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Comparisons of Food Consumption and Food Sources of Nutrients in the Diets of Postmenopausal Women with Normocholesterolemia and Hypercholesterolemia in Seoul, Korea

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Women have a greater incidence of coronary heart disease (CHD) after menopause. This relates to hormone imbalance-induced changes in known CHD risk factors, especially hyperlipidemia. The purpose of this study was to explore the differences in food consumption and food sources of nutrients in the Korean diet between postmenopausal women aged 50-74 years with normocholesterolemia (NC) and those with hypercholesterolemia (HC). Each subject was either classified as part of the NC group (n=39, serum total cholesterol con. < 200 mg/dl) or the HC group (n=31, serum total cholesterol con. ≥ 240 mg/dl) based on the Guideline for Korean Hyperlipidemia. Diet was assessed through a validated semi-quantitative food frequency questionnaire. Consumption of foods such as biscuits and/or crackers, squid and eggs was significantly ($p<0.05$) higher in the HC group than in the NC group. On the other hand, consumption of potatoes/starches and carrots was significantly ($p<0.05$) lower in the HC group than in the NC group. There was no significant difference between the two groups in terms of the consumption of legumes and legume products containing phytoestrogen and we could not find a relationship between legumes and legume products and serum cholesterol levels. Consumption of green tea tended to be lower in the HC group than in the NC group. Major sources of cholesterol, cholesterol-saturated index and vitamin A in the diets of the HC group consisted of foods high in cholesterol. Our results confirm that postmenopausal women with hypercholesterolemia in Korea tend to consume cholesterol-rich foods and dishes.

Keywords: Food consumption, Food sources, Postmenopausal women, Hypercholesterolemia

INTRODUCTION

Cardiovascular disease is the leading cause of death in Korea.[1)] Moreover, the incidence of coronary heart disease (CHD) increases with age in women, with the rate of increase being particularly marked after menopause.[2,3)] This relates to hormone imbalance-induced changes in known CHD risk factors, especially hyperlipidemia.[3,4)] Accordingly, once women are diagnosed, the rates of morbidity and mortality are higher than those for men.[5)] Thus, preventive strategies are critical to improve the quality of life for women in the later years. Many risk factors for CHD, including high blood levels of cholesterol, hypertension, obesity and diabetes are substantially influenced by dietary factors.[6,7)] Because these risk factors are modifiable, primary preventive efforts hold much promise. The diet in Korea is of interest for the investigation of diet and disease relationships.[8)] Moreover, epidemiological and clinical studies suggest that diets high in plant foods are associated with lower risks of CHD.[9,10)] Recent evidence[10)] suggests that oxidative damage may be involved in hypercholesterolemia and thus, dietary antioxidants such as vitamin A, beta-carotene and vitamin E may reduce the risks of hypercholesterolemia.

Health educators and nutritionists need to know which foods in the Korean diet are the major contributors of each nutrient among women with hypercholesterolemia. This question has been answered in the past based on information about the nutrient content of individual foods and from the judgment and experience of nutritionists regarding the dietary patterns of the population. Quantitative information regarding the role each food plays in contributing to the nutrient intake of the total population may be useful for nutritionists and physicians examining individual diets, for public health planners and food policy makers examining the population's diet, and for epidemiologists investigating the role of diet in health and disease.[11,12)] In addition to the general nutritional interests mentioned above, the ability to quantify the importance of particular foods may help

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investigators to develop improved instruments for dietary assessment.[12]

Therefore, the purpose of this study was to investigate the difference in food consumption and food sources of cholesterol and antioxidant vitamins such as vitamin A, beta-carotene and vitamin E in the Korean diet between two groups of postmenopausal women aged 50-74 years. These data will be useful in providing a quantified characterization of the dietary choices of postmenopausal women in Seoul, Korea.

