

Dietary Patterns and Health Behaviors of Hypertensive Korean Adults

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Abstract

Findings from European and American studies have indicated such health behaviors as smoking, drinking, lack of exercise, and insufficient intake of grains, fruits and vegetables as risk factors for hypertension. However, because dietary pattern and health behaviors of Korean differ from people of other countries, the risk factors for Koreans could be different. Therefore, the aim of this study was to identify food consumption patterns and health behavior characteristics of Korean hypertensive adults. Data on food consumptions and other health behaviors such as smoking, drinking, and exercise together with development of hypertension were collected from 597 persons aged 20 to 69 years in a local community. The first stage of analysis utilized cluster analysis to aggregate individuals into different health behavior and food consumption groups. Four health behavior groups were characterized by passive cluster, smoker cluster, fitness cluster and drinker cluster. Food consumption patterns of the subjects were also aggregated into 4 different clusters: dairy cluster, grain & vegetable cluster, fruit cluster, and fish & meat cluster. Then univariate analysis was followed to identify the variables associated with hypertension. The final stage of analysis was the identification of the relative importance of the variables selected from the univariate analysis on hypertension, using multiple logistic analysis. The results showed that heavy drinking was the most significant health behavior associated hypertension, which was similar to the findings in European and American studies. However, unlike the findings from foreign studies, grain and vegetable consumption appeared to be a risk factor for hypertension. A possible reason for the contradictory results between Korean and Western studies may be the dependence of Koreans on white rice as the major staple food, and/or the frequent consumption of salted vegetables, rather than fresh vegetables as is customary in Europe and America.

Key words: hypertension, food consumption, risk factor, health behavior, cluster analysis

INTRODUCTION

According to various epidemiologic and clinical research studies, smoking, drinking, physical exercise and food consumption behaviors are the major variables, or risk factors, related to hypertension. There is general consensus that blood pressure is negatively correlated with smoking (1-3), and physical exercise (4-6); and positively correlated with alcohol consumption (7-9).

Excessive salt consumption is also a dietary factor known to increase blood pressure in some people (10). Desirable food habits for preventing cardiovascular disease include: increased consumption of whole grains, vegetables, and fruits; and reduced salt consumption (11).

Differences in diet and lifestyles in Korea may result in different risk factors for cardiovascular disease from other countries. The 1998 Korean National Nutrition Survey (12) showed that the basic menu patterns of Koreans were: rice + soup, rice + stew, only rice and rice + soup+

stew. Rice was the main dish in about 90% of the menus, and the most popular menu pattern of Koreans was rice+ soup + kimchi. When rice was eaten as a main dish, soup, kimchi, and 1 or 2 other side dishes were usually also included. The rice-oriented Korean diets were primarily comprised of vegetable foods such as grains, potatoes, sugar and sweeteners, beans, vegetables, and fruits. The mean daily energy intake was 1985 kcal per person per day. Seventy percents of energy intake was from carbohydrate and 12% and 18%, from protein and fat, respectively. The intake of most nutrients met the Korean Recommended Dietary Allowances (KRDA), except for calcium.

Although Koreans have a high consumption of vegetable foods, hypertension is still a major public health problem. According to the Korean National Health Survey (12) 27.8% of adult Koreans have hypertension, defined as a systolic blood pressure above 140 mmHg or diastolic blood pressure above 90 mmHg. Stroke triggered

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by hypertension is the leading cause of death in Korea. Twenty seven point three out of 100,000 deaths caused by hypertension and the number contribute nearly 70% of death from all cardiovascular diseases.

The annual Korean death rate from hypertension is 27.3 per 100,000 people, and hypertension is responsible for 70% of all deaths from cardiovascular disease.

In most studies, respective health behaviors were used as a unit of analysis for identifying risk behaviors for hypertension. In this study, therefore, we identified the health behaviors and food consumption patterns which influence hypertension in Korea, using concept of cluster analysis.

MATERIALS AND METHODS

Subjects

The subjects in this study were participants in the Health and Nutritional Examination Survey conducted in 1998 in Kuri City of Kyungki Province, Korea. The target population was the 915,000 non-institutionalized residents of Kuri City between the ages of 20 and 69. From the target population 0.1% were sampled using multistage random sampling. The initial sampling unit was the Primary Sampling Unit (PUS) that consisted of an average of 60 households, which were again divided into 6 segments of 10 households each. Segments and households were used as the second and the third stage of sampling units. As a result of the sampling process, 854 persons (339 males and 515 females) were selected as the study subjects.

