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Use and Abuse of Vitamins in Children

M L WAHLQVIST
Department of Medicine, Monash University, Prince Henry's Hospital
Melbourne, Australia

The Phenomenon

Parental concern about the nutritional well-being of children is understandable and desirable. It can express itself in various ways. These include the accord and significance given to the occasions of eating in the household, the ways of using food in celebration, the development of food-health beliefs, the purchase and preparation of food, and the involvement of children in these processes, the extent to which food is used in a disciplinary sense, the sense of security about the nutritional quality of processed food, and the potential health giving properties attributed to nutrients themselves.

From work in Australia by Worsley and Crawford, there appear to be broadly two pathways which lead to dietary supplementation. The first is termed the subjective "well-being pathway" and the other the "food-centredness pathway". In relation to the first, supplements are used to gain some health benefit. Yet, as far as health is concerned, supplementers appear to have a harder time than non-supplementers. This applies in the area of physical symptoms such as sore throats and headaches and emotional symptoms. But there are specific beliefs about one's body or one's self (e.g., that legs are weak and prone to trouble), suggested and related cognitive processes (e.g., if one reads about a character with an illness one is more likely to report similar symptoms), and the greater likelihood of symptom reporting in stressful situations. For all their supplementation, users do not appear to perceive themselves as healthier than non-supplementers. This does not mean that supplementation necessarily causes ill-health or poor well-being. The food-centredness pathway is one where supplementers take a more suspicious view of the food supply than non-supplementers. They regard it as deficient in nutritional quality and are concerned about harmful added chemicals. At the same time, they are more aware of scientifically based advice to improve food intake in relation to

health; they have a greater knowledge of the prudent diet or national dietary guidelines. They quite correctly believe that poor diet is a major cause of several diseases such as heart disease and bowel cancer and they understand this to a greater extent than other people. One suspects that were there a more sound base of biological education for such people, they would be more discriminating between scientifically and non-scientifically based information. Such people may actually be one of the best allies for those who seek useful change in eating patterns in society.

The prevalence of supplementation with vitamins and minerals in the community is, however, cause for concern. Two surveys by The National Heart Foundation of Australia, in 1980 and 1983, on representative samples of adults in capital cities, indicate that about one-fifth regularly consume vitamin and mineral supplements. When the definition is widened to nutrients in general, including, for example, wheat germ and bran, in Adelaide, Australia, 37% of men and 53% of women regularly consume nutrient supplements. A breakdown of the use of various supplements by men and women in Adelaide is given in Tables 1 and 2.

TABLE 1
THE PERCENTAGES OF MEN AND WOMEN TAKING SELECTED DIETARY SUPPLEMENTS IN THE MONTH BEFORE THE SURVEY

Supplement	Men (n=380)	Women (n=380)	Overall (n=725)
Bran	11.6	24.0	18.0
Multivitamins	15.9	15.8	15.8
B-complex vitamins	7.5	14.0	10.9
Vitamin C	8.8	10.9	9.8
Wheat germ	4.9	9.2	7.2
Vitamin E	2.3	6.8	4.7
Iron	0.6	6.1	3.4
Lecithin	2.3	4.2	3.3
Vitamin B-6	1.2	4.2	2.8
Low sodium salt	3.19	2.1	2.6
Kelp	1.2	2.9	2.1

Note: n = number of subjects studied.

TABLE 2
MEAN DAILY INTAKE OF SELECTED VITAMINS AND MINERALS BY SUPPLEMENT USERS

Supplement	Adult RDI* (mg/day)	Mean intake (mg/day)
Vitamin C (n=40)	30-60	279.0
Vitamin E (n=16)	13-16.5	136.0
Vitamin B-6 (n=16)	2-2.5	46.2
Iron (n=12)	10-15	314.5

*Recommended daily allowance or intake.

It is of interest that more women than men use vitamin and other dietary supplements regularly. More people over 50 years of age are regular supplementers. Among men, more of those in high-status occupations are supplementers. Educational background is not related to overall supplementation rates in Australia, although in the United States it appears that use is common amongst the more educated and higher income groups.

