Original Article

J Prev Med Public Health 2022;55:506-519 • https://doi.org/10.3961/jpmph.22.264

pISSN 1975-8375 eISSN 2233-4521

Journal of Preventive Medicine & Public Health

Effects of Marital Status and Income on Hypertension: The Korean Genome and Epidemiology Study (KoGES)

Mia Son[1], Yeon Jeong Heo[2], Hye-Jin Hyun[2], Ho Jong Kwak[2]

[1]Department of Preventive Medicine, Kangwon National University School of Medicine, Chuncheon, Korea; [2]Department of Nursing, Kangwon National University, Chuncheon, Korea

Objectives: This study aimed to analyze the associations of income, marital status, and health behaviors with hypertension in male and female over 40 years of age in the Korea.

Methods: The data were derived from the Korean Genome and Epidemiology Study (KoGES; 4851-302) which included 211 576 participants. To analyze the relationships of income, marital status, and health behaviors with hypertension in male and female over 40 years of age, multiple logistic regression was conducted with adjustments for these variables.

Results: The prevalence of hypertension increased linearly as income decreased. The odds ratio for developing hypertension in people with an income of <0.5 million Korean won (KRW) compared to ≥6.0 million KRW was 1.55 (95% confidence interval [CI], 1.25 to 1.93) in the total population, 1.58 (95% CI, 1.27 to 1.98) in male, and 1.07 (95% CI, 0.35 to 3.28) in female. The combined effect of income level and marital status on hypertension was significant. According to income level and marital status, in male, low income and divorce were most associated with hypertension (1.76 times; 95% CI, 1.01 to 3.08). However, in female, the low-income, married group was most associated with hypertension (1.83 times; 95% CI, 1.71 to 1.97).

Conclusions: The results of this study show that it is necessary to approach male and female marital status separately according to income in health policies to address inequalities in the prevalence of hypertension.

Key words: Hypertension, Prevalence, Socioeconomic factor, Income, Risk factor

INTRODUCTION

Hypertension is a major risk factor for non-communicable diseases, such as cardiovascular diseases, diabetes, and chronic kidney disease [1]. The prevalence of hypertension increased from 24.5% in 2007 in Korea to 27.2% in 2019 [2], and the rate of hypertension control is below 50%, indicating the need to manage hypertension risk factors in Korea [3].

Socioeconomic status (SES) is associated with a high prevalence of hypertension [4]. Demographic factors (e.g., age or sex), socioeconomic factors (e.g., income, marital status, education, etc.), and health behavior factors (smoking, drinking, body mass index [BMI], etc.) are well-known risk factors associated with hypertension [5]. Marital status was an important risk factor for hypertension in previous studies, and the results of studies on the relationship between marital status and hypertension were not consistent [6-9]. In studies such as that of Defianna et al. [5], socioeconomic factors and sex differences in marital status were observed to affect hypertension risk.

Many international studies have reported relationships be-

Received: June 9, 2022 Accepted: September 2, 2022

Corresponding author: Yeon Jeong Heo
Department of Nursing, Kangwon National University,
1 Ganwondaehak-gil, Chuncheon 24341, Korea
E-mail: far1555@naver.com

tween hypertension control and socioeconomic levels, but there are few studies related to hypertension control in Korea, and those studies are limited to research on mortality according to some socioeconomic levels [10]. A previous study found that marital status was not associated with hypertension control [10]. However, the results of Lim [10] were different from those of previous studies [11,12]. The results of previous studies showed that hypertension control was high in married subjects—that is, those living with a spouse [11] regardless of race and age. Shah and Cook [12] reported that people living alone did not have well-controlled hypertension. In some Korean studies, income was associated with all causes of hypertension, increases in cardiovascular mortality and cardiovascular events [13], as well as hypertension diagnoses [14].

Although income was reported to have a large effect on hypertension [13,15-20], few Korean studies have investigated the effect of marriage on hypertension, especially the correlation between marriage and income, have been reported. We need to figure out how the interactions of socio-political issues such as income and marriage affect hypertension. It is also necessary to consider marital status by subdividing it into groups of married, unmarried, separated, divorced, and those with deceased spouses. The purpose of this study was to investigate how the income, marital status, and health behavior factors of male and female over 40 years of age were correlated.

The hypotheses of this study were: (1) the prevalence rate of hypertension is associated with demographic characteristics, income, marital status, and health behaviors, and (2) marital status and income level affect the prevalence of hypertension more than health behavior risk factors.

METHODS

Research Materials and Targets

The data in this study were obtained from the Korean Genome and Epidemiology Study (KoGES; 4851-302), National Institute of Health, Korea Disease Control and Prevention Agency, Korea. The population-based cohorts in the KoGES, including the KoGES Ansan and Ansung study, the KoGES Health Examinee Study, and the KoGES Cardiovascular Disease Association Study, consisted of community-dwellers and male and female participants, aged ≥40 years at baseline recruited from the national health examinee registry. The purpose of the KoGES survey data was to identify lifestyle, diet, and environmental factors in people between the ages of 40 and 69 with chronic diseases in rural and medium sized city populations.

A total of 211 576 participants were collected by the KoGES as the general cohort between 2001 and 2013. Finally, 210 413 were included in this study, excluding 1163 who did not respond to information from demographic characteristics, income, marital status, and health behavior factors.

Hypertension

The definition of hypertension in this study was a measured systolic blood pressure of over 140 mmHg or diastolic blood pressure of 90 mmHg, or when the participant was diagnosed with hypertension by a physician.

Demographic characteristics

The demographic characteristics included sex (male and female) and age (40-44, 45-49, 50-54, 55-59, 60-64 years, and over).

Income level

The income level was investigated as the average monthly income of the family, and was divided into <0.500 million Korean won (KRW), 0.500-0.999 million KRW, <1.000-1.499 million KRW, 1.500-1.999 million KRW, 2.000-2.999 million KRW, 3.000-3.999 million KRW, and ≥6.000 million KRW.

