



# University of Baghdad

## College of Medicine

**Title: Malnutrition- 2**

**Grade: Fifth**

**Module: Pediatrics**

**Speaker: Prof. Dr. Mohammad Fadhil Ibraheem**

# Learning objectives



- To define kwashiorkor, nutritional marasmus and marasmic kwashiorkor know their presentations.
- To understand the basics of treatment of severe malnutrition
- How to deal with refeeding syndrome.
- Direct causes of death in malnutrition
- Prognosis of the cases.

# Kwashiorkor

- "*the one who is displaced*" reflecting the development of the condition in the older child who has been weaned from the breast once a new sibling is born.

- Jamaican pediatrician Dr. Cicely Williams introduced the name into the medical community in her 1935 Lancet article.

The name is derived from the Ga language of coastal Ghana.





# Kwashiorkor

Many studies have found that a lack of **antioxidant micronutrients** such as  **$\beta$ -carotene**, **lycopene**, other **carotenoids**, and **vitamin C** as well as the presence of **aflatoxins** may play a role in the development of the disease. However, the exact cause of kwashiorkor is still unknown.

-  $\beta$ -Carotene (beta-carotene) is an organic, strongly colored red-orange pigment abundant in fungi, plants, and fruits. Dietary  $\beta$ -carotene is a provitamin A compound, converting in the body to retinol (vitamin A). In foods, it has rich content in carrots, pumpkin, spinach, and sweet potato.

-Lycopene is an organic compound classified as a tetraterpene and a carotene. Aside from tomatoes, it is found in red carrots, watermelons, grapefruits, and papayas. It is not present in strawberries or cherries.

- - Vitamin C (also known as ascorbic acid and ascorbate) University of Baghdad/ College of Medicine 2022-2023

is a water-soluble vitamin found in citrus and other fruits, berries and vegetables. Vitamin C is an essential nutrient involved in the

repair of tissue, the formation of collagen, and the enzymatic production of certain neurotransmitters. It is required for the functioning of several enzymes and is important for immune system function



-Aflatoxins are various poisonous carcinogens and mutagens that are produced by certain molds, particularly *Aspergillus* species mainly by *Aspergillus flavus* and *Aspergillus parasiticus*. The fungi grow in soil, decaying vegetation and various staple foodstuffs and commodities such as hay, maize, peanuts, coffee, wheat, millet, sorghum, cassava, rice, chili peppers, cottonseed, tree nuts, sesame seeds, sunflower seeds, and various cereal grains and oil seeds. In short, the relevant fungi grow on almost any crop or food.



- Deficiency of protein with relatively adequate energy intake.
- **Failure of growth:**
  - **Oedema:** pitting, bilateral including lower extremities. May be localized or extensive, including eyelids.
  - **The muscles are wasted;** This is particularly noticeable around the chest and the upper arm; the wasting of the legs and around the hips is frequently concealed by oedema.

## Kwashiorkor



# Kwashiorkor

- **Mental changes::** the child is apathetic and miserable.

- **Hair:** becomes fine, straight and often sparse.

Children with long straight black hair may show a pale band across the hair, corresponding to an earlier episode of kwashiorkor, the 'flag sign'.

- **Skin:** pigmentation, desquamation and ulceration.

A severe case may look like an extensive burn.

The legs, buttocks and perineum are most frequently involved, but any region may be affected.

This is called **flaky skin** which is caused by inadequate protein or fat in the context of ongoing carbohydrate intake.





#### 4. Hair change

- Hair of normal asian child is dark, black, coarse in texture and reflects light.
- In kwashiorkor hair become –
  - thin
  - lack of luster
  - dull and lifeless
  - Easily pluckable without pain
  - Change to raddish color







**Mucous membranes:** angular stomatitis, cheilosis and a smooth tongue are commonly seen, as is ulceration around the anus.