METHODS

The full methods and primary analyses have been previously reported.[13] In brief, seventy postmenopausal women aged 50-74 years who underwent regular health checks were recruited from a medical center in Seoul, Korea. All participants had experienced spontaneous physiologic menopause. All had normal results of thyroid function tests, normal fasting serum glucose levels and no evidence of hepatic, renal or secondary lipid disorders. None was taking supplements or medication, including estrogen. The subjects were classified as having normocholesterolemia (NC, n=39, serum total cholesterol con. < 200 mg/dl) or hypercholesterolemia (HC, n=31, serum total cholesterol con. ≥ 240 mg/dl) based on the Guideline for Korean Hyperlipidemia[14]. Informed consent was obtained from all subjects and the consent forms and study protocol were made in accordance with the principles embodied in the Helsinki Declaration.

The dietary data were collected through a validated semi-quantitative food frequency questionnaire (Semi-FFQ).[15,16] The Semi-FFQ consisted of 120 questions covering all major food groups according to the frequency of consumption (3 times per day, 2 times per day, 1 time per day, 1 time per week, 4 times per week, 2-3 times per week, 1 time per week, 2-3 times per month, 1 time per month, less than once a month). Nutrient intakes were computed from the Semi-FFQ using standard portion sizes and food composition tables, as previously described.[15,16] Further validations of the Semi-FFQ in elderly women have been reported separately.[16] The Pearson's correlation coefficients (r) averaged 0.41 on a semi- FFQ vs. 24 hr recall and 0.45 on the semi FFQ vs. biomarkers.[16] Foods consumed were coded and analyzed by computer. The nutrient composition of foods was calculated using data taken from the Korean Nutrition Society.[17] A list of foods contributing to 60-90% of the total intake of cholesterol, vitamin A, beta carotene, vitamin E and the cholesterol-saturated index (CSI) was compiled according to procedures described by Block et al..[18] That is, the methods used for determining the quantitative contribution of various foods to daily nutrient intake of the subjects followed the method of Block et al..[18,19] The percentage contribution of foods in a particular category was determined by dividing the total nutrients from all servings of foods in a category by the total nutrients consumed by all individuals in the sample. As for the major food sources of each nutrient, the top 20 contributors appear in the tables.

A 12-h fasting venous sample was taken for serum lipid analyses when the subjects visited a clinic for weight, height and blood pressure measurements. Serum total cholesterol was measured with commercially available kits on a Hitachi 7150 Auto analyzer (Hitachi Ltd, Tokyo). An average of 3 measurements was recorded for each subject. The body heights and weights of subjects in light clothing were measured and BMI was computed.

Statistical analyses were performed with SPSS/PC+ (version 9.0; SPSS Inc, Chicago). For descriptive purposes, values were presented as means±SEMs, frequency and cumulative percent of distribution. Differences between mean values for the food and nutrient data from the NC and HC groups were assessed by independent two-tailed t-tests. Pearson's correlation coefficients were used to assess the relationship between food consumption and total serum cholesterol levels. A p-value < 0.05 was considered to indicate statistical significance.

RESULTS

The sample included 70 women from a total of 112 subjects, who were classified as having normocholesterolemia (NC, n=39, serum total cholesterol con.

Table 1. General characteristics and lipid profiles of normocholesterolemic and hypercholesterolemic subjects.

Characteristics	NC	HC	p-value
Age(yr)	57.4±1.0[1)]	58.0±1.0	0.663
Age at menarche(yr)	16.6±0.3	16.1±0.3	0.209
Menopausal age(yr)	49.4±0.8	50.9±0.5	0.094
Menopausal period(yr)	8.0±1.4	7.2±1.1	0.652
Weight(kg)	57.6±1.8	57.8±1.1	0.993
Height(cm)	155.3±0.9	153.1±0.7	0.043
BMI(kg/m^2)	23.8±0.7	24.8±0.4	0.233
Total cholesterol(mg/dl)	182.1±2.9	261.3±2.9	0.000
HDL-C(mg/dl)	46.4±1.9	53.8±1.5	0.003
LDL-C(mg/dl)	102.5±3.7	173.8±3.5	0.000
Triglyceride(mg/dl)	165.9±16.7	168.6±12.4	0.897

NC: normocholesterolemia group, HC: hypercholesterolemia group, p-value by two-tailed t-test
1) mean±SEM

