

Long Term Mineral and Vitamin Supplements: Which Patients will Need Them?

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Long term vitamin and mineral supplements may be indicated where a deficiency causing acute disease occurs, but only after every effort has been made to correct associated food-intake deficiencies

Food provides energy [measured as kilojoules (kJ) or calories (cal)], and consists of dietary fibre and other nutrients which include minerals and vitamins. Whilst the understanding of the functions of these components is facilitated by a separate consideration of each, each component is inter-related. It is possible to speak of the 'energy density' and the 'nutrient density' of various foods. The availability of nutrients to the body depends not only on the amounts present in the food, but the kind of food (bioavailability). For example, too much phytate, from unleavened cereals, could reduce the availability of zinc or iron.

The physical characteristics of food, including particle size, viscosity and acidity, are also important. Recommended nutrient allowances (see tables I and II) endeavour to allow for a wide range of circumstances and provide for an additional amount over requirement, as long as this is safe. In the di-

etary allowances for use in Australia, for example, some attempt has been made to allow for sex, age, pregnancy and lactation as well as level of physical activity. In contrast, a nutrient requirement necessitates knowledge of a particular individual under a particular set of circumstances. Clearly, need is likely to be influenced not only by age, sex, whether pregnant or lactating, but also by climate, level of physical activity, state of health, and whether or not the individual is taking particular medications.

Causes of Vitamin and Mineral Deficiency

Foodstyle Problems

Food-faddism: A 'food fad' is an idea about food which has no factual basis, and usually interests people for a short time only. It exists because of confusion, fear and a quest for a simple solution to health problems. There are many examples of why people may subscribe to a food fad. Where a food supply system is changing, people may be suspicious about the nutritional value of the new foods.

Because so much information about food is available, it may be difficult to make food choices. Some people believe that health problems can be

solved through following a particular dietary pattern and that performance can be improved, whether it is athletic, sexual or mental.

Dissatisfaction with our society has led some people to seek alternative lifestyles and alternative foodstyles. The pressures to be slim are great, especially for women, and by far the most popular diets in the Western world today are weight reduction regimens. The most popular of these are low in carbohydrate, high in fat and moderate in

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protein. Where consumption of food falls on a long term basis below 1200 cal/day, (500 kJ/day), not enough food can be eaten to provide the essential nutrients, including minerals and vitamins.

Geobiochemical Problems: The consumption of a wide variety of basic foods will ensure an adequate intake of all essential nutrients. Although it has often been necessary for man to have

a staple food provide most of his calories or energy requirements, a wide variety of sources of energy is a safer food system (e.g. the potato famine in Ireland of last century). Similar effects can be seen with regard to mineral and vitamin requirements. In areas of northern China, where the food source comes from a single selenium-poor soil area, Keshan disease has been well documented as a cardiomyopathy in children which is associated with low

blood, hair and nail selenium levels and is responsive to selenium administration. Other areas of the world including South Eastern Australia and Tasmania are recognised as iodine deficient areas, and this deficiency may occasionally manifest as goitre and hypothyroidism in subjects living in these areas.

Low fluoride-containing areas are associated with an increased incidence of dental caries.

Table I. Recommended or adequate daily allowances of vitamins in different countries for the reference adult

	Sex	A (RE µg)	D (µg)	E (mg)	K (µg)	B ₁ (mg)	B ₂ (mg)	Niacin (mg)	B ₆ (mg)	Folacin				Panto- thenic acid (mg)	C (mg)
										free (µg)	total (µg)	B ₁₂ (µg)	biotin (µg)		
Australia	M	750	-	-	-	1.1	1.4	18	-	200	-	2.0	-	-	30
	F	750	-	-	-	0.8	1.0	13	-	200	-	2.0	-	-	30
USA	M	1000	5	10	70-140	1.4	1.6	18	2.2	-	400	3	100-200	4-7	60
	F	800	5	8	70-140	1.0	1.2	13	2.0	-	400	3	100-200	4-7	60
UK	M	750	2.5	10	-	1.1	1.7	18	1-2	-	200-600	3-4	-	10-20	30
	F	750	2.5	10	-	0.9	1.3	15	1-2	-	200-600	3-4	-	1-20	30

Table II. Recommended or adequate daily allowances of minerals in the USA for the reference adult

Ca (mg)	P (mg)	M (mg)	Fe (mg)	Zn (mg)	I ₂ (µg)	Cu (mg)	Mn (mg)	F (mg)	Cr (mg)	Se (mg)	Mo (mg)	Na (mg)	K (mg)	Cl (mg)
800	800	300	M 10 F 18	15	150	2-3	2.5-5	1.5-4	0.05-0.2	0.05-0.2	0.15-0.5	1100-3300	1575-5626	1700-5600