**Liver:** this may be enlarged.

**Gastrointestinal system:** anorexia is usually present and sometimes vomiting. There is nearly always diarrhea, with the passage of stools containing undigested food. The diarrhea may be due to impaired secretion of digestive enzymes, to intestinal mucosal atrophy or to an intestinal infection.

**Anaemia**

**Associated vitamines deficiencies:**

vit. A, thiamine, niacine, folate, vitamin k.





# Kwashiorkor



Sparse, straight, readily pluckable hair

Puffy eyes, mooned face

Apathy, misery, anorexia, anaemia

Wasting upper arms and upper trunk

Hepatomegaly

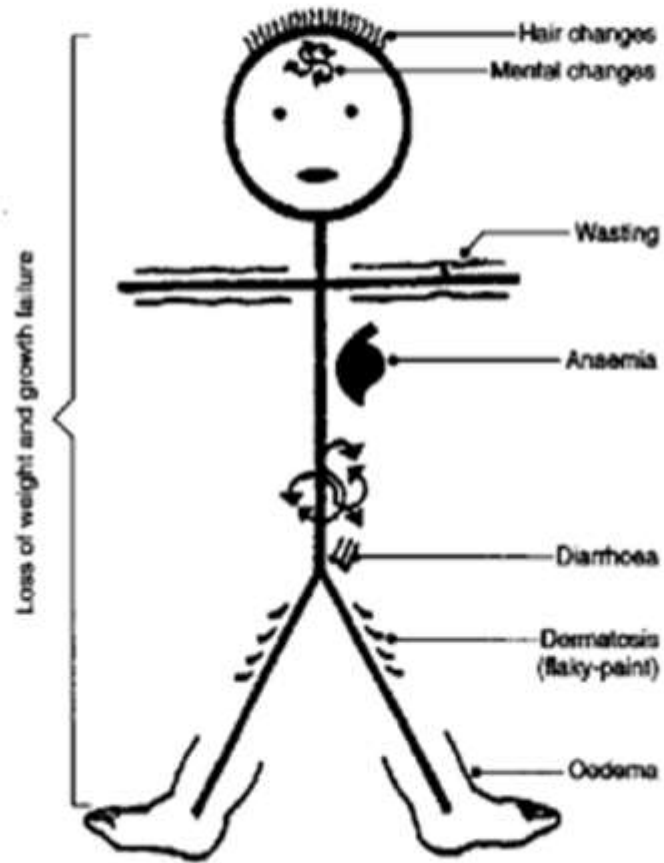
Oedema of lower arms and legs and lower trunk

Crazy paving scaly skin rash with areas of depigmentation

Ulceration on lower limbs

**Death does not occur from actual starvation but from secondary infection**

# Kwashiorkor





# Kwashiorkor

## Signs of Kwashiorkor:

- Oedema of the legs and arms and face
- Moon face
- Moderately low weight
- Misery and apathy
- Poor appetite
- Pale, thin, peeling skin
- Pale sparse hair with weak roots
- Enlarge liver



Thinning of hair, odema, stomatitis indicates an accompanying vitamin B deficiency





## Kwashiorkor

- Oedema and skin lesions in a 3-year-old child with kwashiorkor





Kwashiorkor; skin changes



# Nutritional marasmus



The word "marasmus" comes from the Greek marasmos ("withering").

- Due to a severe and prolonged restriction of all food, i.e. energy sources & other nutrients + protein.
- The two constant features of marasmus are:

**1– Retardation of growth and reduction of weight.**

**2– Wasting of muscles & loss of subcutaneous fat started from the abdominal wall then the buttocks then from the buccal pad of fat which gave the infant a wizened, old appearance.**



- Appetite is usually preserved or enhanced & the liver is usually normal, with no fatty infiltration.



- Episodes of hypothermia and fasting hypoglycemia are common.
- Emaciated: thin, flaccid skin (the 'little old man' appearance), fat and muscle tissue grossly reduced, prominence spine and ribs.







- Behaviour: alert and irritable.
- Electrolyte imbalance, dehydration. Infection.
- Normal hair.
- There is no biochemical or hematological changes diagnostic of the condition.