Marital status

The current marital status was categorized by the response to the question "What is your current marital status?" Participants were divided into married, unmarried, separated, divorced, deceased spouse, and other groups.

Health behavior factors

The health behaviors were smoking, drinking, and BMI. Smoking was investigated through the question "Have you ever smoked?" The responses were divided into "no," "yes (past smoker)," and "yes (current smoker)." Pack-years were classified as 1-9, 10-19, 20-39, 40-59, and 60 or more." Drinking was investigated through the question "Haven't you ever consumed alcohol?" The responses were divided into "yes" or "no (past drinking)," and "no (current drinking)". Total alcohol consumption (g/day) was obtained by the consumption of alcoholic beverages including *makgeolli*, beer, *jeongjong* (*cheongju*), wine, soju, and liquor. The density of ethanol is 0.7893 g/mL, and the alcohol concentration (%) was 6% in Juru *makgeolli*, 4.5% in beer, 15% in *jeongjong* (*cheongju*), 13% in wine, 22% in soju,

and 40% in liquor. The alcohol intake was calculated according to the following formula: drinking frequency×one drink×alcohol content (g/drink). The total alcohol intake was classified as 0.05-0.09, 1.00-9.99, 10.00-19.99, and 20.00-29.99 g/day, or more. BMI is a statistical index that uses a person's weight and height to provide an estimate of body fat and is a value obtained by dividing a person's weight (kg) by his or her height (m^2). A BMI of <18.5 kg/m^2 was considered underweight, normal was 18.5-22.9 kg/m^2, pre-obese was 23.0-24.9 kg/m^2, and stage 1 obesity was 25.0-29.9 kg/m^2. Stage 2 obesity was classified as a BMI of 30.0-34.9 kg/m^2, and stage 3 obesity was classified as over 35.0 kg/m^2 [21].

Statistical Analysis

The prevalence of hypertension was analyzed according to the demographic characteristics, income levels, marital status, and health behavior factors of the study population. Logistic regression was used to analyze the effects of income level, marital status, and health behaviors on hypertension among male and female, adjusting for age, health behavior (smoking, alcohol, and BMI), and nutrition, and the odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. Trend analysis using the likelihood ratio test was conducted in relation to the relationship between demographic characteristics and income level, marital status, and health behaviors of patients with hypertension. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

Ethics Statement

This study was approved by the Kangwon National University Institutional Review Board (approval No. KWNUIRB-2021-02-002) and performed in accordance with the principles of the Declaration of Helsinki.

Table 1. Prevalence of hypertension according to demographic characteristics, income level, marital status, and health behavior factors

Variables	Total	Hypertension	Male	Hypertension	Female	Hypertension
Total	210 413	40 575 (19.28)	-	-	-	-
Demographic characteristics						
Sex						
Female	136 008	22 761 (16.74)	-	-	-	-
Male	74 405	17 814 (23.94)	-	-	-	-
Total	210 413	40 575 (19.28)	-	-	-	-
Age (y)						
40-44	36 621	3751 (10.24)	12 651	2238 (17.69)	23 970	1513 (6.31)
45-49	36 887	5329 (14.45)	11 581	2467 (21.30)	25 306	2862 (11.31)
50-54	42 842	7604 (17.79)	13 432	3050 (22.71)	29 310	4554 (15.54)
55-59	35 285	7545 (21.38)	12 313	3100 (25.18)	22 972	4445 (19.35)
60-64	30 112	7779 (25.83)	11 807	3226 (27.32)	18 305	4553 (24.87)
≥65	28 766	8567 (29.78)	12 621	3733 (29.58)	16 145	4834 (29.94)
Total	210 413	40 575 (19.28)	74 405	17 814 (23.94)	136 008	22 761 (16.74)
Socioeconomic factors						
Income (1000 korean won)						
≥6000	12 425	1554 (12.51)	5301	974 (18.37)	7124	580 (8.14)
4000-5999	24 807	3316 (13.37)	9650	1886 (19.54)	15 157	1430 (9.43)
3000-3999	31 034	4575 (14.74)	11 823	2417 (20.44)	19 211	2158 (11.23)
2000-2999	36 293	6233 (17.17)	13 460	2978 (22.12)	22 833	3255 (14.26)
1500-1999	18 996	3673 (19.34)	7006	1706 (24.35)	11 990	1967 (16.41)
1000-1499	17 704	3940 (22.25)	6000	1653 (27.55)	11 704	2287 (19.54)
500-999	13 486	3563 (26.42)	4205	1345 (31.99)	9281	2218 (23.90)
<500	15 181	4504 (29.67)	4402	1415 (32.14)	10 779	3089 (28.66)
Total	169 926	31 358 (18.45)	61 847	14 374 (23.24)	108 079	16 984 (15.71)

(*Continued to the next page*)