< 200 mg/dl) or hypercholesterolemia (HC, n=31, serum total cholesterol con. ≥ 240 mg/dl) based on the Guideline for Korean Hyperlipidemia.[14] The distribution of general characteristics and lipid profiles is presented in Table 1. There was no significant difference in age, age at menarche and menopausal period between the NC and the HC groups. Body mass index (BMI) was not significantly different between the two groups. On the other hand, the HC group had significantly ($p<0.05$) higher serum total cholesterol, HDL-C and LDL-C levels than the NC group did. However, there was no significant difference in serum triglyceride levels between the two groups.

A comparison of daily food intake levels by food group between the NC and HC groups is presented in Table 2. Consumption of potatoes and starches was significantly ($p<0.05$) lower in the HC group than in the NC group. On the other hand, that of squid and eggs was significantly ($p<0.05$) higher in the HC group than in the NC group. There was no significant difference between the two groups in terms of the consumption of legumes and legume products containing phytoestrogen but the intake of green tea tended to be lower in the HC group than in the NC group. A comparison of daily food intake between the NC and HC groups is presented in Table 3. The HC group tended to consume more cooked rice and less mixed rice than the NC group, even though there was no statistically significant difference. The HC group tended to consume more fried foods, such as fried chicken, butter, coffee and soft drinks than the NC group did, but tended to consume less onion, yogurt and persimmon than the NC group, but therewere no statistically significant difference. Consumption of carrots was significantly ($p<0.05$) higher in the NC group than in the HC group. However, that of biscuits and/or

Table 2. Comparison of daily food intake level by food group in normocholesterolemic and hypercholesterolemic subjects. (unit : g/day)

Foods	NC	HC	p-value
Cereals & Grains	728.5±36.7[1)]	698.6±32.7	0.546
Potatoes & Starches	63.6±21.5	13.8±2.8	0.028*
Sugars & Sweets	13.1±3.4	19.3±6.3	0.426
Legumes & Their products	14.6±3.1	17.9±5.1	0.583
Seeds & Nuts	1.0±0.5	1.2±0.4	0.735
Vegetables	289.2±32.9	275.5±30.6	0.761
Fruits	337.8±42.9	322.6±41.6	0.801
Seaweed	5.6±1.7	3.7±0.7	0.272
Mushrooms	3.0±0.7	3.7±1.4	0.705
Sub-total (plant foods)	1456.5±73.8	1356.2±74.0	0.347
Meat & Meat products	32.8±8.0	52.7±14.2	0.258
Fish	49.2±52.0	44.7±6.2	0.569
Dark fish	10.4±2.8	8.5±1.9	0.802
White fish	34.4±9.0	32.1±5.4	0.864
Bone fish	4.4±1.2	4.1±0.9	0.682
Squid	2.6±0.9	14.8±5.5	0.036*
Eggs	12.0±2.0	37.0±5.8	0.046*
Milk & Dairy products	192.3±51.0	136.0±21.3	0.276
Animal fats	3.9±1.0	4.9±2.0	0.655
Sub-total (Animal foods)	286.7±52.7	271.6±33.5	0.802
Alcoholic beverages	15.3±7.5	20.5±8.8	0.665
Nonalcohoic beverages (Soft drink, fruit juice)	102.0±20.5	103.3±23.9	0.967
Green tea(unit: cup)	3.2±0.9	1.2±0.3	0.058

NC: normocholesterolemia group, HC: hypercholesterolemia group, p-value by two-tailed t-test.
1) mean±SEM
* $p<0.05$

Table 3. Comparison of daily food intake of normocholesterolemic and hypercholesterolemic subjects. (unit: g/day)