# Signs of marasmus:

- Extremely low weight
- Extreme wasting
- An ' old person's face'
- Pot belly: the child's abdomen protruded, because the muscles of the abdominal wall are wasted and weak
- Irritability
- Hunger



# Marasmic-Kwashiorkor

- Marasmic kwashiorkor:
  - Wasting in the upper arms
  - Characteristics of kwashiorkor in the lower limbs.
  - marasmic kwashiorkor The most severe form of protein-energy malnutrition in children, with weight for height less than 60% of that expected, and with oedema and other symptoms of kwashiorkor.
  - According to the FAO, it remains unclear why some people develop marasmus, and others develop kwashiorkor.



## MARASMIC-KWASHIORKOR

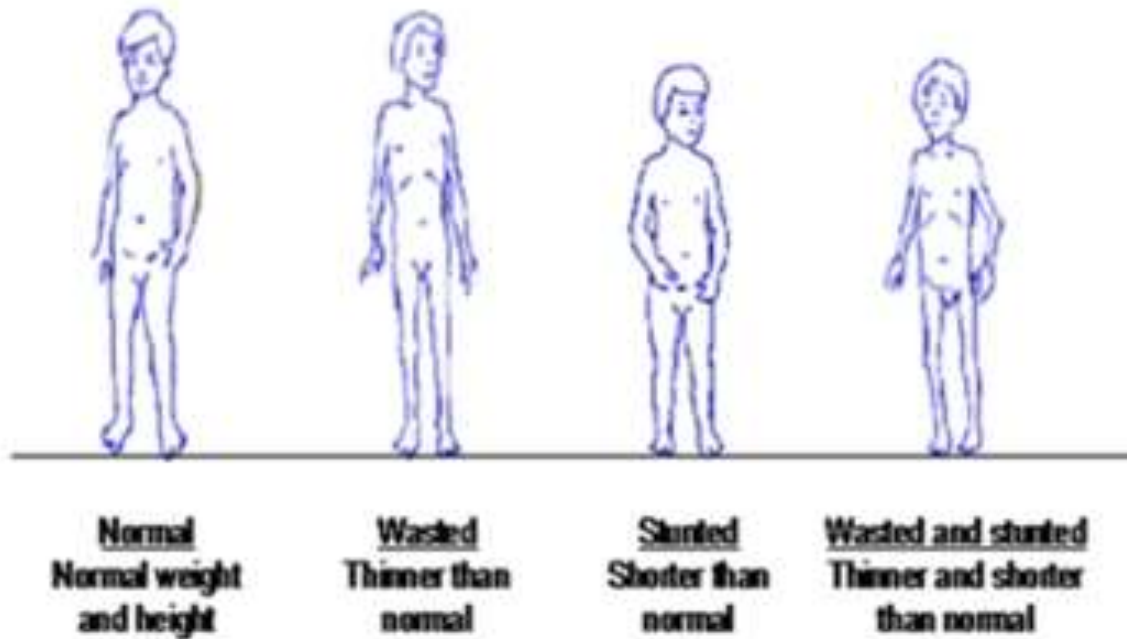
A severely malnourished child with features of both marasmus and Kwashiorkor.

- The features of Kwashiorkor are severe oedema of feet and legs and also hands, lower arms, abdomen and face. Also there is pale skin and hair, and the child is unhappy.
- There are also signs of marasmus, wasting of the muscles of the upper arms, shoulders and chest so that you can see the ribs.