From the 854 people selected, 57 who were being treated for hypertension were excluded and the remaining 797 persons (304 males and 493 females) were retained as the initial group of study subjects. In order to balance the gender ratio, 597 subjects (297 males and 300 females) were randomly selected as the final study subjects.

Assessment of health behavior and food consumption

Subjects were interviewed and examined at a mobile examination center (MEC) during July and August of 1999. Blood pressure was measured twice at a 10 minute interval using a mercury sphygmomanometer recommended by The American Heart Association (13). Hypertension was defined as an average systolic blood pressure above 140 mmHg or diastolic blood pressure above 90 mmHg.

A questionnaire was used to collect health behavior information. The questionnaire consisted of five parts: general characteristics of the subjects, food frequency, smoking habits, drinking habits, and exercise.

Part one was about general characteristics of subjects such as age, sex, and occupation, etc.

Part two evaluated food consumption using a semi-quantitative food frequency method. In the questionnaire, 93 food items were selected which appeared frequently in the 24 hour recall survey. The 24-hour recall survey

was conducted prior to the main survey. The 93 food items were classified into 7 food groups: 1) milk and dairy products, 2) fish and poultry, 3) eggs and organ meats, 4) red and luncheon meats, 5) grains and seeds, 6) fruits, and 7) vegetables. The criteria chosen for classifying foods into the 7 categories were based on their composition of fat, cholesterol, sodium and potassium. Those nutrients were chosen because they have important implication in the etiology of hypertension (14,15). The average food intake frequency for each of the 7 categories was calculated by adding up the average monthly intake frequency for each of the food items.

Part three was about smoking habits, how much the subjects smoked and for how long they had been smokers. Part four was about drinking habits; monthly frequency of drinking and the quantity of alcohol consumed per drinking session. The unit of drinking quantity (one drink) was set to a glass of Korean liquor which contained 12.86 g of alcohol.

In part five, physical exercise was checked based on accumulated time (minute/week) of weekly physical exercise. The survey also included a biochemical assessment of blood and anthropometric measurements of weight and height. Fasting blood total cholesterol, triglyceride, and high density lipoprotein cholesterol were assayed using a Hitachi 747 Automatic Analyzer.

Statistical analysis

A cluster analysis was used to aggregate the individuals into different health behavior and food consumption groups. The Fastclus procedure (16), which forms mutually exclusive clusters though interactive algorithm based on Euclidean Distance, was applied. Food consumption groups were classified based on the average frequency of monthly intake (times/month) of the 7 different categories of foods (17). Univariate analysis of association was used to evaluate the relationship between hypertension and the risk factor variables. Demographic and social variables included: gender, age, educational level, occupation, and marital status. Other variables included, anthropometric variables, body mass index, family history of various illness, biochemical variables of blood lipid levels, and health-related variables of drinking, smoking, exercise and food consumption. A Chi-square test and Wilcoxon's rank sum test were used for this stage of analysis. After adjusting significant variables obtained from the univariate analysis, the final stage of analysis evaluated the relative importance between variables by multiple logistic regression analysis, using a SAS program.

RESULTS AND DISCUSSION

Characteristic of the 4 health practices

Lifestyle behavior patterns of individuals were catego-

rized into the following 4 clusters: passive cluster (cluster 1), smoker cluster (cluster 2), fitness cluster (cluster 3) and drinker cluster (cluster 4), depending on the dominant behavior. Figure 1 shows the mean z score which formed the basis for identifying dominant health behaviors of the four clusters.

Table 1 shows that a major portion of the subjects were in the passive cluster (n = 388, 65%), and that they tended to have relatively low levels of smoking, drinking and exercise (1.1 cigarettes/day, 3.9 drinks/month, 8.5 minutes/week, respectively).

Subjects in the smoker cluster (n=95, 15.9%) generally smoked a lot (22.5 cigarettes/day), drank a little (11.8 drinks/month) and did little exercise (8.5minutes/week). Those who belonged to the fitness cluster (n=64, 10.7%) drank and smoked a little (6.5 cigarettes/day and 8.0 drinks/month) but exercised a lot (192.4 minutes/week). Those

who belonged to the drinker cluster (n=50, 8.4%) smoked moderately (14.9 cigarettes/day), did little exercise (19.9 minutes/week) and drank a lot (81.7 drinks/months).

