RELATIONSHIP BETWEEN SERUM VITAMIN E LEVELS AND SERUM CHOLESTEROL IN NORMAL ADULTS IN RURAL REGIONS OF YAMAGATA PREFECTURE, JAPAN

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Summary Serum vitamin E and cholesterol levels were determined for the residents in rural regions of Yamagata Prefecture, Japan. The average serum vitamin E were 0.99 ± 0.25 mg/100 ml in 166 men, and 1.06 ± 0.26 mg/100 ml in 178 women. Only 0.6% of the subjects were below 0.5 mg/100 ml. There was a significant difference between the serum vitamin E levels of men and women. However there were no statistically significant differences among serum vitamin E of various age groups. The best correlation for serum vitamin E was found with serum cholesterol.

The susceptibility of red blood cells to hemolysis due to dialuric acid or hydrogen peroxide was observed to increase with vitamin E deficiency in human beings (1,2). Several investigators have reported on vitamin E levels in normal adults in assessing the nutritional status with regard to this vitamin (3-6). In Japan, no investigation have been reported on blood vitamin E levels in normal adults except for a few investigations on infants and children (7,8). Recently a relationship between vitamin E and cholesterol levels have been reported in normal adults by DESAI and LEE (9) and LEWIS *et al.* (10).

In this report, we present the results of the survey on serum vitamin E levels in normal adults in rural regions in Japan, and a correlation between serum vitamin E and serum cholesterol.

METHODS

The study population consisted of 344 persons from three rural regions, Kaneyama area (72 men, 69 women), Kawanishi area (51 men, 61 women) and

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Shirataka area (43 men, 48 women), in Yamagata Prefecture, Japan. These regions belong mainly to a rice-cultivating district. There were 166 men and 178 women ranging in age from 18 to 60 years. Blood collection was carried out before breakfast. The serum was separated and frozen until further analysis. Serum vitamin E was determined by Thompson's fluorometric method modified by ABE and KATSUI (11) 1.0 ml absolute EtOH was added to a mixture of 0.2 ml serum and 1.0 ml distilled water and shaken vigorously and followed by the addition of 5.0 ml *n*-hexane. After vigorous shaking for one minute, the extracted vitamin E in the *n*-hexane layer was determined fluorometrically: excitation 295 nm, emission 320 nm. Serum total cholesterol was determined with a cholesteroltest kit using a modified Zak-Henly method (12,13).

RESULTS AND DISCUSSION

The mean serum vitamin E levels are presented in Table 1. The mean serum vitamin E concentration and standard deviation in milligrams per 100 ml for the entire survey were 0.99 ± 0.25 with a range of 0.57 to 1.77 in men, and 1.06 ± 0.26

Table 1. Mean serum vitamin E levels in normal adults.

Area	Men				Women			
	<i>n</i>	Av. $\pm$ S.D.	Min.	Max.	<i>n</i>	Av. $\pm$ S.D.	Min.	Max.
Kaneyama	72	0.99 ± 0.27	0.66	1.77	69	1.05 ± 0.23	0.58	2.05
Kawanishi	51	1.03 ± 0.24	0.65	1.57	61	1.14 ± 0.28	0.70	1.84
Shirataka	43	0.94 ± 0.22	0.57	1.39	48	0.99 ± 0.24	0.38	1.54
Total	166	0.99 ± 0.25	0.57	1.77	178	1.06 ± 0.26	0.38	2.05

n, number of sample; Av, average (mg/100 ml); S.D., standard deviation.

with a range of 0.38 to 2.05 in women respectively. HARRIS *et al.* (3) have reported average plasma vitamin E levels in Rochester, New York, of 1.05 ± 0.32 mg/100 ml. BIERI *et al.* (4) found an average of 1.05 ± 0.26 mg/100 ml in 132 normal adults in Washington D.C. DESAI (5) found an average of 0.97 ± 0.29 mg/100 ml in 379 normal adults residing in metropolitan Vancouver and in the nearby rural community of Chillwack. Similar vitamin E levels were obtained in our investigation in comparison with these reports and others (6). There was significant difference between the serum vitamin E levels of men and women. The frequency distributions of this vitamin levels in men and women are presented in Table 2. Only 0.6% of the subjects were below 0.5 mg/100 ml. About 37.4% of the men and 23.1% of the women were below 0.9 mg/100 ml, while about 26.2% of the men and 37.0% of the women were above 1.1 mg/100 ml. Table 3 shows average serum vitamin E and cholesterol levels of men and women ranging in age from 18 to 60 years. It has been reported that there was a tendency for

Table 2. Frequency distribution of serum vitamin E in normal adults.

