MK Inamdar

Biochemical Assessment of Nutritional Status

Use of Biochemical Measures

- Biochemical tests available for assessing nutritional status can be grouped into two general and somewhat arbitrary categories: *static tests* and *functional tests*.
- These are sometimes referred to as *direct* and *indirect tests*, respectively. Static tests are also referred to as qualitative and quantitative biochemical indicators.
- Functional tests are also referred to as biological, functional, and histologic indicators. Static tests are based on measurement of a nutrient or its metabolite in the blood, urine, or body tissue—for example, serum measurements of folate, retinol, vitamin B 12 , vitamin D.
- These are among the most readily available tests, but they have certain limitations. Although they may indicate nutrient levels in the particular tissue or fluid sampled, they often fail to reflect the overall nutrient status of an individual or whether the body as a whole is in a state of nutrient excess or depletion.
- For example, the amount of calcium in serum can be easily determined, but that single static measurement is a poor indicator of the body's overall calcium status or of bone mineral content.
- Functional tests of nutritional status are based on the ultimate outcome of a nutrient deficiency which is the failure of the physiologic processes that rely on that nutrient for optimal performance.
- Included among these functional tests are measurement of dark adaptation (assesses vitamin A status) and urinary excretion of xanthurenic acid in response to consumption of tryptophan (assesses vitamin B 6 status).
- Although many functional tests remain in the experimental stage, this is an area of active research and one that is likely to be fruitful.
- One drawback of some functional tests, however, is a tendency to be nonspecific; they may indicate general nutritional status but not allow identification of specific nutrient deficiencies.

Creatinine Excretion and Creatinine-Height Index

- A biochemical test sometimes used for estimating body muscle mass is 24-hour urinary creatinine excretion.
- Creatinine, a product of skeletal muscle, is excreted in a relatively constant proportion to the mass of muscle in the body. It is readily measured by any clinical laboratory.
- Lean body mass can be estimated by comparing 24-hour urine creatinine excretion with a standard based on stature or from reference values of 23 and 18 mg/kg of recommended

body weight for males and females, respectively. Another approach is using the creatinine- height index (CHI), a ratio of a patient's measured 24-hour urinary creatinine excretion and the expected excretion of a reference adult of the same sex and stature.

- The CHI is expressed by the following formula:

$$\text{CHI} = \frac{\text{24-hr urine creatinine (mg)} \times 100}{\text{Expected 24-hr urine creatinine (mg)}}$$

TABLE 9.1 Expected 24-Hour Urinary Creatinine Values for Height for Adult Males and Females

Adult Males*		Adult Females†	
Height (cm)	Creatinine (mg)	Height (cm)	Creatinine (mg)
157.5	1288	147.3	830
160.0	1325	149.9	851
162.6	1359	152.4	875
165.1	1386	154.9	900
167.6	1426	157.5	925
170.2	1467	160.0	949
172.7	1513	162.6	977
175.3	1555	165.1	1006
177.8	1596	167.6	1044
180.3	1642	170.2	1076
182.9	1691	172.7	1109
185.4	1739	175.3	1141
188.0	1785	177.8	1174
190.5	1831	180.3	1206
193.0	1891	182.9	1240

Nitrogen Balance

Nitrogen balance studies involve 24-hour measurement of protein intake and an estimate of nitrogen losses from the body. The following formula is used:

$$N_2 \text{ Balance} = \frac{PRO}{6.25} - UUN - 4$$

where N 2 Balance = Nitrogen balance; PRO = protein intake (g/24 h); and UUN = urine urea nitrogen (g/24 h).

TABLE 9.2 | Serum Proteins Used in Nutritional Assessment

Serum Protein		Half-Life	Function	Comments*
Albumin		18–20 days	Maintains plasma oncotic pressure; carrier for small molecules	In addition to protein status, other factors affect serum concentrations.
Normal:	3.5–5.0 g/L			
Mild depletion:	3.0–3.4 g/L			
Moderate depletion:	2.4–2.9 g/L			
Severe depletion:	< 2.4 g/L			
Transferrin		8–9 days	Binds iron in plasma and transports to bone marrow	Iron deficiency increases hepatic synthesis and plasma levels; increases during pregnancy, during estrogen therapy, and in acute hepatitis; reduced in protein-losing enteropathy and nephropathy, chronic infections, uremia, and acute catabolic states; often measured indirectly by total iron-binding capacity; equations for indirect prediction should be developed locally.
Normal:	200–400 mg/dL			
Mild depletion:	150–200 mg/dL			
Moderate depletion:	100–149 mg/dL			
Severe depletion:	< 100 mg/dL			
Prealbumin (Transthyretin)		2–3 days	Binds T_3 and, to a lesser extent, T_4; carrier for retinol-binding protein	Level is increased in patients with chronic renal failure on dialysis due to decreased renal catabolism; reduced in acute catabolic states, after surgery, in hyperthyroidism, in protein-losing enteropathy; increased in some cases of nephrotic syndrome; serum level determined by overall energy balance as well as nitrogen balance.
Normal:	16–40 mg/dL			
Mild depletion:	10–15 mg/dL			
Moderate depletion:	5–9 mg/dL			
Severe depletion:	< 5 mg/dL			
Retinol-binding protein (RBP)		12 hours	Transports vitamin A in plasma; binds noncovalently to prealbumin	It is catabolized in renal proximal tubular cell; with renal disease, RBP increases and half-life is prolonged; low in vitamin A deficiency, acute catabolic states, after surgery, and in hyperthyroidism.
Normal:	2.1–6.4 mg/dL			

Iron Status

- Anemia is a hemoglobin level below the normal reference range for individuals of the same sex and age.

- Descriptive terms such as *microcytic, macrocytic,* and *hypochromic* are sometimes used to describe anemias. *Microcytic* refers to abnormally small red blood cells defined by a mean corpuscular volume (MCV) < 80 femtoliters (fL), whereas *macrocytic* describes unusually large red blood cells defined as an MCV > 100 fL.
- Hypochromic cells are those with abnormally low levels of hemoglobin as defined by a mean corpuscular hemoglobin concentration < 320 g of hemoglobin/L or by a mean corpuscular hemoglobin < 27 picograms (pg, 10^{-12} grams).

TABLE 9.3 The Three Stages of Iron Deficiency and the Indicators Used to Identify Them

Stage of Iron Deficiency	Indicator	Diagnostic Range
1. Depleted stores	Serum ferritin concentration	< 12 μg/L
	Total iron binding capacity	> 400 μg/dL
2. Early functional iron deficiency (without anemia)	Transferrin saturation	< 16%
	Free erythrocyte protoporphyrin	> 70 μg/dL erythrocyte
	Serum transferrin receptor	> 8.5 mg/L
3. Iron deficiency anemia	Hemoglobin concentration	< 130 g/L in males
		< 120 g/L in females
	Mean corpuscular volume	< 80 fL

Transferrin saturation is the ratio of serum iron to TIBC and is calculated using the following formula:

$$TS = \frac{\text{Serum iron } (\mu \text{ mol/L})}{\text{TIBC } (\mu \text{ mol/L})} \times 100$$

where TS = percent transferrin saturation and TIBC = total iron-binding capacity.

TABLE 9.4 Normal Ranges for Hemoglobin and Hematocrit

Age Group	Hemoglobin (g/dL)	Hematocrit (%)
Newborn	14–24	44–64
2–8 weeks	12–20	39–59
2–6 months	10–17	35–50
6–12 months	9.5–14	29–43
1–6 years	9.5–14	30–40
6–18 years	10–15.5	32–44
Adult male	14–18	42–52
Adult female	12–16	37–47
Pregnant female	> 11	> 33

TABLE 9.5 Reference Blood Cell Values for Adults

	Males	Females
Hemoglobin (g/dL of blood)	14–18	12–16
Hematocrit (%)	40–54	37–47
Red cell count ($\times 10^{12}$/L blood)	4.7–6.1	4.2–5.4
Mean corpuscular hemoglobin (pg)	27–33	27–33
Mean corpuscular hemoglobin concentration (g/dL of blood)	31–35	31–35
Mean corpuscular volume (fL)	82–98	82–98

Assessing Iron Status

TABLE 9.6 Models for Assessing Iron Status

Model	Measurements Used
Body iron model*	Soluble transferrin receptor (sTfR) Serum ferritin
Ferritin model†	Serum ferritin Transferrin saturation Erythrocyte protoporphyrin
Mean corpuscular volume (MCV) model‡	MCV Transferrin saturation Erythrocyte protoporphyrin

Calcium Status

TABLE 9.7 Normal Values for Calcium in Body Fluids

	Mean	Normal Range
Plasma		
Total calcium (mmol/L)	2.5	2.3–2.75
Ionized (mmol/L)	1.18	1.1–1.28
Complexed (mmol/L)		0.15–0.30
Protein-bound (mmol/L)		0.93–1.08
Urine		
24-hour calcium (mmol/L)		
Women	4.55	1.25–10
Men	6.22	1.25–12.5
Fasting calcium: creatinine ratio (molar)		
Postmenopausal women	0.341 ± 0.183*	
Men	0.169 ± 0.099*	

Iodine Status

Box 9.1 **Manifestations of Iodine Deficiency Disorder Throughout the Lifespan**

Fetal Period
Spontaneous abortion
Stillbirth
Congenital anomalies in offspring
Increased perinatal mortality

Neonatal Period
Increased infant mortality
Cretinism

Childhood and Adolescence
Impaired mental function
Cretinism
Delayed physical development

Adulthood
Impaired mental function
Decreased ability to learn
Apathy
Reduced work productivity

All Ages
Goiter
Hypothyroidism
Increased susceptibility of the thyroid gland to nuclear radiation

TABLE 9.9 **World Health Organization Categories for Median UI Concentrations for Assessing Iodine Status in Pregnant and Lactating Women and Children Less than 2 Years of Age**

Population Group	Median Urinary Iodine (ng/mL)	Category of Iodine Intake
Pregnant Women	< 150	Insufficient
	150–249	Adequate
	250–499	More than adequate
	≥ 500	Excessive
Lactating Women	< 100	Insufficient
	≥ 100	Adequate
Children < 2 years of age	< 100	Insufficient
	≥ 100	Adequate

Plasma and Erythrocyte Pyridoxal 5' –Phosphate(PLP)

TABLE 9.10 Factors Affecting Plasma PLP* Concentrations

Factors	Effect
Increased vitamin B_6 intake	Increases
Increased protein intake	Decreases
Increased glucose	Decreases (a)†
Increased plasma volume	Decreases
Increased physical activity	Increases (a)
Decreased uptake into nonhepatic tissues	Increases
Increased age	Decreases