Table 1. Continued from the previous page

Variables	Total	Hypertension	Male	Hypertension	Female	Hypertension
Marital status						
Married	182 631	34 457 (18.87)	68 997	16 407 (23.78)	113 634	18 050 (15.88)
unmarried	4210	633 (15.04)	1654	357 (21.58)	2556	276 (10.80)
Separated	1243	246 (19.79)	338	91 (26.92)	905	155 (17.13)
Divorced	5002	841 (16.81)	1239	326 (26.31)	3763	515 (13.69)
Deceased spouse	14 135	3623 (25.63)	968	275 (28.41)	13 167	3348 (25.43)
Others	1751	477 (27.24)	712	234 (32.87)	1039	243 (23.39)
Total	208 972	40 277 (19.27)	73 908	17 690 (23.94)	135 064	22 587 (16.72)
Health behaviors						
Smoking						
No	150 162	27 126 (18.06)	20 381	5229 (25.66)	129 781	21 897 (16.87)
Yes (past)	30 873	7534 (24.40)	29 079	7274 (25.01)	1794	260 (14.49)
Yes (currently)	27 910	5660 (20.28)	24 610	5241 (21.30)	3300	419 (12.70)
Total	208 945	40 320 (19.30)	74 070	17 744 (23.96)	134 875	22 576 (16.74)
Total smoking amount, pack (y)						
1-9	6862	1163 (16.95)	5388	1001 (18.58)	1474	162 (10.99)
10-19	8579	1644 (19.16)	8047	1590 (19.76)	532	54 (2.34)
20-39	11 838	2418 (20.43)	11 570	2382 (20.59)	268	36 (13.43)
40-59	2937	661 (22.51)	2907	655 (22.53)	30	6 (20.00)
≥60	993	244 (24.57)	985	241 (24.47)	8	3 (37.50)
Total	31 209	6130 (19.64)	28 897	2869 (20.31)	2312	261 (11.29)
Drinking						
Yes	105 870	18 923 (17.87)	15 237	3009 (19.75)	90 633	15 914 (17.56)
No (past)	9521	2074 (21.78)	6245	1441 (23.07)	3276	633 (19.32)
No (current)	93 717	19 339 (20.64)	52 602	13 302 (25.29)	41 115	6037 (14.68)
Total	209 108	40 336 (19.29)	74 084	17 752 (23.96)	135 024	22 584 (16.73)
Total alcohol intake (g/day)						
0.05-0.09	11 166	1763 (15.79)	1910	369 (19.32)	9256	1394 (15.06)
1.00-9.99	42 317	7293 (17.23)	18 296	3944 (21.56)	24 021	3349 (13.94)
10.00-19.99	12 362	2811 (22.74)	9122	2304 (25.26)	3240	507 (15.65)
20.00-29.99	9379	2377 (25.34)	7951	2120 (26.66)	1428	257 (18.00)
≥30.00	15 085	4392 (29.12)	13 792	4136 (29.99)	1293	256 (19.80)
Total	90 309	18 636 (20.64)	51 071	12 873 (25.21)	39 238	5763 (14.69)
Body mass index						
Underweight	3787	370 (9.11)	1182	166 (14.04)	2605	204 (7.83)
Normal	76 104	9693 (12.74)	21 986	3907 (17.77)	54 118	5486 (10.69)
Pre-obese stage	57 397	10 609 (18.48)	21 584	4865 (22.54)	35 813	5744 (16.04)
Stage 1 obesity	65 589	17 207 (26.23)	27 385	7993 (29.19)	38 204	9214 (24.12)
Stage 2 obesity	6314	2306 (36.52)	1907	760 (39.85)	4407	1546 (35.08)
Stage 3 obesity	447	197 (44.07)	77	34 (44.16)	370	163 (44.05)
Total	209 638	40 382 (19.26)	74 121	17 725 (23.91)	135 517	22 657 (16.72)

Values are presented as number or number (%).

RESULTS

The Prevalence of Hypertension According to Demographic Characteristics, Income Level, Marital Status, and Health Behavior Factors

The prevalence of hypertension was 19.28% in the total study population, 16.74% in female and 23.94% in male. Older people showed a higher prevalence of hypertension, with the highest at 29.78% for those aged 65 years or older.

Lower income levels were associated with a higher prevalence of hypertension. The prevalence of hypertension was 12.51% for those with an income of over 6.0 million KRW, while it was 29.67% for those with an income below 0.5 million KRW (male, 18.37% and 32.14%; female, 8.14% and 28.66%, respectively). The prevalence of hypertension was the lowest among unmarried people at 15.04% (male, 21.58%; female, 10.80%), followed by 25.63% for those with a deceased spouse, and 19.79% for separated and 16.81% for divorced individuals (male, 28.41%, 26.92%, and 26.31%; female, 25.43%, 17.13, and 13.69%, respectively).

In terms of health behavior factors, the prevalence of hypertension was 24.40% in past smokers, 20.28% in current smokers, and 24.57% in ≥60 pack-year smokers. The prevalence was 29.12% in the ≥30.00 g/day total alcohol group and 19.26% in the stage 3 obesity group. The prevalence of hypertension was higher in male and the older age, lower-income level, deceased spouse, divorced, presently drinking, higher total alcohol intake (g/day), and stage 3 obesity groups (Table 1).

Table 2. Relationships of demographic characteristics, income level, marital status, and health behavior factors with hypertension

