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Water-Soluble Vitamin Intakes in the Elderly

Cross-Cultural Findings in the IUNS Study

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Many population studies from different parts of the world have shown that most free-living elderly people have relatively good food habits and nutrient intake (Horwath, 1989; Horwath et al., 1992; Steen, 1977; Rasanen et al., 1992; Lowik et al., 1989) and that the aging process per se is not a cause of malnutrition in healthy elderly (Vellas et al., 1992; Lundgren et al., 1987; Sjogren et al., 1993). However, nutritional status surveys of the elderly have shown a moderate prevalence of nutrient deficiencies. Numerous factors have been linked with malnutrition in the elderly such as their reduced energy needs, presence of chronic diseases, sociopsychological factors such as loneliness, limited social networks, and social activity, economic factors, and education. The published studies suggest that inadequate intakes of fruit and vegetables and some animal-derived foods may be common; that calcium, zinc, potassium, magnesium, and the water-soluble vitamins (WSV) thiamin, riboflavin, vitamin B_6, and folacin are likely to be the nutrients least adequately supplied in the diets of elderly people (Horwath, 1989; de Groot et al., 1991).

This chapter reviews the intake of WSV by elderly people by drawing on data from the International Union of Nutritional Sciences (IUNS) project "Food Habits in Later Life: A Cross-Cultural Study" conducted between 1988 and 1993 (Wahlqvist et al., 1994).

Data on 1,166 elderly people aged 70 years and over (or upper decile) are presented from eight study communities: Australia (Greek and Anglo-Celtic Melbournians), Greece (Spata), Sweden (Gothenburg), China (Tianjin rural and urban; Bei-

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TABLE 3. *Daily intake of water-soluble vitamins (thiamin, riboflavin, niacin equivalent, and vitamin C)*

	Men						Women					
	Young			Old			Young			Old		
	Mean	SD	P50	Mean	SD	P50	Mean	SD	P50	Mean	SD	P50
Thiamin (mg/day)												
ACA	2.32	2.11	1.44	2.22	1.22	1.99	2.03	1.42	1.58	3.05	2.03	2.31
GRK-M	1.27	0.46	1.17	1.22	0.34	1.14	1.01	0.30	0.98	0.95	0.29	0.95
GRK-S	0.88	0.26	0.90	0.74	0.17	0.75	0.66	0.20	0.68	0.66	0.22	0.60
SWE	1.70	0.49	1.64	1.57	0.42	1.49	1.48	0.46	1.48	1.47	0.41	1.40
CBJ	1.38	0.61	1.27	1.12	0.40	1.08	1.05	0.44	0.99	0.87	0.31	0.83
CTJ-R	1.12	0.48	1.06	1.02	0.31	0.89	1.04	0.22	1.03	1.02	0.35	1.01
CTJ-U	1.07	0.17	1.05	1.02	0.21	0.95	0.90	0.24	0.90	0.91	0.23	0.93
JPN-O	0.88	0.27	0.90	0.95	0.30	0.96	0.78	0.20	0.75	0.65	0.18	0.62
Riboflavin (mg/day)												
ACA	3.12	2.50	2.24	3.07	1.32	2.88	2.93	2.29	2.55	3.74	2.11	2.93
GRK-M	1.79	0.65	1.66	1.83	0.68	1.71	1.43	0.41	1.40	1.37	0.44	1.30
GRK-S	1.29	0.42	1.24	1.32	0.42	1.24	1.02	0.35	1.06	1.12	0.42	1.05
SWE	2.35	0.70	2.18	2.10	0.74	1.89	2.06	0.68	2.02	2.12	0.71	2.02
CBJ	0.98	0.45	0.94	0.88	0.31	0.86	0.82	0.49	0.77	0.78	0.42	0.76
CTJ-R	0.73	0.26	0.71	0.71	0.16	0.64	0.76	0.21	0.72	0.72	0.18	0.67
CTJ-U	0.49	0.09	0.48	0.48	0.07	0.46	0.40	0.09	0.41	0.40	0.09	0.36
JPN-O	1.07	0.30	1.02	1.30	0.53	1.31	1.04	0.34	0.95	0.91	0.22	0.94
Niacin equivalent (mg/day)												
ACA	28.95	16.63	22.11	25.90	9.32	22.47	25.31	12.92	21.41	32.28	16.81	27.60
GRK-M	26.09	6.96	26.66	23.36	6.30	22.87	19.89	5.87	19.29	18.17	5.51	17.99
GRK-S	17.49	4.53	17.39	15.48	5.26	14.83	12.91	4.75	13.55	12.62	4.28	11.84
CBJ	16.64	5.90	15.41	12.13	4.81	11.96	12.93	6.10	11.33	10.33	4.72	9.36
CTJ-R	12.47	6.45	11.35	10.81	2.27	9.82	10.95	2.29	10.83	10.80	3.48	10.97
CTJ-U	10.29	1.31	10.16	9.93	1.75	9.15	8.57	2.27	8.81	8.35	1.82	8.22
Vitamin C (mg/day)												
ACA	171	87	155	155	63	160	171	74	160	249	108	282
GRK-M	172	73	158	151	81	136	147	69	136	124	65	105
GRK-S	87	35	81	74	22	68	74	32	73	69	37	57
SWE	123	68	118	92	50	89	127	75	96	122	67	114
CBJ	88	65	72	67	47	52	75	49	67	68	36	63
CTJ-R	60	56	47	88	32	70	48	28	42	62	15	62
CTJ-U	77	25	79	77	26	71	69	25	69	63	26	67
JPN-O	72	41	70	65	27	72	75	32	72	54	20	49

