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A Nested Case-Control Study on the High-Normal Blood Pressure as a Risk Factor of Hypertension in Korean Middle-Aged Men

The aim of this study was to identify the 'high-normal blood pressure' as a risk factor of hypertension for applying primary prevention strategy in Korean people. To keep time sequence of events, and to prevent information bias, nested case-control study was chosen for avoiding measurement errors because hypertension is a benign disease. Source population consisted of the 'Seoul Cohort' participants and follow-up was done by using Korea Medical Insurance Corporation's database on the utilization of health services from January 1, 1993 to June 30, 1997. Incidence cases were ascertained through the chart review, telephone contacts, and direct blood pressure measurements. Controls included the pairing of 4 individuals to each case on the basis of age. The statistically significant risk factors of hypertension were body mass index, dietary fiber, alcohol consumption, weekly activity, and history of quitting smoking as well as high-normal blood pressure (p<0.05). The multivariate odds ratio of high-normal blood pressure adjusted for all risk factors was 1.84 (95% CI, 1.31-2.56). Thus, the 'high-normal blood pressure' is considered as a risk factor for hypertension in Korean middle-aged men, which suggests that the vigorous lifestyle modification for persons with 'high-normal blood pressure' is needed.

Key Words : *Primary Prevention; Hypertension; Case-control Study*

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INTRODUCTION

As the hypertension has been known as a major risk factor of cardiovascular disease, cerebrovascular disease, congestive heart failure, chronic renal failure, and peripheral vascular disease (1-3), the primary prevention of hypertension is very important (4, 5). Among the known risk factors of hypertension in westernized populations, 'high-normal blood pressure (HNBP)' is especially important for the prevention of hypertension because it can be detected early and controlled by some drugs. However, there has been no prospective study of identifying the HNBP as a risk factor of hypertension in Koreans, so that an active prevention of hypertension by the control of HNBP has not been done. This study was done to elucidate the HNBP as a risk factor of hypertension to be applied in the primary prevention strategy in Korean population.

MATERIALS AND METHODS

To identify the HNBP as a risk factor of hypertension, an individual level of blood pressure should be taken before the occurrence of hypertension. Especially for the causal relationship, a prospective cohort study should be done after getting information on confounders as well as potential risk factors.

The study cohort was constructed from the Seoul Cohort, which is comprised of 54,378 men (Fig. 1). The eligibility criteria for the Seoul Cohort were that subjects were male beneficiaries of the Korea Medical Insurance Corporation (KMIC)

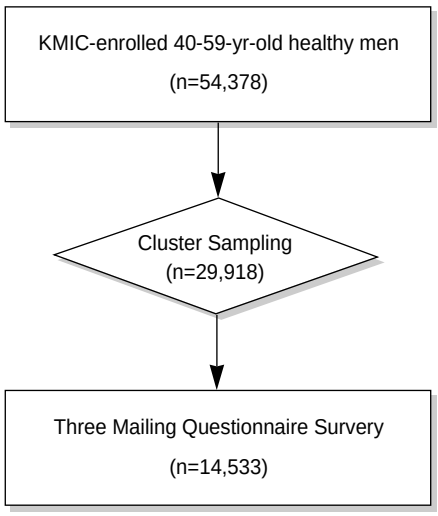

Fig. 1. Flow chart of Seoul Cohort construction.

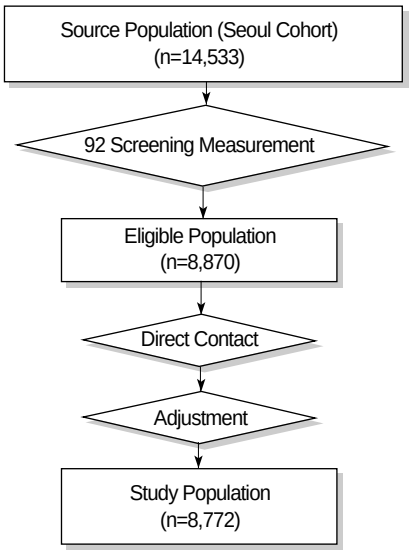

Fig. 2. Flow chart of recruiting study population.