Variables	Hypertension patients			Male			Female		
	n	Unadjusted	Adjusted[1]	n	Unadjusted	Adjusted[1]	n	Unadjusted	Adjusted[1]
Total	40 575								
Demographic characteristics									
Sex									
Female	22 761	1.00 (reference)	1.00 (reference)	-	-	-	-	-	-
Male	17 814	1.57 (1.53, 1.60)	1.98 (1.60, 2.45)	-	-	-	-	-	-
Total	40 575								
Age (y)									
40-44	3751	1.00 (reference)	1.00 (reference)	2238	1.00 (reference)	1.00 (reference)	1513	1.00 (reference)	1.00 (reference)
45-49	5329	1.48 (1.42, 1.55)	1.11 (0.98, 1.25)	2467	1.26 (1.18, 1.34)	1.08 (0.95, 1.23)	2862	1.89 (1.77, 2.02)	1.66 (0.93, 2.98)
50-54	7604	1.90 (1.82, 1.98)	1.20 (1.06, 1.35)	3050	1.37 (1.29, 1.45)	1.18 (1.05, 1.33)	4554	2.73 (2.57, 2.90)	1.49 (0.83, 2.67)
55-59	7545	2.38 (2.29, 2.49)	1.28 (1.13, 1.45)	3100	1.57 (1.47, 1.66)	1.28 (1.12, 1.45)	4445	3.56 (3.35, 3.79)	1.24 (0.59, 2.62)
60-64	7779	3.05 (2.93, 3.19)	1.35 (1.18, 1.55)	3226	1.75 (1.65, 1.66)	1.32 (1.15, 1.52)	4553	4.91 (4.62, 5.23)	1.97 (0.82, 4.75)
≥65	8567	3.72 (3.56, 3.88)	1.42 (1.21, 1.65)	3733	1.95 (1.84, 2.07)	1.38 (1.18, 1.61)	4834	6.34 (5.96, 6.75)	2.50 (0.85, 7.37)
Total	40 575			17 814			22 761		
Socioeconomic factors									
Income (unit 1000 KRW)									
≥6000	1554	1.00 (reference)	1.00 (reference)[2]	974	1.00 (reference)	1.00 (reference)[3]	580	1.00 (reference)	1.00 (reference)[4]
4000-5999	3316	1.08 (1.01, 1.15)	1.30 (1.13, 1.50)	1886	1.08 (0.99, 1.18)	1.30 (1.13, 1.51)	1430	1.18 (1.06, 1.30)	1.24 (0.48, 3.23)
3000-3999	4575	1.21 (1.14, 1.29)	1.45 (1.26, 1.67)	2417	1.14 (1.05, 1.24)	1.46 (1.27, 1.69)	2158	1.43 (1.30, 1.57)	0.81 (0.31, 2.11)
2000-2999	6233	1.45 (1.37, 1.54)	1.49 (1.30, 1.72)	2978	1.26 (1.16, 1.37)	1.52 (1.32, 1.75)	3255	1.88 (1.71, 2.06)	0.66 (0.25, 1.70)
1500-1999	3673	1.68 (1.57, 1.79)	1.54 (1.31, 1.81)	1706	1.43 (1.31, 1.56)	1.54 (1.31, 1.82)	1967	2.21 (2.01, 2.44)	1.14 (0.43, 3.00)
1000-1499	3940	2.00 (1.88, 2.14)	1.58 (1.32, 1.89)	1653	1.69 (1.54, 1.85)	1.60 (1.33, 1.92)	2287	2.74 (2.49, 3.02)	1.09 (0.42, 2.84)
500-999	3563	2.51 (2.35, 2.68)	1.62 (1.30, 2.01)	1345	2.09 (1.90, 2.30)	1.60 (1.28, 2.01)	2218	3.54 (3.21, 3.91)	1.53 (0.54, 4.32)
<500	4504	2.95 (2.77, 3.15)	1.55 (1.25, 1.93)	1415	2.11 (1.92, 2.31)	1.58 (1.27, 1.98)	3089	4.53 (4.12, 4.98)	1.07 (0.35, 3.28)
Total	31 358			14 374			16 984		

(*Continued to the next page*)