Dietary patterns of 4 diet clusters

The cluster analysis used the 7 categories of food consumption patterns to aggregate the subjects into 4 distinct clusters (Table 2, Fig. 2). The four clusters were: the milk and dairy cluster (cluster 1), grain and vegetable cluster (cluster 2), fruit cluster (cluster 3), and meat and fish cluster (cluster 4). Among the total subjects 30.3% (n=179) belonged to the milk cluster. Dairy products accounted for 37.1% of their total food intake. Grain and vegetable consumption of this group was the lowest level among the 4 food consumption clusters. Among the subjects, 26.3% (n=157) belonged to the grain and vegetable cluster. Grains and vegetables accounted for 27.8% and 36.9%, respectively, of their total food intake, and they frequently had lowest intake of dairy products and fruit. Among the subjects, 29.1% (n=151) belonged to the fruits cluster. Fruit represented 29.1% of their total food intake. Subjects in the meat and fish cluster (n=110) had a 10.4%~11.7% frequency of fish and meat consumption, which was twice that of the other cluster's intakes, and a relatively low intake of other foods.

Dietary and characteristics of the hypertensive group

There were 74 hypertensive subjects, representing 12.5% of the total population. There were more males than females among the hypertensive subjects compared to normotensive subjects. The univariate analysis revealed that, gender, age, occupation, body mass index, health behavior pattern, food consumption pattern and blood-lipid profiles were significantly correlated with hypertension (p<0.05)

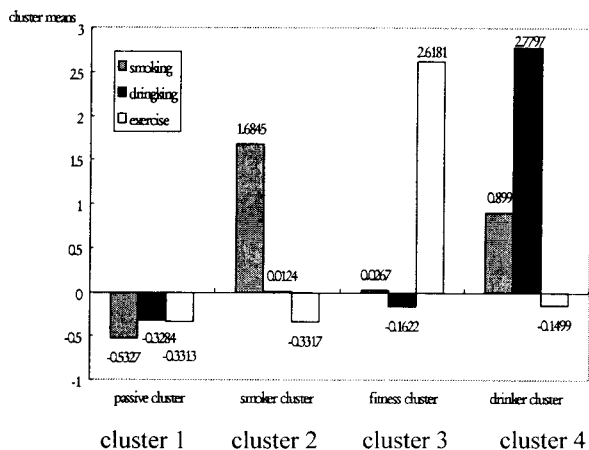


Fig. 1. Mean levels of smoking, drinking and exercise of 4 health behavior clusters.

Table 1. Mean levels of smoking, drinking and exercise by health behavior clusters Unit: mean (SD)

	Passive cluster (n = 388)	Smoker cluster (n = 95)	Fitness cluster (n = 64)	Drinker cluster (n = 50)	Total (n = 597)
Smoking (cigarettes/day)	1.1 (2.8)	22.5 (6.0)	6.5 (9.8)	14.9 (8.9)	6.2 (9.7)
Drinking (drinks/month)	3.9 (9.6)	11.8 (14.9)	8.0 (15.3)	81.7 (25.8)	12.1 (25.0)
Exercise (minutes/week)	8.5 (21.5)	8.5 (21.5)	192.4 (32.0)	19.9 (48.3)	29.2 (62.3)

Table 2. Mean proportions of food intake frequency by food consumption clusters Unit: %mean (SD)

	Fruit cluster (n = 151)	Milk cluster (n = 179)	Meat & fish cluster (n = 110)	Grain & vegetable cluster (n = 157)	Total (n = 597)
Milk & dairy products	12.0 (8.6)	37.1 (10.7)	13.9 (8.6)	9.7 (7.6)	19.3 (14.9)
Fish & poultry	5.6 (3.4)	4.6 (2.8)	10.4 (5.5)	5.3 (3.1)	6.1 (4.3)
Eggs & organ meats	5.3 (3.7)	5.2 (3.5)	11.7 (7.5)	6.0 (4.2)	6.7 (5.3)
Red & luncheon meat	4.6 (3.2)	4.5 (3.0)	11.8 (5.7)	4.5 (3.0)	5.9 (4.7)
Grain & seeds	17.7 (7.5)	16.9 (5.5)	18.1 (7.3)	27.8 (10.3)	20.2 (9.1)
Fruits	29.1 (7.7)	12.1 (6.0)	13.1 (6.6)	9.8 (5.4)	16.0 (10.1)
Vegetables	25.7 (8.3)	19.5 (6.9)	21.0 (8.1)	36.9 (10.9)	25.9 (11.1)
Total	100.0	100.0	100.0	100.0	100.0