Of particular importance is the apparent impact of the parent on supplementation practice in children and adolescents (Table 3).

A two- to threefold increase in supplement use is seen amongst the children where one spouse is a supplement user, compared with those families in which parents are not users of supplements.

One of the most important misunderstandings in supplement use is

TABLE 3
PERCENTAGES OF DIETARY SUPPLEMENT USERS IN THE RESPONDENTS' FAMILIES

	Supplement users	Non-users
Infants (0-5 years; n=90)	45.7	18.2
Children (6-12 years; n=136)	43.3	10.5
Adolescents (13-18 years; n=126)	32.8	7.4
Spouses (n=500)	40.8	12.0

Note: n = number of subjects studied in a representative sample of the population.

that one can entirely simulate food with nutrients or even with a few nutrients. Food is far more complicated than this. Food includes, of course, the macronutrients, fat, carbohydrate, protein, ethanol and dietary fibre. Water is an important component of food, and about half of our daily water intake can come from food. The micronutrients include vitamins and minerals, both major and trace elements. But there are many non-nutrients and these include the natural flavours and colours of food. A flavour can depend on a dozen or more different chemicals whose biological role for people consuming them is scarcely understood. Of the scores of other compounds in food, only a few are carefully studied, like caffeine, phytic acid and the natural oestrogens in food. The physical properties of food are also important. These include the particle size of food, its viscosity and its acidity or alkalinity. We know, for example, that peanuts are not handled by the bowel in the same way as peanut paste. We need to think more of food and food patterns than nutrients.

The Risks

The areas of risk include the intake of nutrients themselves, vitamins and elements (otherwise known as minerals), substances purported to be nutrients, and excepients (fillers, colourings, flavours, and effervescents, often containing sodium).

Indication of the regularly daily intake above which adverse effects of vitamins are seen is given in Table 4.

It should not be presumed that new forms of vitamin toxicity will not be discovered with the passage of time. There are several reasons why this might be the case. Firstly, the last of the thirteen vitamins, the water-soluble vitamin B-12, was only discovered in the late 1940's. Continuous use for very long periods of time may still yield adverse effects not experienced with shorter time frames. Additionally, their use in childhood and continued use thereafter, provide potential for very long periods of use. There has also been a push from the health food industry for greater and greater dosages. This reflects the mistaken view that, if a little is good, more is better. Ultimately, all chemicals, including those we need like vitamins, can assume toxicological properties. In an intermediate range between the provision of normal bodily function (physiology) and toxicology, some may have useful therapeutic properties.

Often, substances are included in nutrient supplements which are purported to be nutrients when they are not. These include pangamic acid ("vitamin B-15"), amygdalin ("vitamin B-17"), and orotic (orotate, "vitamin B-13"). There are only thirteen recognized vitamins, and none of these three just mentioned is an accepted vitamin. Then, there are food substances, which may appear in supplements with pharmacological rather than nutritional properties. These include the bioflavonoids (vitamin P factors), steroids and caffeine. There are also some substances which are nutrients which may not be essential in the diet, let alone supplements; these include

TABLE 4
VITAMIN TOXICITY

Vitamin	Adverse Effects	Regular Daily Intake above which Adverse Effects are Seen
A	Neurological Alopecia Bone Teratogenicity	200-1000 μg RE/kg body weight 700-800 IU (210-240 μg RE) kg/day (RE = retinol equivalent; IU = international units)
D	Hypercalcaemia and its effects	Possible at 10,000 IU (240 μg) daily over several months but 50,000-500,000 IU daily for several years may be necessary for toxicity to develop. Because of the expression in countries where the intakes in the region of 3000-4000 IU (75-100 μg) with fortification of teratogenicity, it would seem product to keep intakes as near to 400 IU (10 μg)/day) as possible. Problems have been seen in infants at 900-100 μg/day.
	Possible hypercholesterolaemia Developmental abnormalities	
E	Interference with absorption of A and K Minor gastro-intestinal side-effects (nausea, flatulence, diarrhoae)	300-600 mg
K	Long-term effects uncertain in infants, haemolytic anaemia Increased analgesia in interaction with opiates and salicylates	5-10 mg/day in infants may lead to haemolytic anaemia.
B-1	Hypersensitivity reactions, parenterally	Very low level of toxicity
B-2	Not described	Very low level of toxicity Limited water-solubility and therefore urinary excretion limited.