Note: See Table 1 for explanation of codes.

thiamin density was also found to be above the RND for these communities. The main sources of thiamin in these communities were from breakfast cereals, bread, meat, and organ meat (mainly Swedes).

Average daily thiamin intakes were similar among the Greeks in Melbourne, the Chinese, and the Japanese (see Table 3), with 10% to 20% not achieving the RDA. Mean thiamin densities for these communities reached the RND. The major source of thiamin in the diet of Greek Melbournians was from meat and breakfast cereals. Even though rice is not a good source of thiamin, when eaten in large quantities as found in the Chinese and Japanese elderly, it becomes an important source of this vitamin. Furthermore, pasta/noodle consumption was also high among Chinese elderly, equal to that of rice intake (except in Beijing, where bread was also consumed), which also provided major sources of thiamin in the diet, along with pork.

The Greeks in Spata had the lowest thiamin intake, with 30% to 50% eating less than two-thirds of the RDA and a mean daily thiamin density well below that of the RND. This is probably related to their consumption of refined bread, low meat intake, and lack of breakfast cereals in their diets.

Other studies conducted on Anglo-Celtic Australians have not found inadequate thiamin intakes in elderly people as judged by Australian RDAs (Horwath, 1989). However, in the Euronut SENECA study of about 2,000 elderly people aged 70 to 75 years in 19 European centers (de Groot et al., 1991), about 20% of the men and 30% of the women were not achieving the lowest European RDA. Also, surveys show that up to 47% of the U.S. elderly have thiamin intakes below two-thirds of the RDA.

Riboflavin

In the IUNS study, Anglo-Celtic Australians and Swedes had a somewhat higher riboflavin intake compared to other communities. Less than 2% of the subjects did not achieve the RDA. This was probably related to their significantly greater intake of dairy products, especially milk. Greek Melbournians had a higher riboflavin intake than their counterparts in Greece, mainly because of their higher intake of dairy products on migration to Australia, namely milk. Nevertheless, only 5% of Melbourne Greeks and 10% to 20% of Spata Greeks did not achieve the RDAs and mean riboflavin density was above the RND. More than 75% of the Chinese in Tianjin had mean intakes below two-thirds of the U.S. RDA—they were the only study community that had mean daily riboflavin densities below the U.S. RND. This is probably related to their low intake of dairy products, breakfast cereals, and meat.

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Niacin

In most studies, niacin has not been found to be consumed inadequately by elderly people (Horwath, 1989). Similarly in the IUNS study, most subjects achieved the RDA for niacin. This is probably related to adequate intakes of niacin-rich foods such as meat and fish in Australia, Greece, and Sweden, and fish in China and Japan. However, the mean daily intakes of niacin in Tianjin were borderline when compared with RNDs.

Pyridoxine

In the IUNS study, consumption of certain vitamin B_6–rich foods was significant in Sweden (organ meats, fish, meat, and bread), Anglo-Celtic Melbournians (meat, bread, dairy products), Greek Melbournians (meat, fish, leafy greens, bread), Greeks in Spata (fish, leafy greens, bread), Chinese, and Japanese (fish, rice, and eggs).