Food	NC	HC	p-value
Rice, Cooked	268.6±67.9[1)]	312.3±50.8	0.600
Mixed rice, Cooked	236.6±52.8	171.6±42.4	0.334
Barley rice, Cooked	51.8±36.0	36.6±19.9	0.699
Ramyon, Instant	4.1±1.6	5.2±1.6	0.632
Breads	18.2±6.2	28.5±7.2	0.295
Rice cakes	2.7±0.7	3.2±1.2	0.708
Snacks	3.4±1.3	2.2±0.7	0.419
Biscuits/Crackers	0.1±0.0	1.3±0.5	0.050*
Fried foods	14.4±3.2	20.9±10.4	0.586
Fried chicken	5.2±1.4	10.5±3.8	0.196
Ham & Sausage	0.1±0.1	0.6±0.3	0.121
Pork Belly	9.0±3.4	14.5±5.4	0.900
Beef	7.1±1.4	14.9±4.3	0.094
Soybean curd	10.6±2.4	16.8±5.0	0.260
Yellow fin tuna, Canned	1.9±1.0	0.3±0.2	0.142
Butter	0.0±0.0	0.6±0.3	0.070
Margarine	0.6±0.4	0.2±0.1	0.323
Kimchi, Korean cabbage	195.6±29.9	204.0±23.2	0.480
Kimchi, Green onion	14.6±8.0	6.6±2.7	0.347
Doragi, Steamed	4.8±2.5	2.0±0.7	0.285
Cham chwi, Wild plant	4.3±1.2	1.8±0.6	0.061
Carrots	8.3±2.7	0.8±0.2	0.010**
Onions	4.4±2.9	1.3±0.8	0.266
Tomatoes	28.0±5.9	23.3±5.2	0.547
Melons	21.6±3.7	28.0±6.4	0.389
Persimmons	59.0±15.1	30.9±6.7	0.096
Bananas	9.7±4.9	14.0±5.4	0.562
Yogurt	52.2±24.2	9.8±3.3	0.092
Coffee, Instant	1.7±0.4	2.5±0.4	0.153
Cream, Coffee	1.8±0.5	2.1±0.4	0.671
Soft drinks	27.9±11.9	37.5±12.9	0.596

NC: normocholesterolemia group, HC: hypercholesterolemia group, p-value by two-tailed t-test
1) mean±SEM
* $p<0.05$, ** $p<0.01$

Table 4. Major sources of cholesterol in the diet of the study subjects.

NC				HC			
Rank	Name	% of cholesterol	Cumulative % of cholesterol	Rank	Name	% of cholesterol	Cumulative % of cholesterol
1	Eggs	20.24	20.24	1	Eggs	36.22	36.22
2	Grilled yellow croaker	14.28	34.52	2	Squid	9.06	45.29
3	Pork belly	7.52	42.04	3	Pork belly	6.94	52.23
4	Yogurt	7.51	49.55	4	Grilled yellow croaker	6.00	58.22
5	Sponge cake	4.44	53.99	5	Sponge cake	4.48	62.70
6	Grilled mackerel	3.71	57.71	6	Fried chicken	4.09	66.79
7	Fried chicken	3.48	61.19	7	Milk	3.83	70.62
8	Milk	3.26	64.45	8	Beef	3.79	74.41
9	Beef	3.15	67.60	9	Pan-fried leek	2.00	76.41
10	Pan-fried leeks	3.00	70.60	10	Salt-fermented roe of alaska pollack	1.94	78.36
11	Squid	2.77	73.37	11	Grilled mackerel	1.83	80.19
12	Mayonnaise	2.16	75.53	12	Yogurt	1.77	81.95
13	Anchovies	1.82	77.35	13	Mayonnaise	1.75	83.70
14	Grilled hair tail	1.75	79.10	14	Seasoned dried alaska pollack	1.52	85.22
15	Flounder	1.52	80.61	15	Fried shrimp	1.13	86.36
16	Fried shrimp	1.38	81.99	16	Anchovy	0.99	87.34
17	Green onion kimchi	1.38	83.37	17	Snacks	0.86	88.20
18	Ice cream	1.10	84.47	18	Grilled hair tail	0.82	89.02
19	Crab	0.97	85.44	19	Crab	0.81	89.83
20	Salt-fermented roe of alaskan pollack	0.96	86.40	20	Steamed alaskan pollack	0.74	90.57

NC : normocholesterolemia group, HC : hypercholesterolemia group

Table 5. Major sources of CSI in the diet of the study subjects.