Range of serum vitamin E levels (mg/100 ml)	Men		Women		Total	
	Frequency (%)	No. in group	Frequency (%)	No. in group	Frequency (%)	No. in group
0.300-0.399	—	—	0.6	1	0.3	1
0.400-0.499	—	—	0.6	1	0.3	1
0.500-0.599	1.2	2	1.1	2	1.2	4
0.600-0.699	7.2	12	2.8	5	4.9	17
0.700-0.799	14.5	24	5.6	10	9.9	34
0.800-0.899	14.5	24	12.4	22	13.4	46
0.900-0.999	16.9	28	23.6	42	20.3	70
1.000-1.099	20.5	34	16.3	29	18.3	63
1.100-1.199	8.4	14	11.2	20	9.9	34
1.200-1.299	3.6	6	11.2	20	7.6	26
1.300-1.399	4.8	8	5.6	10	5.2	18
1.400-1.499	3.6	6	1.7	3	2.6	9
1.500-1.599	3.6	6	3.9	7	3.8	13
1.600-1.699	0.6	1	—	—	0.3	1
1.700-1.799	0.6	1	2.2	4	1.5	5
1.800-1.899	—	—	0.6	1	0.3	1
1.900-1.999	—	—	—	—	—	—
2.000-2.099	—	—	0.6	1	0.3	1
Total	100	166	100	178	100	344

Table 3. Mean values and standard deviation of serum vitamin E and serum cholesterol in age groups.

Range of age (years)		18-19	20-29	30-39	40-49	50-60
Sample No.	Men	12	37	26	56	35
	Women	3	32	35	68	39
Average of age	Men	18.3	24.1	34.7	45.0	54.4
	Women	18.3	24.1	34.9	44.3	54.3
Vitamin E (mg/100 ml)	Men	0.90±0.18	1.02±0.25	0.95±0.20	1.05±0.26	0.96±0.23
	Women	0.95±0.32	1.11±0.22	0.98±0.30	1.08±0.25	1.07±0.24
Cholesterol (mg/100 ml)	Men	144±15	150±19	140±19	154±23	150±21
	Women	167±19	160±24	145±20	160±20	168±24

Table 4. Coefficients of correlation for serum vitamin E to serum cholesterol in normal adults.

Area	Sex	
	Men	Women
Kaneyama	0.392 (72)*	0.475 (69)*
Kawanishi	0.263 (51)	0.488 (61)*
Shirataka	0.632 (43)*	0.512 (48)*
Total	0.323 (166)*	0.425 (178)*

* $p < 0.001$; (n), number of person.

the average serum vitamin E to increase with age (5,6,9,10). In our subjects, there were no correlation for these vitamin levels to age. The nationwide investigation on serum cholesterol levels in normal adults in Japan indicates that serum cholesterol levels increase with age and that serum cholesterol levels in the residents in cities were higher than in rural regions (14). In our survey, no increase of serum cholesterol levels with age was observed, and serum cholesterol levels were lower in comparison with the average of whole country of Japan. Coefficients of correlation for serum vitamin E to serum cholesterol are presented in Table 4. Correlation of this vitamin to cholesterol were statistically significant at 0.1% levels of probability except for men in the Kawanishi area. BAKER *et al.* (15) indicate that plasma vitamin E is associated with the β -lipoprotein fraction, which is also a common carrier of plasma cholesterol. Recently DESAI and LEE (9) found the best correlation for plasma vitamin E with plasma cholesterol and age. In our investigation, there were also statistically significant correlation for serum vitamin E with serum cholesterol. On the other hand, there was no increase of serum vitamin E and cholesterol with age. These results seem to support that the relationship between serum vitamin E and cholesterol reflects a close association with serum β -lipoprotein fraction.

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