Cobalamin (Vitamin B_{12})

In most studies, vitamin B_{12} has been found to be consumed inadequately by elderly people (Horwath, 1989). In free-living middle- to upper-class U.S. elderly, 24% of the men and 39% of the women had B_{12} intakes below three-fourths of the RDA (Ahmed, 1992), most of whom were able to maintain normal levels of serum B_{12} despite intakes below the RDA.

In the IUNS study, consumption of vitamin B_{12}–rich foods was high in all centers. In the Chinese and Japanese elderly the major source of B_{12} was eggs and fish and in the European samples the major source was meat, organ meats, and dairy products. In the IUNS study, mean plasma B_{12} levels of the Caucasian elderly were above the cutoff of 111 pmol/L used to define a high risk of deficiency. Spata women had the highest plasma level (because of supplementation), followed by the Swedes, Melbourne Greeks, and Anglo-Celtics. A greater percentage of Greek elderly had plasma levels below 111 pmol/L (8%) compared with Swedes and Anglo-Celtics (<2%).

Folate

Reports of dietary folate intake are scarce because of the difficulty in estimating the folate content of foods. Estimates vary widely because of differences in assay methods and because folate does not occur in food in a single form but in both "free" and "conjugated" forms. Additionally, it is readily destroyed by sunlight, oxidation, and cooking (Horwath, 1989).

In the IUNS study, consumption of folate-rich foods was high among Greek

elderly (namely, leafy greens) but moderate to low in most other centers. In Sweden, the major source of folate was from organ meats (e.g., blood pudding), bread, fruit, and fruit juice (leafy green intake was very low). The major source of folate in the Anglo-Celtic Australian sample was from fruit juice, fruit, and bread. Intake of leafy greens was high in Beijing elderly (second highest intake after Greeks) and moderate to low in Tianjin elderly (especially in rural area). Fruit intake was the lowest among the Chinese and Japanese elderly.

Plasma folate values have been found to be highly correlated with recent dietary intake; serum folate is therefore best measured using fasting samples (Roe, 1986). Plasma folate below 6.8 ng/mL is considered below normal.

In the IUNS study, mean plasma folate levels in the Caucasian elderly were above the minimum cutoff of 6.8 nmol/L. Folate status appeared good in most subjects with less than 5% having values below this cutoff. Similarly in the Euronut SENECA study, folate status was good in all centers: there were no subjects at risk of deficiency with blood levels below 6.8 nmol/L (de Groot et al., 1991).

Pantothenate

The major source of pantothenic acid in the diets of the Chinese and Japanese elderly was from their high intake of eggs. In the Caucasian elderly, meat, organ meats (mainly Swedes), and leafy greens (mainly Greeks) formed the important sources of this vitamin.

Biotin

Intake of biotin-rich foods was high in all the centers studied. Intake appeared particularly high in Chinese and Japanese elderly because of the marked consumption of eggs and rice. In the other centers, major sources of biotin included meat, organ meats (mainly Swedes), and dairy products.

Vitamin C

In the IUNS study, the highest mean intakes of vitamin C were observed in the Anglo-Celtic and Greek Melbournians—none of the subjects had intakes below two-thirds of the RDA. The main food source of vitamin C in the Anglo-Celtic sample was fruit juice, compared with fresh fruit (mainly oranges) and vegetables in the Greek sample in Melbourne. About 5% to 10% of the Swedish elderly did not achieve the U.S. RDA. In Sweden, the main sources of vitamin C are fruits (especially seasonal berries) and fruit juices.

The Spata Greeks, followed by the Chinese and Japanese elderly, had the lowest mean vitamin C intakes. Spata elderly had lower mean intakes than their counterparts in Melbourne, with 5% to 15% not achieving two-thirds of the RDA. Com-

pared to Australia, oranges are not available all year round and fruit juices were rarely consumed by Spata elderly; furthermore, their total vegetable intake was lower than Melbourne Greeks. In China, up to 40% of the elderly were not achieving their RDA. This is probably related to their low intakes of fruit, especially in rural Tianjin. Nevertheless, mean daily vitamin C density in all study communities was above the U.S. RND.

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