

NUTRITIONAL ASSESSMENT

1. A Guide to Nutritional Care

The first step in the nutritional care process is patient evaluation of data (screening) to determine whether any potential for nutritional risks exists.

Some Considerations in Interviewing/Diet History

Determine:

- Eating habits
- Changes in: appetite, funds, weight, taste, smell, chewing, swallowing
- Food intolerances, allergies
- Pertinent medication
- Living situation, cooking facilities, funds, food purchasing facilities
- Educational needs
- Educational level- occupation
- Vitamin supplementation, if any
- Food supplements, if any
- Risk factors for poor nutritional status

Medical History

- Recent major surgery or illness
- Nausea and vomiting
- Diarrhea
- Surgical procedures involving GI tract
- Cancer
- Circulatory problems
- Coronary artery disease
- Chronic disease of GI tract
- Chronic liver disease
- Chronic lung disease
- Chronic renal disease
- Diabetes
- Heart failure
- Hyperlipidemia
- Mental retardation
- Neurologic disorders
- Pancreatic insufficiency
- Paralysis
- Hypertension

Drug History

Antibiotics
 Anticonvulsants
 Antihypertensive Agents
 Catabolic steroids
 Antineoplastic agents
 Oral contraceptives
 Vitamins
 Nutrient preparation

Dietary History

Anorexia
 Alcohol abuse
 Chewing or swallowing difficulties
 Inadequate food intake
 Restricted or fad diets
 Frequent meals away from home
 No nutrient intake for ten or more days
 IV fluids only for ten or more days

Socioeconomic History

Inadequate food budget (low income)
 Inadequate food preparation facilities
 Inadequate food storage facilities
 Handicapped
 Elderly
 Lives or eats alone

2. A Guide to Nutritional Assessment Screening

Criteria for nutritional intervention:

Recent, unintentional weight loss greater than 10 #

Illness lasting longer than three weeks

Recent surgery

Less than or greater than 85% of ideal body weight

Muscle wasting

Inadequate dietary intake (<50-60% PO)

Elderly patient with loss, dependency, loneliness, or chronic illness

Measure patient's height and weight upon admission and compare to ideal body weight (IBW) and normal body weight (NBW).

Evaluation of Weight Change from Normal

<u>Time</u>	<u>Significant Weight Loss</u>	<u>Severe Weight Loss</u>
1 wk	1-2 %	>2 %
1 mo	5 %	>5 %
3 mo	7.5 %	>7.5 %
6 mo	10 %	>10 %

Laboratory Indices of Significance for Screening Purposes

Prealbumin
 Total lymphocyte
 Serum transferrin
 Hematocrit
 Total iron binding capacity
 Cell mediated immunity (delayed hypersensitivity)
 Serum lipids

Absolute measurement indicates that protein is about 18.5 % of the total body weight or around 13 kg of an average, 70 kg man. Much of this protein is skeletal muscle (4.5 kg or 6.4 % of the total body weight), skin and skeleton (6.3 kg or 9 % of total body), viscera (1.5 kg or 2.1 % of total body weight), and a small amount in the plasma (0.3 kg or .43 % of total body weight).

Nutritional Implications of Selected laboratory Tests

SERUM ALBUMIN Reflects visceral protein stores. Half-life is 14-20 days and repletion responds slowly to changes in nutritional status. Albumin's functions primarily as a carrier protein and maintains oncotic pressure.

A negative acute phase reactant; levels increase during the acute phase response.

Catabolism of albumin directly correlates with an increase in positive acute-phase reactants, ceruloplasmin and alpha-1 acid glycoprotein.

Causes of hypoalbuminemia include: poor protein intake, impaired digestion (pancreatic insufficiency, inadequate absorption), chronic loss (nephrotic syndrome, burns), inadequate syntheses (congestive heart failure, cirrhosis, familial dysproteinemia), exudative enteropathy (excessive loss into GI tract), eclampsia and over

hydration.

Hypoalbuminemia is the body's response to injury and infection. Serum levels of albumin, prealbumin, and transferrin decrease in response to infection, injury, or trauma and increase with recovery from the same conditions. Resolution of inflammation, not macronutrients (protein, CHO and fat) from nutrition support, restores normal hepatic protein metabolism and thus serum levels (ada hep proteins).

