AN OVERVIEW OF CLINICAL MEASUREMENT OF NUTRITIONAL STATUS IN THE AUSTRALIAN ADULT

Professor Mark L. Wahlqvist, B. Med.Sc., M.D., B.S., (Adelaide), M.D., (Uppsala) F.R.A.C.P.

Transactions of the Menzies Foundation: 1981, Volume 3, page 7-18

ABSTRACT

With the growing recognition of the nutritional relationships of a number of diseases, nutritional assessment techniques require better definition. In turn, nutritional strategies in preventive medicine and modification of the cause of illness will be more reliably evaluated. In the final analysis, nutritional assessment must link nutrient intake, from food, enterally and parenterally, with well-being, morbidity and mortality. These endpoints must be considered as food culture, food intake, anthropometric, physical, biochemical, haematological and immunological data are collected. And usually some arrangement of priorities, nutritional against non-nutritional, and one nutritional against another nutritional priority is required.

KEY WORDS : Nutritional status, assessment, clinical, nutritional risk factors, energy, nutrient deficiency, self nutrient supplementation, enteral nutrition, parenteral nutrition, medication.

INTRODUCTION

The clinical assessment of nutritional status now involves medical practitioners in family practice, occupational medicine, paediatrics, internal medicine, surgery, obstetrics and gynaecology. It also involves other health professionals, especially nursing staff, dietitians and physiotherapists. Those with the least training in assessment, the pharmacists, are probably called on most by the public to make a nutritional assessment. Physical educators and those who work in fitness centres are also in the business of making nutritional assessments of individuals.

Important for the contemporary Australian clinician are the development of nutritional risk factor profiles, the recognition of energy excess and deficit, of specific nutrient deficiencies, of alcohol abuse, of self-nutrient supplementation, of the nutritional consequences of medication, of the indications for nutritional modification of disease and of the place of nutritional support.

NUTRITIONAL RISK FACTOR PROFILES

If the burden of nutritionally-related illness in Australia is to be reduced, the early recognition of those at risk is necessary (Wahlqvist, 1980; Wahlqvist, 1981a; Wahlqvist 1981b; Wahlqvist and Flint, 1981). Some of the important nutritional risk factor profiles are outlined:

1. Obesity

   a. Family history of obesity
   b. Lower socioeconomic group
   c. Recent change in circumstances (marriage, purchase of car, etc).
   d. Sedentary life style
   e. Preference for energy-dense foods
   f. Alcohol abuse
   g. Need for oral satisfaction of psychological needs
   h. Low self-esteem

2. Atherosclerotic Vascular Disease

   a. Excess energy intake
   b. Preference for foods with a high saturated fat and/or cholesterol content
   c. Preference for sodium
   d. Relative lack of dietary fibre-rich foods
   e. Elevated serum cholesterol and triglycerides and low serum high density lipoprotein
   f. Hypertension

3. Neoplastic disease (especially colorectal, breast, uterus and respiratory tract)

   a. Excess energy intake
   b. Preference for fat of animal origin
   c. Low intake of vegetables, wholegrain cereals and fruits
   d. Alcohol abuse

4. Non-insulin dependent diabetes mellitus

   a. Excess energy intake
   b. Avoidance of vegetables, wholegrain cereals and fruits
   c. Alcohol abuse

5. Upper gastrointestinal haemorrhage

   a. Alcohol abuse

6. Joint disease (gout and osteo-arthritis)

   a. Excess energy intake with consequent obesity
   b. Alcohol abuse with consequent hyperuricaemia

7. Urinary calculi

   a. Inadequate water intake
   b. Alcohol abuse
   c. High purine intake
   d. Excessive ascorbic acid intake

8. Dental caries

   a. Sucrose abuse
   b. Snacking

9. Food sensitivity

   a. Individual sensitivity

ENERGY EXCESS

The body weight which constitutes an unacceptably high risk of excess mortality is a matter of judgement. Whereas 120 per cent of desirable body weight is ordinarily taken to indicate obesity, some argue that there should not be concern until a weight 130 per cent of desirable is reached (Keys, 1981; Wahlqvist, 1981b). Moreover, different ethnic groups may be variously at risk and there is an interaction between obesity and other risk factors for reduced life expectancy. Nevertheless, most clinicians would agree that moderate degrees of overweight are more easily managed than larger degrees of overweight, so that from a preventative point of view, intervention at less than 130 per cent of desirable body weight is probably desirable.