NC				HC			
Rank	Name	% of CSI	Cumulative % of CSI	Rank	Name	% of CSI	Cumulative % of CSI
1	Eggs	9.21	9.21	1	Eggs	20.72	20.72
2	Pork belly	8.23	17.44	2	Pork belly	9.55	30.27
3	Grilled yellow croaker	7.40	24.84	3	Milk	7.56	37.83
4	Yogurt	6.84	31.67	4	Squid	4.64	42.48
5	Yogurt, Curd type	5.93	37.60	5	Beef	4.50	46.98
6	Milk	5.12	42.72	6	Grilled yellow croaker	3.91	50.88
7	Grilled mackerel	3.42	46.14	7	Yogurt, Curd type	2.93	53.81
8	Beef	3.00	49.14	8	Fried chicken	2.90	56.71
9	Ice cream	2.57	51.71	9	Sponge cake	2.55	59.26
10	Beef soup	2.06	53.77	10	Snacks	2.45	61.71
11	Sponge cake	2.01	55.78	11	Grilled mackerel	2.30	64.01
12	Mayonnaise	1.97	57.75	12	Mayonnaise	2.00	66.01
13	Fried chicken	1.96	59.71	13	Hot mackerel stew	1.99	68.00
14	Cooked mixed rice	1.93	61.64	14	Ice cream	1.60	69.60
15	Snacks	1.74	63.38	15	Butter	1.50	71.10
16	Pan-fried leeks	1.63	65.01	16	Beef soup	1.39	72.49
17	Cream for coffee	1.62	66.63	17	Pan-fried leek	1.37	73.86
18	Grilled hair tail	1.60	68.23	18	Cream for coffee	1.35	75.21
19	Hot hair tail stew	1.56	69.79	19	Kimchi stew	1.20	76.41
20	Chocolate, Candy	1.55	71.34	20	Fried shrimp	1.14	77.55

NC : normocholesterolemia group, HC : hypercholesterolemia group, CSI(cholesterol/saturated-fat index) = (1.01×SFA) + (0.05×cholesterol)

Table 6. Major sources of vitamin A in the diet of the study subjects.

NC				HC			
Rank	Name	% of vt A	Cumulative % of vt A	Rank	Name	% of vt A	Cumulative % of vt A
1	Carrots	15.58	15.58	1	Eggs	12.79	12.79
2	Radish leaves kimchi	8.75	24.34	2	Radish leaf kimchi	10.62	25.58
3	Laver	6.99	31.32	3	Laver	7.37	36.19
4	Peaches	6.38	37.70	4	Seasoned spinach	4.57	43.56
5	Spinach soup	5.33	43.03	5	Korean cabbage kimchi	4.49	48.13
6	Seasoned spinach	5.08	48.11	6	Milk	4.32	52.62
7	Persimmons	4.30	52.42	7	Peaches	4.28	56.94
8	Green onion kimchi	3.91	56.33	8	Spinach soup	4.17	61.22
9	Soybean paste soup with mallow	3.33	59.66	9	Persimmons	2.91	65.39
10	Eggs	3.18	62.84	10	Soybean paste soup w/ith mallow	2.83	68.31
11	Korean cabbage kimchi	2.94	65.78	11	Tomatoes	2.46	71.13
12	Seasoned water dropwort	2.36	68.13	12	Green onion kimchi	2.28	73.59
13	Tomatoes	2.29	70.42	13	Cucumbers	2.03	75.87
14	Lettus	2.24	72.66	14	Lettuce	1.95	77.89
15	Yogurt	2.12	74.78	15	Carrots	1.92	79.84
16	Cham chwi, Wild plant	2.11	76.89	16	Rolled rice	1.88	81.76
17	Radish kimchi	2.05	78.93	17	Yogurt	1.88	83.65
18	Milk	1.64	80.57	18	Soybean paste soup with mallow	1.81	85.52
19	Salads	1.30	81.87	19	Sea mustard soup	1.33	87.33
20	Cucumbers	1.21	83.08	20	Beef	1.32	88.66

NC : normocholesterolemia group, HC : hypercholesterolemia group

Table 7. Major sources of beta-carotene in the diet of the study subjects.