A significant decrease can occur in ten days or less in patients in catabolic stress receiving only 5 % dextrose. A possible mechanism is insulin, produced as a response to stress and the dextrose, depresses the release of amino acids from muscle tissue to maintain visceral synthesis of serum proteins. A decrease in serum albumin, seen with an elevation of CRP, is a signal of an inflammatory response or other comorbidities, not nutritional status (even with of adequate energy and protein intake)

Values:	g/100 ml	3.5-5.5	Normal
		3.0-3.5	
		2.0-3.0	
		< 2.0	

Albumin is a poor indicator of visceral protein status, but may be an indicator of morbidity and mortality affected by factors other than nutritional intake. Assessment parameters of visceral protein also indicate plasma protein level. Serum albumin and serum transferrin levels indicate the extent of protein depletion in the liver, as these are circulating proteins produced by the organ.

Serum transferrin may be a short term indicator of visceral depletion (visceral attrition). Serum albumin levels tend to reflect long-term depletion, because the body stores large amounts of albumin in the skin as well as in circulation. Serum albumin levels do not reflect protein malnutrition until skin reserves are depleted (from 10-14 days). Other serum protein levels such as the immune globulins may or may not indicate protein depletion, depending on the patient's disease diagnosis. Cancer patients, for example, sometimes show abnormally

high serum gamma-globulin levels.

Protein intake has very little effect on the total albumin pool on a daily basis. Most albumin changes are likely due to redistribution between the extravascular and intravascular space in response to increased albumin levels with dehydration, marasmus, blood transfusion, exogenous albumin; or decreased levels with overhydration/asites, hepatic failure, inflammation/infection/metabolic stress, nephritic syndrome, protein losing states, burns, trauma/post-operative states, Kwashiorkor, collagen disease, cancer, corticosteroid use, bed rest, zinc deficiency, and pregnancy.

Hepatic proteins such as albumin, prealbumin (transthyretin), and transferrin are markers of inflammatory processes that precipitate nutritional depletion and thus are not associated not with nutritional status, but with morbidity, mortality, and recovery from an acute or chronic disease; shows positive correlations with the severity of an underlying disease.

Currently, serum albumin in predialysis is used to determine nutritional status for patients with ESRD treated with hemodialysis. But predialysis albumin may not be an accurate indicator of nutrition.

With protein-energy depletion, serum albumin levels remain unchanged. Normal serum albumin levels are maintained under conditions of nutrient intake deficit, because rates of albumin synthesis and catabolism are reduced.

Although Kwashiorkor has been initially characterized as protein-malnutrition, children receiving adequate protein from breastfeeding may show symptoms of developing Kwashiorkor. Symptoms may be caused by infection and inflammation rather than severe dietary protein deficit.

PREALBUMIN

A visceral, negative acute-phase reactant protein (like albumin), is also known as transthyretin or transthyretin-bound prealbumin and has a shorter half-life of 2-3 days, a significantly smaller body pool than albumin, and is sensitive to short term changes in inflammation and protein intake.

Levels are affected by altered nutritional intake and inflammation, due to capillary leakage or alteration of normal hepatic protein metabolism. The half-life of rapid turnover proteins—RTP—(prealbumin, RBP, and transferrin), is relatively short. Although RTP levels change with altered nutritional intake, they are also inversely correlated with inflammation.

Functions: transport protein for thyroxine and carrier for retinol-binding protein (RBP).
Elevated levels are seen in ARF (acute renal failure) due to its degradation by the kidney.

Levels may be elevated in severe renal failure, corticosteroid use, and oral contraceptives.

Decreased levels are seen in liver failure or disease/hepatitis, post-surgery, infection/metabolic stress/inflammation, dialysis, hyperthyroidism, sudden demand for protein synthesis, pregnancy, and severe hyperglycemia.

Prealbumin levels may be maintained in states of undernutrition when inflammation is absent or minimal.

SERUM TRANSFERRIN

Acute-phase reactant; main function is iron transport; half-life 8-10 days; correlates with nitrogen balance. Each molecule can bind two molecules of iron. Normally, only 30-40 % of transferrin (or iron-binding capacity) is used for iron transport and thus levels are influenced by iron status. Lacks sensitivity and specificity for undernutrition.

Increased levels are often used to determine total iron binding capacity. Elevated values occur in iron deficiency, pregnancy (third trimester), hypoxia, chronic blood loss, oral contraception/estrogens, hepatitis, and chronic renal failure. Decreased values occur in pernicious anemia (B₁₂ deficiency), folate deficiency anemia, anemia of chronic disease, chronic infection, acute catabolic states, uremia, nephritic syndrome, severe liver disease/hepatic congestion, Kwashiorkor, increased age, zinc deficiency, corticosteroids, cancer, and iron overload..

Serum transferrin is not a good indicator of nutritional status of those who already have protein-energy malnutrition both with and without infection or inflammation (t/f).