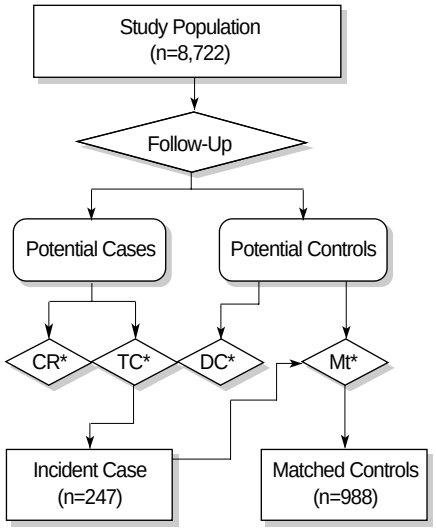

Fig. 3. Flow chart of selection of cases and controls (CR: chart review; TC: telephone contact; DC: direct contact; Mt: age-matching).

Table 1. Comparisons of sociodemographic factors and anthropometric values between incident cases (n=247) and controls (n=988) among Seoul Cohort Study, 1992*

Variables		Control group (column%)	Case group (column%)	Crude OR	95% CI	*p*-value (χ^2 for trend)
Age (yr)						NS
	40-44	372 (37.65)	93 (37.65)	1.00		
	45-49	324 (32.79)	81 (32.79)	-		
	50-54	236 (23.89)	59 (23.89)	-		
	55-59	56 (5.67)	14 (5.67)	-		
Marriage						-
	married	968 (98.47)	245 (99.19)	1.00		
	single	15 (1.53)	2 (0.81)	0.53	[0.08, 2.42]	
Education (yr)						NS
	≤11	167 (17.41)	27 (11.20)	1.00		
	12-15	389 (40.56)	111 (46.06)	1.76	[1.09, 2.87]	
	16≤	403 (42.02)	103 (42.74)	1.58	[0.98, 2.57]	
Occupation						NS
	Management	263 (27.51)	67 (27.80)	1.00		
	Clerical workers	463 (48.43)	125 (51.87)	1.06	[0.75, 1.50]	
	Laborer	230 (24.06)	49 (20.33)	0.84	[0.54, 1.28]	
SEI+						NS
	<3.0	234 (34.01)	56 (32.75)	1.00		
	3.0-<4.0	158 (22.97)	37 (21.64)	0.98	[0.60, 1.59]	
	4.0≤	296 (43.02)	78 (45.61)	1.10	[0.74, 1.65]	
Initial blood pressure						-
	Normal	401 (40.59)	62 (25.10)	1.00		
	High-normal	587 (59.41)	185 (74.90)	2.04	[1.47, 2.83]	
Body mass index (kg/M^2)						0.05
	<20	92 (9.39)	9 (3.64)	1.00		
	20≤-<25	695 (70.92)	178 (72.06)	2.62	[1.25, 5.67]	
	25+	193 (19.69)	60 (24.29)	3.18	[1.45, 7.20]	
Family history of hypertension						
	No	823 (86.18)	196 (82.70)	1.00		
	Yes	132 (13.82)	41 (17.30)	1.30	[0.87, 1.95]	

*Missing values were excluded. +SEI (Social Economic Index)=monthly electric costs (₩1,000)/number of family members.

Table 2. Comparisons of smoking and drinking habits between incident cases (n=247) and controls (n=988) among Seoul Cohort Study, 1992*

Variables		Control group (column%)	Case group (column%)	Crude OR	95% CI	*p*-value (χ^2 for trend)
Smoking history						NS
	No	218 (22.52)	48 (19.67)	1.00		
	Quit	243 (25.10)	82 (33.61)	1.53	[1.01, 2.33]	
	Yes	507 (52.38)	114 (46.72)	1.02	[0.69, 1.51]	
Total cigarette index						NS
(pack-year)	0	223 (23.77)	52 (21.85)	1.00		
	1-10	155 (16.52)	49 (20.59)	1.36	[0.85, 2.16]	
	11-15	79 (8.42)	31 (13.03)	1.68	[0.98, 2.90]	
	16-20	111 (11.83)	25 (10.50)	0.97	[0.55, 1.69]	
	21-34	273 (29.10)	56 (23.53)	0.88	[0.57, 1.36]	
	35+	97 (10.34)	25 (10.50)	1.11	[0.63, 1.94]	
Drinking history						-
	No	151 (17.16)	33 (13.98)	1.00		
	Yes	729 (82.84)	203 (86.02)	1.27	[0.83, 1.96]	
Weekly amounts of ethanol intake						0.01
(g/week)	0	151 (17.16)	33 (13.98)	1.00		
	1-70	249 (28.30)	52 (22.03)	0.96	[0.58, 1.59]	
	71-280	230 (26.14)	60 (25.42)	1.19	[0.73, 1.97]	
	281-560	127 (14.43)	55 (23.31)	1.98	[1.18, 3.34]	
	561+	123 (13.98)	36 (15.25)	1.34	[0.76, 2.35]	

*Missing values were excluded.