Table 2. Continued from the previous page

Variables	Hypertension patients			Male			Female		
	n	Unadjusted	Adjusted[1]	n	Unadjusted	Adjusted[1]	n	Unadjusted	Adjusted[1]
Marital status									
Married	34 457	1.00 (reference)	1.00 (reference)	16 407	1.00 (reference)	1.00 (reference)	18 050	1.00 (reference)	1.00 (reference)
Unmarried	633	0.76 (0.70, 0.83)	1.11 (0.90, 1.38)	357	0.88 (0.78, 0.99)	1.14 (0.91, 1.43)	276	0.64 (0.57, 0.73)	0.94 (0.46, 1.89)
Separated	246	1.06 (0.92, 1.22)	1.35 (0.82, 2.23)	91	1.18 (0.93, 1.50)	1.23 (0.70, 2.14)	155	1.09 (0.92, 1.30)	1.63 (0.64, 4.15)
Divorced	841	0.87 (0.81, 0.94)	1.25 (0.99, 1.57)	326	1.15 (1.01, 1.30)	1.34 (1.05, 1.71)	515	0.84 (0.76, 0.92)	0.93 (0.57, 1.52)
Deceased spouse	3623	1.48 (1.43, 1.54)	1.15 (0.83, 1.59)	275	1.27 (1.11, 1.46)	1.29 (0.90, 1.86)	3348	1.81 (1.73, 1.88)	0.95 (0.54, 1.65)
Others	477	1.48 (1.43, 1.54)	1.83 (1.23, 2.72)	234	1.57 (1.34, 1.84)	1.98 (1.32, 2.97)	243	1.62 (1.40, 1.87)	0.46 (0.06, 3.54)
Total	40 277			17 690			22 587		
Health behavior									
Smoking									
No	27 126	1.00 (reference)	1.00 (reference)	5229	1.00 (reference)	1.00 (reference)	21 897	1.00 (reference)	1.00 (reference)
Yes (past)	7534	1.46 (1.42, 1.51)	0.86 (0.81, 0.91)	7274	0.97 (0.93, 1.01)	0.89 (0.83, 0.94)	260	0.84 (0.73, 0.95)	0.60 (0.45, 0.79)
Yes (currently)	5660	1.15 (1.12, 1.19)	0.78 (0.73, 0.82)	5241	0.78 (0.75, 0.82)	0.77 (0.72, 0.82)	419	0.72 (0.65, 0.80)	0.78 (0.65, 0.92)
Total	40 320			17 744			22 576		
Total smoking amount, pack (y)									
1-9	1163	1.00 (reference)	1.00 (reference)	1001	1.00 (reference)	1.00 (reference)	162	1.00 (reference)	1.00 (reference)
10-19	1644	1.16 (1.07, 1.26)	1.06 (0.96, 1.18)	1590	1.08 (0.99, 1.18)	1.08 (0.97, 1.20)	54	0.92 (0.66, 1.27)	0.81 (0.54, 1.21)
20-39	2418	1.26 (1.16, 1.36)	1.03 (0.92, 1.14)	2382	1.14 (1.05, 1.23)	1.04 (0.93, 1.15)	36	1.26 (0.85, 1.85)	0.90 (0.55, 1.49)
40-59	661	1.42 (1.28, 1.58)	1.02 (0.87, 1.19)	655	1.28 (1.14, 1.42)	1.04 (0.89, 1.21)	6	2.03 (0.82, 5.03)	0.87 (0.24, 3.17)
≥60	244	1.60 (1.36, 1.87)	1.03 (0.81, 1.30)	241	1.42 (1.21, 1.67)	1.02 (0.81, 1.30)	3	4.86 (1.15, 20.53)	1.87 (0.20, 17.37)
Total	6130			2869			261		
Drinking									
Yes	18 923	1.00 (reference)	1.00 (reference)	3009	1.00 (reference)	1.00 (reference)	15 914	1.00 (reference)	1.00 (reference)
No (past)	2074	1.28 (1.22, 1.35)	1.16 (1.00, 1.35)	1441	1.22 (1.14, 1.31)	1.17 (1.00, 1.36)	633	1.13 (1.03, 1.23)	1.11 (0.55, 2.27)
No (currently)	19 339	1.20 (1.17, 1.22)	1.61 (1.46, 1.78)	13 302	1.38 (1.32, 1.44)	1.63 (1.47, 1.80)	6037	0.81 (0.78, 0.84)	1.55 (1.08, 2.23)
Total	40 336			17 752			22 584		
Total alcohol intake (g/day)									
0.05-0.09	1763	1.00 (reference)	1.00 (reference)	369	1.00 (reference)	1.00 (reference)	1394	1.00 (reference)	1.00 (reference)
1.00-9.99	7293	1.11 (1.05, 1.18)	1.13 (0.90, 1.42)	3944	1.15 (1.02, 1.29)	1.07 (0.85, 1.35)	3349	0.91 (0.85, 0.98)	3.38 (0.78, 14.65)
10.00-19.99	2811	1.57 (1.47, 1.68)	1.36 (1.08, 1.73)	2304	1.41 (1.25, 1.60)	1.31 (1.03, 1.67)	507	1.05 (0.94, 1.17)	3.27 (0.71, 15.06)
20.00-29.99	2377	1.81 (1.69, 1.94)	1.50 (1.18, 1.89)	2120	1.52 (1.34, 1.72)	1.44 (1.13, 1.83)	257	1.24 (1.07, 1.43)	3.74 (0.82, 17.08)
≥30.00	4392	2.19 (2.06, 2.33)	1.74 (1.39, 2.20)	4136	1.79 (1.59, 2.02)	1.67 (1.32, 2.11)	256	1.39 (1.20, 1.62)	4.42 (0.96, 20.32)
Total	18 636			12 873			5763		
Body mass index									
Underweight	3787	0.74 (0.67, 0.83)	0.78 (0.52, 1.17)	1182	0.76 (0.64, 0.89)	0.81 (0.54, 1.23)	2605	0.71 (0.61, 0.82)	0.41 (0.05, 3.12)
Normal	76 104	1.00 (reference)	1.00 (reference)	21 986	1.00 (reference)	1.00 (reference)	54 118	1.00 (reference)	1.00 (reference)
Pre, obese stage	57 397	1.56 (1.51, 1.60)	1.42 (1.28, 1.57)	21 584	1.35 (1.29, 1.41)	1.38 (1.25, 1.54)	35 813	1.60 (1.53, 1.66)	2.96 (1.75, 5.01)
Stage 1 obesity	65 589	2.44 (2.37, 2.51)	2.05 (1.87, 2.26)	27 385	1.91 (1.83, 1.99)	2.02 (1.84, 2.23)	38 204	2.66 (2.56, 2.75)	3.11 (1.86, 5.21)
Stage 2 obesity	6314	3.94 (3.73, 4.17)	3.33 (2.73, 4.06)	1907	3.07 (2.78, 3.38)	3.39 (2.77, 4.15)	4407	4.51 (4.22, 4.83)	2.51 (0.80, 7.94)
Stage 3 obesity	447	5.40 (4.47, 6.52)	3.77 (1.84, 7.71)	77	3.66 (2.33, 5.75)	4.08 (1.87, 8.88)	370	6.58 (5.35, 8.09)	2.80 (0.32, 24.67)
Total	209 638			74 121			135 517		

Values are presented as odds ratio (95% confidence interval).
KRW, Korean won.
[1]Sex, age, socioeconomic factors (income, marital status), health behavior (smoking, drinking, body mass index), and nutrition (energy, protein, fat, carbohydrates, calcium, phosphorus, iron, potassium, vitamin A, sodium, vitamin B1, vitamin B2, niacin, vitamin C, zinc, vitamin B6, folate, retinol, carotene, ash, fiber, vitamin E, cholesterol), adjusted.
[2]Test for trend (likelihood ratio tests) (△-2logL=962.754, △df=7, $p<0.001$).
[3]Test for trend (likelihood ratio tests) (△-2logL=916.403, △df=7, $p<0.001$).
[4]Test for trend (likelihood ratio tests) (△-2logL=60.995, △df=7, $p<0.001$).

The Relationship of Demographic Characteristics and Income Levels, Marital Status, and Health Behaviors in People With Hypertension

The OR for hypertension among male was 1.98 (95% CI, 1.60 to 2.45) compared to female. The OR for developing hypertension in people with an income of <0.5 million KRW compared to ≥6.0 million KRW was 1.55 (95% CI, 1.25 to 1.93) in the total population, 1.58 (95% CI, 1.27 to 1.98) in male, and 1.07 (95% CI, 0.35 to 3.28) in female. The risk of hypertension related to marital status was higher for those who were separated, divorced, and those with deceased spouses. The risk of hypertension related to health behaviors was higher among those with past and present smoking, higher pack-years, current drinking, higher total alcohol intake (g/day), and stage 3 obesity. In further tests for trend (likelihood ratio tests), we identified trends in the association with income for male (p for $_{trend}$<0.001), female (p for $_{trend}$<0.001), and the total population (p for $_{trend}$ <0.001) (Table 2).