Problems of Age and Physiological States

Paediatric Feeding: For the infant who is breast-fed up until the 4th to 6th months of life, there should be little concern about vitamin nutrition, provided there is sufficient exposure to sunlight to ensure that vitamin D is formed. However, cow's milk, containing 1.8mg vitamin C/100ml milk, cannot supply an adequate amount of vitamin C, so that a known source such as orange or tomato juice, or a supplement of 25 to 30mg vitamin C should be included in the diet. Deficiency of vitamins A and E may be seen in infants fed skim milk only, and some in-

fants may manifest an anaemia, which is responsive to vitamin E supplementation. Formula feeding can provide iron, vitamin E and fluoride where these are deficient, especially in low birthweight infants.

The Elderly: As physical activity declines with advancing years, energy requirements fall, and food must become increasingly 'nutrient dense' to maintain adequate vitamin and mineral intake. Thus, physical activity should be kept as high as possible. Common deficiencies in the elderly are those of folic acid, riboflavin and pyridoxine.

Factors such as income, physical disability, drugs and antibiotics may

further reduce vitamin absorption and/or availability.

Pregnancy and Lactation: Folic acid requirements are known to be increased during pregnancy, as are iron and calcium requirements. Low serum folate levels are common in pregnancy. Although requirements are not well established, the dietary allowance has been set at twice that of non-pregnant females. Although dietary sources can provide this amount, some authorities consider that it is best provided as a supplement of 200 to 400 µg/day during the latter half of pregnancy, because the folate content of food may vary markedly according to how it is

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stored and/or prepared. Total iron requirements for the fetus are approximately 700mg by term, but 150mg is saved by lack of menstrual loss, i.e. 2 mg/day throughout pregnancy. Maximal iron absorption is 30%, and the average mixed diet contains only 1 to 1.5mg of iron per 1000kJ of energy. Therefore, iron supplements are often prescribed. Anaemia early in pregnancy may increase the requirements.

Although calcium depletion in women of childbearing age, after multiple pregnancies, and on a low calcium diet (<500 mg/day) has not been found unless vitamin D status is poor, increased dietary allowances of an additional 400 mg/day are recommended for individuals whose way of life prevents exposure to sunlight.

Lifestyle-related Problems

Alcohol Abuse: Apart from its metabolic and organic effects, excessive alcohol intake is associated with many nutritional derangements. Besides its effects on energy intake, protein, carbohydrate, lipid and water metabolism, alcohol also affects vitamin and mineral status.

The most common effect of excessive alcohol intake is the associated deficient intake of nutrient-dense foods, where alcohol comes to dominate the total food intake. Deficiencies in intake of the water-soluble B group vitamins (causing Wernicke's encephalopathy, wet beri-beri, peripheral neuropathy, pellagra, cheilosis), of ascorbic acid (causing scurvy), of folic acid (causing macrocytic anaemia), and of iron intake (causing microcytic anaemia) are seen frequently. Magnesium deficiency has been implicated in

the precipitation of delirium tremens. In addition, ethanol may directly prevent uptake of water-soluble vitamins in the upper small intestine. The effect of ethanol on liver and pancreatic function often impairs fat-soluble vitamin function, resulting in either failure of absorption (vitamins A, D and K), failure of activation (vitamin D), or failure of synthesis of carrier protein (vitamin A). Ethanol also promotes hyperzincuria, and the associated zinc deficiency may lead to loss of hair, taste, protein synthesis and vitamin A transport and metabolism, amongst other effects.

Cigarette-smoking: Plasma ascorbic acid levels tend to be lower in cigarette smokers than in non-smokers, although platelet and leukocyte ascorbic acid levels are not significantly altered. It is uncertain whether this phenomenon represents an increased need for

ascorbic acid. Chronic alcohol abusers tend to be smokers as well.

Oral Contraception: Lowered levels of plasma ascorbic acid and pyridoxine have been found in females using oral contraceptives. This may represent a shift in plasma binding, or a shift into other tissue stores. However, the need for replacement supplementation is unclear. Whilst some cases of associated depression are pyridoxine-responsive, further work is needed to clarify whether there is an increased need in all cases.

Occupation: A significant percentage of Australasian workforces work rotating shifts. Under these circumstances food consumption tends to be energy-dense rather than nutrient-dense. In addition, regular meal times may be missed as the worker adjusts to a new sleep/work cycle.