Table 3. Comparisons of physical activity between incident cases (n=247) and controls (n=988) among Seoul Cohort Study, 1992*

Variables		Control group (column%)	Case group (column%)	Crude OR	95% CI	*p*-value (χ^2 for trend)
Daily sleeping time						NS
(hr/day)	-6	319 (32.65)	69 (27.94)	1.00		
	7-8	619 (63.36)	166 (67.21)	1.24	[0.90, 1.71]	
	9+	39 (3.99)	12 (4.86)	1.42	[0.67, 2.99]	
Sitting time						NS
(hr/day)	-2	872 (88.98)	218 (88.26)	1.00		
	3-6	95 (9.69)	26 (10.53)	1.09	[0.67, 1.77]	
	7+	13 (1.33)	3 (1.21)	0.92	[0.21, 3.50]	
Weekly physical activity						NS
(times/week)	0	340 (35.38)	82 (33.47)	1.00		
	1-3	489 (50.88)	144 (58.78)	1.22	[0.89, 1.67]	
	4+	132 (13.74)	19 (7.76)	0.60	[0.34, 1.05]	
Total energy expenditure						NS
(Kcal/day)	<2,142	247 (25.76)	57 (23.36)	1.00		
	2,142-<2,358	225 (23.46)	55 (22.54)	1.06	[0.69, 1.63]	
	2,358-<2,635	246 (25.65)	60 (24.59)	1.06	[0.69, 1.61]	
	2,635≤	241 (25.13)	72 (29.51)	1.29	[0.86, 1.95]	

*Missing values were excluded.

and confirmed as healthy people by the medical screening in 1990; 40 to 59 yr of age; living in Seoul, the largest city in Korea; and were respondents to a self-administered questionnaire survey distributed via mail in 1991 (6-8) (Fig. 2). The KMIC includes the government employees, schoolteachers, and pensioners living with their families since 1978. The total number of the beneficiaries was around 4.7 million in 1993, which is about 11% of the total Korean population. The age distribution of the Seoul Cohort members was very similar to that of the Korean population. The data of blood pressure levels of the source population was obtained by the biennial screening survey done in 1990 by KMIC.

As the hypertension could be treated as an outpatient and attributed to a measurement error, identification of incident cases using only the follow-up system is not appropriate. Hence, a nested case-control study with new selection criteria for incident cases was taken for elucidating a causal relationship. The subcohort participants were those who had systolic blood pressure below 140 mmHg and diastolic blood pressure below 90 mmHg in screening test in 1992 among the nor-

Table 4. Comparisons of intakes of drugs and tastes foods between incident cases (n=247) and controls (n=988) among Seoul Cohort Study, 1992*