NC				HC			
Rank	Name	% of β-carotene	Cumulative % of β-carotene	Rank	Name	% of β-carotene	Cumulative % of β-carotene
1	Laver	38.50	38.50	1	Laver	39.62	39.62
2	Seasoned spinach	23.91	62.41	2	Seasoned spinach	20.96	60.58
3	Water dropwort	10.72	73.13	3	Rolled rice	8.32	68.91
4	Green tea	8.99	82.11	4	Water dropwort	8.24	77.15
5	Sea mustard soup	5.06	87.17	5	Sea mustard soup	6.68	83.83
6	Rolled rice	4.15	91.31	6	Green tea	3.60	87.43
7	Green oninon kimchi	1.70	93.01	7	Snacks	2.54	89.97
8	Sea mustard	1.30	94.32	8	Seasoned raddishes	1.60	91.58
9	Snacks	0.87	95.18	9	Milk	1.39	92.97
10	Mandu	0.84	96.03	10	Mandu	1.14	94.11
11	Bean sprout soup	0.67	96.70	11	Green onion kimchi	0.96	95.07
12	Seasoned radishes	0.66	97.36	12	Cucumbers	0.92	95.99
13	Cucumbers	0.56	97.92	13	Sea mustard	0.90	96.89
14	Milk	0.54	98.46	14	Bean sprout soup	0.68	97.56
15	Cooked rice w/ assorted vegetables	0.27	98.73	15	Pan-fried potatoes	0.46	98.02
16	Kimchi stew	0.18	98.91	16	Kimchi stew	0.31	98.33
17	Pan-fried potatoes	0.18	99.08	17	Cooked rice with assorted vegetables	0.31	98.64
18	Hot Alaska pollack stew	0.16	99.25	18	Hot Alaska pollack stew	0.28	98.92
19	Kiwis	0.16	99.41	19	Squid	0.26	99.17
20	Seasoned bracken	0.14	99.55	20	Seasoned bracken	0.13	99.31

NC : normocholesterolemia group, HC : hypercholesterolemia group

crackers was significantly ($p<0.05$) higher in the HC group than in the NC group. Therefore, biscuit and cracker intake significantly positively correlated with serum cholesterol levels ($r=0.25$, $p<0.01$) and carrot intake significantly negatively correlated with serum cholesterol levels ($r=-0.30$, $p<0.01$; not shown in the table).

The major contributors of cholesterol in the diets of the study subjects are shown in Table 4. The percentage of total nutrient intake provided by each food is presented for the top 20 contributors of each of the nutrients listed in the table, as well as the proportion of the population that consumed them. Eggs provided the largest percentage of food consumed, followed by grilled yellow croaker, pork belly, yogurt, sponge cake, grilled mackerel and fried chicken in the NC group's diets. Eggs provided 20.2% of total cholesterol in the NC group. Eggs also provided the largest percentage of food consumed, followed by squid, pork belly, grilled yellow croaker, sponge cake and fried chicken in the HC group's diets. Eggs provided 36.2% of the total cholesterol in the HC group's diets. The leading role of eggs in the HC group's diets was not surprising, but the magnitude of their contribution was remarkable.

Table 5 presents the major sources of CSI. The item reported most frequently was eggs (9.21% of total CSI), followed by pork belly (8.23%) and grilled yellow croaker (7.40%) in the NC group's diets, and eggs (20.72%) followed by pork belly (9.55%) and milk (7.56%) in the HC group's diets.

Table 6 presents the contributors of vitamin A in the diets of the study subjects. Carrot in the NC group's diets and eggs in the HC group's diets provided the largest percentages. The leading contribution of eggs in the HC group's diets is remarkable, reflecting the importance of frequency of consumption of eggs.