Transferrin can be measured directly by immunologic methods or estimated from total iron-binding capacity (TIBC) by the following formula:

$$\text{Transferrin (mg/100ml)} = \frac{\text{TIBC (mcg / 100 ml)}}{1.45}$$

Or (0.8 X TIBC) - 43

Assess value weekly.

Values mg/dl	180- 260	normal
	200- 180	mild
	180- 160	moderate
	160	severe

FIBRONECTIN

One study found decreased concentrations of Fibronectin immediately upon starvation & refeeding.

TOTAL IRON-BINDING CAPACITY (mcg / 100 ml)

Iron is transported in the plasma bound to transferrin. Total iron-binding capacity (TIBC) is the total amount of iron that can be carried in the plasma by the transferrin. Normal transferrin is one-third (30-40 %) saturated and thus the serum iron levels are one-third the level of the total iron-binding capacity.

TIBC levels greater than 400 mcg/ 100 ml indicate iron deficiency. Levels are also elevated with pregnancy, hypoxia, blood loss, and hepatitis.

Decreased levels occur in conditions of iron overload (hemochromatosis, frequent transfusions), infection, malnutrition, protein-losing enteropathies, liver cirrhosis, thalassemia, uremia, rheumatoid arthritis, neoplasm, and nephrosis.

Assess this value weekly.

Values mcg /dl	300 - 360	normal
	214 - 182	mild
	182 - 152	moderate
	<152	severe

RETINOL-BINDING PROTEIN (RBP)

Majority of RBP presents as a retinol-circulating complex which includes prealbumin, retinol, and RBP. Elevated levels are seen with renal failure because it is catabolized in the kidney. Dependency is seen with normal Vitamin A and Zinc levels; reduced levels of these nutrients cause hindered mobilization of RBP in the liver. Responds to very short-term changes in nutritional status. Utility is altered with response to stress and inflammation, thus it may not be a valid tool for assessing nutritional status.

Although prealbumin and RBP may not be valid indicators of nutritional status, they may be used for evaluating nutrition therapy for critically ill patients, but further studies need to be conducted to support this assumption (t/f). Serum hepatic levels may not identify the patients most likely to develop malnourishment, even with adequate nutritional status.

TOTAL LYMPHOCYTE

Percent lymphocytes may also be determined from a differential count.

Relative lymphopenia (total lymphocyte <1200 mm³) is a nonspecific marker for undernutrition. Although malnutrition is associated with depressed

immune competence, is it not reflected with decreased total lymphocyte counts. Possible mechanism for the depression of lymphocytes is insulin, produced as a response to stress and 5 % dextrose IV=s, depresses the release of amino acids from muscle tissue to support synthesis of lymphocytes.

Restore lymphocyte counts and immune function (in the absence of immune deficiency diseases) with refeeding.

$$\text{Total lymphocyte count} = \frac{\% \text{ lymphocyte count} \times \text{WBC}}{100}$$

Assess this value weekly:

Values per (mm ³)	1500 - 4000	normal
	1800 - 1500	mild
	1500 - 900	moderate
	< 900	severe

HEMATOCRIT

Represents packed cell volume or the concentration of RBC in the blood. Hct is often used to diagnose iron deficiency but is not a conclusive measure. Decreased values occur in anemia, hemorrhage, and water overload. Elevated values occur in dehydration and polycythemia.

Normal values (%)	37 - 47	Females
	42 - 52	Males

CELL MEDIATED IMMUNITY

Can be a useful gauge of nutritional status and post-operative risk of morbidity and mortality. Delayed hypersensitivity is a widely used assay of immune function; it involves the intradermal injection of recall antigens- Candida, purified protein derivative (PPD), mumps, and trichophyton on the volar surface of the forearm.

A positive response is defined as a reaction greater than 5mm of induration evaluated at 24 and 48 hours at each injection site. Patients failing to respond are considered anergic. Anergy (failure of immune system to recognize a foreign protein) can be produced by many disease processes such as uremia, liver disease, malignancy,

infection by systemic cortocosteroid therapy; infection, trauma, sepsis, shock, and age greater than 80.

Values:

no positive response	=	anergy
one positive response	=	relatively anergic
two positive responses or more	=	normal

A determination of cell mediated immunity or delayed hypersensitive reaction also indicates protein reserve depletion. The body is not being provided with exogenous amino acids, and reserved stores are so depleted that only critical requirements are being met by amino acids available from endogenous protein turnover. The body is not making the quantities of lymphocyte, monocytes, and thymocytes necessary to fight the invasion of foreign antigens. A determination of CMI, therefore is indicative, not only of protein depletion, but also of the body's potential inability to fight infection. CMI determinations are carried out by administering a series of A screening antigen @ intracutaneously (under the skin). Delayed hypersensitivity can be expected when serum albumin falls below 3.0 gram percent. In marasmus, immune function is usually intact until the percentage of ideal body weight falls below 85 %. Skin tests are normal if diameter is greater than 5 mm diameter in 24 to 48 hours and results are reported as percentage of normal for purposes of nutritional and metabolic assessment.