Variables		Control group (column%)	Case group (column%)	Crude OR	95% CI	*p*-value (χ^2 for trend)
Multivitamin						NS
(tablets/day)	0	468 (48.00)	116 (47.35)	1.00		
	0<-<1	218 (22.36)	59 (24.08)	1.09	[0.76, 1.58]	
	1<=	289 (29.64)	70 (28.57)	0.98	[0.69, 1.38]	
Vitamin A						0.038
(tablets/day)	0	930 (94.99)	225 (91.46)	1.00		
	0<-<1	29 (2.96)	12 (4.88)	1.71	[0.81, 3.55]	
	1<=	20 (2.04)	9 (3.66)	1.86	[0.77, 4.37]	
Vitamin C						0.056
(tablets/day)	0	881 (90.27)	209 (84.96)	1.00		
	0<-<1	51 (5.23)	23 (9.35)	1.90	[1.10, 3.27]	
	1<=	44 (4.51)	14 (5.69)	1.34	[0.69, 2.58]	
Vitamin E						0.073
(tablets/day)	0	926 (94.30)	226 (91.87)	1.00		
	0<-<1	29 (2.95)	7 (2.85)	0.99	[0.39, 2.40]	
	1<=	27 (2.75)	13 (5.28)	1.97	[0.95, 4.05]	
Green tea						NS
(times/week)	0	764 (78.84)	190 (77.87)	1.00		
	0<-<7	137 (14.14)	43 (17.62)	1.26	[0.85, 1.87]	
	7<=	68 (7.02)	11 (4.51)	0.65	[0.32, 1.30]	
Ginseng						0.089
(times/week)	0	774 (79.38)	206 (84.43)	1.00		
	0<-<7	157 (16.10)	30 (12.30)	0.72	[0.46, 1.11]	
	7<=	44 (4.51)	8 (3.28)	0.68	[0.29, 1.54]	
Coffee						NS
(times/week)	0	223 (22.71)	56 (22.67)	1.00		
	0<-<7	192 (19.55)	40 (16.19)	0.83	[0.52, 1.33]	
	7<=	567 (57.74)	151 (61.13)	1.06	[0.74, 1.52]	
Coke						NS
(times/week)	0	744 (76.46)	194 (79.84)	1.00		
	0<-<7	216 (22.20)	46 (18.93)	0.82	[0.56, 1.18]	
	7<=	13 (1.34)	3 (1.23)	0.89	[0.20, 3.36]	

*Missing values were excluded.

motensive participants of the Seoul Cohort.

Follow-up was done from January 1, 1993 to June 30, 1997 using the medical treatment claims (MTC) database of KMIC, which were sent from the medical care institution whenever a beneficiary received any treatment. If a study subject had a diagnostic code of 401-405 on ICD-9 or I10-I15 on ICD-10 during the follow-up period, we regarded him/her as a potential case. The incident date was defined as the earliest date of receiving treatments. However, since the MTC database of KMIC was only the secondary data source, the potential case had to be confirmed as an incident case. We performed three methods as review of medical records through the hospital survey, telephone contacts, and direct measurements of blood pressure.

An incident case was defined as follow: first, a blood pressure level meeting the criteria of hypertension on JNC VI (9) or a history of taking some anti-hypertensive drugs in the medical review; second, a history of diagnosis with hypertension in telephone contacts; third, a blood pressure level meeting the criteria of hypertension on JNC VI in direct measurement. The participants of Seoul Cohort excluding the potential cases were considered as potential controls. Among them, controls were selected by frequency matching with 1-to-4 ratio according to the year of birth in each case. Three kinds of methods for case identification-chart review, telephone contact, and direct measurement-were done in 118, 591, and 465 potential cases, respectively, among subcohort participants (n=8,722), so that 247 cases were finally confirmed (Fig. 3). Thus, the total number of subjects was 988, because controls were selected by frequency matching with 1-to-4 ratio.

Baseline Information on potential confounders was obtained by self-administered questionnaires survey, which was done in 1992 (6-8). Covariates without known cut-off values, total energy expenditure, intakes of herb medicine, intakes of foods and nutrients, were categorized according to quartile.

After excluding the nonresponding data of exposure variables as missing (10), odds ratios (OR) and their 95% confidence intervals (CI) were calculated to determine any statistically significant difference between cases and controls. For

Table 5. Comparisons of intakes of food items between incident cases (n=247) and controls (n=988) among Seoul Cohort Study, 1992*

