

Malnutrition (Kwashiorkor and Marasmus) — Symptoms and Treatment

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One of the most common reasons for the death of almost 300,000 children per year is malnutrition. It is seen more frequently among children who are younger than five years and reside in developing countries. The number contributes to half of the total deaths in the child age groups across the world. Protein-energy malnutrition (PEM) is a type of malnutrition commonly seen among children aged six months to 5 years.



Types of Malnutrition

- **Kwashiorkor:** insufficient protein consumption
- **Marasmus:** energy deficiency
- **Marasmic kwashiorkor:** deficiency of both calories and protein

Kwashiorkor

Kwashiorkor is a debilitating and life-threatening condition caused by the **lack of protein** in the diet.

Distribution of kwashiorkor

It is commonly seen in the following areas:

- Famine-stricken regions
- Countries with limited food supply
- Countries with a higher illiteracy rate

Pathophysiology of kwashiorkor

Lack of protein results in an **osmotic imbalance** and **irregularities in the lymphatic system**. Three major functions served by the lymphatic system of the body are:

- Fluid recovery
- Immunity
- Lipid absorption

In the case of protein subnutrition, the patient exhibits reduced ability towards fluid recovery; there is a lack of immunity and insufficient lipid absorption.

Lack of proteins results in 0 substantial pressure gradient and, therefore, a failure to draw fluids from tissues into the bloodstream. This failure leads to the **pooling of fluids in the abdomen**.

Failure of fluid recovery by the lymphatics results in **edema** and **belly distension**, which is the typical presentation of an undernourished child. Edema may trick the parents into thinking that the child is well nourished despite the lack of protein intake.

Signs and symptoms of kwashiorkor

For an undernourished child suffering from Kwashiorkor, **pitting edema** is the characteristic sign. Other signs and symptoms include:



Image: "Protruded belly in a child suffering from kwashiorkor." by Dr. Lyle Conrad – Centers for Disease Control and Prevention, Atlanta, Georgia, USA Public Health Image Library (PHIL); ID: 6901 <http://phil.cdc.gov/>. License: Public Domain

- **Weight loss** or decreased muscle mass in arms and legs
- **Swollen abdomen** due to fatty liver and increased capillary permeability resulting in ascites
- **Peripheral edema** resulting from decreased oncotic pressure
- Anemia
- Desquamative rash on flexures and buttocks
- Skin pigmentation
- Thinning of hair
- Failure to gain bodyweight
- **Retarded growth**
- Lethargy or apathy
- **Behavioral changes:** Patients are irritable, apathetic, and miserable. Physicians believe that the return of a smile is the first sign of treatment response.
- Inability to fight infections due to poor immunity
- Change in hair color
- **Diarrhea**
- **Edema:** Initially, it involves the dorsum of the feet and ankles and later spreads upwards to the whole body. Edema accounts for 5–20% of the body weight. Loss of fluid can mark a striking change in appearance.
- Shock is seen in later stages
- Loss of teeth
- **Anorexia**
- Reddish appearance due to discoloration of hair and skin
- Poor renal function
- Metabolic and electrolyte imbalance

Diagnosis of kwashiorkor

The physical examination shows general swelling, protruded belly, and hepatomegaly. Investigations may include:

- **Arterial blood gas analysis**
- Total protein levels
- **Urinalysis**
- Serum potassium
- Creatinine clearance
- Serum creatinine
- Blood urea nitrogen (BUN)
- Complete blood count (CBC)

Treatment of kwashiorkor

Treatment options depend on the severity of the condition. In the early stages of the disease, treatment revolves around **providing an adequate diet** for the child, with more calories and protein.

However, this will not compensate for the damage that has already been done to the growth and height potential of the child. **Carbohydrates**, in the form of simple sugars and fats, are given first to cater to the catabolic needs, and this is because the protein catabolism includes the urea cycle that can overwhelm the already damaged liver.

So, **proteins** are given after other sources of energy have been provided. They only

serve anabolic purposes. **Vitamins and minerals** are also essential to restore the nutritional status of the patient.

Food must be introduced slowly and gradually to prevent issues arising from the administration of high calories after a long time.

Patients of Kwashiorkor may develop **lactose intolerance**. They require supplemental enzyme lactase.

Those in the later stages of the disease may present with **shock**. The treatment then aims to restore the blood volume and maintain blood pressure.

Prognosis of kwashiorkor

Early treatment can produce better results. Treatment in the later stages improves the nutritional status of the child. However, it does not compensate for the physical and mental damage that has already been done. It can be a **life-threatening condition** if not treated on time.

Possible complications of kwashiorkor

If not treated on time, the following complications are seen:

- **Coma**
- Permanent mental and physical disability
- Shock

Prevention of kwashiorkor

Prevention is through an **adequate diet** containing sufficient carbohydrates, fats that provide 10% of the total caloric needs, and proteins that makeup 15% of the caloric intake. Proteins can be found in the following foods:



[Image](#): "Protein-rich foods." by Smastronardo – Own work.
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- Seafood
- Peas
- Nuts
- Seeds
- Eggs

- Lean meat
- Beans

Marasmus

Marasmus is a type of malnutrition primarily caused by a **deficiency in calories and energy**. There is a severe deficiency of nearly all nutrients, especially protein, carbohydrates, and lipids.