TABLE 9.11 Indices for Evaluating Vitamin B_6 Status and Suggested Values for Adequate Status in Adults

Indices	Suggested Values for Adequate Status*
Direct	
Blood	
Plasma pyridoxal 5'-phosphate (PLP)	> 30 nmol/L
Plasma pyridoxal	NV†
Plasma total vitamin B_6	> 40 nmol/L
Erythrocyte PLP	NV
Urine	
4-pyridoxic acid	> 3.0 μmol/day
Indirect	
Urine	
3-g methionine load: cystathionine	< 350 μmol/day
Oxalate excretion	NV
Diet Intake	
Vitamin B_6 intake, weekly average	> 1.2–1.5 mg/day
Vitamin B_6: protein ratio	> 0.020
Other	
Electroencephalogram pattern	NV

CHAPTER 10

CLINICAL ASSESSMENT OF NUTRITIONAL STATUS

OUTLINE

STUDENT LEARNING OUTCOMES

After studying this chapter, the student will be able to:

1. Name the components of a patient's medical history that are relevant to nutritional assessment.
2. Explain the advantages and limitations of Subjective Global Assessment.
3. Use Subjective Global Assessment to assess a patient's nutritional status.
4. Differentiate between kwashiorkor and marasmus.
5. Calculate and interpret percent weight for height.
6. Calculate and interpret percent height for age.
7. Describe the body composition changes that result from lipodystrophy in HIV patients.
8. Discuss the American Psychiatric Association's diagnostic criteria for anorexia nervosa and bulimia.

INTRODUCTION

Clinical assessment of nutritional status involves a detailed history, a thorough physical examination, and the interpretation of the signs and symptoms associated with malnutrition. It can be an efficient and effective way for an experienced and astute clinician to evaluate a patient's nutritional status without having to depend entirely on laboratory and diagnostic tests that may delay initiation of nutritional support and increase the time and cost of hospitalization. **Signs** are defined as observations, made by a qualified examiner, of which the patient is usually unaware. **Symptoms** are clinical manifestations reported by the patient. This chapter discusses clinical assessment of nutritional status and gives examples of clinical indicators of impaired nutritional status. As a dietitian or nutritionist, you will likely see some of the conditions discussed and illustrated in this chapter. For example, protein-energy malnutrition and severe wasting are common features of certain cancers, acquired immunodeficiency syndrome (AIDS), and advanced disease of the gastrointestinal tract. However, some of the other conditions discussed in this chapter, such as clinical signs of advanced nutrient deficiency, are not often seen in developed countries but occur more frequently in less

industrialized nations. But given the global nature of the work of health care professionals, understanding how to evaluate advanced malnutrition and starvation will be of interest to students and practitioners of nutrition. Because many of the clinical findings are not specific for a particular nutrient deficiency, they often must be integrated with anthropometric, biochemical, and dietary data before arriving at a definitive diagnosis.

Medical History

Obtaining a patient's history is the first step in the clinical assessment of nutritional status.[1] A good way to begin is by reviewing the patient's medical record, giving careful attention to the patient's medical history.[2,3] Components from the medical history to consider in nutritional assessment are shown in Box 10.1.

Essential components of a patient's history include pertinent facts about past and current health and use of medications, as well as personal and household information.[1,2] A variety of diseases can affect nutritional status. Among these are diabetes, kidney disease, various cancers, coronary heart disease, stroke, liver disease (e.g., hepatitis and cirrhosis), gallbladder disease, AIDS, ulcers, and colitis, as well as recent or past surgical procedures. Other conditions affecting nutritional status also should be explored: the ability to chew and swallow; appetite; and the presence of vomiting, diarrhea, constipation, flatulence, belching, or indigestion. An inquiry should be made about the patient's usual weight and any recent changes (gains or losses) in weight. A systematic approach to the detection of deficiency syndromes based on findings from the history is shown in Table 10.1.

Information on the use of medications will provide clues about the patient's actual or perceived medical condition. This will include prescription and over-the-counter medications, vitamin and mineral supplements, and nontraditional medications, such as herbal and folk remedies. This information can also be helpful in identifying drug-nutrient interactions potentially having an adverse effect on the patient's nutritional status.[3]

Psychosocial factors include the patient's age; occupation; educational level; marital status; income; living arrangements; number of dependents; use of alcohol, tobacco, and illicit drugs; degree of social and emotional support; and access to and ability to pay for health care. These factors are summarized in Box 10.2.

The necessary detail of the history will vary depending on circumstances and will be influenced by the patient's ability to respond to questioning. In some instances, the necessary information might need to be obtained from

Box 10.1 Components of the Medical History to Consider in Nutritional Assessment

- Past and current diagnoses of nutritional consequence
- Diagnostic procedures
- Surgeries
- Chemotherapy and radiation therapy
- History of nutrition-related problems
- Existing nutrient deficiencies
- Medications and their nutrient interactions
- Psychosocial history—alcohol, smoking, finances, social support
- Signs or symptoms suggestive of vitamin deficiency
- Signs or symptoms suggestive of mineral deficiency

Adapted from Phinney SD. 1981. The assessment of protein nutrition in the hospitalized patient. *Clinics in Laboratory Medicine* 1:767–774; McLaren DS. 1992. *A colour atlas and text of diet-related disorders*, 2nd ed. London: Mosby Europe; Jeejeebhoy KN. 1994. Clinical and functional assessments. In Shils ME, Olson JA, Shike M (eds.), *Modern nutrition in health and disease*, 8th ed. Philadelphia: Lea & Febiger.

Box 10.2 Factors to Consider in Taking a Dietary History

- Weight changes
- Usual meal pattern
- Appetite
- Satiety
- Discomfort after eating
- Chewing/swallowing ability
- Likes/dislikes
- Taste changes/aversions
- Allergies
- Nausea/vomiting
- Bowel habits—diarrhea, constipation, steatorrhea
- Living conditions
- Snack consumption
- Vitamin/mineral supplement use
- Alcohol/drug use
- Previous diet restrictions
- Surgery/chronic diseases
- Ability to purchase and prepare food
- Access to and ability to pay for health care

TABLE 10.1 Nutritional History Screen—A Systematic Approach to the Detection of Deficiency Syndromes

Mechanism of Deficiency	If History Of	Suspect Deficiency Of
Inadequate intake	Alcoholism	Energy, protein, thiamin, niacin, folate, pyridoxine, riboflavin
	Avoidance of fruit, vegetables, grains	Vitamin C, thiamin, niacin, folate
	Avoidance of meat, dairy products, eggs	Protein, vitamin B_{12}
	Constipation, hemorrhoids, diverticulosis	Dietary fiber
	Isolation, poverty, dental disease, food idiosyncrasies	Various nutrients
	Weight loss	Energy, other nutrients
Inadequate absorption	Drugs (especially antacids, anticonvulsants, cholestyramine, laxatives, neomycin, alcohol)	Various nutrients, depending on drug/nutrient interaction
	Malabsorption (diarrhea, weight loss, steatorrhea)	Vitamins A, D, K; energy; protein; calcium; magnesium; zinc
	Parasites	Iron, vitamin B_{12} (fish tapeworm)
	Pernicious anemia	Vitamin B_{12}
	Surgery	
	Gastrectomy	Vitamin B_{12}, iron
	Small bowel resection	Vitamin B_{12}, (if distal ileum), others as in malabsorption
Decreased utilization	Drugs (especially anticonvulsants, antimetabolites, oral contraceptives, isoniazid, alcohol)	Various nutrients, depending on drug/nutrient interaction
	Inborn errors of metabolism (by family history)	Various nutrients
Increased losses	Alcohol abuse	Magnesium, zinc
	Blood loss	Iron
	Centesis (ascitic, pleural taps)	Protein
	Diabetes, uncontrolled	Energy
	Diarrhea	Protein, zinc, electrolytes
	Draining abscesses, wounds	Protein, zinc
	Nephrotic syndrome	Protein, zinc
	Peritoneal dialysis or hemodialysis	Protein, water-soluble vitamins, zinc
Increased requirements	Fever	Energy
	Hyperthyroidism	Energy
	Physiologic demands (infancy, adolescence, pregnancy, lactation)	Various nutrients
	Surgery, trauma, burns, infection	Energy, protein, vitamin C, zinc
	Tissue hypoxia	Energy (inefficient utilization)
	Cigarette smoking	Vitamin C, folic acid

a surrogate (a parent, a companion, a sibling, or another person knowledgeable about the patient's life habits). Much of this information can be obtained from the history and physical examination performed by the admitting physician, from the notes of nurses or social workers, and from previous medical records. Remember that this and all information about the patient should be dealt with in a confidential and strictly professional manner.

DIETARY HISTORY

Included with the dietary history is information about the patient's eating practices. This includes a wide range of information about usual eating patterns (timing and location of meals and snacks), food preferences and aversions, intolerances and allergies, amount of money available for purchasing food, ability to obtain and prepare food, eligibility for and access to food assistance programs, and use of vitamin, mineral, and other supplements. These and other factors are included in Box 10.2.

For example, when inquiring about appetite, satiety, or discomfort, it is important to ask if the patient has experienced any changes in desire for food, if he or she experiences satiety earlier or later than usual, and if there is any pain or discomfort associated with eating. Questions about the ability to chew and swallow food are important. Are there dental or oral problems making it difficult to chew certain foods or to consume adequate energy to support normal body weight? If the patient wears dentures, are they well fitting? If swallowing is painful or difficult, for what foods?

Questioning the patient about bowel habits can often provide information pertinent to the diagnosis of gastrointestinal disease. The patient should be asked about changes in bowel habits, such as constipation, diarrhea, or unusual amounts of flatus (gas), and about stool

consistency and color. Obviously, the presence of bright red blood in the stool is an important finding. Stools containing digested blood (e.g., from a bleeding peptic ulcer) may appear black or tarry. The finding of frothy, watery, and foul-smelling stools suggests the possibility of fat malabsorption. Table 10.2 gives a listing of clinical findings and links their presence with either an excess or a deficiency of various nutrients.

Subjective Global Assessment

Subjective Global Assessment (SGA) is a clinical technique for assessing the nutritional status of a patient based on features of the patient's history and physical examination.[4] Unlike traditional methods that rely heavily on objective anthropometric and biochemical data, SGA is based on four elements of the patient's history (recent loss of body weight, changes in usual diet, presence of significant gastrointestinal symptoms, and the patient's functional capacity) and three elements of the physical examination (loss of subcutaneous fat, muscle wasting, and presence of edema or ascites).[4] Information obtained from the history and physical examination can be entered into a form, such as the one shown in Figure 10.1, to arrive at an SGA rating of nutritional status.