## PROTEIN-ENERGY MALNUTRITION





**KWASHIORKOR**

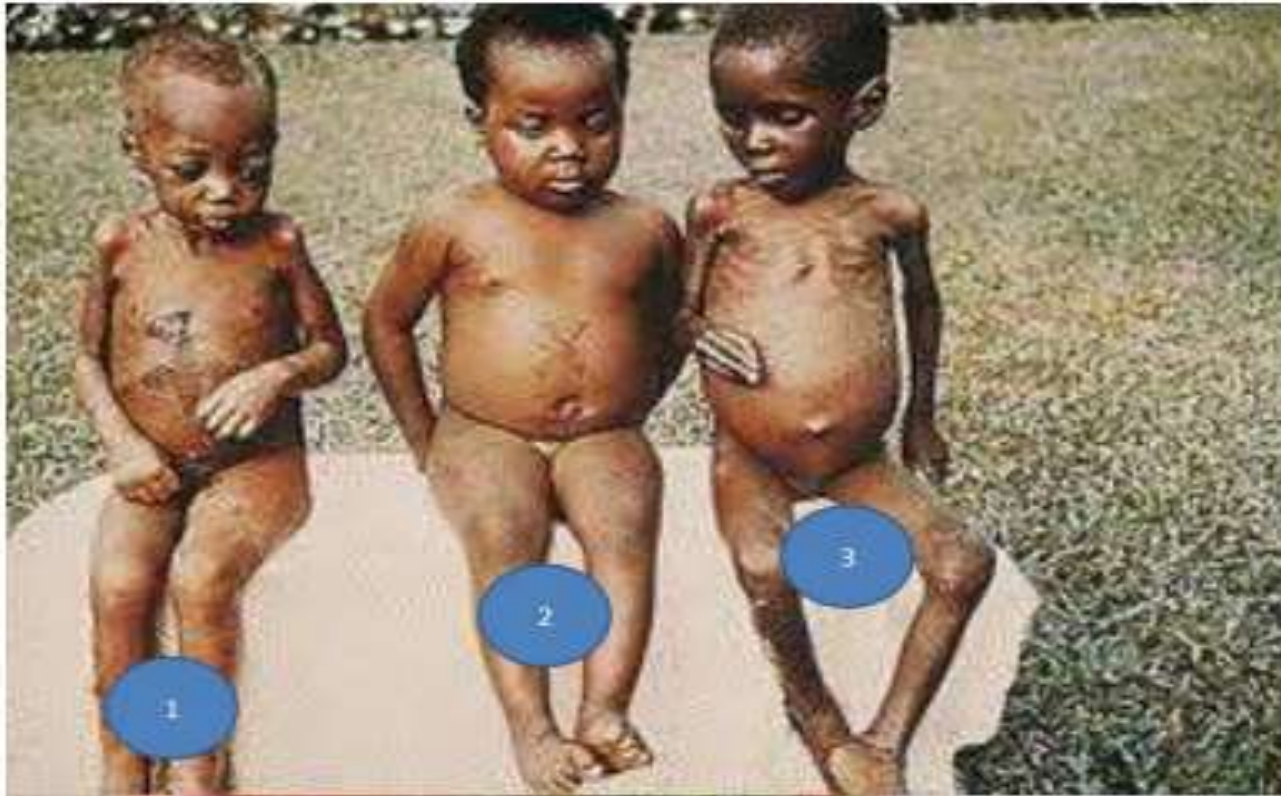


**MARASMUS**





## Quiz?



# Evaluation



## Practical nutritional assessment

Complete history, including a detailed dietary history  
Growth measurements, including weight and length/height;

head circumference in children younger than 3 years  
Complete

physical examination

## Laboratory investigations are generally unhelpful

- Tests that may be useful in the assessment of PEM and management of complications:
  - laboratory studies evaluating protein status
  - hematological studies
  - Blood glucose
  - GUE & culture
  - Stool exam & culture
  - CXR

# MANAGEMENT



- Successful management of malnutrition should mean complete catch-up followed by sustained normal growth, health and development.
- **Treatment of severe malnutrition**
- Monitoring of:
  1. Weight
  2. Height
  3. Oedema
  4. Vomiting
  5. Diarrhea
  6. Temperature
  7. Heart rate
  8. Respiratory rate



# Phases of treatment

## Initial (stabilization) phase

Management of severe malnutrition is best divided into three phases.



Following clinical evaluation, the **Initial Phase** (days 1-7 ) involves resuscitation, treatment of infection and correction of disordered metabolism.