The OR of hypertension was 1.58 (95% CI, 1.30 to 1.96) in the total population, 1.61 (95% CI, 1.28 to 2.01) in male, and 0.93 (95% CI, 0.31 to 2.83) in female with an income of <0.5 million KRW compared to those with ≥6.0 million KRW. The effect of income on hypertension was stronger in male than female. The trends in the association with income for male (p for $_{trend}$ <0.001), female (p for $_{trend}$<0.001), and the total population (p for $_{trend}$<0.001) were also identified using Test for trend (likelihood ratio tests) (Table 3).

Regarding the relationship between marital status and hypertension, divorce showed the most strongest association, with 1.30 times (95% CI, 1.04 to 1.62) higher odds of hypertension in the total population and 1.40 times (95% CI, 1.10 to 1.79) in male. However, the marital status of female had a weaker association with hypertension than that of male. In the case of single male, there was a 1.27 times (95% CI, 1.02 to 1.57) higher likelihood of hypertension, but in female, there was no significant correlation with being single, at 0.99 times (95% CI, 0.49 to 1.97). In the association between marital status and hypertension, when a spouse died, the association with hypertension increased in the other spouse (total group: unadjusted OR, 1.48; 95% CI, 1.43 to 1.54), and this association was attenuated (OR, 1.23; 95% CI, 1.18 to 1.28) when adjusted for sex and age. The health behavior variables and nutritional variables did not significantly attenuate this association. Finally, when all sex, age, nutrition, and health behavior variables were adjusted, the OR was 1.29 (95% CI, 0.95 to 1.74). Thus, as a result of adjusting several covariates in the relationship between marital status and high blood pressure, sex and age acted more as confounding variables than the health behavior and nutrition variables (Table 4).

According to the income level and marital status in the total population, hypertension was associated with an income of ≥ 3.0 million KRW and having a deceased spouse (2.69 times; 95% CI, 1.13 to 6.40). Hypertension was also associated with an income of 1.0 million KRW to <3.0 million KRW and being unmarried (1.58 times; 95% CI, 1.24 to 2.02), and an income of <1.0 million KRW and being separated (4.92 times; 95% CI, 1.50 to 16.19). In male, low income and divorce were most associated with hypertension (1.76 times; 95% CI, 1.01 to 3.08). However, in female, the low-income, married group was most associated with hypertension (1.83 times; 95% CI, 1.71 to 1.97]). Further test for trend (likelihood ratio tests) showed trends in the association between income and marital status, for male (p for $_{trend}$<0.001), female (p for $_{trend}$<0.001), and the total population (p for $_{trend}$<0.001) (Table 5).

DISCUSSION

The key result of this study is that the association between income level and marital status and hypertension was stronger in male than in female. Divorce was most influential in the overall population and for male, whereas female was less strongly affected by marriage. The association between marital status and hypertension was strongest in the lower-income group. Low-income groups showed the strongest overall impact of separation on hypertension, whereas divorce in male, and being married in female were most strongly associated with hypertension.

The Prevalence Rate of Hypertension

The countries with the lowest prevalence of hypertension in female are Switzerland (17%), Peru (18%), Canada (20%), and Taiwan and Spain (21%), whereas, for male, it is Eritrea (22%) and Peru (23%), and Bangladesh and Canada (24%) [22]. In this study, the prevalence of hypertension in female in Korea was 16.74% in female and 23.94% in male.

Income Level and Hypertension

Currently, studies on the relationship between income level and hypertension [13,19,20,23] and the relationship between marital status and hypertension [5-9] are being conducted. In

Table 3. The strong inverse linear relationship between income level and hypertension