Elements of the History

The first of the four elements of the SGA history is the percent and pattern of weight loss within 6 months prior to examination. A weight loss < 5% is considered small. A 5% to 10% weight loss is considered potentially significant. A weight loss > 10% is considered definitely significant. The pattern of weight loss is also important. A patient who has lost 12% of his or her weight in the past 6 months but has recently gained 6% of it back is considered better nourished than a patient who has lost 6% of his or her weight in the past 6 months and continues to lose weight. Information about the patient's maximum weight and what it was 6 months ago can be compared with the patient's current weight. Questions about changes in the way clothing fits may confirm reports of weight change. Information about changes in body weight in the past 2 weeks (increase, no change, decrease) should be elicited as well. These data can be entered or noted in the appropriate places in Figure 10.1.

Dietary intake, the second element of the history, is classified as either normal (i.e., what the patient usually eats) or abnormal (i.e., a change from the patient's usual diet). If intake is abnormal, the duration in weeks is entered, and the appropriate box is checked to indicate the type of dietary intake abnormality (i.e., increased intake, suboptimal solid, full-liquid, IV or hypocaloric liquids, or starvation). The patient can be asked if the amount of food consumed has changed and, if so, by how much and why. If the patient is eating less, it would be valuable to know what happens when he or she tries to eat more. Ask for a description of a typical breakfast, lunch, and dinner and how that compares with what the patient typically ate 6 or 12 months ago.

Information about any gastrointestinal symptoms persisting more than 2 weeks (the third history element) should be elicited and noted on the form. Diarrhea or occasional vomiting lasting only a few days is not considered significant. The presence or absence of any dysfunction in the patient's ability to attend to activities of daily living (the last history element) should also be noted on the form. If a dysfunction is present, its duration and type should be noted.

Elements of the Physical Examination

The first of the three elements of the physical examination is loss of subcutaneous fat. The four anatomic areas listed in Figure 10.1 (shoulders, triceps, chest, and hands) should be checked for loss of fullness or loose-fitting skin, although the latter may appear in older persons who are not malnourished. Illustrations of subcutaneous fat loss in the arm, chest wall, and hands are shown in Figure 10.2 and Figure 10.3. Loss of subcutaneous fat should be noted as normal (0), mild loss (1+), moderate loss (2+), or severe loss (3+).

According to Detsky, the presence of muscle wasting (the second element of the physical examination) is best assessed by examining the deltoid muscles (located at the sides of the shoulders) and the quadriceps femoris muscles (the muscles of the anterior thigh).[4] Loss of subcutaneous fat in the shoulders and deltoid muscle wasting gives the shoulders a squared-off appearance, similar to that shown in Figure 10.4. These areas can be assessed as being normal or mildly, moderately, or severely wasted.

The presence of edema at the ankle or sacrum can also be assessed as absent, mild, moderate, or severe. The presence of "pitting" edema can be checked by momentarily pressing the area with a finger and then looking for a persistent depression (more than 5 seconds) where the finger was. Ankle edema and ascites can be assessed as absent, mild, moderate, or severe. When considerable edema or ascites are present, weight loss is a less important variable.

The final step in SGA is arriving at a rating of nutritional assessment. Instead of an explicit numerical weighting scheme SGA depends on the clinician's subjectively combining the various elements to arrive at an overall, or global, assessment. Patients with weight loss > 10% that is continuing, poor dietary intake, and severe loss of subcutaneous fat and muscle wasting fall within the severely malnourished category (class C rank). Patients with at least a 5% weight loss, reduced dietary intake, and mild to moderate loss of subcutaneous fat and muscle wasting fall within the moderately malnourished category (class B rank). Patients are generally ranked as well nourished when they have had a recent improvement in appetite or the other historical features of SGA. A class A rank would be given to patients having a recent

TABLE 10.2 Clinical Nutrition Examination

Clinical Findings	Consider Deficiency Of	Consider Excess Of	Frequency
Hair, Nails			
Flag sign (traverse depigmentation of hair)	Protein		Rare
Easily pluckable hair	Protein		Common
Sparse hair	Protein, biotin, zinc	Vitamin A	Occasional
Corkscrew hairs and unemerged coiled hairs	Vitamin C		Common
Traverse ridging of nails	Protein		Occasional
Skin			
Scaling	Vitamin A, zinc, essential fatty acids	Vitamin A	Occasional
Cellophane appearance	Protein		Occasional
Cracking (flaky paint or crazy pavement dermatosis)	Protein		Rare
Follicular hyperkeratosis	Vitamins A, C		Occasional
Petechiae (especially perifollicular)	Vitamin C		Occasional
Purpura	Vitamins C, K		Common
Pigmentation, desquamation of sun-exposed areas	Niacin		Rare
Yellow pigmentation-sparing sclerae (benign)		Carotene	Common
Eyes			
Papilledema		Vitamin A	Rare
Night blindness	Vitamin A		Rare
Perioral			
Angular stomatitis	Riboflavin, pyridoxine, niacin		Occasional
Cheilosis (dry, cracking, ulcerated lips)	Riboflavin, pyridoxine, niacin		Rare
Oral			
Atrophic lingual papillae (slick tongue)	Riboflavin, niacin, folate, vitamin B_{12}, protein, iron		Common
Glossitis (scarlet, raw tongue)	Riboflavin, niacin, pyridoxine, folate, vitamin B_{12}		Occasional
Hypogeusesthesia, hyposmia	Zinc		Occasional
Swollen, retracted, bleeding gums (if teeth are present)	Vitamin C		Occasional
Bones, Joints			
Beading of ribs, epiphyseal swelling, bowlegs	Vitamin D		Rare
Tenderness (subperiosteal hemorrhage in child)	Vitamin C		Rare
Neurologic			
Headache		Vitamin A	Rare
Drowsiness, lethargy, vomiting		Vitamins A, D	Rare
Dementia	Niacin, vitamin B_{12}		Rare
Confabulation; disorientation	Thiamin (Korsakoff's psychosis)		Occasional
Ophthalmoplegia	Thiamin, phosphorus		Occasional
Peripheral neuropathy (e.g., weakness; paresthesia; ataxia; decreased tendon reflexes; fine tactile sense, vibratory sense, and position sense)	Thiamin, pyridoxine, vitamin B_{12}	Pyridoxine	Occasional
Tetany	Calcium, magnesium		Occasional
Other			
Parotid enlargement	Protein (also consider bulimia)		Occasional
Heart failure	Thiamin (wet beriberi), phosphorus		Occasional
Sudden heart failure, death	Vitamin C		Rare
Hepatomegaly	Protein	Vitamin A	Rare
Edema	Protein, thiamin		Common
Poor wound healing, pressure ulcers	Protein, vitamin C, zinc		Common

HISTORY

1. Weight Change

$$\% \text{ Wt change} = \frac{\text{wt 6 months ago} - \text{current wt}}{\text{wt 6 mos ago}} \times 100$$

Maximum body weight _____
Weight 6 months ago _____
Current weight _____
Overall weight loss in past 6 months _____
Percent weight loss in past 6 months _____
Change in 2 past weeks: _____ increase _____ no change _____ decrease

2. Dietary Intake (relative to normal)

_____ No change
_____ Change Duration: _____ Weeks
Type: _____ Increased intake
_____ Suboptimal solid diet
_____ Full liquid diet
_____ IV or hypocaloric liquids
_____ Starvation

3. Gastrointestinal Symptoms (lasting > 2 weeks)

_____ None
_____ Nausea _____ Vomiting _____ Diarrhea _____ Anorexia

4. Functional Capacity

_____ No dysfunction
_____ Dysfunction Duration: _____ weeks
Type: _____ Works suboptimally
_____ Ambulatory
_____ Bedridden

PHYSICAL EXAMINATION

(For each trait specify: 0 = normal; 1+ = mild; 2+ = moderate; 3+ = severe)

_____ Loss of subcutaneous fat (shoulders, triceps, chest, hands)
_____ Muscle wasting (quadriceps, deltoids)
_____ Ankle edema
_____ Ascites

Subjective Global Assessment Rating (select one)

_____ A = well nourished
_____ B = moderately (or suspected of being) malnourished
_____ C = severely malnourished

Figure 10.1 Form for rating nutritional status based on Subjective Global Assessment.

Source: Adapted from Detsky AS, McLaughlin JR, Baker JP, Johnston N, Whittaker S, Mendelson RA, Jeejeebhoy KN. 1987. What is Subjective Global Assessment of nutritional status? *Journal of Parenteral and Enteral Nutrition* 11:8–13; Detsky AS, Smalley PS, Change J. 1994. Is this patient malnourished? *Journal of the American Medical Association* 271:54–58.

increase in weight (that is not fluid retention), even if their net loss for the past 6 months was between 5% and 10%. Using this approach, very few well-nourished patients are classified as malnourished, but some patients with mild malnutrition may be missed.[4]

Despite this subjective nature, clinicians (nurses and residents) trained to use SGA were shown to have arrived at very similar rankings when comparing their evaluations of a series of 109 patients.[4] The method has also been shown to be a powerful predictor of postoperative complications.[4,5] SGA has been shown to be a simple, safe, effective, and inexpensive tool for clinicians to identify patients who are malnourished or at risk of malnutrition. It is regarded by many as the most reliable and efficient method to assess nutritional status at the bedside and is considered the gold standard for bedside assessment tools.[6,7]

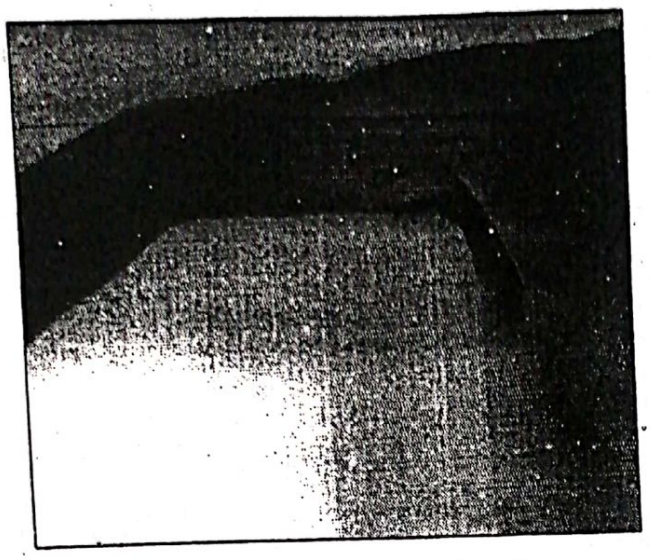


Figure 10.2 Subcutaneous tissue loss from the arm and chest wall.
Source: The McGraw-Hill Companies, Inc./Mark Dierker, photographer.