The principal tasks are:

- To treat or prevent hypoglycemia ( $<3\text{mmol/l}$  or  $54\text{mg/dl}$ ) and hypothermia (axillary  $<35.0\text{C}^\circ$ ; rectal  $<35.5\text{C}^\circ$ ). (usually occurs together).
- To treat or prevent dehydration and restore electrolyte balance.
- To treat septic shock, if present.
- To start to feed the child.
- To treat infection.
- To identify and treat any other problems, including vitamin deficiency, severe anemia and heart failure.

- At each feed the food should be offered by mouth,
- after which the remainder is given by NG tube.
- Severely malnourished patients do not tolerate the usual amounts of **dietary protein, fat, and sodium**, and require a diet low in these components and in osmolality, but high in **carbohydrate**.



## **Response**

Usually within a week, the recovery is heralded by the following criteria :-

- 1- Eating well.
- 2- Mental status has improved; smiles, responds to stimuli, interested in surroundings.
- 3- Normal temperature (36.5-37.5°C).
- 4-No vomiting or diarrhea.
- 5- No oedema.
- 6-Gaining weight:> 5g/kg of body weight per day for 3 successive days.

# Rehabilitation Phase



The second or Rehabilitation Phase (weeks 2-6 )

The principal tasks are:

- 1- To encourage the child to eat as much as possible.
- 2- To re-initiate and/or encourage breastfeeding as necessary.
- 3- To stimulate emotional and physical development; and
- 4- To prepare the mother to continue to look after the child after discharge

At this stage, the formula feed is changed to one that provides more energy (150-220 kcal/kg/d) and protein (4g/kg/24hr) for growth.

The child's dietary intake increases steadily, the frequency of feeding is reduced and weight gain is rapid, up to 20 times normal, on average 10 g/kg/day.

The child's mother must be taught of nutrition and food preparation and hygiene.



## **Follow-Up Phase** (weeks 7-26 )

Ideally, the child is visited at increasing intervals for up to 3 years to ensure that recurrence of malnutrition is prevented.



# • Follow WHO Guidelines

1. Treat/prevent hypoglycemia
2. Treat/prevent hypothermia
3. Treat/prevent dehydration
4. Correct electrolyte imbalance
5. Treat/prevent infection
6. Correct micronutrient deficiencies
7. Initiate refeeding
8. Facilitate catch-up growth
9. Provide sensory stimulation & emotional support
10. Prepare for follow-up after recovery





# Time-frame for the management of a child with severe malnutrition

Activity	Initial treatment		Rehabilitation	Follow up
	Days 1-2	Days 3-7	Weeks 2-6	Weeks 7-26
Hypoglycemia Hypothermia Dehydration	----->			
Correct electrolyte imbalance	----->	----->	----->	
Treat infection	----->			
Correct micronutrient deficiencies	-----> without iron	----->	-----> With iron	
Begin feeding	----->			
Increase feeding to recover lost weight ("catch-up growth")			----->	----->
Stimulate emotional and sensorial development	----->			----->
Prepare for discharge			----->	