From a practical point of view, the simplest way to estimate excessive adiposity is to examine the weight/height relationship as, for example, the body mass index. The desirable body weight for height is that associated with the best life expectancy according to actuarial data. With densitometric or isotopic techniques, the percentage of the body mass that is fat can be related to percentage desirable body weight or to body mass index (Table 1). However, such relationships do not always obtain, especially in athletes (Inge et al., 1981). Skinfold thicknesses are also used as a more direct way of assessing adiposity (Table 1), but these also can be misleading in athletes. The more obese the individual, the more difficult it is to make precise skinfold thickness measurements and, therefore, the value of serial measurements is compromised.

TABLE 1

Relationships between different indices of adiposity

Men aged 17 - 76 years

Per cent Desirable # Body Weight	*Body Mass Index* (W/H^2)	*Per cent Body Mass as Fat **	*Triceps Skinfold (mm)***
90	20.5	15	6
100	23	18.5	9
110	25	21	11
120	27.5	24.5	14
130	29.5	27	17

Women aged 17 - 68 years

Per cent Desirable # Body Weight	*Body Mass Index* (W/H^2)	*Per cent Body Mass as Fat **	*Triceps Skinfold (mm)***
90	20	24	12
100	22	26.5	14
110	24	29.5	17
120	26.5	33	21
130	28.5	35.5	25

* *Based on Womersley and Durnin, 1977*

** *Based on Durnin and Womersley, 1974*

\# *In this paper "desirable body weight" is taken as the middle value of the median frame range of the Metropolitan Life Insurance desirable weight tables.*

ENERGY DEFICIT

The recognition of the nutritionally reversible component of wasting disease is particularly important. This applies to neoplastic disease, gastrointestinal disease (fistulae, malabsorption syndromes, bowel obstruction) burns, mental and neurological disabilities, chronic renal failure, cardiac and respiratory failure.

Irrespective of starting weight, a recent weight loss of 10 per cent or more of usual body weight identifies an at-risk patient. If the loss occurred in less than two weeks, it would more likely be a change in fluid balance, but if it occurred over several weeks it could be

due to a loss of adipose tissue and lean body mass. With a weight for height 90 per cent of the desirable, protein energy malnutrition (PEM) must be considered. When the serum albumin concentration is less than 28 g/L, adult kwashiorkor may be evident.

Standards for assessing adiposity by way of triceps skinfold thicknesses and muscle mass by way of mid-muscle circumference are shown in Table 2 (Jelliffe, 1966).

TABLE 2

*Skinfold, Arm Circumference and Muscle Circumference Standards for Adults**

	Standard Standard	*90% Standard*	*80% Standard*	*70% Standard*	*60%*
Triceps Skinfold (mm)					
Male	12.5	11.3	10.0	8.8	7.5
Female	16.5	14.9	13.2	11.6	9.0
Arm circumference (cm)					
Male	29.3	26.3	23.4	20.5	17.6
Female	28.5	25.7	22.8	20.0	17.1
Muscle circumference (cm)					
Male	25.3	22.8	20.2	17.7	15.2
Female	23.2	20.9	18.6	16.2	13.9

**From Jelliffe, D.B. (1966)*

Whereas lean body mass reflects somatic protein, plasma proteins and lymphocyte count reflect visceral protein (Table 3, Kaminski and Winborn, 1978).

The adequacy of protein intake can be assessed by way of nitrogen balance, although this does not take into account the possible diversion of amino acids to somatic protein and away from visceral protein, especially enzymes and antibodies.

TABLE 3

*Assessment of Visceral Protein Deficiency**

	Mild	*Moderate*	*Severe*
Serum albumin (g/L)	30 to 35	25 to 29	25
Lymphocytes (cells 10^9/L)	1.5 to 1.8	0.9 to 1.49	0.9

* *From Kaminski, M.Y. and Winborn, A.L.* (1978)

SPECIFIC NUTRIENT DEFICIENCIES

There are several circumstances in which specific nutrient deficiencies can emerge in Australia and these include:

1. Particular age groups (women in reproductive age, elderly)

2. Domestic circumstances (single persons, single parents, institutionalised persons)

3. Life style problems (physically inactive, alcohol abusers, cigarette smokers)

4. Socioeconomically disadvantaged (limited education, Aborigines)

5. Iatrogenic (medication, surgery)

6. Other medical problems (obesity, wasting diseases)

7. Food faddism

The nutrient deficiencies to which Australians are subject include the vitamins folacin, thiamin and ascorbic acid, the minerals iron and zinc, dietary fibre and water. For optimal health, a greater intake of carotenoids and of essential fatty acids (both ω6 and ω 3 series) is probably desirable.

Thus, the various symptoms and signs of nutrient deficiency must be recognised as follows (McLaren, 1981):

Protein:

Muscle wasting; oedema; hair which is depigmented, dull and easily plucked; leuconychia; parotid enlargement, hepatomegaly (fatty liver).