Variables	Hypertension patients, n	Unadjusted	Sex, age adjusted[1]	Health behavior adjusted[2]	Nutrition adjusted[3]	Sex, age, health behavior adjusted[4]	Sex, age, nutrition adjusted[5]	Sex, age, health behavior, nutrition adjusted[6]
Income (unit: 1000 KRW)								
≥6000	1554	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)[7]
4000-5999	3316	1.08 (1.01, 1.15)	1.12 (1.05, 1.19)	1.28 (1.11, 1.47)	1.07 (1.00, 1.14)	1.29 (1.12, 1.48)	1.10 (1.03, 1.18)	1.30 (1.26, 1.50)
3000-3999	4575	1.21 (1.14, 1.29)	1.22 (1.15, 1.30)	1.45 (1.26, 1.65)	1.19 (1.11, 1.26)	1.45 (1.27, 1.66)	1.20 (1.13, 1.28)	1.45 (1.26, 1.67)
2000-2999	6233	1.45 (1.37, 1.54)	1.39 (1.31, 1.48)	1.56 (1.37, 1.79)	1.41 (1.32, 1.49)	1.54 (1.35, 1.76)	1.35 (1.27, 1.44)	1.50 (1.30, 1.72)
1500-1999	3673	1.68 (1.57, 1.79)	1.50 (1.41, 1.61)	1.65 (1.42, 1.92)	1.59 (1.49, 1.70)	1.59 (1.37, 1.85)	1.44 (1.34, 1.54)	1.55 (1.31, 1.82)
1000-1499	3940	2.00 (1.88, 2.14)	1.72 (1.61, 1.84)	1.97 (1.68, 2.30)	1.86 (1.74, 1.99)	1.87 (1.60, 2.19)	1.62 (1.51, 1.73)	1.59 (1.33, 1.91)
500-999	3563	2.51 (2.35, 2.68)	2.05 (1.92, 2.19)	2.22 (1.86, 2.65)	2.25 (2.10, 2.41)	2.04 (1.70, 2.44)	1.87 (1.74, 2.00)	1.65 (1.33, 2.05)
<500	4504	2.95 (2.77, 3.15)	2.24 (2.30, 2.40)	2.35 (1.96, 2.81)	2.57 (2.41, 2.75)	2.09 (1.74, 2.52)	2.00 (1.86, 2.14)	1.58 (1.30, 1.96)
Total	31 358							
Male								
≥6000	974	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)[8]
4000-5999	1886	1.08 (0.99, 1.18)	1.08 (1.00, 1.18)	1.28 (1.11, 1.47)	1.08 (0.99, 1.18)	1.28 (1.11, 1.48)	1.08 (1.00, 1.18)	1.30 (1.13, 1.50)
3000-3999	2417	1.14 (1.05, 1.24)	1.14 (1.05, 1.24)	1.46 (1.28, 1.68)	1.13 (1.04, 1.23)	1.47 (1.28, 1.68)	1.13 (1.03, 1.23)	1.47 (1.27, 1.69)
2000-2999	2978	1.26 (1.16, 1.37)	1.22 (1.13, 1.33)	1.60 (1.40, 1.83)	1.23 (1.13, 1.34)	1.57 (1.37, 1.79)	1.19 (1.09, 1.29)	1.52 (1.32, 1.76)
1500-1999	1706	1.43 (1.31, 1.56)	1.34 (1.22, 1.46)	1.69 (1.45, 1.97)	1.40 (1.28, 1.53)	1.60 (1.37, 1.86)	1.30 (1.18, 1.42)	1.55 (1.32, 1.83)
1000-1499	1653	1.69 (1.54, 1.85)	1.52 (1.39, 1.67)	2.05 (1.75, 2.41)	1.60 (1.45, 1.76)	1.89 (1.60, 2.22)	1.43 (1.30, 1.58)	1.61 (1.34, 1.93)
500-999	1345	2.09 (1.90, 2.30)	1.81 (1.64, 2.00)	2.30 (1.91, 2.76)	1.97 (1.78, 2.18)	2.02 (1.68, 2.44)	1.69 (1.53, 1.88)	1.63 (1.30, 2.04)
<500	1415	2.11 (1.92, 2.31)	1.77 (1.61, 1.95)	2.43 (2.02, 2.92)	1.95 (1.76, 2.16)	2.09 (1.73, 2.52)	1.64 (1.48, 1.82)	1.61 (1.28, 2.01)
Total	14 374							
Female								
≥6000	580	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)[9]
4000-5999	1430	1.16 (1.06, 1.30)	1.19 (1.07, 1.32)	1.31 (0.52, 3.33)	1.16 (1.04, 1.28)	0.90 (0.35, 2.28)	1.17 (1.05, 1.29)	1.25 (0.48, 3.25)
3000-3999	2158	1.43 (1.30, 1.57)	1.37 (1.24, 1.50)	0.93 (0.37, 2.35)	1.39 (1.26, 1.54)	0.65 (0.26, 1.66)	1.34 (1.21, 1.47)	0.80 (0.31, 2.09)
2000-2999	3255	1.88 (1.70, 2.06)	1.64 (1.50, 1.80)	0.71 (0.28, 1.81)	1.80 (1.64, 1.98)	1.14 (0.45, 2.93)	1.60 (1.45, 1.76)	0.66 (0.25, 1.69)
1500-1999	1967	2.21 (2.01, 2.44)	1.76 (1.60, 1.94)	1.23 (0.48, 3.15)	2.05 (1.85, 2.26)	1.22 (0.49, 3.03)	1.66 (1.50, 1.83)	1.10 (0.42, 2.89)
1000-1499	2287	2.74 (2.49, 3.02)	2.00 (1.82, 2.21)	1.35 (0.54, 3.33)	2.50 (2.26, 2.75)	1.22 (0.49, 3.03)	1.87 (1.70, 2.07)	1.03 (0.40, 2.65)
500-999	2218	3.54 (3.21, 3.91)	2.35 (2.13, 2.60)	1.92 (0.76, 4.87)	3.03 (2.74, 3.35)	1.60 (0.62, 4.10)	2.10 (1.89, 2.33)	1.34 (0.48, 3.72)
<500	3089	4.53 (4.12, 4.98)	2.61 (2.36, 2.87)	2.03 (0.80, 5.16)	3.67 (3.35, 4.08)	1.49 (0.57, 3.94)	2.27 (2.05, 2.51)	0.93 (0.31, 2.82)
Total	16 984							

Values are presented as odds ratio (95% confidence interval).
KRW, Korean won; BMI, body mass index.
[1]Sex, age, adjusted.
[2]Health behavior (smoking, drinking, BMI), adjusted.
[3]Nutrition (energy, protein, fat, carbohydrates, calcium, phosphorus, iron, potassium, vitamin A, sodium, vitamin B1, vitamin B2, niacin, vitamin C, zinc, vitamin B6, folate, retinol, carotene, ash, fiber, vitamin E, cholesterol), adjusted.
[4]Sex, age and health behavior (smoking, drinking, BMI), adjusted.
[5]Sex, age and nutrition (energy, protein, fat, carbohydrates, calcium, phosphorus, iron, potassium, vitamin A, sodium, vitamin B1, vitamin B2, niacin, vitamin C, zinc, vitamin B6, folate, retinol, carotene, ash, fiber, vitamin E, cholesterol), adjusted.
[6]Sex, age, nutrition (energy, protein, fat, carbohydrates, calcium, phosphorus, iron, potassium, vitamin A, sodium, vitamin B1, vitamin B2, niacin, vitamin C, zinc, vitamin B6, folate, retinol, carotene, ash, fiber, vitamin E, cholesterol), and health behavior (smoking, drinking, BMI), adjusted.
[7]Test for trend (likelihood ratio tests) ($\triangle$, 2logL=975.408, $\triangle$df=7, $p<0.001$).
[8]Test for trend (likelihood ratio tests) ($\triangle$, 2logL= 929.174, $\triangle$df=7, $p<0.001$).
[9]Test for trend (likelihood ratio tests) ($\triangle$, 2logL= 59.395, $\triangle$df=7, $p<0.001$).