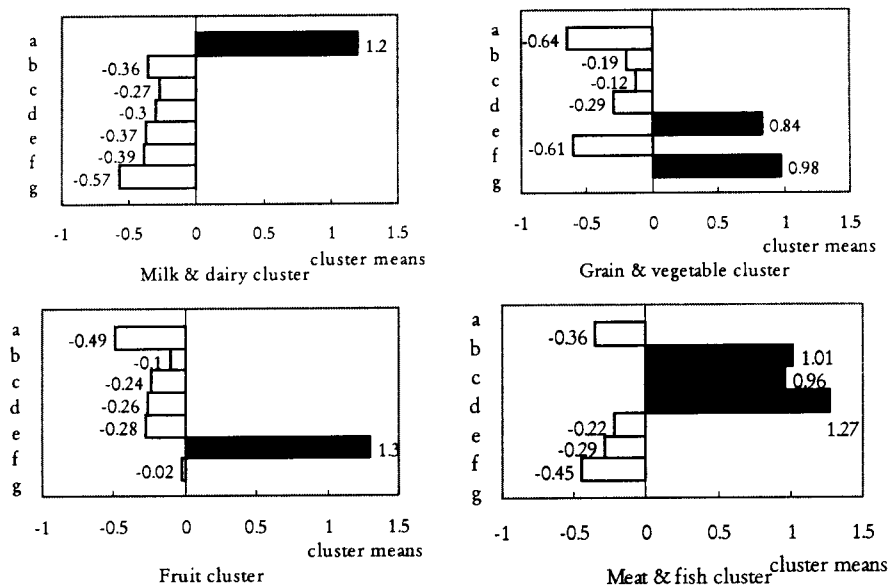


Fig. 2. Mean intake of 7 food groups for 4 food consumption clusters.

a: milk & dairy products, b: fish & poultry, c: eggs & organ meats, d: red and luncheon meats, e: grains and seeds, f: fruits, g: vegetables.

Table 3. Characteristics of hypertensive and normotensive subjects

Variables	Hypertensive	Normotensive	Total	X ² or z
Sex (male %)	70.3	46.5	49.4	14.7 ¹⁾ **
Age (SD)	45.5 (10.7)	40.5 (11.0)	41.1 (11.0)	3.9 ²⁾ **
Education (beyond college %)	16.2	14.8	14.9	0.1 ¹⁾
Occupation				
White color %	29.7	21.2	22.3	
Blue color %	39.2	30.8	31.8	7.6 ¹⁾ *
Others %	31.1	48.0	45.9	
Marital status				
Single %	6.8	11.9	1.2	
Married %	89.2	82.8	83.6	2.0 ²⁾
Others %	4.0	5.3	15.2	
Family history				
Hypertension %	16.2	11.7	12.2	1.3 ²⁾
Cerebrovascular disease %	10.8	7.8	8.2	0.8 ²⁾
Cardiovascular disease %	2.7	3.4	3.4	0.1 ²⁾
BMI (mean SD)	25.3±3.0	23.3±3.0	23.5±3.1	5.4 ²⁾ **
Level of blood lipid (SD)				
Total-cholesterol	191.0±38.7	175.6±32.3	177.5±33.5	3.4 ²⁾ **
Triglyceride	213.0±165.6	137.8±129.2	147.1±136.3	5.6 ²⁾ **
HDL-cholesterol	33.6±6.8	35.9±7.7	35.6±7.6	-2.5 ²⁾ **
Health behavior cluster				
Drinker %	23.0	6.3	8.4	
Smoker %	18.9	15.5	15.9	
Fitness %	12.2	10.5	10.7	26.9 ¹⁾ **
Passive %	45.9	67.7	65.0	
Food consumption cluster				
Fruit %	12.2	27.1	25.3	
Milk %	20.3	31.4	30.0	24.5 ¹⁾ **
Meat & Fish %	18.9	18.4	18.4	
Grain & vegetable %	48.6	23.1	26.3	

¹⁾Chi-square test. ²⁾Wilcoxon's rank sum test. ³⁾Others include widows and divorces. *p<0.05, **p<0.001.

(Table 3). There were also a significantly higher number of office workers among the hypertensive subjects. Hyper

tensive subjects were older, and had higher plasma concentrations of total cholesterol and triglycerides, but lower

HDL cholesterol, than normotensive subjects.