Vitamins:

Thiamin (B_1) : high-output cardiac failure ("wet beriberi"); peripheral neuropathy; Wernicke's encephalopathy; Korsakoff's psychosis.
Riboflavin (B_2) : angular stomatitis; cheilosis; glossitis; blepharitis; corneal vascularization; scrotal or vulval dermatosis.
Niacin : pellagra; glossitis; mental disorders; diarrhoea.
Pyridoxine (B_6) : peripheral neuropathy; encephalopathy.
Vitamin B_{12} : features of anaemia; mild icterus; peripheral neuropathy; subacute combined degeneration of spinal cord; optic neuritis; mental disturbance.
Folic acid : features of anaemia; leucopenia and/or thrombocytopenia; glossitis; diarrhoea.

Ascorbic acid (C) : petechiae, purpura; perifollicular haemorrhage; swollen bleeding gums; corkscrew hairs; bone pain in children; delayed wound healing.
Vitamin A : impaired dark adaptation; xerophthalmia; Bitot's spots, follicular keratosis.
Vitamin D : Rickets; osteomalacia
Vitamin E : Anaemia
Vitamin K : Abnormal bleeding.

Minerals:

Iron : features of anaemia; angular stomatitis; koilonychia.
Iodine : goitre.
Calcium : rickets; osteomalacia; tetany, convulsions.
Phosphorus : weakness, osteomalacia.
Magnesium : weakness; tetany; convulsions; mental disturbance; cardiac arrhythmias.
Zinc : growth retardation; hypogonadism; impaired taste and smell; delayed wound healing; impaired dark adaptation.

Essential fatty acids:

Xerosis; anaemia; disorders of platelet aggregation.

Dietary fibre:

Functional bowel disorders; constipation, haemorrhoids.

All regions of the body should be systematically examined. When the head and neck are examined, factors influencing mastication including dentition should be remembered.

Of all the factors likely to produce nutrient deficiency in Australia, alcohol abuse must rank as one of the most important (Roe, 1979).

Particular care must be paid to the potential nutrient deficiencies of single, adolescent, pregnant women (Aebi and Whitehead, 1980; Rutishauser, 1981).

SELF NUTRIENT SUPPLEMENTATION

Although no good data are available for the prevalence of self-medication with nutrients in Australia, the practice appears to be wide-spread. In the United States, in the period 1973 to 1975, the Food and Drug Administration surveys indicated that about 55 per cent of total consumers were using nutrient supplements (Campbell et al, 1981). Those most likely to use supplements were female homemakers aged 18 to 34 years with children. Nutrition knowledge appeared actually to increase the likelihood of nutrient supplementation rather than the reverse. For the Australian doctor who will enquire, it has become evident that possibly half his patients are consumers of nutrient supplements,

often to the exclusion or substitution of other medication. Indeed, it is now important to establish, as part of good history taking, what health and nutrition beliefs have led to this practice. In part, it reflects a mistrust of the food supply and a misunderstanding of food processing techniques. In part, it is a quest for a more 'natural', albeit by way of pills, solution to a health problem. There is also the quest for better and better health by having more where a little might be beneficial. What is probably an epidemic of nutrient supplementation reflects wide-spread ignorance of the nature of food and basic nutritional principles. Somehow the concept of a safe range of intake of nutrients with deficiency to one side of this range and pharmacology and toxicology to the other side needs to be developed in the public mind.

One of the problems for the health professions is a general lack of information about the long term effects of chronic high dose nutrient supplementation. This is an almost virgin area of nutritional research posing new questions about nutrient interaction. Indeed, it is likely that some of the manifestations of nutrient toxicity have yet to be recognised. The possibilities for megadosage vitamin C are only just emerging such as withdrawal scurvy, impaired glucose tolerance, vitamin B_{12} deficiency, excess iron and mecury storage, oxaluria and uvicosura.

Another aspect of this area of nutritional assessment is that with nutrient supplementation the patient may be delaying diagnosis of non-nutritional disorders.

NUTRITIONAL CONSEQUENCES OF MEDICATIONS

Yet another area of nutritional assessment which is emerging for the contemporary clinician is that related to the nutritional consequences of medication. There are several mechanisms by which medication can affect nutritional status including (Roe, 1976):

1. Appetite
2. Absorption of nutrients
3. Blood transport of nutrients
4. Metabolism of nutrients
5. Excretion of nutrients in bile or urine
6. Utilisation of nutrients.

Food intake and nutritional status can also affect the efficacy of medications.