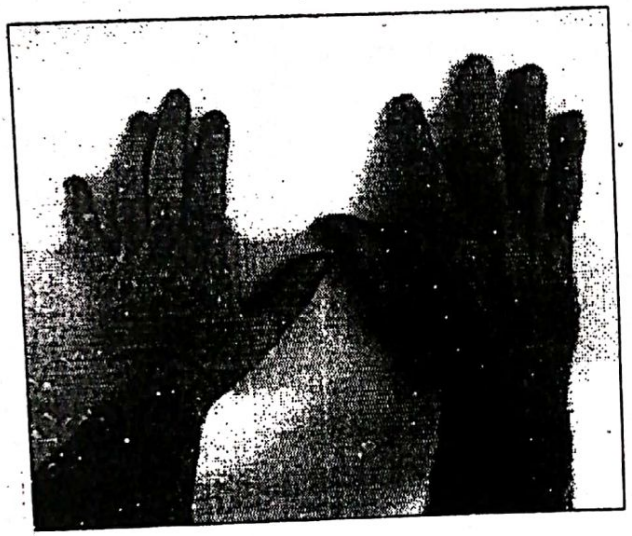


Figure 10.3
Loss of subcutaneous tissue can be clearly seen in the hand on the left, compared with the hand of a healthy person on the right.
Source: The McGraw-Hill Companies, Inc./Mark Dierker, photographer.

Protein-Energy Malnutrition

Clinical Signs

In its most severe states, protein-energy malnutrition (PEM) takes the form of kwashiorkor or marasmus. Kwashiorkor is predominantly a protein deficiency, whereas marasmus is mainly an energy deficiency.[8] Kwashiorkor (Figure 10.5) is characterized by a relatively normal weight, generally intact skeletal musculature, and decreased concentrations of serum proteins.[8–10] A common feature is soft, pitting, painless edema in the feet and legs, extending into the perineum, upper extremities,

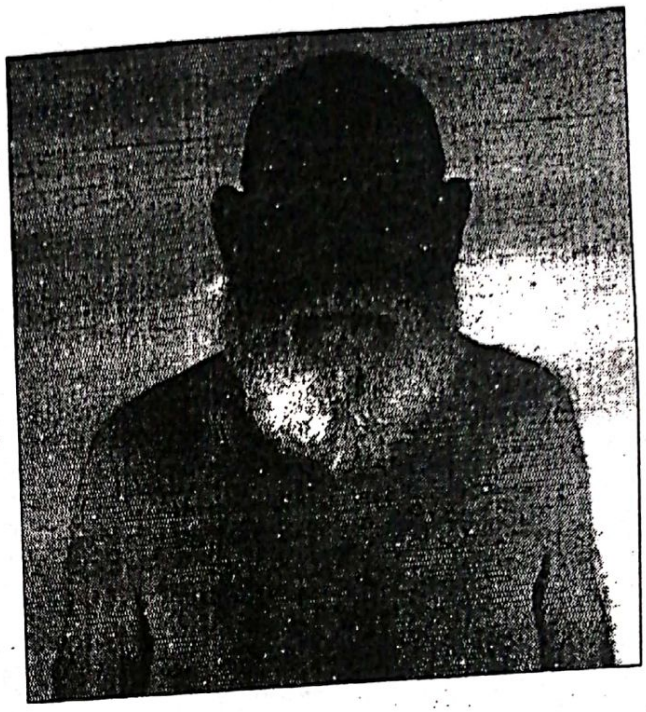


Figure 10.4
The squared-off appearance of the shoulders indicates the loss of subcutaneous tissue and wasting of the deltoid muscle. Loss of subcutaneous fat and muscle wasting is also apparent in the upper arms.
Source: The McGraw-Hill Companies, Inc./Mark Dierker, photographer.

and face in severe cases. The hair can become dry, brittle, dull, and easily pulled out without pain. The marasmic patient typically presents with significant loss of body weight, skeletal muscle, and adipose tissue mass but with serum protein concentrations relatively intact. Patients are often seen at 60% or less of their expected weight for height, and marasmic children have a marked reduction in their longitudinal growth. Patients are described as having a "skin and bones" appearance. General characteristics of kwashiorkor and marasmus are outlined in Table 10.3.

Although such obvious cases of kwashiorkor and marasmus as illustrated in Figure 10.5 will not often be seen in developed countries, severe cases of protein-energy malnutrition and wasting still occur, especially as a result of AIDS, certain cancers, some gastrointestinal diseases, and alcoholism and other instances of substance abuse. The emaciated condition of the body and general ill health resulting from these and other diseases is also called **cachexia.** Many patients presenting with protein-energy malnutrition and wasting will have diagnostic features in common with either marasmus or kwashiorkor. For example, Figure 10.6 illustrates a case of severe protein-energy malnutrition having several diagnostic features common to marasmus. When this 29-year-old male presented for treatment (A and B), he had lost considerable skeletal muscle, adipose tissue, and body weight. There was no edema present. The wasting is particularly apparent in the neck, shoulders, and upper arm in A and B. After 3 months

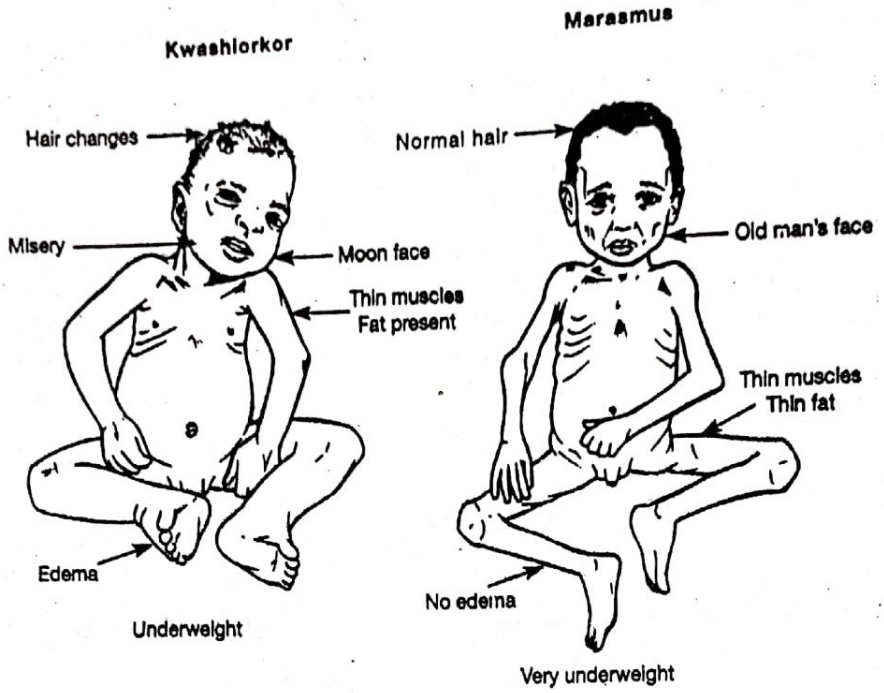


Figure 10.5 Differences in clinical signs between kwashiorkor and marasmus.
Source: Adapted from Jellife DB. 1968. *Clinical nutrition in developing countries.* Washington, DC: U.S. Department of Health and Human Services.

of nutritional support (C and D), there was an obvious increase in skeletal muscle, adipose tissue, and body weight. The face became fuller and there was considerably less wasting apparent in the neck, shoulders, and upper arm.

An example of severe protein-energy malnutrition is illustrated in Figure 10.7. As is the case with kwashiorkor, edema can be clearly seen, especially in the legs and feet of this 46-year-old male (A and B). Some wasting can also be seen in the neck, shoulders, and upper arms. After 3 months of treatment (C and D), there was a fuller appearance to the face, neck, shoulders, and upper arms and no apparent edema.

TABLE 10.3

Variable	Kwashiorkor	Marasmus
Skeletal muscle	No major losses	Significant losses
Serum proteins	Significantly decreased	Relatively normal
Adipose tissue	Preserved	Significant loss
Body weight	Relatively normal	Significant loss
Edema	Pitting edema common	Absent
Predisposing factors	Ample energy with little or no protein	Starvation, lack of both protein and total energy

Other clinical signs of PEM include the "flag sign" and growth failure. In the flag sign, there are alternating bands of depigmented and normal-colored hair produced by alternating periods of poor and relatively good protein intake. Hair grown during periods of poor protein intake can become depigmented and turn a dull brown, red, or even yellowish white. Hair grown during periods of more adequate protein intake returns to its normal color. The flag sign is especially noticeable in persons with long, dark-colored hair. An example of the flag sign is shown Figure 10.8.

Growth failure (or failure to thrive) is the most common sign of malnutrition in children. It is a failure to gain weight and height at the expected rate. Growth failure can result from one or any combination of factors, such as inadequate nutrient intake, nutrient malabsorption, failure to utilize nutrients, increased nutrient losses, and increased nutrient requirements. Major contributing factors to growth failure include poverty, inadequate emotional and social nurturing, and infections, especially parasitic gut infestations. Figure 10.9 illustrates growth failure. The ages of the children in this picture are, from left to right, 2, 4.5, and 5.5 years. The child on the left and the child in the center are of normal size for their age. However, the child on the right has a markedly reduced height for age and weight for age, although his weight-to-height ratio is normal and there appear to be no other signs of clinical malnutrition. Although he is 3.5 years older than the child on the left, he is less than 5 cm taller.


A


B


C


D

Figure 10.6 **Marasmic-like severe protein-energy malnutrition in a 29-year-old male before treatment (A and B) and after 3 months of nutritional support (C and D).**

Source: From McLaren DS. 1992. *A colour atlas and text of diet-related disorders*, 2nd ed. London: Mosby Europe.


A


B


C


D

Figure 10.7 **Kwashiorkor-like protein-energy malnutrition in a 46-year-old male before treatment (A and B) and after 3 months of nutritional support (C and D).**

Source: From McLaren DS. 1992. *A colour atlas and text of diet-related disorders*, 2nd ed. London: Mosby Europe.