TABLE 4 (CONTINUED)

Vitamin	Adverse Effects	Regular Daily Intake above which Adverse Effects are Seen
Niacin	Niacinamide has little adverse effect compared with niacin; vascular dilatation (flush) experienced at any dose which leads to a fluctuation in blood levels. Slow introduction of pharmacological amounts can avoid changes in hepatic enzymes. Variable hyperuricaemia should be checked.	50-100 mg
B-6	Sensory neuropathy Phocomelia (possible) Withdrawal depression (a clinical observation requiring a formal study)	> 200 mg
Folacin	Exacerbation of B-12 deficiency Secondary zinc deficiency	Problem occurs with the folic acid form of folacin. Preferable to keep dosage within 2 or 3 orders of RDI.
B-12	None recognized	Not established
Biotin	None recognized in humans. In experimental animals, interference with reproductive function.	Not established
Pantothenic acid	Diarrhoea	10,000-20,000 mg
C	Diarrhoea, oxaluria, uricosuria Withdrawal scurvy, iron storage disease, increased toxicity of other metals, hypoglycaemic effects, gastrointestinal reflux, possible increase in requirement for vitamin B-6, associated excessive sodium intake, dental erosions, haemolysis in G-6-PD deficiency, mutagenic breakdown products, interaction with warfarin, gastrointestinal obstruction	Adverse effects seen at levels of > 500-1000 mg

(From Use and Abuse of Vitamins, Wahlqvist, Huang and Worsley, 1987).

choline, myoinositol, lipoic acid and carnitine (vitamin B-T). Therefore, there is no need to run the risk of toxicity from these compounds through their inclusion in supplements.

There are several colours, some of which lead to sensitivity reactions, which are found in vitamin supplements, and these include amaranth, brilliant blue, carmosine, erythrosine, sunset yellow and tartrazine. Of considerable concern has been the level of sodium, especially in effervescent vitamin preparations. Up to about 300 mg sodium per tablet has been found in Australian vitamin supplements. When it is considered that we need only about 360 mg of sodium each day, the problem is clear. The particular risks of excessive sodium intake include high blood pressure and increased loss of calcium in the urine.

The Benefits

There are some who may benefit from nutrient supplements. In periods of illness, the ability to eat enough solid or even liquid food may be limited, and whilst energy or calorie (kilojoule) intake may be down, the level of essential nutrients can still be maintained with nutrient supplements. Obviously, the duration of supplementation need not extend very much beyond the period of catch-up after the illness itself. Where supplementation has started late on in the illness, there may also need to be an intake which exceeds the recommended dietary intakes for the period of time as part of the catch-up program. But the nearer the supplementation to the recommended dietary intake, the safer it is.

Globally, some of the world's major nutritional problems are nutrient deficiencies, principally in developing countries. These include the mineral deficiencies of iron, iodine and zinc and the vitamin deficiencies of thiamin (B-1), riboflavin (B-2), niacin (B-3), folacin (folic acid), vitamin A and vitamin D. At risk groups in developed countries include those who do not receive enough exposure to sunlight and may therefore suffer vitamin D deficiency; and infants overly dependent on cow's milk which cannot supply an adequate amount of vitamin C. Skim milk should be avoided in infancy because the fat has been removed and the fat-soluble vitamins with it; in particular, there are risks of vitamin A and vitamin E deficiency in this circumstance. Some fat is needed in the diet to assist the absorption of these vitamins in any case. Infants or children with malabsorption syndromes are also prone to a range of vitamin deficiencies, and nutrient supplementation is required; this may take the form of a simulated food rather than specific nutrients.

