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Original Article

The Association of Life Style with Hypertension in Korean Women

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Abstract

Background: This study examined the relationship between lifestyle factors and hypertension in Korean women.
Methods: The subjects were 8,836 women, aged 20 to 81 yr, who visited a health promotion center for a medical check up during 2004-2008. The diagnosis of hypertension was defined in the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) report. Statistical significance was set at $\alpha<0.05$ and SPSS ver. 12.0 software (SPSS, Chicago, IL, USA) was used.
Results: The prevalence of hypertension was 12.8% in this study population. Multivariate logistic regression demonstrated that the odds ratio (95% CI) of hypertension across age groups were 3.43 (1.68-7.02) for forties, 7.13 (3.48-14.60) for fifties, 12.97 (6.27-26.81) for sixties, and 24.28 (11.09-53.14) for over seventies compared to the twenties. In addition, compared with the normal weight group, the odds ratio (95% CI) of hypertension in the over-weight and obese groups were 2.41 (2.00-2.89) and 3.50 (2.95-4.16), respectively. The odds ratio (95% CI) of hypertension in those who consumed more than 3 drinks per week was 1.88 (1.29-2.76, *P*=0.001) compared with non-drinking group.
Conclusion: The significant risk factors of hypertension were age, BMI, and alcohol drinking among Korean women and that smoking, exercise, and diet were not related to the risk of hypertension.

Keywords: *Hypertension, Life style, Body mass index, Drinking, Smoking, Exercise, Korea*

Introduction

Recently, there have been sharp increases in the number of cases of hypertension in Korea due to the lack of exercise and westernized diet (1). The Third Korea National Health and Nutrition Examination Survey (KNHANES III) reports that the prevalence of hypertension is 34.4% in men over the age of thirty and 26.5% in women over the age of thirty (2). Furthermore, the risk of hypertension increases, as people get older. People in their 30s, 40s, 50s, 60s and over 70s have a 2.3%, 8.7%, 23.2%, 35.6%, and 42.4% of risk of getting hypertension respectively (1).

Hypertension is major risk factor for stroke and cardiovascular disease. In addition, hypertension causes abnormal cardiac pressure, which may cause an enlargement of the left ventricle of the heart. This causes an increased cardiac output and peripheral resistance, both of which keep blood pressure constantly high (3). The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure reported that high blood pressure is defined as a repeatedly elevated blood pressure exceeding 140 over 90 mmHg -- a systolic pressure above 140 and a diastolic pressure above 90 (4).

Although hypertension studies classify 90~95% of hypertensions in adult population as essential hypertension, hypertension is caused by both genetic factors and lifestyle habits (5). Genetic factors include family history, age, body shape, lifestyle and habits include drinking, smoking, exercise rate, stress, obesity, and high-salt intake

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(6-9).People with healthier life styles have a lower death rate and 5 of 10 major mortality factors are related to unhealthy life styles (10-11). Of known mortality factors, 43% are due to an unhealthy life style, 27% are due to genetic factors, 19% are due to medical factor, and 11% are due to environmental factor (12). Since some of the life style factors such as genetic, environment and medical factors are difficult to control artificially, brain and/or cardiovascular diseases related to hypertension can be refer to as man-made diseases caused by unhealthy life styles.

Because prevention of hypertension through intervention of the life style factors may prevent other related diseases, it may be important to find out which factors among the life style factors, such as BMI, alcohol consumption, smoking, exercise, or diet, are important in prevention and intervention of hypertension (5).

However, only a few studies have examined the relationship between lifestyle factors and hypertension in adult Korea women. No study has assessed how lifestyle factors affect hypertension. Hence, this study is to provide primary preventive data for hypertension management by analyzing the relationship between hypertension and lifestyle habits and basic research data for Korean women, which are both needed to build hypertension management system.

Materials and Methods

Subjects

Subjects were drawn from 9648 adult Korean females over the age of twenty yr. Subjects visited a health promotion center at Yang-Cheon Gu public health center in Seoul, Korea and took a comprehensive medical test, including a hypertension test, from 01-02-2004 to 09-30-2008. Those excluded were women who took a hypertensive drug or had a family history of hypertension. Women were also excluded if they had family history of stroke, heart failure, angina, or myocardial infarction. A total of 8836 of the subjects participated in this study.