Distribution of marasmus

It is commonly seen in the following areas:

- Famine-stricken regions
- Urban slums and shantytowns of developing countries
- Countries with higher illiteracy rates

Causes of marasmus

Negative energy balance causes marasmus, and this can be due to factors such as:

- Decreased energy intake
- Increased loss of ingested calories due to emesis, chronic [diarrhea](#), burns, etc.
- Increased energy expenditure
- Viral, [bacterial](#), and parasitic infections
- Bottle feeding
- Combinations of the above factors

Pathophysiology of marasmus

In response to a low-calorie diet and low energy, the body responds in the following ways:

- **Fat stores** decrease up to 5% of the total body weight, and the **extracellular water** content of the body increases.
- **Protein mass** can decrease up to 30% in severe cases, and muscle fibers lose striations and become thin. Protein sparing mechanisms redirect amino acids to the vital organs.
- **Hypothermia** and **hypoglycemia** are more frequent in infants due to underdeveloped systems.
- **Potassium deficiency** of up to 15 mEq/kg results in hypotonia and impaired cardiac function.
- Elevated levels of **intracellular sodium** are present in muscles, brain, and blood cells.
- Metabolic adaptations in marasmus are like those in starvation.
- **Basal metabolic rate** decreases. The energy is diverted from muscles to the vital organs. **Muscle loss** is a result of decreased energy expenditure.
- Brain, skeleton, and kidney are preserved, whereas the liver, heart, pancreas, and digestive tract are affected first.
- **Impaired glucose clearance** in marasmus is due to compromised pancreatic beta-cell function.
- Secretory functions of mucosal surfaces are impaired along with **decreased HCL production**, and **slow peristalsis**.
- Adaptations are seen by thyroid hormones, insulin, and growth hormone.

- Thymus and all other T lymphocytes-producing tissues are affected, leading to an **immunocompromised state**.
- The brain is usually preserved during marasmus.
- **Myofibril contractility** is impaired.

Signs and symptoms of marasmus



Image: "A shrunken wasted appearance is a characteristic feature in marasmus." Photo Credit: Content Provider(s): CDC/ Don Eddins - This media comes from the Centers for Disease Control and Prevention's Public Health Image Library (PHIL), with identification number #1702. License: Public Domain

Shrunken, wasted appearance is the classical presentation of marasmus. Other clinical manifestations are as follows:

- Prominence of ribs
- Slow growth
- Drastic loss of adipose tissue
- Chronic diarrhea
- Muscle atrophy, especially in the upper arms and buttocks
- Skin folds
- "Old man" face
- Unusual body temperature (**hypothermia** or **pyrexia**)
- Anemia
- **Dehydration** (frequent thirst and shrunken eyes)
- Corneal lesions due to **vitamin A deficiency**
- Dermal manifestations
- Otitis and rhinitis
- **Hypovolemic shock** leading to weak radial pulse, cold extremities, and decreased consciousness
- Tachypnea
- **Paralysis of the lower extremities**
- **Weak bladder and bowel control**
- Blood or mucus in stools

- Metallic bowel sounds
- Infections
- Weight loss
- Lethargy
- **Fainting or alteration of awareness**
- **Persistent vomiting**

Complications of marasmus

- Lack of proper growth in children
- Permanent vision loss
- Organ failure
- Severe weakness
- Joint deformities

Diagnosis of marasmus

Lab values are taken to construct an appropriate treatment plan. Diagnosis is based on the following lab tests:

- **Blood glucose** values lower than 3 mmol/L are indicative of hypoglycemia.
- **Hemoglobin** levels lower than 40 g/L are indicative of severe **anemia**.
- **Examination of blood smears** by microscopy: parasite detection is indicative of infection.
- **Albumin value** lower than 35 g/L is indicative of severe protein synthesis impairment.
- Urine examination and culture
- Microscopic stool examination
- **Electrolytes**: Hyponatremia is evident. However, results are rarely helpful and can also lead to inappropriate therapy.
- **HIV tests** are not routinely performed.

Treatment of marasmus

- **Correct water and electrolyte balance**
 - Use a nasogastric tube
 - Continue **breastfeeding** as soon as possible; contraindicated in case of shock and coma
 - Start other food after 3-4 hours of rehydration
- **Treat infections**
- **Provide dietary support**
 - Vitamins and mineral supplements
 - 3-4 g protein and 200 cal/kg body weight/day
- Counsel parents and plan the future, including immunization and diet supplements
- Add frequent small feeds
- Use a liquid diet
- Prevent hypothermia
- Give vitamin A and folic acid
- Use lactose-free or soybean formula for treating **diarrhea**
- Treat lactose intolerance
- In cases of shock, provide intravenous rehydration with lactated Ringer's

solution and 5% dextrose

- Encourage the child to eat frequently
- Stimulate the emotional and physical development of the child

Prevention of marasmus

- Provide a diet rich in calories, proteins, and other dietary essentials to the pregnant and lactating mothers and children
- Encourage breastfeeding
- Nutritional education
- Early treatment for affected children
- Immunization against 6 major killer diseases

References

[Marasmus](#) via medscape.com

[Kwashiorkor](#) via medlineplus.gov

[What you should know about Marasmus](#) via healthline.com

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