Those in institutions, more dependent on others to prepare their food, the socio-economically disadvantaged, those on certain medications and food faddists are also prone to nutrient deficiency and may therefore require supplementation.

There are inherited metabolic disorders where it is necessary to have higher intakes of particular vitamins to overcome the block in a metabolic pathway. The vitamins in question include thiamin (B-1), niacin

(B-3), B-6 (pyridoxine), B-12 and biotin.

Rarely, specific vitamins can be used in a therapeutic sense and in a way which has nothing to do with their function as vitamins. One of the best examples is the use of niacin (nicotinic acid or vitamin B-3) in the management of high blood fat concentrations (such as high cholesterol levels). There have been other suggested therapeutic uses for vitamins such as for the management of psychotic disorders which have not been substantiated by proper clinical trials.

A recent report by Benton and Roberts from Wales raises the possibility that nutrient supplementation may favourably influence non-verbal cognitive function in school children.

Guidelines for the Use of Vitamin Supplements

1. Minimize the need for them by having a regular intake of a wide variety of goods and by being sufficiently physically active so that enough can be eaten (Table 5).
2. Limit the use of nutrient supplementation to where there is a clear need and for the shortest possible time.
3. Evaluate the supplementation against national recommended dietary intakes (Table 6).
4. Only purchase nutrient supplements where there is full ingredient labelling, including excipients.

TABLE 5
NUMBER OF FOOD TYPES

Considering the biological source of food items, how wide is the variety of foods you eat? Consider plant sources (root vegetables), green leafy vegetables, yellow vegetables, leguminous vegetables, various whole grain cereals, citrus fruits, stone fruits, apples and pears, tropical fruits, berries, nuts, herbs), and animal sources (eggs, milk and dairy products, ruminant muscle meats from sheep and cattle, single-stomach animal muscle meat such as pork, poultry , fish, crustaceans, shell fish, organ meats such as liver).

Number of Food Types Each Day

	Assessment
* 0-3	Poor
* 4-6	Fair
* 7-9	Good
* 10-12	Excellent

TABLE 6A
RECOMMENDED DIETARY INTAKE OF FAT SOLUBLE VITAMINS (AUS. OR OTHERWISE USA*) OR SAFE AND ADEQUATE RANGE OR INTAKE FOR CHILDREN (USA**)

	Energy	Protein g	A (μg RE)	D (μg)	E (μg α-TE)	K** (μg)
Infants						
0-0.5	--	kg[1]×2.0*	425	10*	2.5	12
0.5-1	460-420	kg[1]×2.0*	300	10	4.0	10-20
Children						
1-3	5400	20-39	300	10	5.0	15-30
4-7	--	30*	350	10*	6.0	20-40
Boys						
7-11	9200	37-66	500	10*	8.0	30-60
12-15	12,200	51-87	725	10*	10.5	50-100
16-18	12,600	67-90	750	10*	11.0	50-100
Girls						
7-11	9200	37-66	500	10*	8.0	30-60
12-15	10,400	52-75	750	10*	9.0	50-100
16-18	9200	60-66	750	10*	8.0	50-100

1. Body weight in kg is required for this calculation.

TABLE 6B
RECOMMENDED DIETARY INTAKE (AUS. OR OTHERWISE USA*) OF WATER SOLUBLE VITAMINS OR SAFE AND ADEQUATE RANGE OR INTAKE FOR CHILDREN (USA**)

	Thiamin B1 mg	Riboflavin B2 mg	Niacin B3 mg NE*	B6 mg	Folacin μg	B12 μg
Infants						
0-0.5	0.3	0.4	4	0.3	50	0.3
0.5-1	0.35	0.6	7	0.5	75	0.7
Children						
1-3	0.5	0.8	9-10	0.6-0.9	100	1.0
4-7	0.7	1.1	11-13	0.8-1.3	100	1.5
Boys						
8-11	0.9	1.4	14-16	1.1-1.6	150	1.5
12-15	1.2	1.8	19-21	1.4-2.1	200	2.0
16-18	1.2	1.9	20-22	1.5-2.2	200	2.0
Girls						
8-11	0.8	1.3	14-16	1.0-1.5	150	1.5
12-15	1.0	1.6	17-19	1.2-1.8	200	2.0
16-18	0.9	1.4	15-17	1.1-1.6	200	2.0

*NE = niacin equivalent.