Therapeutic Procedure

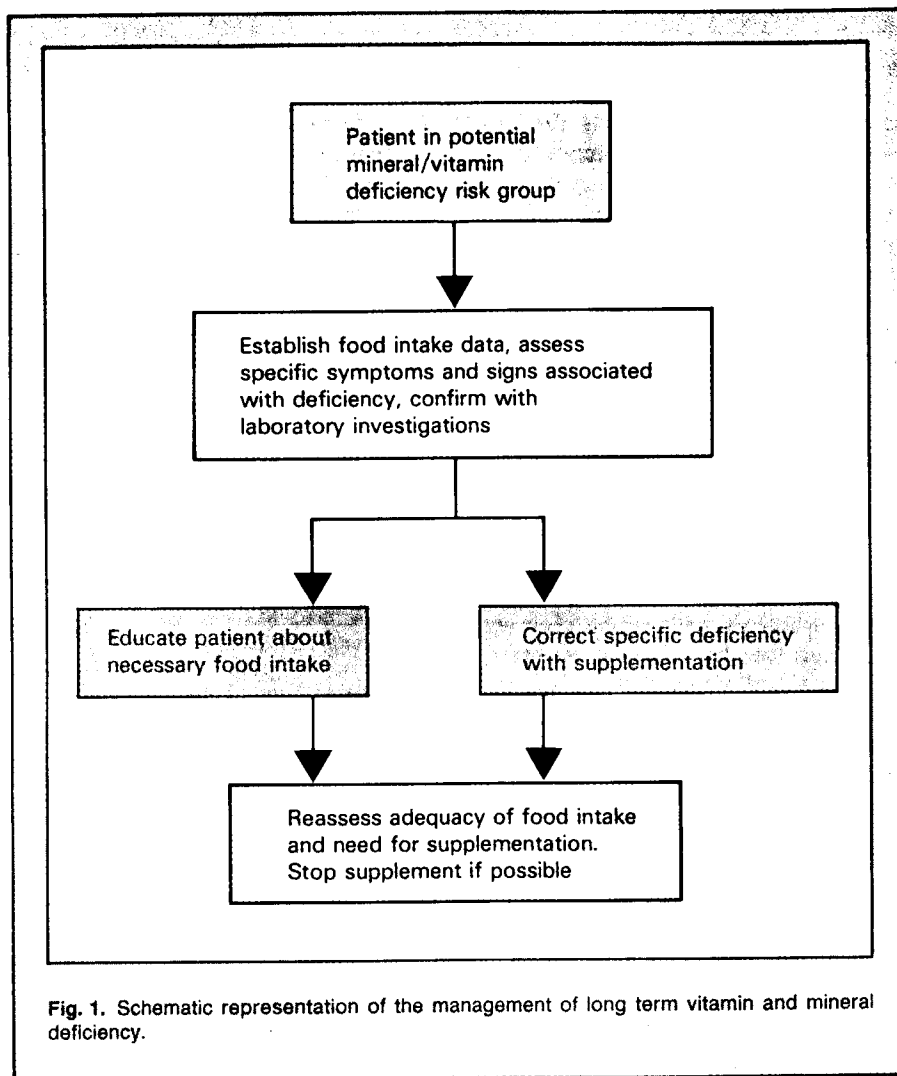
Summary of indications for and management of long term vitamin and mineral supplementation

1. Situations in which vitamin and mineral supplements may be indicated:

- a) Foodstyle problems
 - i) Food-faddism, e.g. low carbohydrate diets
 - ii) Geobiochemical deficiencies, e.g. iodine
- b) Age-related problems
 - i) Paediatric feeding
 - ii) The elderly
 - iii) Pregnancy and lactation
- c) Lifestyle-related problems
 - i) Alcohol abuse
 - ii) Cigarette smoking
 - iii) Oral contraceptive use
 - iv) Occupation, e.g. shift-workers
- d) Specific disease states
 - i) Gastrointestinal disease
 - ii) Neoplasia
 - iii) Renal disease
 - iv) Drug effects
 - v) Perioperative problems
- e) Genetic diseases, e.g. pyridoxine-responsive anaemia

2. Management of supplementation:

- a) Supplement at a level sufficient to replenish stores and to compensate for extra requirements
- b) Develop appropriate food intake patterns as early as possible
- c) Do not continue supplements beyond the period of need



Subjects in other occupations, such as racing jockeys or ballet dancers, may find it necessary, as part of their occupation, to maintain themselves on long term low energy density foods with subsequent vitamin and mineral intake deficiencies.