Classifying Protein-Energy Malnutrition

The severity of PEM in children and adolescents can be classified using records of age and measurements of weight and height or length.[8] From these, weight for height (or length) and height for age can be calculated. Weight for height is a convenient index of current nutritional status, while height for age better represents past nutritional status. In this context of classifying the severity of PEM, **wasting** has been suggested as a term for a deficit in weight for height, and the term **stunting** has been suggested for a deficit in height for age. Patients with PEM can be placed in one of four categories: normal; wasted but not stunted (indicating acute PEM); wasted and stunted (indicating acute and chronic PEM); or stunted but not wasted (indicating past PEM with adequate nutrition at present).[6] The severity of wasting can be determined by calculating weight as a percentage of the reference median weight for height using the following equation:

$$\% \text{ weight for height} = \frac{\text{Actual body weight}}{\text{Reference weight for height}} \times 100$$

where reference weight for height = the median (or 50th percentile) weight for height for the subject's age and sex. To determine the severity of stunting, calculate the height as a percentage of the reference height for age using the following equation:

$$\% \text{ height for age} = \frac{\text{Actual height or length}}{\text{Reference height for age}} \times 100$$

where reference height for age = the median (or 50th percentile) height for the subject's age and sex. The values

A

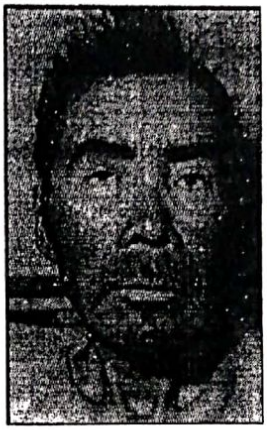
B

C

D

Figure 10.6 **Marasmic-like severe protein-energy malnutrition in a 29-year-old male before treatment (A and B) and after 3 months of nutritional support (C and D).**

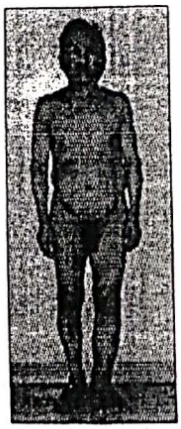
Source: From McLaren DS. 1992. *A colour atlas and text of diet-related disorders*, 2nd ed. London: Mosby Europe.



A

B

C



D

Figure 10.7 **Kwashiorkor-like protein-energy malnutrition in a 46-year-old male before treatment (A and B) and after 3 months of nutritional support (C and D).**

Source: From McLaren DS. 1992. *A colour atlas and text of diet-related disorders*, 2nd ed. London: Mosby Europe.

Classifying Protein-Energy Malnutrition

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$$\% \text{ weight for height} = \frac{\text{Actual body weight}}{\text{Reference weight for height}} \times 100$$

where reference weight for height = the median (or 50th percentile) weight for height for the subject's age and sex. To determine the severity of stunting, calculate the height as a percentage of the reference height for age using the following equation:

$$\% \text{ height for age} = \frac{\text{Actual height or length}}{\text{Reference height for age}} \times 100$$

where reference height for age = the median (or 50th percentile) height for the subject's age and sex. The values

TABLE 10.4 Reference Values for Classifying Deficits in Weight for Height* and Height for Age*

Classification	Weight for Height† (Deficit = Wasting)	Height for Age† (Deficit = Stunting)
Normal	90% to 110%	95% to 105%
Mild deficit	80% to 89%	90% to 94%
Moderate deficit	75% to 79%	85% to 89%
Severe deficit	< 75% or with edema	< 85%

Adapted from Torun B. 2006. Protein-energy malnutrition. In Shils ME, Shike M, Ross AC, Cabellero B, Cousins RJ (eds.), *Modern nutrition in health and disease*, 10th ed. Philadelphia: Lippincott Williams & Wilkins, 881–908.

*Reference values for classifying the severity of deficits in weight for height (wasting) are derived using the percentage of reference median weight for height, and deficits in height for age (stunting) are derived using the percentage of reference median height for age. Median weight for height and median height for age are derived from the CDC growth charts (see Chapter 6).

†Percentage calculated from equations discussed in the text.

TABLE 10.5 Reference Values for Classifying the Severity of Protein-Energy Malnutrition (PEM) in Adult Males and Females and the Presence of PEM in Adolescent Males and Females

Subject Age	Body Mass Index	PEM
18 years and older	< 16.0	Severe
	16.0–16.9	Moderate
	17.0–18.4	Mild
	≥ 18.5	Not Present
14–17 years old	14.5– < 16.5	Present
	< 14.5	Severe
11–13 years old	13.5– < 15.0	Present
	< 13.5	Severe

Adapted from Torun B, 2006. Protein-energy malnutrition. In Shils ME, Shike M, Ross AC, Cabellero B, Cousins RJ (eds.), *Modern nutrition in health and disease*, 10th ed. Philadelphia: Lippincott Williams & Wilkins, 881–908.

enhance physical and social functioning, and enrich the quality of life of people with AIDS.[11,12,14] Although HIV wasting is a multifactorial condition, the causes can be categorized under three general headings: decreased food intake, increased nutrient requirements, and nutrient malabsorption. These are outlined in Table 10.6.

With the introduction of protease inhibitors in 1996 and even newer antiretroviral therapies in more recent years, the number of patients dying from AIDS in developed countries has decreased by 67%, the prognosis of HIV-infected patients in these countries has dramatically improved, and HIV wasting syndrome is no longer the AIDS terminal phase.[13] Despite these dramatic improvements, some people with AIDS experience marked changes in body fat distribution (referred to as lipodystrophy) and certain metabolic alterations, such as hyperlipidemia, insulin resistance, and diabetes mellitus.[13,15,16] These changes in body fat distribution include fat accumulation (lipohypertrophy) in the abdominal region (truncal and visceral obesity), in the axillary pads (bilateral symmetric lipomatosis), and in the dorsocervical pads at the posterior base of the neck (referred to by some as "buffalo hump" or "bull neck") and loss of fat (lipoatrophy) in the arms, legs, and nasolabial and cheek pads (peripheral lipodystrophy).[13] An example of increased adiposity in the dorsocervical pads of a patient receiving protease inhibitor therapy for AIDS is shown in Figure 10.10. It appears that these alterations in body fat distribution are due, at least in part, to certain metabolic changes brought about by the multiple drugs used to treat HIV infection.[13–18] The so-called buffalo hump is also a clinical feature of Cushing's syndrome, a combination of symptoms and signs resulting from a persistent elevation of serum glucocorticosteroids. Unlike the loss of facial fat seen in patients presenting with peripheral lipodystrophy, a characteristic feature of Cushing's syndrome is a fullness or roundness of the face, which is referred to as "moon face."

Because changes in the distribution of body fat and increased adiposity can occur at the same time as decreased fat-free mass in patients with HIV/AIDS, changes in weight and BMI alone may not be suitable indicators of nutritional status. Approaches to assessing body fat distribution, somatic muscle status, and body composition will be required in some instances to evaluate a patient's nutritional status and response to HIV/AIDS therapy and nutritional support.[15,16,19] Approaches that can be used to monitor changes in body fat distribution include waist circumference, waist-to-hip ratio, skinfold measurements, dual-energy X-ray absorptiometry (DXA), and computed tomography. Somatic or skeletal muscle status can be assessed using mid-arm circumference, arm muscle area,

Box 10.3 ome as Defin[illegible] Centers for Disease Control

1. Involuntary weight loss of more than 10% of weight
2. Chronic diarrhea (at least two loose stools a day for 30 days or more) or chronic weakness
3. Constant or intermittent fever for 30 days or more
4. Absence of a condition or an illness other than HIV infection that might cause symptoms

Adapted from Kurtzweil P. 1995. Warding off HIV wasting syndrome. *FDA Consumer* 29(3):16–20.

TABLE 10.6 Causes of and Contributing Factors for HIV Wasting Syndrome

Causes	Contributing Factors
Decreased Food Intake	
Loss of appetite	Nausea, vomiting, medications, altered taste; anorexia caused by the effects of cytokines, such as tissue necrosis factor, interleukin-1, and interferon; the presence of undigested micronutrients in ileum and colon may also depress appetite
Difficulty chewing and swallowing	Mouth and throat sores from Kaposi's sarcoma and opportunistic infections, such as candidiasis and herpes simplex; esophageal ulcers of viral, mycobacterial, and neoplastic origin; neurologic disease
Decreased interest in eating	Depression, ostracism, isolation, loneliness
Inability to prepare meals	Lack of access to food, poverty, profound weakness, AIDS-induced dementia
Increased Nutrient Requirements	
Hypermetabolism	Resting metabolic rate is generally increased in persons with AIDS unless severe wasting is present; loss of adipose tissue and negative nitrogen balance are exacerbated by near-normal serum levels of the thyroid hormone triiodothyronine (T_3) that ordinarily fall below normal in the presence of malnutrition and wasting
Fever	Opportunistic infections of viral, mycobacterial, and neoplastic origin
Nutrient Malabsorption	
Diarrhea	Occurs in > 50% of persons with AIDS; many cases apparently caused by protozoal infections
Inflammation of bowel mucosa	Protozoal infections (cryptosporidiosis and microsporidiosis) appear to result in malabsorption apart from diarrhea; deficiency of lactase and disaccharidase activity seen; HIV alone may affect the structure and function of the small bowel

Data from Oster MH, Enders SR, Samuels SJ, Cone LA, Hooton TM, Browder HP, Flynn NM. 1994. Megestrol acetate in patients with AIDS and cachexia. *Annals of Internal Medicine* 121:400–408; Von Roenn JH, Armstrong D, Kotler DP, Cohn DL, Klimas NG, Tchekmedyian NS, Cone L, Brennan PJ, Weitzman SA. 1994. Megestrol acetate in patients with AIDS-related cachexia. *Annals of Internal Medicine* 121:393–399; Hecker LM, Kotler DP. 1990. Malnutrition in patients with AIDS. *Nutrition Reviews* 48:393–401; Singer P, Katz DP, Dillon L, Kirvelä O, Lazarus T, Askanazi J. 1992. Nutritional aspects of the acquired immunodeficiency syndrome. *American Journal of Gastroenterology* 87:265–273.