Experimental procedures

Women were separated into different categories based on self-reported data. There were 3 smoking categories: non-smoking, smoking less one pack of cigarettes per day, and smoking one or more packs of cigarettes per day. There were three drinking categories: non-drinking, 1-2 drinks per week, and 3 or more drinks per week. There were 3 exercise groups: no exercise, 1-2 occasions of exercise per week, and 3 or more occasions of exercise per week. There were 3 meal categories: 3 meals per day, 2 meals per day, and 1 meal per day. There were 6 age categories: twenties, thirties, forties, fifties, sixties, and seventy and over. Height and weight were assessed in patients wearing a light gown by Inbody 3.0 (Biospace, Korea) and BMI (kg/m^2) was calculated from height and weight. According to WHO's Asia-Pacific standard of obesity, which was considered as a standard definition in this study too, underweight women have a BMI of under 18.5, normal women have a BMI between 18.5 and 23, overweight women have a BMI between 23 and 25, and obese women have a BMI over 25 (13).

After filling out questionnaire, the subjects rested for over 10 minutes in a sitting position. Systolic and diastolic blood pressure was then measured by a nurse practitioner using a mercury sphygmomanometer at the right brachial artery. According to the JNC7, hypertension (stage 1) exists when blood pressure was over 140mmHg / 90mmHg and normal tension exists when blood pressure was under 140mmHg/90mmHg (4). Blood pressure was measured twice separately over 2 min of interval and at least 12 h later it was measured again. The nurse specialist determined mean value of blood pressure.

Statistical analysis

All results are summarized as mean and standard deviation. Univariate analyses were completed with predictor variables after dividing the women into hypertensive and normotensive groups. Independent sample *t*-tests or Chi square tests were used to test for differences. If the expected

frequency counts in chi-square test were under 5, a Fisher's exact test was conducted.

Multivariate logistic regression analysis was conducted to evaluate the effect of each predictor variable on hypertension and partial correlation coefficient was used to adjust confounding variables when analyzing correlation of each predictor variable, systolic blood pressure, and diastolic blood pressure. Statistical significance was set at $\alpha<0.05$ and SPSS ver. 12.0 software (SPSS, Chicago, IL, USA) was used.

Results

The characteristic of subjects

The characteristics of subjects are shown in Table 1. The prevalence of hypertension was 12.8% in this study population. The average age of the subjects was 46.64±10.15 and ranged from 20 to 81 years old, the average height was 156.81±5.19cm and ranged from 140.20cm to 182.00cm, and the average weight was 57.99± 7.62kg and ranged from 35.10kg to 101.10kg. According to their BMIs, 180 (2.0%) were underweight, 3875 (43.9%) were of normal weight, 2312 (26.2%) were overweight, and 2469 (27.9%) were obese.

The relationship between each predictor variables and hypertension

The relationship between each predictor variable and hypertension is shown in Table 2. The hypertensive group were statistically older ($P<0.001$), shorter ($P<0.001$), heavier ($P<0.001$), and had a higher BMI ($P<0.001$). In addition, the hypertensive group had a statistically higher frequency of drinks per week ($P=0.001$), lower occasions of exercise per week ($P=0.001$), and lower frequencies of meals per day ($P=0.005$). However, there was no statistical significance for smoking ($P= 0.893$).

The impact of each predictor variable on hypertension

The impact of each predictor variable on hypertension is shown in Table 3. Multivariate logistic regression demonstrated that the odds ratio (95% CI) of hypertension across age groups were 3.43 (1.68-7.02, $P=0.001$) for forties, 7.13 (3.48-14.60, $P<0.001$) for fifties, 12.97 (6.27-26.81, $P<0.001$) for sixties, 24.28 (11.09-53.14, $P< 0.001$) for over seventies compared to the twenties. However, there was no statistical significance between thirties ($P= 0.336$) and twenties.