SERUM LIPIDS

With an inflammatory reaction, consumption of cholesterol by the body is increased to such high levels that a significant depletion of cholesterol is seen in the peripheral circulating lipoproteins; VLDL is decreased; HDL maintains its protective function.

Decreased values of cholesterol can be due to with malnutrition, infection, hyperthyroidism, malabsorption, anemia, and inflammation. Severe malnutrition causes decreased levels of total

cholesterol, HDL cholesterol, and LDL cholesterol

Inflammatory cytokines likely mediate a decline in cholesterol levels. Low cholesterol concentration is not associated with dietary intake. However, (Chol < 160 mg/dl) is commonly seen in the undernourished with serious underlying diseases. Non-specific feature of poor health status because it reflects the cytokine-mediated inflammatory condition. Further research needed to support prognostic function cytokines as indicators of inflammatory status.

CRP:

Positive-acute phase protein: elevated with an active inflammatory response. Useful in discerning inflammation contribution to reduced visceral proteins.

3. Subjective Global Assessment / Physical Assessment/Mini Nutritional Assessment (MNA)

Subjective Global Assessment (SGA): <http://www.jacn.org/cgi/content/full/19/5/570/F1>

Purpose: To assess nutrition status. Includes assessments of weight change, dietary intake, gastrointestinal symptoms, functional capacity, presence of disease, and physical exam.

3 categories: (a) Well Nourished; (b) Moderately (or suspected of being) Undernourished; and (c) Severely undernourished.

Reliable predictor of postoperative complications and is known as one of the better validated nutrition screening and assessment tools to measure nutritional status.

Mini Nutritional Assessment: Best validated nutritional screening device for elder population. Classified into 3 levels of nutritional status from a scale of 0 to 30.

Score 24: indicates satisfactory nutritional status;

Score 17-23.5: indicates risk of undernutrition;

Score < 17: suggests protein-energy malnutrition.

Scores correlate with dietary intake, anthropometrics, and pertinent laboratory parameters.

4. The Nutritional Care Plan

If there is a nutritional deficit based on analysis and interpretation of the screening and

assessment variables, establish a nutritional care plan that will rapidly restore proper nutritional status. The goal of the plan is to restore body weight and replenish protein stores; it should provide the amount of calories and protein to meet the patient's needs.

Estimating Energy and Protein Requirements

Basal Energy Expenditure (BEE) represents the minimum calories requirements of the resting, unstressed patient.

The calculation of BEE is performed using the following equations: *

$$\text{Women BEE} = 665 + (9.6 \times W) + (1.7 \times H) - (4.7 \times A)$$

$$\text{Men BEE} = 66 + (13.7 \times W) + (5 \times H) - (6.8 \times A)$$

W = actual weight in Kg

H = actual height in cm

A = age in years

The requirements for anabolism is expressed as a function of BEE. Caloric intake at levels below these will most likely produce a catabolic effect.

* not valid in very lean or obese patients

Type of Therapy

Extreme stress (major burns, trauma)	2.5 X BEE
Parental anabolic	1.75 X BEE
Oral anabolic	1.50 X BEE
Oral maintenance	1.20 X BEE

Desirable Body Weight and Caloric and Protein Needs

The average hospital patient may require 12 to 18 g of nitrogen and 2000 to 3000 calories daily to maintain nitrogen balance and prevent tissue catabolism.

<u>Calorie requirements:</u>	22 cal/ kg ideal body weight-----Basal
	33 cal/ kg ideal body weight-----Maintenance
	44 cal/ kg ideal body weight-----Hyper Metabolic

Increased Energy Requirements (above maintenance requirements):

Elective Surgery, mild trauma	10 %
Sepsis	20- 25 %
Peritonitis or major infection	35- 50 %
Multiple Fractures	30 - 50 %
Major Burns (> 50 %)	100 % +
Radiation Therapy	100 % +
For every one degree F fever	> 7 - 10 %

Protein Requirements:

Normal Adult 1- 1.5 g protein/ kg ideal body weight

Moderately Stressed 1.5 - 2.0 g protein/ kg ideal body weight

Severely stressed 2.0 - 4.0 g protein/ kg ideal body weight

Example: Normal 70 Kg man, moderate activity, enters hospital with multiple fractures and develops sepsis. The man who normally needs 2000 calories, 70 g protein, now needs:

:

20 % increase (sepsis)
+ 50 % increase (multiple fractures)
70 % total increase

2000 calories X .70 = 1400 additional calories
+ 2000
3400 calories now needed

70 g protein X .70 = 49 g additional protein
+ 70 g normal needs
119 g protein

Trauma and Stress

Stress is defined as the non-specific response of the body to any demand, both psychological (emotional tension, anxiety) and physical (injury, surgery, trauma, infection, burns, environmental extremes of temperature). It involves a number of adaptive neuro- endocrine and metabolic adjustments.