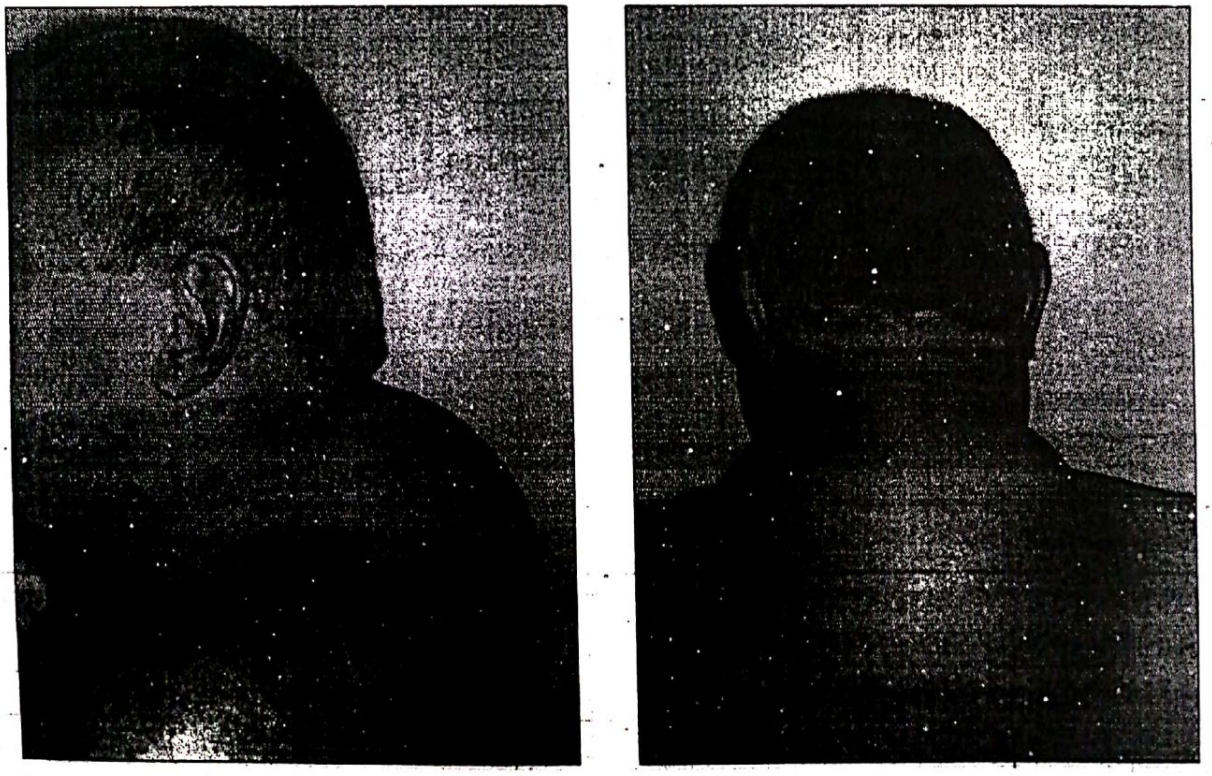

Figure 10.10 Increased adiposity in the dorsocervical fat pads of a patient receiving protease inhibitor therapy for AIDS. This is referred to by some as "buffalo hump" or "bull neck" and is one of the alterations in body fat distribution seen in AIDS patients presenting with lipodystrophy syndrome.

Source: Reproduced with permission of *Canadian Journal of Plastic Surgery*. 1999; 7:129–131.

the creatinine-height index, and computed tomography. Changes in body composition can be assessed using skinfold measurements, bioelectrical impedance analysis, DXA, and computed tomography.[15,16,19]

EATING DISORDERS

Anorexia nervosa and bulimia nervosa are conditions in which a disturbance in eating behavior is seen. Both have clinical signs aiding in their diagnosis. Anorexia nervosa is characterized by a refusal to maintain a minimally normal body weight, an intense fear of gaining weight that is not alleviated by losing weight, and a distorted perception of body shape or size in which a person feels overweight (either globally or in certain body areas) despite being markedly underweight.[20] The American Psychiatric Association's diagnostic criteria for anorexia nervosa are shown in Box 10.4. A prominent clinical feature of persons with anorexia nervosa is marked weight loss, which in some instances can become extreme and life threatening. Figure 10.11 gives an example of the severe wasting commonly seen in persons with anorexia nervosa.

Box 10.4 The American Psychiatric Association's Diagnostic Criteria for Anorexia Nervosa

A. Refusal to maintain body weight at or above a minimally normal weight for age and height (e.g., weight loss leading to maintenance of body weight less than 85% of that expected or failure to make expected weight gain during period of growth, leading to body weight less than 85% of that expected)

B. Intense fear of gaining weight or becoming fat, even though underweight

C. Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight

D. In postmenarchal females, amenorrhea (i.e., the absence of at least three consecutive menstrual cycles (a woman is considered to have amenorrhea if her periods occur only following hormone administration—e.g., estrogen)

TYPES OF ANOREXIA NERVOSA

Restricting type: During the current episode of anorexia nervosa, the person has not regularly engaged in binge-eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas)

Binge-eating/purging type: During the current episode of anorexia nervosa, the person has regularly engaged in binge-eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas)

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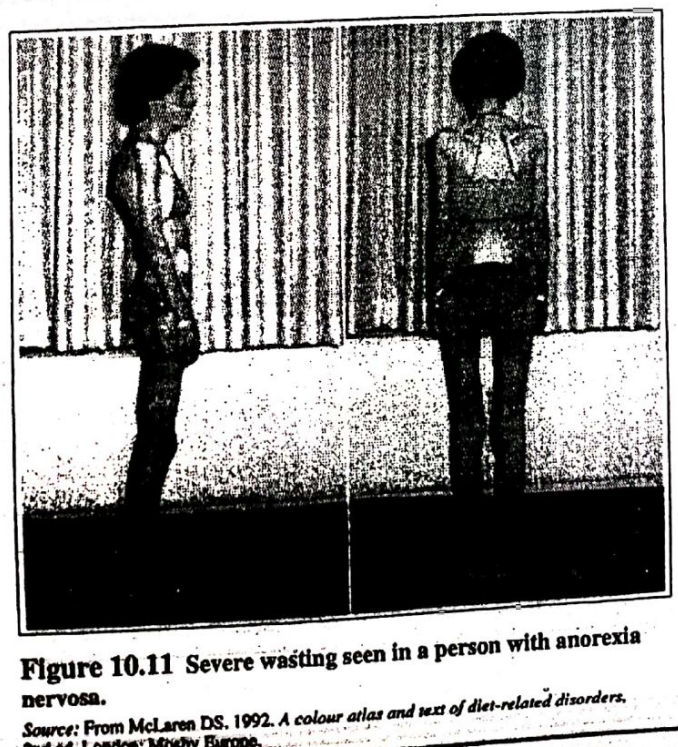

Figure 10.11 Severe wasting seen in a person with anorexia nervosa.

Source: From McLaren DS. 1992. *A colour atlas and text of diet-related disorders.* 2nd ed. London: Mosby Europe.

Bulimia nervosa is characterized by episodes of binging (eating unusually large amounts of food in a discrete period of time), followed by some behavior to prevent weight gain, such as purging (usually self-induced vomiting but also including misuse of laxatives, diuretics, enemas, or other medications), fasting, or excessive exercise.[20–23] The American Psychiatric Association's diagnostic criteria for bulimia nervosa are shown in Box 10.5. Persons with bulimia nervosa are usually within the normal weight range, although some may be slightly underweight or overweight. Recurrent vomiting may erode the teeth, especially the lingual surfaces of the front teeth, and increase the incidence of dental caries. An example of dental erosion in an 18-year-old female who had, from age 15 years, used vomiting as a purging method is shown in Figure 10.12. There may also be noticeable enlargement of the salivary glands, particularly the parotid glands. An example of asymmetrical hypertrophy of the parotid gland in a 20-year-old female who developed bulimia nervosa at age 17 years is shown in Figure 10.13.

A third category of disordered eating recognized by the American Psychiatric Association is called eating disorder not otherwise specified. This category is for eating disorders that fail to meet the criteria for either anorexia nervosa or bulimia nervosa.[16,17] Examples of disordered eating that fall under this category are outlined in Box 10.6.

Box 10.5 The American Psychiatric Association's Diagnostic Criteria for Bulimia Nervosa

A. Recurrent episodes of binge eating. An episode of binge eating is characterized by both of the following:
   (1) Eating, in a discrete period (e.g., within any 2-hour period), an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances
   (2) A sense of lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating)

B. Recurrent inappropriate compensatory behavior in order to prevent weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, enemas, or other medications; fasting; or excessive exercise

C. The binge eating and inappropriate compensatory behaviors both occur, on average, at least twice a week for 3 months

D. Self-evaluation is unduly influenced by body shape and weight

E. The disturbance does not occur exclusively during episodes of anorexia nervosa

Types of Bulimia Nervosa

Purging type: During the current episode of bulimia nervosa, the person has regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas

Nonpurging type: During the current episode of bulimia nervosa, the person has used other inappropriate compensatory behaviors, such as fasting or excessive exercise, but has not regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas

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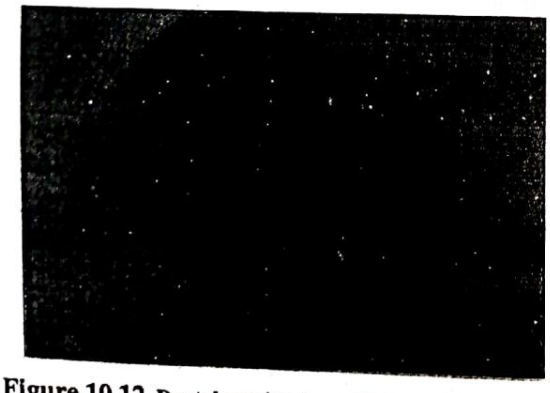

Figure 10.12 Dental erosion in an 18-year-old female who had been vomiting to control her weight from the age of 15 years; note that her top incisors are markedly eroded.
Source: From McLaren DS. 1992. *A colour atlas and text of diet-related disorders*, 2nd ed. London: Mosby Europe.

Figure 10.13 Asymmetrical parotid gland enlargement in a 20-year-old female who developed bulimia nervosa at the age of 17 years; she was vomiting four times each day.
Source: From McLaren DS. 1992. *A colour atlas and text of diet-related disorders*, 2nd ed. London: Mosby Europe.