There were significantly more hypertensive subjects in the grain and vegetable cluster (48.6%), but fewer in the fruit cluster (12.2%). At the beginning of the study, subjects previously identified as hypertensive were excluded, since knowledge of their hypertension may have already influenced their health behaviors and dietary patterns. Population studies have found that vegetarians have lower blood pressure than non-vegetarians (18), and that blood pressure decreases when either hypertensive or normotensive non-vegetarians adopt a vegetarian diet (19,20). The blood pressure lowering effect of vegetarian diets may be due to increased dietary calcium, potassium, magnesium and fiber, which have antihypertensive effects (15). Clinical trials of nutritional effects on hypertension usually have similar results as seen above, but not always. The inconsistent results may be caused by small effects of single nutrients, too small to be detected, and the lack of nutrient interactions that are not well understood and controlled for in the trials.

The DASH (Dietary Approaches to Stop Hypertension) study (21) was a multi-center, controlled clinical trial conducted to identify the effects of dietary patterns and nutritional components on blood pressure. As a result of the study, it was reported that fruit and vegetarian diets lower both systolic and diastolic blood pressure, and that adding dairy products lowers blood pressure even more effectively (14).

This study analyzed food intake because we considered it more practical to conduct than analysis based on nutrient intake. We found that subjects who ate diets high in grains and vegetables developed hypertension significantly more often, compared to the other food intake groups. Those who belonged to the fruit group developed significantly less hypertension. However, there is a need to consider the limitations of the dietary data since we did not take into account the absolute quantity of individual foods, because of the limitations of using the semi-quantitative food frequency method. Nevertheless, it is necessary to consider the characteristics of Korean dietary habits, because Koreans eat grains and vegetables more frequently than people of many other countries. The reason why the grains and vegetables were clustered together as one category is that Koreans customarily eat vegetables whenever they eat grains. The unique manner in which Koreans prepare vegetables must also be considered. Koreans usually eat vegetables as salted foods such as Kimchi or salty vegetable soups, similar to Japanese miso soup which is also rather salty. Traditionally, Koreans eat less dairy products and fruits than many other ethnic groups, since grains are their staple foods. Such dietary facts explain the high mortality rate caused by hypertension among Koreans who eat

the more rice-oriented traditional diet common to rural areas (22).

Relative importance between the variables affecting on hypertension

The results of the multivariate analysis (logistic regression analysis) of association between hypertension and health behavior, including food consumption patterns, are presented in Table 4. The lifestyle cluster most significantly associated with hypertension was the drinker cluster. There was, therefore, a positive correlation between hypertension and alcohol consumption, demonstrating that heavy drinkers are the Koreans at most risk for hypertension. Most other studies have also found that moderate to heavy drinking increases blood pressure and that there exists a linear correlation with a (9) or U (or V) shape curved (23-25) between alcohol consumption and blood pressure. Recent Asian cross-sectional studies have further confirmed that moderate drinking increases blood pressure, when compared to not drinking (26,27).

The food consumption cluster most significantly associated with hypertension was the grain and vegetable cluster, followed by the fruit cluster. The grain and vegetable cluster was positively correlated with hypertension whereas the fruit cluster was negative correlated with hypertension.

In conclusion, heavy drinkers are primary target population for the prevention and management of hypertension

Table 4. Estimated coefficient of variables from multiple logistic regression analysis of hypertension

Variables	Estimate	Standard error	χ^2
Sex (male)	0.1886	0.2046	
Age	0.0403	0.0139	*
Occupation			
White color	0.4777	0.2355	*
Blue color	0.0097	0.2043	
Others	-0.4875	0.2540	
BMI	0.1976	0.0505	**
Health behavior lifestyle cluster			
Drinker %	0.7171	0.2988	*
Smoker %	-0.4553	0.2988	
Fitness %	0.1320	0.3268	
Passive %	-0.3938	0.2535	
Food consumption cluster			
Fruit %	-0.7085	0.2976	*
Milk %	-0.2221	0.2575	
Meat & fish %	0.1050	0.2692	
Grain & vegetable %	0.8255	0.2128	**
Level of blood lipid			
Total-cholesterol	0.0074	0.0046	
Triglyceride	0.0007	0.0008	
HDL-cholesterol	-0.0139	0.0213	

* $p < 0.05$, ** $p < 0.001$.

risk in Korea. To reduce the risk of hypertension, the target group should be encouraged to eat more fruit and reduce the intake of refined grains and salted vegetables.

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