Variables		Control group (column%)	Case group (column%)	Crude OR	95% CI	*p*-value (χ^2 for trend)
Beef (grilled, broiled)						NS
(g/day)	< 3.15	348 (35.26)	97 (39.27)	1.00		
	3.15<=-<4.78	29 (2.94)	6 (2.43)	0.74	[0.27, 1.94]	
	4.78<=-<9.44	320 (32.42)	77 (31.17)	0.86	[0.61, 1.22]	
	9.44 +	290 (29.38)	67 (27.13)	0.83	[0.58, 1.19]	
Beef (fried, boiled, steamed)						NS
	< 2.41	232 (23.51)	62 (25.10)	1.00		
	2.41<=-<4.21	262 (26.55)	75 (30.36)	1.07	[0.72, 1.59]	
	4.21<=-<8.83	243 (24.62)	58 (23.48)	0.89	[0.59, 1.36]	
	8.83+	250 (25.33)	52 (21.05)	0.78	[0.51, 1.20]	
Pork (grilled, broiled)						NS
	< 2.76	204 (20.67)	38 (15.38)	1.00		
	2.76<=-<6.86	251 (25.43)	66 (26.72)	1.41	[0.89, 2.24]	
	6.86<=-<11.83	273 (27.66)	83 (33.60)	1.63	[1.05, 2.55]	
	11.83+	259 (26.24)	60 (24.29)	1.24	[0.78, 1.99]	
Pork (fried, boiled)						NS
	< 0.70	251 (25.43)	50 (20.24)	1.00		
	0.70<=-<1.49	249 (25.23)	62 (25.10)	1.25	[0.81, 1.93]	
	1.49<=-<3.90	227 (23.00)	75 (30.36)	1.66	[1.09, 2.52]	
	3.90+	260 (26.34)	60 (24.29)	1.16	[0.75, 1.79]	
Fishes (grilled)						NS
	<0.82	263 (26.65)	51 (20.65)	1.00		
	0.82<=-<1.98	252 (25.53)	76 (30.77)	1.56	[1.03, 2.35]	
	1.98<=-<3.90	230 (23.30)	51 (20.65)	1.14	[0.73, 1.79]	
	3.90+	242 (24.52)	69 (27.94)	1.47	[0.97, 2.24]	
Fishes (boiled, fried)						NS
	<0.15	241 (24.42)	61 (24.70)	1.00		
	0.15<=-<2.63	279 (28.27)	61 (24.70)	0.86	[0.57, 1.31]	
	2.63<=-<6.50	202 (20.47)	50 (20.24)	0.98	[0.63, 1.52]	
	6.50+	265 (26.85)	75 (30.36)	1.12	[0.75, 1.66]	
Fishes (salt-fermented)						0.04
	< 5.13	264 (26.75)	54 (21.86)	1.00		
	5.13<=-<10.45	220 (22.29)	53 (21.46)	1.18	[0.76, 1.83]	
	10.45<=-<19.69	257 (26.04)	64 (25.91)	1.22	[0.80, 1.85]	
	19.69+	246 (24.92)	76 (30.77)	1.51	[1.00, 2.27]	
Shellfishes (not fried)						NS
	< 0.02	243 (24.62)	48 (19.43)	1.00		
	0.02<=-<0.05	233 (23.61)	74 (29.96)	1.61	[1.05, 2.46]	
	0.05<=-<0.13	280 (28.37)	64 (25.91)	1.16	[0.75, 1.78]	
	0.13+	231 (23.40)	61 (24.70)	1.34	[0.86, 2.08]	

*Missing values were excluded.

the dose-response relationship, Mantel-Haenszel's trend analysis was done. Multivariate logistic analysis was done for the evaluating of the risk factors of hypertension with adjusting confounding effects.

RESULTS

There was no difference in age distribution between two groups due to age matching. There was no statistically significant difference in marriage status, occupation, and socioeconomic index, except education level (Table 1). When the education level was reclassified as below and above 12 yr, a statistically significant difference was revealed (OR 1.67; 95% CI 1.06, 2.64) (Table 7). Both the HNBP according to the initial measurement and higher BMI showed a statistically significant difference, especially, BMI showed a significant trend. Family history of hypertension was not different between two groups.

As for the smoking habit, the group with a history of quitting smoking had a higher risk than no smoking group (Table 2). However, there was no dose-response relationship in total cigarette index. The group with weekly ethanol intake of 281-560 g showed a statistically significant difference,

Table 6. Comparisons of intakes of nutrients between incidence cases (n=247) and controls (n=988) among Seoul Cohort Study, 1992*