Box 10.6 Eating Disorder Not Otherwise Specified

1. For females, all of the criteria for anorexia nervosa are met except that the individual has regular menses
2. All of the criteria for anorexia nervosa are met except that, despite significant weight loss, the individual's current weight is in the normal range
3. All of the criteria for bulimia nervosa are met except that the binge eating and inappropriate compensatory mechanisms occur at a frequency of less than twice a week or for a duration of less than 3 months
4. The regular use of inappropriate compensatory behavior by an individual of normal body weight after eating small amounts of food (e.g., self-induced vomiting after the consumption of two cookies)
5. Repeatedly chewing and spitting out, but not swallowing, large amounts of food
6. Binge-eating disorder: recurrent episodes of binge eating in the absence of the regular use of inappropriate compensatory behaviors characteristic of bulimia nervosa

SUMMARY

1. The first step in the clinical assessment of nutritional status is obtaining a patient's history. This includes pertinent facts about past and current health and use of medications, as well as personal and household information. Sources include the patient's medical record and data obtained directly from the patient or those familiar with the patient.
2. A diet history is valuable in understanding a patient's nutritional status. This includes information about a patient's usual eating pattern, food likes and dislikes, and intolerances and allergies, as well as money available for purchasing food, ability to obtain and prepare food, eligibility for and access to food assistance programs, and use of vitamin, mineral, and other supplements.
3. Subjective Global Assessment is a clinical technique for assessing the nutritional status of a patient based on features of the patient's history and physical examination, rather than relying on more objective measures of nutritional status, such as anthropometric and biochemical data.
4. In severe PEM, the conditions known as kwashiorkor and marasmus are seen. Kwashiorkor is predominantly a protein deficiency characterized by a relatively normal weight, generally intact skeletal musculature, decreased concentrations of serum proteins, and edema. Marasmus is mainly an energy deficiency characterized by significant loss of body weight, skeletal muscle, and adipose tissue mass, but with serum protein concentrations relatively intact and no edema.
5. Severe cases of PEM and wasting can result from AIDS, certain cancers, some gastrointestinal diseases, and alcoholism and other drug abuse. The emaciation and general ill health seen in these diseases is sometimes called cachexia.
6. Growth failure and flag sign are two conditions seen in severe PEM. The flag sign is characterized by alternating bands of depigmented and normal-colored hair produced by alternating periods of poor and relatively good protein intake. Growth failure, a failure to gain weight and height at the expected rate, is the most common sign of malnutrition in children.
7. The severity of PEM in children and adolescents can be assessed by calculating weight as a percentage of reference median weight for height and by calculating height as a percentage of reference height for age. These two values can then be compared with published guidelines. The severity of PEM in an adult can be assessed by comparing body mass index (kg/m^2) with the reference values.
8. Prior to the development of HIV antiretroviral drugs for treating HIV infection, HIV wasting was a common feature of patients with AIDS. Although advances in HIV/AIDS drug treatment have led to decreased incidence of HIV wasting syndrome, altered metabolism and body fat distribution remain common in HIV patients, particularly those treated with protease inhibitors. Metabolic alterations include hyperlipidemia, insulin resistance, and diabetes mellitus. Changes in body fat distribution include fat accumulation in the abdominal region (truncal and visceral obesity) and in the dorsocervical

Savil

Diet Survey

Diet survey constitute an essential part of any complete study of nutritional status of individuals or groups, providing essential information on nutrient intake level, sources of nutrients, food habits and attitudes. Under conditions, where frank signs of malnutrition do not exist, a survey of intake of nutrients may give an indication of the adequacy of the diet for promoting optimal nutrition of individuals or groups. Diet surveys of communities will yeild data regarding the extent of dietary deficiencies and the quantity and type of foods required for overcoming them. The survey also yeild information regarding the economic and social factors influencing food production & consumption.

The factors to be taken into consideration in conducting diet surveys are.

I. Trained personnel :- The first requisite in conducting diet surveys is the availability of trained personnel. They should be capable of meeting house wives and collecting the required information, adopting tactful and persuasive methods. They should also well versed in the calculation of the nutritive value of the diets using food composition tables and comparing the data with recommended dietary allowances.

II Population Sampling and Duration of the Survey.

The choice of sampling method to be used in a population selected for study will depend on the information available

(a) systematic random Sampling:- The households are numbered consecutively in the order in which they appear in the census schedules or in any other list of all the households in the community. The number of household to be included in the sample is first decided. If one out of 13 households is to be selected, then household NO. 13, 26, 39 etc are taken to give the desired sample size.

(b) unrestricted random Sampling:- All the households of a community or area on census schedules or other listings are numbered consecutively. Numbers are drawn by lottery or numbers are actually drawn using a table of random numbers.

(c) stratified random Sampling - This method differs from unrestricted random sampling in that the households are first grouped into homogeneous classes or strata on the basis of some known characteristics such as income level, number of family members, etc. A fixed percentage of household are extracted from each stratum.

The Sample Size:- The desirable samples size depends on various factors. Ideally the sample should be a size which offers the minimum error with the facilities available.

~~Duration of Survey~~

III Methods of Diet Survey:- A number of diet survey methods are available. Depending on the purpose, level at which information is needed and the availability of time and resources in terms of trained manpower, equipment, Transport facility etc., survey method is Chosen.

These methods include:- or Recording method

(a) Questionnaire method:- This method involves distribution of questionnaire containing questions regarding food item consumed, to the head of the families and requesting them to fill them for a period of one week. This cannot be used with families where the head of the family and the housewife are illiterate.

(b) Food Balance sheet method (FBS):- This method is employed when information regarding the availability of food is needed at macro level. The FBS are computed or calculated ✓ on the basis of total food supplies available for human consumption at retail level for a given country/region, from different sources during a reference period of one year. The computation takes into account the food used for animal feeds exports, seeds and wastages.

Availability of food per day is estimated as shown below.

$$\text{Per capita availability per day (g)} = \frac{\text{(Stocks at the beginning of the year + total food produced + imports)} - \text{(Stock at the end of the year + exports + seeds + cattle/poultry feeds + wastage)}}{\text{mid year population} \times 365 \text{ days}}$$

The data from FBS thus tell us the food available at country or regional level; but not the food actually consumed by the people. The FBS are most useful for administrators and planners to keep watch on & to monitor food position in the country & to take affirmative decisions.

(c) Inventory method:- (Food list method):-

This method is often employed in institution like hostels, orphanages, etc where homogenous groups of people take their meals from a common kitchen. In this method the amounts of food stuffs issued to kitchen as per the records maintained by the warden, are taken into consideration for consumption computation of consumption. No direct measurement or weighing is done. A Reference period of one week is desirable.

This method can also be used for assessing food consumption at household level. In this method, the investigator makes two visits: one at the beginning of the survey when a check list of food stocks is prepared and handed over to the

housewife and the other, at the end of the week to collect relevant data. Stocks of foods if any, purchased or discarded during the week are also taken into account. The average intake per person per day is calculated as follows.

Stocks at the beginning of the week + Purchases − Stocks at the end of the week

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Total No. of inmates partaking the meal × No. of days of survey.

The food list method is different from the inventory method in that there is no measurement of the quantity of food present in the house at the beginning, quantity purchased and quantity remaining unused. The quantities of foods consumed as stated by the housewife are entered by the investigator. (Food waste not taken into account)

(a) Weighment method:- In this method as the name implies foods are actually weighed using an accurate balance. The method can be used for weighing of raw as well as cooked foods. This has proved to be a more reliable method of survey than others. The investigator has to stay in the village, so that he can be present to weigh the foods personally or check the weighment of raw foods immediately before cooking.

It is ideal to conduct the survey for 7 consecutive days to capture the true picture of the diet. However, depending on the purpose of the

investigation the period of the survey can either be reduced or increased. In order to obtain the most representative representative picture of the diet the investigator should keep in mind the following Dos and Donts.

Dos

- Every day make at least two visits – one in the morning & the other in the evening before actual cooking is begun by the housewife
- Weigh only the edible portion of raw foods.
- Make note of correct age, sex, physiological status and activity of each member in the household who is partaking meals on the day of survey.
- Account of guests, visitors, pets and absentees in the consumption.
- Collect additional information on socio-economic status of the household, culinary practices & cooking

Donts

- Avoid fast and festival days.
- Do not make false promises of incentives or raise hopes to obtain co-operation from the household/community.

Results of the weighment method employed at household level, are expressed usually as intake of foods in gram per consumption unit or per person per day. Foods are converted to nutrients per 100 gm of edible portion of food. The nutrient intake thus can be expressed per consumption unit (CU) or per capita.

Consumption Unit (CU):- on the basis of energy requirement of the body for carrying out its legitimate functions of growth, wear & tear etc., arbitrary calorie co-efficient values have been assigned for persons of different age, sex & activity groups. The value assigned for adult male doing sedentary work is one. The calorie requirement (RDA) per CU is 2400 kcals for other age, sex & activity/physiological groups, the values assigned form a fraction of this unit.

$$\text{Intake per CU per day (g)} = \frac{\text{Raw amounts of food (g)}}{\text{Total CU} \times \text{No. of days of Survey.}}$$

$$\text{Intake per person per day (g)} = \frac{\text{Raw amounts of each food (g)}}{\text{No. of persons} \times \text{No. of days of Survey.}}$$

Weighment method is relatively more accurate as it involves direct weighing of foods. it is time consuming and needs cooperation of the house wives throghout the study period.

Two major limitations of this methods are:-

- Calorie coefficient values used in computation of the intakes are considered to hold good only for calories & lowes. their applicability to other nutrients like Proteins, vitamins etc is not valid.
- Precise consumption level of specific age and physiological groups with in the family cannot be assessed through this method.

(e) Expenditure pattern method :- In this method, Money Spent on food as well as non-food items is assessed by administering a specially designed questionnaire. The reference period could be either a previous month or week. This method though apparently less cumbersome as it avoids actual weighing of foods, needs time as additional data on price of individual food items, and qualitative aspects of diets becomes necessary for obtaining a realistic picture of the community. The reference period too is usually longer.

(f) Diet History :- This method is useful for obtaining qualitative details of diet and studying patterns of food consumption at household or individual level. The procedure includes assessment of the frequency of consumption of different foods. This method has been used to study meal pattern, dietary pattern, dietary habits, food preferences & avoidances. Special foods etc. At times information on approximate quantities of foods consumed by the households or individuals in terms of gross weight/volumes per month or per day is also collected.

(g) Chemical Analysis (Duplicate Sample) - This method involves the actual analysis of a composite sample of cooked foods consumed by the family or members of an institution. This method involves the sampling of each item served during breakfast, lunch, tea & dinner with subsequent blending of representative samples and analysis for various nutrients. About 10% by weight of the foods consumed by one single individual can be taken as a sample. All the

items are mixed and mashed to a fine paste in a blender or grinding machine and chemically analysed for different nutrients. It is most accurate method but test is costly and needs a good laboratory support.

(K) Dietary Score - This method involves assigning an arbitary score to the foods on the basis of its nutrients content. The consumption of this particular food by an individual is estimated through frequency method. For example grading of food is done according to major source of a specific nutrient. In case of vitamin A, the score for green leafy vegetables is 3, that for egg is 2 and milk 1. The frequency of consumption of foods, the total score and percentages are then ~~collected~~ calculated. The values of this quantitative assessment method is enhanced when it is combined with quantitative method of survey and nutritional status assessment.