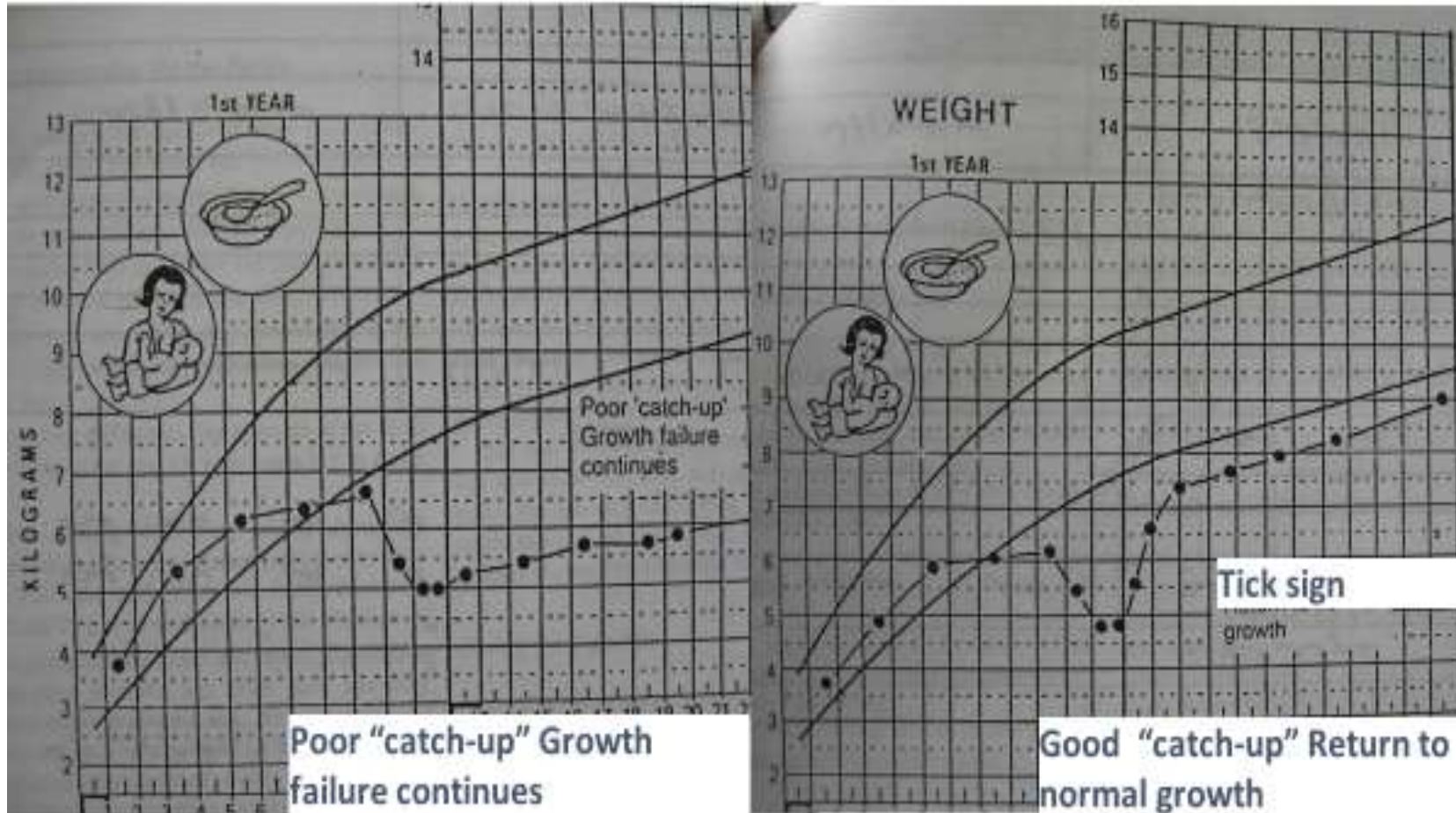
# Treatment of Malnutrition

PHASE	STABILISATION		REHABILITATION
	Day 1-2	Day 2-7+	Week 2-6
1. Hypoglycaemia	→		
2. Hypothermia	→		
3. Dehydration	→		
4. Electrolytes	→		
5. Infection	→		
6. Micronutrients	no iron		with iron →
7. Cautious feeding	→		
8. Rebuild tissues		→	
9. Sensory stimulation	→		
10. Prepare for follow-up		→	





# Catch-up growth





Composition	ReSoMal (mmol/L)	Standard ORS (mmol/L)	Reduced osmolarity ORS
Glucose	125	111	75
Sodium	45	90	75
Potassium	40	20	20
Chloride	70	80	65
Citrate	7	10	10
Magnesium	3	...	...
Zinc	0.3	...	...
Copper	0.045	...	...
Osmolarity (mOsm/L)	300	311	245