Variables	Control group (column%)	Case group (column%)	Crude OR	95% CI	*p*-value (χ^2 for trend)
Total energy intake (Kcal/day)					NS
<2,392.6	260 (26.34)	61 (24.70)	1.00		
2,392.6≤-<2,804.7	254 (25.73)	70 (28.34)	1.17	[0.79, 1.76]	
2,804.7≤-<3,415.5	241 (24.42)	55 (22.27)	0.97	[0.64, 1.49]	
3,415.5+	232 (23.51)	61 (24.70)	1.12	[0.74, 1.70]	
Protein (g/day)					NS
<63.4	260 (26.34)	56 (22.67)	1.00		
63.4≤-<82.6	251 (25.43)	74 (29.96)	1.37	[0.91, 2.06]	
82.6≤-<108.6	243 (24.62)	59 (23.89)	1.13	[0.74, 1.72]	
108.6+	233 (23.61)	58 (23.48)	1.16	[0.75, 1.77]	
Fat (g/day)					NS
<23.2	252 (25.53)	69 (27.94)	1.00		
23.2≤-<33.3	265 (26.85)	57 (23.08)	0.79	[0.52, 1.18]	
33.3≤-<47.8	245 (24.82)	67 (27.13)	1.00	[0.67,1.49]	
47.8+	225 (22.80)	54 (21.86)	0.88	[0.58, 1.33]	
Fiber (g/day)					NS
<4.1	253 (25.63)	61 (24.70)	1.00		
4.1≤-<5.8	237 (24.01)	69 (27.94)	1.21	[0.81, 1.81]	
5.8≤-<8.3	246 (24.92)	76 (30.77)	1.28	[0.86, 1.91]	
8.3 +	251 (25.43)	41 (16.60)	0.68	[0.43, 1.07]	
Sodium (mg/day)					NS
<3,212.9	269 (27.25)	61 (24.70)	1.00		
3,212.9≤-<5,734.1	226 (22.90)	75 (30.36)	1.46	[0.98, 2.18]	
5,734.1≤-<9,496.0	260 (26.34)	45 (18.22)	0.76	[0.49, 1.19]	
9,496.0+	232 (23.51)	66 (26.72)	1.25	[0.83, 1.89]	
Potassium (mg/day)					NS
<2030.3	267 (27.05)	59 (23.89)	1.00		
2,030.3≤-<2,747.2	233 (23.61)	69 (27.94)	1.34	[0.89, 2.02]	
2,747.2≤-<3,733.9	260 (26.34)	66 (26.72)	1.15	[0.76, 1.73]	
3,733.9 +	227 (23.00)	53 (21.46)	1.06	[0.69, 1.63]	
Phosphate (mg/day)					NS
<950.1	265 (26.85)	58 (23.48)	1.00		
950.1≤-<1,239.0	245 (24.82)	71 (28.74)	1.32	[0.88, 1.99]	
1,239.0≤-<1,616.1	252 (25.53)	61 (24.70)	1.11	[0.73, 1.68]	
1,616.1+	225 (22.80)	57 (23.08)	1.16	[0.76, 1.77]	

*Missing values were excluded.

compared with the group with no drinking history (OR 1.98; 95% CI 1.18, 3.34). When recategorizing the weekly amount of ethanol intake into two groups based on 280 g, the odds ratio changed into 1.58 (95% CI 1.16, 2.16) (Table 7).

As for the weekly physical activities, there was no statistically significant difference (Table 3). However recategorizing the variable based on 4 times per week showed a statistically significant difference (Table 3).

None of the intakes of multivitamin, vitamin A, vitamin C, and vitamin E showed a statistically significant (Table 4). However, a dose-response relationship was shown in intakes of vitamin A and C. When recategorizing the two variables, intakes of vitamin A and C, there was a statistically significant difference, compared with non-intake groups (Table 7). There was no significant difference in variables of intakes of taste foods such as coffee, tea, green tea, coke, and ginseng. When recategorizing the variables of coffee and coke, there was a statistically significant difference, compared with non-intake groups (Table 7).

As for the food items, the third quarter group in intake of pork showed a statistically significant difference (Table 5). Also there was a statistical significance in the second quarter group in intake of grilled fishes, the fourth quarter group in intake of salt-fermented fishes, and the second quarter group in intake of raw shellfishes (Table 5).

As for the intakes of nutrients, none of total energy intakes, protein, fat, fiber, sodium, potassium, phosphate showed a statistically difference (Table 6). However the fiber intake showed an opposite direction in OR between the fourth and the other groups, so that the recategorization into two groups showed a statistically significant difference (OR 0.58; 95% CI 0.40, 0.85) (Table 7).