In addition, compared with normal weight group, the odds ratio (95% CI) of hypertension in overweight and obese groups were 2.41 (2.00-2.89, $P< 0.001$) and 3.50 (2.95-4.16, $P< 0.001$), respectively. The odds ratio (95% CI) of hypertension in those who consumed more than 3 drinks per week was 1.88 (1.29-2.76, $P= 0.001$) compared with non-drinking group. However, there was no statistical significance ($P= 0.153$) between those who consumed 1-2 drinks per week and the non-drinking group.

There was no statistical significance between individuals who smoke less than one pack of cigarettes ($P= 0.427$) and the non-smoking group, or between individuals who smoke one or more packs of cigarettes ($P= 0.386$) and the non-smoking group. Moreover, there was no statistical significance between subjects who have 1-2 occasions of exercise ($P= 0.299$) and the no exercise group, or between subjects who have more than 3 occasions of exercise ($P= 0.304$) and the no exercise group. Compared to 3 meals per day, 2 meals per day ($P=0.739$) and 1 meal per day ($P= 0.173$) had no statistical significance.

Correlation analysis between each predictor variable and hypertension

Correlation analysis between each predictor variable and systolic blood pressure and between each predictor variable and diastolic blood pressure is shown in Table 4. A correlation analysis was performed by adjusting every variable (age, BMI, smoking, drinking, exercising and diet). It showed that systolic blood pressure has a significant positive correlation with age ($r= 0.307$, $P< 0.001$) and BMI ($r= 0.272$, $P< 0.001$) statistically. The increase of the amount of drinks consumed ($r= 0.024$, $P= 0.024$) had no statistical signifi-

cance and very low correlation. Smoking (r= -0.002, P= 0.848), exercise (r= -0.009, P= 0.375), and the number of meals (r= -0.001, P= 0.942) also had no statistical significance. There was statistical significance between diastolic blood pressure and age (r= 0.250, P< 0.001) and between diastolic blood pressure and BMI (r= 0.263, P< 0.001). The increase of the amount of drinks consumed (r= 0.047, P< 0.001), smoking (r= -0.018, P= 0.086), exercise (r= -0.008, P= 0.478), and the number of meals (r= 0.007, P= 0.485) showed no statistical significance and/or very low correlation.

Table 1: General characteristics of the study population (n=8836)

Variables	Category		Mean±S. D. or n (%)
Age, years	-		46.64 ± 10.15
Height, cm	-		156.81 ± 5.19
Weight, kg	-		57.99 ± 7.62
BMI, kg/m^2	Underweight	<18.5	180 (2.0%)
	Normal	≥18.5 - <23	3875 (43.9%)
	Overweight	≥23 - <25	2312 (26.2%)
	Obesity	≥25	2469 (27.9%)

Values are mean±standard deviation; BMI, Body Mass Index

Table 2: Relationship between anthropometric and lifestyle factors and hypertension according to HT in Korean women (N=8836)

		Normal (n=7701)	HT (n=1135)	*P* value
Age, yr		45.55±9.75	54.01±9.69	<0.001***
Height, cm		157.02±5.14	155.36±5.33	<0.001***
Weight, kg		57.49±7.42	61.33±8.12	<0.001***
BMI, kg/m^2	<18.5	178 (2.3%)	2 (0.2%)	<0.001***
	≥18.5 - <23	3655 (47.5%)	220 (19.4%)	
	≥23 - <25	1967 (25.5%)	297 (30.4%)	
	≥25	1901 (24.7%)	568 (50.0%)	
Smoking	no	7532 (97.8%)	1109 (97.7%)	0.893
	≤1 pack/day	136 (1.8%)	20 (1.8%)	
	>1 pack/day	33 (0.4%)	6 (0.5%)	
Drinking	no	6629 (86.1%)	965 (85.0%)	0.001**
	1~2 times/weeks	903 (11.7%)	124 (10.9%)	
	≥3 times/weeks	169 (2.2%)	46 (4.1%)	
Exercise	no	3645 (47.3%)	604 (53.2%)	0.001**
	1~2 times/weeks	2388 (31.0%)	320 (28.2%)	
	≥3 times/weeks	1668 (21.7%)	211 (18.6%)	
Meal	3 times/day	6152 (79.9%)	922 (81.2%)	0.005**
	2 times/day	1491 (19.4%)	195 (17.2%)	
	1 time /day	58 (0.8%)	18 (1.6%)	