INDICATIONS FOR NUTRITIONAL MODIFICATION OF DISEASE

There are disorders, such as cystic fibrosis and chronic renal failure, which do not necessarily arise for nutritional reasons, but whose course can be modified by nutritional intervention. In these disorders it is necessary to assess how far food intake is away from the preferred intake for that problem. A thorough knowledge of food composition is usually required for such an assessment (Paul and Southgate, 1978; Thomas and Corden, 1977).

TABLE 4

Vitamin and Trace Mineral Supplements for Total Parenteral Nutrition

ADULTS

Adopted 12/8/79

SUBSTANCE	RECOMMENDED DAILY SUPPLEMENT (per kg BW)			
	Basal Amount	*Moderate Amount*	*High Supply*	
Vitamin Aμg	10	10	20	(1)
Vitamin B group:				
Thiamin mg	0.02	0.04	0.3	
Riboflavin mg	0.03	0.06	0.3	
B6 mg	0.03	0.06	0.4	
Niacin mg	0.2	0.4	2	
B_{12} μg	0.03	0.06	0.06	
Vitamin C mg	0.5	2.0	25	
Pantothenic acid mg	0.2	0.4	0.4	
Folacin (s) μg	3	6	6-9	
Biotin μg MICRO	5	10	10	
Vitamin D μg	0.04	0.04	0.1	(2)
Vitamin E I.U.	0.5	0.75	1.0	
Vitamin K μg	2	2	2	
Chromium μ mol	0.005	-	-	
Copper μmol	0.07	0.3-0.4	0.4-1.0	
Iodine μmol	0.015	-	-	
Iron μmol	0.25-1.0	1.0	1.0	
Manganese μmol	0.04	0.10	0.23	
Zinc μ mol	0.7	0.7-1.5	1.5-3.0	

NOTES; *(1)* *1μg retinol = 3.33 I.U. Vitamin A*
(2) *1μg cholecalciferol = 40 I.U. Vitamin D*

Basal Amounts: *will cover resting metabolism and some physical activity.*

Moderate Amounts: *should be used in depleted patients or in patients with increased losses.*

High Supply: *should be used in severe catabolic conditions.*

PLACE OF NUTRITIONAL SUPPORT

Much of the present renewed interest in and appreciation of nutritional assessment in clinical practice derives from the advent of the nutritional support technique of parenteral nutrition introduced by Robert Elman in 1937 and developed by Arvid Wretlind in 1961 and Stanley Dudrick in 1966 (Grant, 1980; Wretlind, 1981). In due course, improved techniques of enteral nutrition (Silk, 1981) and greater attention to hospital catering systems have led to improvements in nutritional status. But the evaluation of the relative effectiveness of food, enteral and parenteral nutrition in different clinical circumstances, will depend on the quality of the nutrition assessment techniques.

Allowance must be made for the different energy requirements of illness.

An energy deficit can be incurred during illness because of an increase in requirements. The basal metabolic rate (BMR) is about 90 kJ (22 kcal per kg) per kg body weight. The additional energy requirement for most patients who are in bed is 30%, for patients who are up and about, 50%, for rebuilding, 80%, and for fever, 10% per degree Celsius. The basal metabolic rate can be calculated according to the Harris-Benedict equation.

Men : $J = 4.2 (66.473+13.7516W+5.0033H-6.7550A)$
Women : $J = 4.2 (655.0955+9.5634W+1.8496H-4.6756A)$

J = total kilojoules in 24 hours; W = weight in kg; H = height in cm; and A = age in years.

The Australian Society for Parenteral and Enteral Nutrition, in 1979, made recommendations about the daily supplements of nutrients for adults (Table 4) during total parenteral nutrition.

This recommendation and that for Vitamin and Trace Mineral supplements for neonates and infants receiving total parenteral nutrition have been based on recommendations published by A. Shenkin and A. Wretlind (for further details and comprehensive bibliography see Wld.Rev.Nutr.Diet., 1978, 28, 1-111).

CONCLUSIONS

The contemporary clinician needs a thorough knowledge of nutrition assessment techniques based on an understanding of food culture, food intake patterns, food composition (Paul and Southgate, 1978; Thomas and Corden, 1977), recommended dietary allowances (Committee on Dietary Allowances, 1980; National Health & Medical Research Council of Australia, 1979), vulnerable groups in the community, anthropometry, symptoms and signs of nutrient excess and deficiency, and relevant laboratory investigations (Goodhart and Shils, 1980; Interdepartmental Committee on Nutrition for National Defence, 1963).

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Address for reprints:
Professor M. L. Wahlqvist,
Department of Human Nutrition,
Deakin University,
Geelong. Victoria 3217.