Reverse malnutrition without overloading cardiac, renal, gastrointestinal or hepatic function.

- Care needs to be taken to avoid refeeding syndrome.^[18] ^[19] Refeeding syndrome is the potentially fatal shifts in fluids and electrolytes that can occur in malnourished patients receiving artificial refeeding, whether parenteral or enteral. Biochemical features include:
 - Fluid-balance abnormalities
 - Abnormal glucose metabolism
 - Hypophosphataemia
 - Hypomagnesaemia
 - Hypokalaemia
 - Thiamine deficiency
-

Patients at high risk of refeeding syndrome include those with:

- Anorexia nervosa.
- Chronic alcoholism.
- Cancer.
- Postoperative debilitation.
- Elderly patients with comorbidities and decreased physiological reserve.
- Uncontrolled [diabetes mellitus](#).

- Chronic malnutrition:
 - Marasmus.
 - Prolonged fasting or low-energy diet.
 - Morbid obesity with profound weight loss.
 - A high-stress patient unfed for >7 days.
 - Malabsorptive syndrome (eg, inflammatory bowel disease, chronic pancreatitis, cystic fibrosis, short bowel syndrome).
- Long-term use of antacids.
- Long-term use of diuretics.

To prevent refeeding syndrome: ^[1]

- Refeeding should be started at no more than 50% of energy requirements in "patients who have eaten little or nothing for more than five days", with the rate increasing if no refeeding problems are detected on clinical and biochemical monitoring.
- For high-risk patients, nutritional repletion of energy should be started slowly (maximum 0.042 MJ/kg/24 hours), increasing to meet or exceed full needs over 4-7 days.
- In patients who are very malnourished (BMI ≤ 14 or a negligible intake for two weeks or more), refeeding should start at a maximum of 0.021 MJ/kg/24 hours, with cardiac monitoring owing to the risk of cardiac arrhythmias.
- Oral, enteral or intravenous (IV) supplements of potassium, phosphate, calcium and magnesium should be given unless blood levels are high before refeeding.
- Check electrolyte levels once daily for one week and at least three times in the following week.

- Any severely malnourished child with immediately life-threatening complications should be stabilised and treated in an inpatient environment. Refeeding should start at 100 kcal/kg/day, every two hours and is usually with a milk-based formula called F-75. Those with severe malnutrition without complications and who are able to accept and tolerate therapeutic food can be monitored in outpatients and treated in the community. They should be refeed at 175 kcal/kg/day, usually with a therapeutic feed known as F-100.^[9]
- In children, there is often co-existing infection. This has such a high prevalence that WHO recommends use of empirical antibiotics for the first seven days.
- Vitamin supplementation should be started immediately, before and for the first 10 days of refeeding.^[1]
- Hypoglycaemia should be treated with IV glucose and/or oral sucrose.
- Cases showing hypothermia require warming.
- Rehabilitation phase of treatment: starts as the child's appetite returns, usually a week after treatment is started. Many essential nutrients are still deficient. In the developing world, fortified spreads (such as peanut butter carrying protein-rich milk powder and micronutrient powders) has been used to treat acute moderate malnutrition in the community.
- Progress is monitored by regular weighing with weight gain target of 10-15 g/kg/day. Return visits to outpatients can stop when anthropometry and clinical assessment show that the child has recovered.
- Identify causes and involve the family/community in prevention of relapse.

Daycare nutrition centres, residential nutrition centres, primary health clinics and domiciliary rehabilitation can, if adequately resourced and planned, be effective in the treatment of severe malnutrition.^[20]

Complications

The consequences of malnutrition include:^[21]

- Impaired immune response and increased risk of infection.
- Reduced muscle strength.
- Impaired wound healing.
- Impaired psycho-social function, including poor cognition and increased dependency. [22]
- Impaired recovery from illness and surgery.
- Poorer health outcomes.
- Poor quality of life. [23]

Prognosis

Severe malnutrition in children carries a case fatality rate of 5–60%. Fatality rates for kwashiorkor are higher than those for marasmus. [9]

Malnutrition prevention

In adults (NICE guidelines) [1] [24]

Screening for malnutrition and for those at risk of developing it should take place as follows:

- All hospital inpatients on admission and repeated on a weekly basis during admission.
- All outpatient attendees at first clinic appointment.
- On entering a care home.
- At initial registration with a GP and opportunistically at, for example, influenza vaccination.
- Where clinical concern exists.

Options for [nutritional support](#) include the use of oral, [enteral](#) or [parenteral](#) nutrition alone or in combination.

GPs widely prescribe oral nutritional supplements. It is very important to record height, weight or other markers of nutritional status prior to prescribing.

Using oral nutritional support:

- Use appropriate fortified standard foods as first-line treatment of malnourished patients prior to use of supplements.
- Always use in conjunction with appropriate dietary advice.
- Do not prescribe on a long-term basis without regular monitoring and reassessment.
- Nutritional needs and food intake determine the number of supplements needed – usually not more than 500–600 kcal daily (approximately two cartons of sip feed) unless under care of a dietician.
- Supplements should be given between meals and not with or instead of a meal.
- Try different flavours and types of feeds to avoid boredom.
- Only prescribable on the NHS for the Advisory Committee on Borderline Substances (ACBS) approved conditions (short bowel syndrome, malabsorption syndromes, pre-operative preparation of malnourished patients, inflammatory bowel disease, total gastrectomy, dysphagia, bowel fistulae, disease-related malnutrition).

Consider carefully the consent issues and whether or not the provision/withdrawal of nutritional support is appropriate – GMC guidance is available.^[25]

In childhood

- Good prenatal nutrition – importance of pre-conceptual and antenatal care.
- Promotion of [breastfeeding](#).
- Health promotion/education – regular age-appropriate nutritional advice and counselling during childhood.
- Specific programmes addressing micronutrient supplementation/fortification (eg, vitamin D, iodine) according to population needs.

- Improvement of hygiene and sanitation to reduce infectious disease and parasitic load.
- Global political and economic commitment to achieving UN millennium development goals – specifically: the reduction of levels of extreme poverty and hunger to half 1990 levels by 2015.

Further reading

- [Management of Severe Malnutrition: a manual for physicians and other senior health workers](#); World Health Organization
- [Managing Adult Malnutrition in the Community](#)
- [BAPEN nutrition website for professionals](#)
- [Helping older people maintain a healthy diet: A review of what works](#); Public Health England, February 2017
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