# Catch-up growth

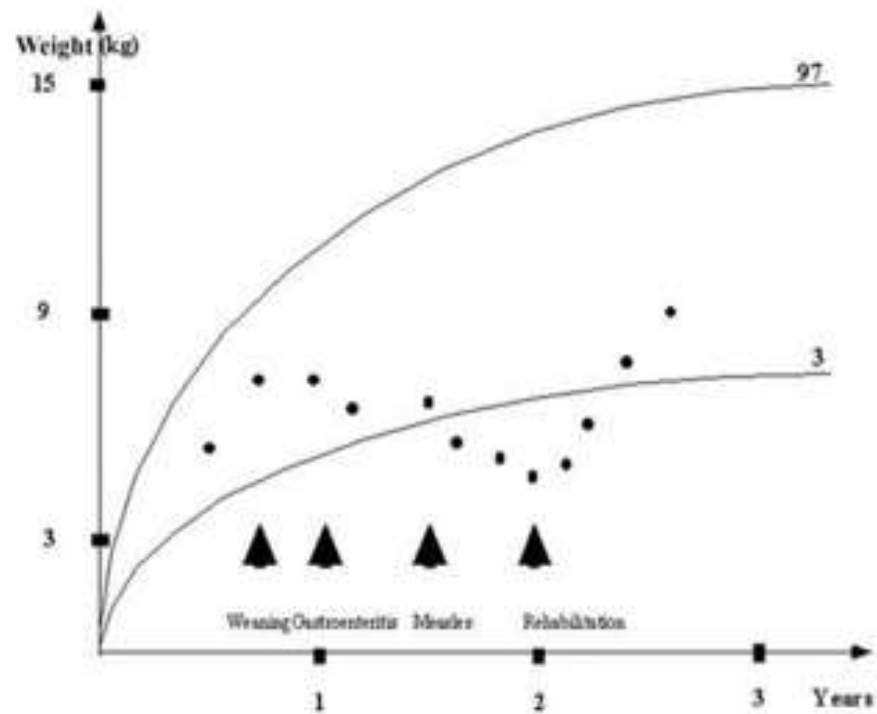


Figure An classical example of a weight chart for a severely

# Prevention

The best way to prevent marasmus is to have an adequate intake of calories and protein, preferably from a healthful, well-balanced diet.

Foods rich in protein, such as skimmed milk, fish, eggs, and nuts are ideal for energy and growth, though any protein and calorie-rich food can be used to prevent marasmus, depending on what is available.



Vegetables and fruits are essential for providing other nutrients and minerals and for preventing vitamin deficiencies. People can also take supplements, but they may be less effective than foods in delivering nutrients. A person who has recovered or is recovering from marasmus should take care to avoid complications, including dehydration and diarrhea.



# Sanitation and hygiene



1- Good sanitation and hygiene can play a role in marasmus, especially in places where there is not a regular supply of healthful food and clean water.

Poor sanitation and hygiene can lead to infections that can worsen the symptoms of marasmus and other types of malnutrition and make it harder to recover.

2- Cooking foods at high heat to destroy bacteria can help, as can freezing food and reheating it before eating.

3- Boiling water before drinking, cooking, or bathing in areas where clean water is difficult to access is essential to prevent spreading waterborne diseases.

4- Breastfeeding infants for 6 months can help protect them from nutritional difficulties, especially in places where food is short.

# Complications

- Severe kwashiorkor and marasmus has a mortality of around 20% even in a well equipped hospital.
- Most deaths occur in the first 10 days
- The usual cause of death are **intercurrent infections** and **severe malnutrition**.



# Refeeding Syndrome



can be defined as the potentially fatal shifts in fluids and electrolytes that may occur in malnourished patients receiving artificial refeeding whether enterally or parenterally (more dangerous).

It may occur if high-energy feeding is started **too soon** or **too vigorously**, and it may lead to sudden death with signs of heart failure.

the risk is not widely recognized.