(L) Dial Questionnaire (24 hours recall): — In this method a set of "standardised cups" suited to local condition are used. The steps involved are —
- the housewife or the member of the household who individually cooks & serves the food is asked about the types of food preparations at different individuals.
- an account of Raw ingredients used for each of the preparations is obtained.
- Information on the total cooked amount of each

~~of each~~ preparation is noted in terms of Standard cups.

- The intake of each food item by the specific individual in the family is assessed by using the cups.

The cups are used mainly to aid the respondent recall the quantities prepared & fed to the individual.

Standardization of cups.

1 Hot Raw rice equivalents :- Take a set of 12 cups of varying sizes, mark the edges of the cups to a particular level and fill each of the cup in a uniform way with cooked rice & weigh them. Deduct the weight of the empty cup from the total weight of cup with rice and convert the net cooked amount in each cup to raw amount by multiplying it with the conversion factor.

Conversion factor Calculation :-

Raw Rice	Water used	Total cooked Rice with water	Wt. of empty cup (g)	Net wt. of cooked rice (g)	Conversion factor (C.F)
500 A	1500 B	2600 C	600 D	2000 E	$\frac{500}{2000} = 0.250$ $\frac{A}{E} = Z$

Ex

Cup No.	Wt of Empty cup	Wt of cup with cooked rice	Wt. net of cooked	C.F	Raw rice in the cup.
5	100	700	300	X 0.25	75 gm

2 volume of cups - preparation like soups, curries etc. have varying consistancy and hence cups can not be standardised in terms of raw amounts. Therefore a set of say. 12 cups is standardised for volumes in the laboratory

$$\text{Individual intake (cooked) and Raw equivalent ingredients used}$$

$$\text{Individual intake in terms of Raw equivalents (g)} = \frac{\text{Total Raw amount of each ingredients (g)}}{\text{Total Cooked amount (ml)}} \times \text{Individual intake of cooked amount (ml)}.$$

Eg.

Raw food ingredients used in the curry	Total cooked Volume	Individual intake (ml)
potato - 250g onion - 100g Tomatoes - 100g oil - 50g salt - 1 tsp chilli powder - ½ tsp oil - 2 tsp	C H (520)	C B (140)

The potatoes consumed by the individual will be

$$= \frac{250}{520} \times 140 = 67.3 \text{ g}.$$

Analysis and interpretation.

The nutritive value of the diets consumed by the families is compared with the recommended allowances of dietary requirements.

The results can be interpreted through frequency distribution, mean, median, range and mean ± SD for socio economic variables and dietary intake (food groups and various nutrients).

Problems in Dietary Surveys & Some Solutions.

Diet survey though well-planned may have some problems pertaining to data collection and analysis and interpretation. Some of the problems encountered by field investigators are -

- Area of survey
- Distance
- lack of Rapport with respondent
- Duration & inconvenient timings of survey.

In order to overcome the above problems, it is necessary to ensure the following

1) Proper communication facilities in the area selected
2) Good Rapport atmosphere between investigator & Respondent & also community leaders.
3) Periodic orientation of the investigator regarding different aspects of the survey.
4) A Pilot survey
5) mid course corrections where necessary.

These will help to improve the quality of data. Before understanding data Processing, it is Necessary to Prepare dummy tables on various aspects of Survey for each analysis and interpretations. All the above aspects have to be taken care of in the planning stage itself.

Even the best of diet surveys give only an approximate estimate of foods and nutrients consumed, but not the amount absorbed or utilised. Twenty-four hour recall method together with diet history (Food frequency), would yield reasonably accurate estimates of the prevalent dietary situation. A combination of dietary, clinical and biochemical assessment is desirable for assessment of nutrition of individuals & communities.

Dietary Methods

Food and nutrient intake data are critical for investigating the relationships between diet and these diseases, identifying groups at risk for nutrient deficiency or excess, and formulating food and nutrition policies for disease reduction and health promotion.

In general, however, there are four major uses of dietary intake data: assessing and monitoring food and nutrient intake, formulating and evaluating government health and agricultural policy, conducting epidemiologic research, and using the data for commercial purposes.

Methods in Measuring Diet

Measurement of dietary intake usually is conducted for one of three purposes: to compare average nutrient intakes of different groups, to rank individuals within a group, and to estimate an individual's usual intake.

Dietary measurement techniques can be categorized as daily food consumption methods (food record and 24-hour recall) and recalled "usual" or average food consumption methods (diet history and food frequency questionnaire).

These techniques have also been categorized as meal-based (food record and 24-hour recall) and list-based (food frequency questionnaire).

24-Hour Recall

In the traditional dietary recall method, a trained interviewer asks the respondent to recall in detail all the food and drink consumed during a period of time in the recent past.

The interviewer then records this information for later coding and analysis. (In coding, a number is assigned to each kind of food, allowing it to be identified easily for computer analysis.) In most instances, the time period is the previous 24 hours.

Thus, the method is most commonly known as the **24-hour recall .** Occasionally, however, the time period is the previous 48 hours, the past 7 days, or, in rare instances, even the preceding month.

However, memories of intake may fade rather quickly beyond the most recent day or two, so that loss in accuracy may exceed gain in representativeness.

In addition to recording responses, the interviewer helps the respondent remember all that was consumed during the period in question and assists the respondent in estimating portion sizes of foods consumed.

A common technique of the 24-hour recall is to begin by asking what the respondent first ate or drank on last awakening. The recall proceeds from the morning of the present day to the current moment.

Box 3.2 **Strengths and Limitations of the 24-Hour Recall**

Strengths	Limitations
Requires less than 20 minutes to administer	One recall is seldom representative of a person's usual intake
Inexpensive	Underreporting/overreporting occurs
Easy to administer	Relies on memory
Can provide detailed information on types of food consumed	Omissions of dressings, sauces, and beverages can lead to low estimates of energy intake
Low respondent burden	May be a tendency to overreport intake at low levels and underreport intake at high levels of consumption
Probability sampling possible	Data entry can be very labor intensive
Can be used to estimate nutrient intake of groups	
Multiple recalls can be used to estimate nutrient intake of individuals	
More objective than dietary history	
Does not alter usual diet	
Useful in clinical settings	

Box 3.3 **Comparison of the Estimated Food Record and the Weighed Food Record**

Estimated Food Record	Weighed Food Record
Amounts of food and leftovers are measured in household measures (cups, tablespoons, teaspoons) or estimated using such measures as coffee cups, bowls, glasses, and dippers	Food and leftovers are weighed using scales or computerized techniques supplied by researchers
The researchers then quantify these measures by volume and weight	Considered more accurate than the estimated food record
Considered less accurate than the weighed food record	Preferred by some researchers for gathering data on individuals
Considered an acceptable method for collecting group intake data	Requires a greater degree of subject cooperation than the estimated food record and thus is likely to have a greater impact on eating habits than the estimated food record
Puts less burden on the respondent than the weighed food record and thus cooperation rates are likely to be higher, especially over long recording periods	Cost of scales may be prohibitive in some instances
As effective in ranking subjects into thirds and fifths as weighed records	

Food Record, or Diary

In this method, the respondent records, at the time of consumption, the identity and amounts of all foods and beverages consumed for a period of time, usually ranging from 1 to 7 days. An example of a food record form.

Food and beverage consumption can be quantified by estimating portion sizes, using household measures, or weighing the food or beverage on scales. In many instances, household measures such as cups, tablespoons, and teaspoons or measurements made with a ruler are used to quantify portion size.

Certain items, such as eggs, apples, or 12-oz cans of soft drinks, may be thought of as units and simply counted. This method is sometimes referred to as the **estimated food record** because portion sizes are estimated (that is, in terms of coffee cups, dippers, bowls, glasses, and so on), or household measures are used.

Box 3.4 Strengths and Limitations of the Food Record

Strengths	Limitations
Does not depend on memory	Requires high degree of cooperation
Can provide detailed intake data	Response burden can result in low response rates when used in large national surveys
Can provide data about eating habits	Subject must be literate
Multiple-day data more representative of usual intake	Takes more time to obtain data
Reasonably valid up to 5 days	Act of recording may alter diet
	Analysis is labor intensive and expensive

Food Frequency Questionnaires

Food frequency questionnaires assess energy and/ or nutrient intake by determining how frequently a person consumes a limited number of foods that are major sources of nutrients or of a particular dietary component in question.

The questionnaires consist of a list of approximately 150 or fewer individual foods or food groups that are important contributors to the population's intake of energy and nutrients. Respondents indicate how many times a day, week, month, or year that they usually consume the foods.

In some food frequency questionnaires, a choice of portion size is not given. These generally use "standard" portion sizes (the amounts customarily eaten per serving for various age/sex groups) drawn from large-population data.

Box 3.5 Strengths and Limitations of Food Frequency Questionnaires

Strengths	Limitations
Can be self-administered	May not represent usual foods or portion sizes chosen by respondents
Machine readable	Intake data can be compromised when multiple foods are grouped within single listings
Modest demand on respondents	Depend on ability of subject to describe diet
Relatively inexpensive for large sample sizes	
May be more representative of usual intake than a few days of diet records	
Design can be based on large population data	
Considered by some as the method of choice for research on diet-disease relationships	

Diet History

Diet history is used to assess an individual's usual dietary intake over an extended period of time, such as the past month or year. Traditionally, the diet history approach has been associated with the method of assessing a respondent's usual diet developed by B. S. Burke during the 1940s.

Burke's original method involved four steps: (1) collect general information about the respondent's health habits, (2) question the respondent about his or her usual eating pattern, (3) perform a cross-check on the data given in step 2, and (4) have the respondent complete a 3-day food record.

A trained nutritionist begins the interview by asking questions about the number of meals eaten per day; appetite; food dislikes; presence or absence of nausea and vomiting; use of nutritional supplements; cigarette smoking; habits related to sleep, rest, work, and exercise; and so on. This allows the interviewer to become acquainted with the respondent in ways that may be helpful in obtaining further information.

Box 3.6 Strengths and Limitations of the Diet History Method

Strengths	Limitations
Assesses usual nutrient intake	Lengthy interview process
Can detect seasonal changes	Requires highly trained interviewers
Data on all nutrients can be obtained	Difficult and expensive to code
Can correlate well with biochemical measures	May tend to overestimate nutrient intake
	Requires cooperative respondent with ability to recall usual diet