The major sources of beta-carotene in the diets of the study subjects are shown in Table 7. The first three items, laver, spinach, and water dropwort, constituted 38.5%, 23.9% and 10.7%, respectively, of the total beta-carotene in the NC group's diets. Laver, spinach and rolled rice constituted 39.6%, 21.0% and 8.3%, respectively, of the total beta-carotene in the HC group's diets.

Table 8 presents the major sources of vitamin E in the diets of the study subjects. Radish leaf kimchi provided the largest percentage, approximately 15% in both groups, followed by green tea, cooked rice and peaches in the NC group's diets, and cooked rice, fried shrimp and grilled yellow croaker in the HC group's diets.

Table 8. Major sources of vitamin E in the diet of the study subjects.

NC				HC			
Rank	Name	% of vt E	Cumulative % of vt E	Rank	Name	% of vt E	Cumulative % of vt E
1	Raddish leaf kimchi	15.52	15.52	1	Raddish leaf kimchi	15.16	15.16
2	Green tea	6.88	22.40	2	Cooked rice	7.89	23.05
3	Cooked rice	6.50	28.90	3	Fried shrimp	3.25	26.30
4	Peaches	4.28	33.18	4	Grilled yellow croaker	3.13	29.43
5	Grilled yellow croaker	4.11	37.29	5	Cooked mixed rice	2.82	32.25
6	Mixed rice	3.73	41.02	6	Fried chicken	2.60	34.85
7	Tomatoes	2.71	43.73	7	Mayonnaise	2.52	37.37
8	Soybean paste soup with chinese cabbage	2.22	45.96	8	Citrus fruits, mandarins	2.47	39.84
9	Fried shrimp	2.19	48.14	9	Tomatoes	2.35	42.19
10	Grilled mackerel	2.17	50.31	10	Eggs	2.34	44.53
11	Spinach	2.11	52.42	11	Peaches	2.31	46.84
12	Citrus fruits, mandarins	2.09	54.51	12	Soybean paste soup with Chinese cabbage	2.30	49.14
13	Lettuce	1.93	56.44	13	Green tea	2.28	51.42
14	Potatoes	1.93	58.37	14	Squid	2.08	53.50
15	Stir-fried zucchini	1.73	60.10	15	Grilled mackerel	1.92	55.42
16	Mayonnaise	1.72	61.82	16	Soybean curd	1.75	57.18
17	Anchovies	1.64	63.46	17	Korean cabbage kimchi	1.58	58.75
18	Soybean paste stew	1.57	65.03	18	Snacks	1.54	60.29
19	Canned tuna	1.47	66.50	19	Spinach	1.53	61.82
20	Korean cabbage kimchi	1.28	67.78	20	Sponge cake	1.51	63.33

NC : normocholesterolemia group, HC : hypercholesterolemia group

DISCUSSION

This study was performed to investigate the differences in food consumption and food sources of nutrients in the Korean diet between postmenopausal women aged 50-74 years with normocholesterolemia (NC) and those with hypercholesterolemia (HC). Our data shows that the HC group tended to consume more cholesterol-rich foods, such as eggs and squid, than the NC group did. Otherwise, there was no significant difference between the two groups in terms of the consumption of legumes and legume products containing phytoestrogen[20] and we could not find a relationship between legumes and legume products and serum cholesterol levels. That is, Koreans tend to eat soybean foods more often than Americans and Europeans. It is also possible that both the NC and HC groups in this study already consumed adequate quantities of legumes. On the other hand, intake of green tea tended to be lower in the HC group than in the NC group.