During refeeding, glycaemia leads to increased insulin and decreased secretion of glucagon. Insulin stimulates glycogen, fat, and protein synthesis. This process requires minerals such as **phosphate** and **magnesium** and cofactors such as **thiamine**. Insulin stimulates the absorption of **potassium** into the cells through the sodium-potassium ATPase symporter, which also transports glucose into the cells.



certain patient groups at particular risk of this condition.

These include patients with a history of:-

- 1- Current or recent history of cancer.
- 2- Eating disorders.
- 3- Chronic debilitating disease .
- 4- Patients post gastrointestinal or head-and-neck surgery.
- 5- Chronic gastrointestinal symptoms.
- 6- Chronic dieting .





Onset is usually **24-48 hr (with a range of 1-5 days)** after the start of high energy feeding and is characterized by **breathlessness, rapid pulse, increased venous pressure, rapid enlargement of the liver, and watery diarrhea.**

## **Biochemical findings of Refeeding Syndrome**

**HYPOPHOSPHATEMIA, HYPOKALEMIA, HYPOMAGNESEMIA, VITAMIN/THIAMINE DEFICIENCY, SODIUM RETENTION**

An increase in the supply of energy (usually carbohydrates) is accompanied by an increase in sodium pump activity, and too sudden a supply risks causing a rapid release of accumulated sodium from cells, causing expansion of extracellular and plasma volumes.

At the same time there is increased uptake by cells of glucose, potassium, magnesium, and phosphate.

**Hypophosphatemia usually is the presenting features of refeeding syndrome.**

Monitoring for sudden increases in pulse and respiration rates during the transition to high-energy feeding is advisable to detect these early warning signs.



## Monitoring and Treatment:

1. Commence PN at approximately 50% of estimated energy requirement (more important to be cautious with glucose intake than total energy intake, aim for 40% energy as glucose intake). Grade up over 3-5 days.
2. Monitor UEC(Urea Electrolytes and Creatinine ), CMP(comprehensive metabolic panel), BSL(Biological Safety Levels ) 6hrly once PN commenced for 24-48hrs.

If re-feeding occurs then stop the PN (switch to IV fluids containing 5% dextrose) + correct electrolyte abnormalities rechecking bloods to confirm correction before re-starting PN.



3. Monitor for bradycardia with immediate medical review.

4. Strict fluid balance

5. Daily weight

6. Consider Thiamine supplementation prior to IV/enteral nutrition commencement at: 1-2mg/kg to a maximum of 100mg/day. Continue for 5 days (IV or oral).

7. Consider multivitamin/mineral supplement (for patients on enteral/oral nutrition only): e.g. Pentavite with iron liquid (< 2yrs) or Blackmores Slow Release MVM for first 5 days or until 100% RDI met.

# Criteria for discharge before full recovery

1. Age 12 months or older
2. Antibiotic treatment completed
3. Good appetite
4. Good weight gain
5. No oedema
6. Potassium, magnesium, mineral supplements, and vitamin supplements taken for two weeks
7. Mother or caretaker is not employed outside the home, has received specific training on appropriate feeding, has the financial resources to feed the child, and is motivated to follow the advice given.





## **Direct causes of death:**

**1. Hypoglycemia**

**2. Hypothermia**

**3. Dehydration**

**4. Infection**

**5. Severe anemia**

# Prognosis

- The sick children usually do not achieve their full growth potential or regain cognitive deficits.
- Over half of childhood mortality in developing countries is either directly or indirectly secondary to malnutrition.







## Summary:



- Welcome classification:- Marasmus; inadequate intake of protein and calories (absence of oedema)
- Kwashiorkor; fair-to-normal calorie intake with inadequate protein intake (presence of oedema).
- In the treatment of severe malnutrition we should Monitoring of: Weight, Height, Oedema, Vomiting, Diarrhea, Temperature, Heart rate, and respiratory rate.
- Direct causes of death: Hypoglycemia, Hypothermia, Dehydration, Infection, and Severe anemia.



**THANK YOU**