Specific Disease States

Gastrointestinal Disease: Malabsorption usually impairs uptake of several different dietary components. Intestinal malabsorption secondary to coeliac disease, giardiasis and Whipple's disease may present with symp-

oms of vitamin and mineral deficiency as well as the classical presentation of weight loss, lethargy and tiredness associated with impaired energy uptake. Hepatobiliary disease and pancreatic disease causing steatorrhoea is associated with fat-soluble vitamin deficiency.

Bacterial overgrowth from blind-loop syndromes and jejunal diverticula may cause vitamin B₁₂ deficiency and the associated increase in bacterial folic acid production and consequent absorption may aggravate the neurological sequelae of vitamin B₁₂ deficiency.

Postgastrectomy syndromes follow-

ing peptic ulcer surgery include vitamin B₁₂ deficiency due to lack of intrinsic factor, and iron-deficiency due to lack of gastric acid.

Terminal ileal disease secondary to Crohn's disease, tuberculosis or jejunoleal bypass surgery may result in malabsorption of vitamins B₁₂ and D.

Neoplasia: Weight loss and impaired appetite are common accompaniments of cancer. Impaired intake due to mechanical obstruction may contribute to this, as may nausea and vomiting. The effects of cytotoxic drugs and radiotherapy on the body may also lead to nausea, vomiting and impaired intake of nutrients. Some cytotoxic drugs such as methotrexate interfere with folic acid metabolism and require folic acid supplementation. There is evidence that cytotoxic drugs are most effective when the nutritional status is optimum.

Renal Disease: The requirements of protein restriction in uraemia may lead to deficient nutrient intake. Folic acid deficiency subsequent to peritoneal dialysis and haemodialysis has been documented. Mineral deficiencies associated with dialysis are not as clearly documented, although problems of sodium/potassium and calcium/phosphate balance are well known. Activation of vitamin D (the dihydroxylated form) occurs in the kidney.

Drug Effects: A number of commonly used drugs may cause vitamin and mineral deficiencies, either by interference with uptake or metabolism, or by promoting excretion.

Phenytoin, phenobarbitone and primidone interfere with folic acid uptake, and reference has been made to the methotrexate/folic acid interaction. Diuretics promote urinary excretion of zinc as well as sodium, potassium and magnesium. Frusemide promotes excretion of calcium, whilst chlorothiazide promotes its retention. Penicillamine used as a chelating agent

in Wilson's disease, or in rheumatoid arthritis, may cause increased excretion of other trace metals, as well as increased pyridoxine requirements. Similar effects on pyridoxine are caused by isoniazid, cycloserine and hydralazine. Cholestyramine can cause binding and subsequent failure of uptake of folic acid, and potentially the fat-soluble vitamins, although this has not been clearly documented. Laxatives may result in potassium loss.

Perioperative Problems: Patients with mechanical obstructions to the gastrointestinal tract, head injury, or postoperative problems may require nutritional support which includes vitamins and minerals.

Genetic Diseases

There are a number of disorders which are dependent on the diminished presence of specific vitamins or minerals for their manifestation. Amongst these are the pyridoxine-dependent disorders, which include a form of childhood convulsions, homocystinuria, and the better known sideroblastic anaemia and other metabolic

disorders, in which key apoenzymes are pyridoxine-dependent.

Recent reports indicate that in patients with cystic fibrosis the appearance of cerebellar dysfunction is reversible with vitamin E supplementation. In addition, neural tube defects occur with increased frequency in babies born to folate-deficient mothers.

Acrodermatitis enteropathica is a disease where there is a specific uptake mechanism disorder for zinc, and Menke's kinky hair syndrome is a similar disorder involving copper.

Techniques of Supplementation

The most appropriate way of correcting most vitamin and mineral deficiencies is by correcting the food intake problems with which they are associated (see fig. 1). In most cases, this needs careful assessment of dietary intake and counselling. Most deficiencies associated with weight reduction diets, alcohol abuse, pregnancy, infant feeding and the elderly are correctable in this manner.

Clearly it is important to assess the psychosocioeconomic circumstances,

and, where possible, to seek the help of paramedical services such as dietitians, nurses, physiotherapists and occupational therapists.

Vitamin and mineral supplements may be indicated where a specific deficit is causing acute disease, but long term therapy with oral supplementation is rarely required once normal body stores are achieved. Parenteral administration of specific nutrients should be confined to those with specific absorption problems.

Further Reading

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