Metabolic Response to Injury

During severe stress, inflammation (body's protective mechanism) alters blood flow.

Hypermetabolism

<u>ADH</u>	Anti-diuretic hormone controls circulating fluid volume and water retention.
<u>ACTH</u>	Adrenocorticotrophic hormone aids in Na retention, K excretion, and stimulates gluconeogenesis, lipolysis, and proteolysis.
<u>Catecholamines</u>	Control lipolysis, suppresses release of insulin, stimulates release of glucagon and reduces peripheral uptake of glucose.
<u>Glucagon:</u>	Stimulates gluconeogenesis, glycogenolysis and lipolysis.
<u>Insulin:</u>	Inadequate nutrition decreases thyroid function and alters insulin production.

Energy and Protein Metabolism

Trauma or disease causes major alterations in energy and protein metabolism. During periods of stress, energy expenditure and nitrogen loss are interrelated and roughly proportional to the degree of injury or extent of infection. Because requirements for energy and protein cannot be independently assessed, they present one of the most complex problems in the nutrition management of hospitalized patients. Studies of nitrogen balance have demonstrated the importance of energy intake level upon nitrogen retention. Over a range of caloric intake, there is a roughly proportional relationship between nitrogen retained and the calories of extra energy added. The beneficial effect of an increase in energy intake upon protein synthesis can be inhibited by inadequate protein intake. On a fixed, adequate caloric intake, the level of protein is the determinant. A more favorable response is achieved if the caloric source is fed at the same time as the protein.

The technique to determine whether protein and calories are at appropriate levels is the Calorie: Nitrogen (C: N) ratio. C:N ratio can be roughly estimated by two methods.

Total Calories:Nitrogen

$$\frac{\text{Protein Content of diet (g)}}{6.25} = \text{Nitrogen content of diet (g)}$$

$$\frac{\text{Total calories of diet}}{\text{Nitrogen content of diet}} = \text{Total calories : nitrogen ratio}$$

Non-protein Calories

Protein content of diet (g) X 4 = Calories contributed by protein

$\frac{\text{Protein content of diet (g)}}{6.25} = \text{Nitrogen content of diet (g)}$

Total calories of diet - calories contributed by protein = non protein calories

$\frac{\text{Nonprotein calories}}{\text{Nitrogen content of diet (g)}} = \text{Nonprotein calories : nitrogen ratio}$

Nitrogen balance is the sum of the gains and losses of nitrogen from various compartments of the body. It is easily calculated using the formula.

Nitrogen balance = Nitrogen intake - Nitrogen output

Nitrogen intake is calculated from a 24 hour dietary intake record.

Convert grams protein to grams nitrogen by dividing protein by 6.25 .

Total nitrogen output is the quantity of nitrogen lost from urine, stool, wound, and fistula drainage, emesis, and skin losses in a 24-hour period. Urinary nitrogen will be expressed as grams urea excreted in 24 hour.

To compensate for nitrogen lost from skin and stools add a constant factor of 4 g nitrogen.

Patients with increased losses, as from fistulas, diarrhea or burn exudate, must be evaluated individually, and these additional losses added to the final figure.

A (-) balance implies catabolism of endogenous protein for energy due to continued stress and /or inadequate provision of Kcal and nitrogen. Due to possible over-estimation of intake and underestimation of output, it is preferable to maintain N balance at a level of +4 to +6 g Nitrogen to allow for errors.

4. Steps in Prescribing a Diabetic Diet

I Calculate ideal body weight

A. Adults - medium frame

Example:

Females $\frac{\text{First 5 feet}}{100 \text{ pounds}}$

$\frac{\text{Each addt=1 INCH}}{5 \text{ pounds}}$

A 5'5" medium frame female should weigh

3. Underweight patient: $\frac{\text{Actual body weight}}{\text{Lower limit of range}} \times 100 = \% \text{ DBW}$

When to use Adjusted Body Weight in calculating BEE:

If the patient's actual body weight is > or = 120 % of the upper limit of their DBW range.

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