HT, Hypertension; BMI, Body Mass Index; **P<0.01 ***P<0.001; tested by student t-test or chi-square test

Table 3: The multivariate logistic regression analysis for lifestyle factors, age and BMI with hypertension in Korean women (n=8836)

	Category	Number (%)	Normal (n=7701)	HT (n=1135)	OR	95% CI	*P* value
Age (yr)	20 - 29	371 (4.2%)	363	8	1.000		
	30 - 39	1743 (19.7%)	1680	63	1.445	0.683 - 3.056	0.336
	40 - 49	3480 (39.4%)	3175	305	3.429	1.675 - 7.019	0.001**
	50 - 59	2274 (25.7%)	1841	433	7.132	3.484 - 14.602	<0.001***
	60 - 69	818 (9.3%)	560	258	12.969	6.273 - 26.809	<0.001***
	≥70	150 (1.7%)	82	68	24.278	11.091 - 53.143	<0.001***
BMI	<23	4055 (45.9%)	3833	222	1.000		
	≥23 - <25	2312 (26.2%)	1967	297	2.405	2.003 - 2.888	<0.001***
	≥25	2469 (27.9%)	1901	568	3.501	2.947 - 4.159	<0.001***
Smoking	no	8641 (97.8%)	7532	1109	1.000		
	≤1 P/D	156 (1.8%)	136	20	0.807	0.476 - 1.369	0.427
	>1 P/D	39 (0.4%)	33	6	0.649	0.244 - 1.725	0.386
Drinking	no	7594 (85.9%)	6629	965	1.000		
	1~2 T/W	1027 (11.6%)	903	124	1.173	0.943 - 1.459	0.153
	≥3 T/W	215 (2.4%)	169	46	1.881	1.285 - 2.755	0.001**
Exercise	no	4249 (48.1%)	3645	604	1.000		
	1~2 T/W	2708 (30.6%)	2388	320	0.921	0.789 - 1.076	0.299
	≥3 T/W	1879 (21.3%)	1668	211	1.100	0.917 - 1.319	0.304
Meal	3 T/D	7074 (80.1%)	6152	922	1.000		
	2 T/D	1686 (19.1%)	1491	195	0.970	0.811 - 1.160	0.739
	1 T/D	76 (0.9%)	58	18	1.500	0.837 - 2.686	0.173

HT, Hypertension; OR, Odd Ratio; CI, Confidence Interval; BMI, Body Mass Index; P/D, pack/day; T/W, time(s)/weeks; T/D, time(s)/day; ***P*<0.01 ****P*<0.001; tested by multivariate logistic regression analysis (adjusted for age, BMI, smoking, drinking, exercise, meal)

Table 4: The partial correlation of systolic and diastolic pressure with lifestyle factors, age and BMI in Korean

	Systolic Pressure		Diastolic Pressure		Category
	r	***P* value**	***r***	***P* value**	
Age	0.307	<0.001***	0.250	<0.001***	
BMI	0.272	<0.001***	0.263	<0.001***	
Smoking	-0.002	0.848	-0.018	0.086	1, no; 2, ≤1 P/D; 3, >1 P/D
Drinking	0.024	0.024*	0.047	<0.001***	1, no; 2, 1-2 T/W; 3, ≥3 T/W
Exercise	-0.009	0.375	-0.008	0.478	1, no; 2, 1-2 T/W; 3, ≥3 T/W
Meal	-0.001	0.942	0.007	0.485	1, 3 T/D; 2, 2 T/D; 3, 1 T/D

BMI, Body Mass Index; P/D, pack/day; T/W, time(s)/weeks; T/D, time(s)/day; *P< 0.05 ***P< 0.001; tested by partial correlation analysis (adjusted for age, BMI, smoking, drinking, exercise, meal)

Discussion

The purpose of this study was to evaluate and define the relationships between blood pressure and life style habits. Hypertension had no statistical significance with smoking, exercise, or diet, and there was especially low positive correlation with drinking. However, there was statistical positive correlation with age and BMI. Our results correspond to previous studies, which indicate that hypertension increases with age (1, 6-7). As people age, significant structural changes appears in the cardiovascular system. In particular, the blood vessel walls and the left ventricle thicken and arteries gets rigid. Lakatta (2002) reported that older people have a higher rate of hypertension because of these structural changes (14).