Some epidemiological data suggest that consumption of green tea reduces serum cholesterol and triglyceride levels and the risk of atherosclerosis and stroke.[21,22] Green tea consists of 15-30% catechins.[23] Catechin is a type of flavonoid that has a powerful antioxidant effect.[23,24] That is, catechin is known to protect serum lipoproteins and vascular endothelium against oxidative stress and lipid peroxidation, which may lead to atherosclerosis.[24,25] Therefore, the intake of green tea is associated with a great reduction of risk factors typically associated with significant declines in health status. However, our data could not find a statistically significant correlation between green tea intake and serum cholesterol levels. The disagreement between our results and those of other researchers could be due to the fact that the study subjects consumed comparatively low amounts of green tea. Imai and Nakachi[22] reported that subjects who drank > 10 cups of green tea daily had significantly lower serum cholesterol levels than those who drank no green tea. Kim et al[26] reported that subjects who drank 3.5 cups of green tea daily had >3 % lower serum cholesterol level than those who drank no green tea. However, there were no statistically significant differences between the subjects who consumed only the small quantities of green tea and those who drank no green tea. Therefore, Kim et al[26] concluded that green tea lowered the serum cholesterol levels, confirming a recommendation to consume > 6 cups of green tea daily. Biscuit and/or cracker consumption significantly positively correlated with serum cholesterol levels ($r=0.25$, $p<0.01$) and carrot consumption significantly negatively correlated with serum cholesterol levels ($r=-0.30$, $p<0.01$) in our study. The results of our study are similar to those recently reported by Willet et al[27] and our data generally support an association between the intake of trans-fatty acids and the risk of high serum cholesterol levels among postmenopausal women. Concerns about the adverse effects of trans-fatty acids were heightened by recent reports that they increased circulating LDL cholesterol and reduced high-density lipoprotein (HDL) cholesterol.[27~29] These data support the hypothesis that the intake of partially hydrogenated vegetable oils may contribute to high serum cholesterol levels. Therefore, our findings must add to concern that the practice of partially hydrogenating vegetable oils to produce solid fats may reduce the anticipated benefits of substituting these oils for highly saturated fats and, instead, contribute to the occurrence of hypercholesterolemia. Therefore, it is possible that they adversely influence the risk of coronary heart disease. The discovery of a significant negative correlation ($r=-0.30$, $p<0.01$) between carrot intake and serum total cholesterol levels in our data is consistent with recent research results.[30,31] Recent evidence[10,30] suggests that oxidative damage may be involved in hypercholesterolemia and thus, dietary antioxidants such as beta-carotene and flavonoid, found in high concentrations in carrots, may reduce the risks of hypercholesterolemia. The major sources of cholesterol, CSI and vitamin A in the diets of the HC group in this study consisted of foods containing high amounts of cholesterol.

On the other hand, foods sometimes overlooked as important nutrient sources, such as carrots, are found in some instances to be quantitatively important to HC group intake as an independent source of vitamin A. Moreover, there were differences in the major sources of nutrients between the NC and HC groups. Therefore, our data shows foods that are not necessarily high in a nutrient, when eaten in large quantities, may be important contributors of that nutrient. On the other hand, foods high in a dietary factor, when eaten less frequently, were revealed to be less important sources.

Such data as has been presented here have a potential value for epidemiologists with a substantive interest in dietary etiology or a methodological interest in dietary assessment. In addition, they may be useful for health care planners and practitioners. For example, the number of individuals consuming liver, or deep yellow or dark green leafy vegetables, the traditional sources of vitamin A and provitamin A, was quite small.[18,32] Physicians and dieticians may find, however, that patients can be encouraged to achieve a substantial vitamin A intake from foods that are more acceptable to them, such as cantaloupe, beef stew, or vegetable soup (in the context, of course, of a well-balanced and varied diet).[18,32,33]

In addition, the tables presented here may be of some use to those conducting public health and nutrition

education programs. For example, although orange juice is the major contributor of vitamin C, it was still consumed by less than one-fourth of the population on any given day.[32~34] Broader public awareness of such facts could promote dietary shifts resulting in a greater intake of this nutrient.

In conclusion, we found that postmenopausal women with hypercholesterolemia in Seoul, Korea tend to consume cholesterol-rich foods and dishes. Therefore, it may be necessary to encourage them to make desirable dietary choices through nutrition education programs. The results of this study provide information that is important in designing appropriate dietary guidelines for hypercholesterolemic postmenopausal women. In addition, the results provide a quantitative description of the food intake of hypercholesterolemic postmenopausal women in Korea. They will be useful in the design of a semi-quantatitive food frequency questionnaire specifically for hypercholesterolemic women in Seoul, Korea.

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