TABLE 6B (CONTINUED)

	Biotin** μg	Pantothenic Acid** mg	C
Infants			
0-0.5	35	2	25
0.5-1	50	3	30
Children			
1-3	65	3	30
4-7	85	3-4	30
Boys			
8-11	120	4-5	30
12-15	100-200	4-7	30
16-18	100-200	4-7	40
Girls			
8-11	120	4-5	30
12-15	100-200	4-7	30
16-18	100-200	4-7	30

TABLE 6C
RECOMMENDED DIETARY INTAKE OF ELEMENTS (AUS. OR OTHERWISE USA*)
OR SAFE AND ADEQUATE RANGE OR INTAKE FOR CHILDREN (USA*)

	Iodine	Zinc	Iron	Magnesium	Calcium	Phosphorus	Sodium	
	μg	mg	mg	mg	mg	mg	mmol	mg
Infants								
0-0.5:								
breast fed	50	3-6	0.5	40	300	240	6-12	140-280
formula fed	50	3-6	3.0	40	500	240	6-12	140-280
0.5-1	60	4.5-6	9.0	60	550	360	14-25	320-580
Children								
1-3	70	4.5-6	6-8	80	700	800	14-50	320-1150
4-7	90	6-9	6-8	110	800	800	20-75	460-1730
Boys								
8-11	120	9-14	6-8	180	800	800	26-100	600-2300
12-15	150	12-18	10-13	260	1200	1200	40-100	920-2300
16-18	150	12-18	10-13	320	1000	1200	40-100	920-2300
Girls								
8-11	120	9-14	6-18	160	900	800	26-100	600-2300
12-15	120	12-18	10-13	270	1000	1200	40-100	920-2300
16-18	120	12-18	10-13	270	800	1200	40-100	920-2300

TABLE 6C (CONTINUED)

	Potassium		Selenium	Manganese*	Copper*
	mmol	mg	μg	mg	mg
Infants					
0-0.5	10-15	390-580	10	0.5-0.7	0.5-0.7
0.5-1.0	12-35	470-1370	15		
Children					
1-3	25-70	980-2730	25	1.0-1.5	1.0-1.5
4-7	40-100	1560-3900	30	1.5-2.0	1.5-2.0
Boys					
8-11	50-140	1950-5460	50	2.0-3.0	2.0-2.5
12-15	50-140	1950-5460	85	2.5-5.0	2.0-3.0
16-18	50-140	1950-5460	85	2.5-5.0	2.0-3.0
Girls					
8-11	50-140	1950-5460	50	2.0-3.0	2.0-2.5
12-15	50-140	1950-5460	70	2.5-5.0	2.0-3.0
16-18	50-140	1950-5460	70	2.5-5.0	2.0-3.0

	Fluoride* mg	Chromium* mg	Molybdenum* mg
Infants			
0-0.5	0.1-0.5	0.01-0.04	0.03-0.06
0.5-1.0	0.2-1.0	0.02-0.06	0.04-0.08
Children			
1-3	0.5-1.5	0.02-0.08	0.05-0.10
4-7	1.0-2.5	0.03-0.12	0.06-0.15
Boys			
8-11	1.5-2.5	0.05-0.20	0.10-0.30
12-15	1.5-2.5	0.05-0.20	0.15-0.50
16-18	1.5-2.5	0.05-0.20	0.15-0.50
Girls			
8-11	1.5-2.5	0.05-0.20	0.10-0.30
12-15	1.5-2.5	0.05-0.20	0.15-0.50
16-18	1.5-2.5	0.05-0.20	0.15-0.50

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