The recategorization of the 11 variables such as education year, history of quitting smoking, weekly amount of ethanol intake, weekly physical activity, intakes of vitamin A and C, intakes of coke and caffeine, daily intake of fiber, BMI and

Table 7. Recategorization of statistically significant risk factors among Seoul Cohort participants, 1992*

Variables		Control group (column%)	Case group (column%)	Crude OR	95% CI
Education (yr)					
	≤11	167 (17.41)	27 (11.20)	1.00	
	12≤	792 (82.59)	214 (88.80)	1.67	[1.06, 2.64]
Body Mass Index (kg/M^2)					
	<20	92 (9.39)	9 (3.64)	1.00	
	20≤-<25	695 (70.92)	178 (72.06)	2.62	[1.25, 5.67]
	25+	193 (19.69)	60 (24.29)	3.18	[1.45, 7.20]
Initial BP					
	Normal	401 (40.59)	62 (25.10)	1.00	
	High-normal	587 (59.41)	185 (74.90)	2.04	[1.47, 2.83]
History of quitting smoking					
	No	725 (74.90)	162 (66.39)	1.00	
	Yes	243 (25.10)	82 (33.61)	1.51	[1.10, 2.07]
Weekly amounts of ethanol intake (gm/week)					
	≤280	630 (71.59)	145 (61.44)	1.00	
	280<	250 (28.41)	91 (38.56)	1.58	[1.16, 2.16]
Weekly physical activity (times/week)					
	≤3	829 (86.26)	226 (92.24)	1.00	
	4≤	132 (13.74)	19 (7.76)	0.53	[0.31, 0.89]
Vitamin A					
	No	930 (94.99)	225 (91.46)	1.00	
	Yes	49 (5.01)	21 (8.54)	1.77	[1.01, 3.10]
Vitamin C					
	No	881 (90.27)	209 (84.96)	1.00	
	Yes	95 (9.73)	37 (15.04)	1.64	[1.07, 2.52]
Coke					
	No	378 (41.45)	71 (29.83)	1.00	
	Yes	534 (58.55)	167 (70.17)	1.66	[1.21, 2.29]
Caffeine					
	No	85 (9.34)	9 (3.80)	1.00	
	Yes	825 (90.66)	228 (96.20)	2.61	[1.25, 5.64]
Fiber (g/day)					
	<8.3	736 (74.57)	206 (83.40)	1.00	
	8.3≤	251 (25.43)	41 (16.60)	0.58	[0.40, 0.85]

*Missing values were excluded.

HNBP, showed statistically significant differences in univariate analysis (Table 7). After testing for intervariable independence among the 11 variables, 9 variables, except intakes of vitamin C and coke, were finally selected for multivariate analysis. The forward regresssion methods revealed the most fitted models for six variables-HNBP group, BMI, daily amounts of dietary fiber intake, weekly amount of alcohol intake, history of quitting smoking, and weekly times of exercise (Table 8-model 3). The final model revealed HNBP, BMI, weekly amount of alcohol intake, and history of quitting smoking as risk factors, and daily amount of dietary fiber intake and weekly times of exercise as protective factors.

DISCUSSION

In accrodance with previous reports that HNBP was one of the risk factors of hypertension (1, 4, 11-12), this paper also showed that HNBP would be the risk factor after adjusting for sociodemographic factors, BMI, family history, smoking and drinking, sleep and daily activity, intakes of drugs and taste foods, and dietary habits. Thus, physicians suggest some strategies for prevention of hypertension for Korean middle-aged men with HNBP.

The results of this study showed four risk factors such as obesity, excessive drinking, lack of exercise, and HNBP, in agreement with National High Blood Pressure Education Program Working Group, which suggested HNBP, obesity, family history of hypertension, excessive intakes of salt and drinking, lack of exercise, and African-American as risk factors of hypertension (13). If a person had one of these risk factors, certain measures for the primary prevention were recommended and proved to prevent an elevation of blood pressure (11, 14-16).

The excessive intake of salt did not show a statistical significance, in contrast with previous reports (2, 17). Some methodologic challenges might have existed in studies on the relationship between sodium intake and blood pressure.