We found that the possibility of developing hypertension did not differ between people in their 20s and 30s. However, the possibility increased dramatically for people who were in their 40s or older, and possibility increases as aging progresses. In addition, there is a positive correlation between age and blood pressure and, even if all variables such as BMI are adjusted, age is the major risk factor of hypertension for women in Korea.

Blood pressure is very sensitive to changes in weight (6-8). Huang et al. (1998) examined women who lost at least 10kg of body weight and maintained their new weight (15). They had 0.45 times (CI= 0.4-0.7) lower prevalence of hypertension compared with other overweight women in a population of 82,473 nurses. In contrast, he observed that women who gained 10 to 19.9kg of body weight showed 2.2 times (CI= 2.0-2.4) higher prevalence of hypertension. Mikhail et al. (1999) reported that obesity causes hyperinsulemia and accumulation of sodium that elevate blood pressure by activating the sympathetic nervous system (16).

In this study, the odds ratio (95% CI) of hypertension in overweight and obese groups was approximately 2 to 3 times higher, which is a dramatic difference. Also, even though all confounding variables, including age, was adjusted, increased BMI is an independent risk factor for prevalence of hypertension because the increase of BMI and blood pressure showed a distinct positive correlation (systolic r= 0.272, P< 0.001; diastolic r= 0.263, P< 0.001).

Moderate drinking by western people may provide a protective effect against cardio-vascular diseases and may lower the rate of cardiovascular disease (17-19). In contrast to Westerners, Korean men had tendency to show increased

systolic and diastolic blood pressure as the amount and frequency of drinking increased (20). However, Korean women had tendency to show J-curve like westerners (20). Park et al. reported that, because of analyzing 'Analyses of the Third National Health and Nutrition Examination Survey', drinking increases cardiocerebro vascular disease because of the increased risk of hypertension, diabetes, and hypertriglyceridemia (21). In Korean men, less than 3 drinks per month showed 1.14 times higher prevalence of hypertension, 1-3 drinks per week showed 1.32 times higher prevalence of hypertension, and >4 drinks per week showed 1.55 times higher prevalence of hypertension. In Korean women, only >4 drinks per week increases prevalence of hypertension 3 times. In this study, women drinking only >3 drinks per week showed a 1.881 times higher risk of hypertension compared with non-drinking females. It was unclear if 1-2 drinks per week had an influence in Korean similar to the trend in westerner.

Smoking is an independent risk factor for cardiovascular disease and it should be recommended not to smoke (22). In addition, because smoking is the most important factor for preventing disease and death, the priority of smoking should be emphasized more. However, because of multiple regression analysis and partial correlation, there was no statistical significance between smoking and hypertension. It is because of cultural differences, Korea does not allow women to smoke. There was no statistical significance because almost all of subjects were non-smokers (97.8%). Therefore, the sample size of the smokers in this study itself is biased by Korean culture and is too small to be considered as impartial, we need another further study about this issue.

We found no statistical significance between hypertension and exercise and diet. However, this study did not include the intensity, type, and time of exercise or the amount and quality of nutrients. A more accurately designed study is needed.

Another limitation of this study was that it was cross sectional. Thus, we did not see cause and effect, only correlation. In addition, the data are not representative of all Korean women since the participants only resided in Seoul. We did not ask the amount of drinking, period of smoking, and type, duration, and intensity of exercise. Moreover, the exclusion criteria such as family history of hypertension may have affected the generalization and external validity of the study. However, compared to the other studies in Korea, the number of subjects that participated in this research (N= 8836) is very large and, therefore is a great advantage of this research.

In conclusion, the significant risk factors of hypertension were age, BMI, and alcohol drinking among Korean women. Smoking, exercise, and diet were not related to the risk of hypertension.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

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The authors declare that they have no conflict of interests.

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