Table 8. The Model Selection by the logistic regression and the adjusted OR in incidence of hypertension among Seoul Cohort participants, 1992

*/+	BMI1	BMI2	IBP	FIBE	ALCO	QTHX	ACTIV	VITA	CAFE	EDUC
Model 1	1.95	2.22	1.91	0.23	1.50	1.59	0.66	1.43	1.85	1.22
	[0.94, 4.06]	[1.01, 4.87]	[1.35, 2.69]	[0.35, 0.78]	[1.09, 2.07]	[1.15, 2.21]	[0.37, 1.14]	[0.79, 2.58]	[0.85, 4.01]	[0.74, 2.01]
Model 2	2.43	2.99	1.86	0.48	1.49	1.55				
	[1.19, 4.98]	[1.39, 6.41]	[1.34, 2.60]	[0.33, 0.71]	[1.09, 2.03]	[1.13, 2.13]				
Model 3	2.41	2.89	1.84	0.50	1.52	1.54	0.58			
	[1.17, 4.95]	[1.34, 6.21]	[1.31, 2.56]	[0.34, 0.74]	[1.11, 2.07]	[1.12, 2.12]	[0.34, 0.99]			
Model 4	2.41	2.93	1.84	0.49	1.51	1.56		1.66		
	[1.17, 4.94]	[1.36, 6.28]	[1.32, 2.56]	[0.33, 0.72]	[1.11, 2.06]	[1.13, 2.15]		[0.94, 2.92]		
Model 5	2.13	2.59	1.94	0.48	1.51	1.59			1.99	
	[1.03, 4.42]	[1.18, 5.58]	[1.38, 2.73]	[0.33, 0.72]	[1.09, 2.06]	[1.15, 2.21]			[0.93, 4.30]	
Model 6	2.24	2.63	1.88	0.49	1.50	1.54				1.37
	[1.09, 4.61]	[1.22, 5.68]	[1.35, 2.63]	[0.34, 0.73]	[1.09, 2.06]	[1.12, 2.12]				[0.86, 2.18]

*BMI1: 20≤-<25; BMI2: 25+; IBP: initial blood pressure; FIBE: intake of dietary fiber; ALCO: amount of weekly ethanol intake; QTHX: history of quitting smoking; ACTIV: weekly physical activities; VITA: intake of vitamin A; CAFE: intake of caffeine; EDUC: years of education.
+Odds ratio and 95% confidence interval.

These include measurement difficulties due to variation in day-to-day consumption of sodium (18) as well as a limitation of the measurement itself (19, 20), the inter-relation between dietary habit and individual characteristics (21), the interaction of nutrition absorption (22), and the correlation to other risk factors of hypertension (23). However, the highest intake of salted-fish showed a statistical significance (OR=1.51; 95% CI 1.00-2.27) and a trend so that the limitation of salt intake should be recommended without further evidences.

Smoking was not shown as a risk factor of hypertension in this study. It would be due to the prohibit smoking before measurement of blood pressure (24). However, smoking is known as a risk factor of cardiovascular disease (25), so that a person with some risk factors of hypertension should be strongly recommended to stop smoking (26).

The history of quitting smoking was shown as a risk factor of hypertension in this study as well as other reports (27, 28). This result could be explained by the relaxing effect of beta-endorphin (29). A person who has quitted smoking cannot control the stress level effectively, so that the risk of hypertension increases (30, 31). Moreover, there was an increasing trend in odds ratio until 14 yr after quitting smoking (χ^2_{trend}=7.56; *p*-value<0.01). These results would suggest that it should be necessary to follow up for at least 15 yr after quitting smoking.

One should interpret the results carefully according to the selection of cases and controls. Review of medical charts, telephone contacts, and direct measurements of blood pressure levels were used to select the cases. But the controls were chosen by age matching among those who had not received any medical service during the follow-up periods. Controls might be incomplete without a survey for individual identification and this may bias the relative risk towards the nulls and weaken the statistical power. Hence we need an additional study for some variables, which did not show a statistical significance.

In conclusion, a middle-aged Korean man with a HNBP should take some measures for the prevention of hypertention (OR=1.84; 95% CI 1.31-2.56). Physician should suggest some strategies for the prevention of hypertention to a visitor having overweight, over-drinking, low physical activity, or history of quitting smoking. The primary strategies against hypertension in Korean men may be weight control, control of ethanol intake (below 70 gm per week), adequate exercise (above 4 times per week), and adequate intake of dietary fiber.

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