Table 4. Relationships between marital status and hypertension

Variables	Hypertension patients, n	Unadjusted	Sex, age adjusted[1]	Health behavior adjusted[2]	Nutrition adjusted[3]	Sex, age, health behavior adjusted[4]	Sex, age, nutrition adjusted[5]	Sex, age, health behavior, nutrition adjusted[6]
Marital status								
Married	34 457	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Unmarried	633	0.76 (0.70, 0.83)	1.03 (0.94, 1.12)	1.00 (0.82, 1.21)	0.77 (0.71, 0.85)	1.20 (0.99, 1.47)	1.02 (0.94, 1.12)	1.24 (1.00, 1.52)
Separated	246	1.06 (0.92, 1.22)	1.09 (0.95, 1.26)	1.14 (0.73, 1.78)	1.10 (0.95, 1.28)	1.21 (0.78, 1.90)	1.14 (0.98, 1.32)	1.31 (0.80, 2.15)
Divorced	841	0.87 (0.81, 0.94)	1.00 (0.93, 1.08)	1.04 (0.84, 1.28)	0.89 (0.83, 0.96)	1.20 (0.97, 1.48)	1.02 (0.94, 1.10)	1.30 (1.04, 1.62)
Deceased spouse	3623	1.48 (1.43, 1.54)	1.23 (1.18, 1.28)	1.38 (1.06, 1.80)	1.39 (1.33, 1.45)	1.35 (1.03, 1.77)	1.20 (1.15, 1.26)	1.29 (0.95, 1.74)
Others	477	1.48 (1.43, 1.54)	1.44 (1.29, 1.60)	1.95 (1.34, 2.85)	1.60 (1.44, 1.79)	1.87 (1.28, 2.74)	1.45 (1.30, 1.62)	1.93 (1.30, 2.84)
Total	40 277							
Male								
Married	16 407	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Unmarried	357	0.88 (0.78, 0.99)	1.10 (0.98, 1.25)	1.06 (0.87, 1.28)	0.89 (0.79, 1.00)	1.24 (1.01, 1.52)	1.10 (0.97, 1.24)	1.27 (1.02, 1.57)
Separated	91	1.18 (0.93, 1.50)	1.18 (0.93, 1.51)	1.04 (0.63, 1.71)	1.21 (0.94, 1.56)	1.03 (0.62, 1.70)	1.21 (0.94, 1.56)	1.17 (0.67, 2.02)
Divorced	326	1.46 (1.01, 1.30)	1.22 (1.07, 1.39)	1.25 (1.00, 1.58)	1.14 (1.00, 1.30)	1.30 (1.03, 1.64)	1.21 (1.06, 1.38)	1.40 (1.10, 1.79)
Deceased spouse	275	1.27 (1.11, 1.46)	1.07 (0.93, 1.24)	1.57 (1.16, 2.13)	1.24 (1.07, 1.44)	1.36 (1.00, 1.84)	1.06 (0.92, 1.24)	1.28 (0.91, 1.81)
Others	234	1.57 (1.34, 1.84)	1.46 (1.24, 1.71)	2.09 (1.41, 3.09)	1.54 (1.31, 1.81)	1.95 (1.32, 2.88)	1.46 (1.24, 1.71)	2.06 (1.39, 3.07)
Total	17 690							
Female								
Married	18 050	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Unmarried	276	0.64 (0.57, 0.73)	0.86 (0.76, 0.98)	0.69 (0.31, 1.55)	0.65 (0.57, 0.75)	0.84 (0.37, 1.90)	0.86 (0.75, 0.98)	0.99 (0.49, 1.97)
Separated	155	1.09 (0.92, 1.30)	1.03 (0.86, 1.22)	2.34 (0.90, 6.08)	1.13 (0.94, 1.35)	2.30 (0.88, 6.04)	1.08 (0.90, 1.29)	1.81 (0.72, 4.57)
Divorced	515	0.84 (0.76, 0.92)	0.90 (0.82, 1.00)	0.77 (0.45, 1.34)	0.87 (0.79, 0.96)	0.79 (0.46, 1.37)	0.93 (0.84, 1.03)	0.97 (0.61, 1.56)
Deceased spouse	3348	1.81 (1.73, 1.88)	1.09 (1.05, 1.14)	1.42 (0.79, 2.55)	1.62 (1.55, 1.69)	1.11 (0.60, 2.03)	1.08 (1.03, 1.13)	1.22 (0.76, 1.98)
Others	243	1.62 (1.40, 1.87)	1.45 (1.25, 1.68)	0.83 (0.11, 6.55)	1.63 (1.40, 1.89)	0.82 (0.10, 6.46)	1.48 (1.27, 1.72)	0.51 (0.07, 3.83)
Total	22 587							

Values are presented as odds ratio (95% confidence interval).
BMI, body mass index.
[1]Sex, age, adjusted.
[2]Health behavior (smoking, drinking, BMI), adjusted.
[3]Nutrition (energy, protein, fat, carbohydrates, calcium, phosphorus, iron, potassium, vitamin A, sodium, vitamin B1, vitamin B2, niacin, vitamin C, zinc, vitamin B6, folate, retinol, carotene, ash, fiber, vitamin E, cholesterol), adjusted.
[4]Sex, age and health behavior (smoking, drinking, BMI), adjusted.
[5]Sex, age and nutrition (energy, protein, fat, carbohydrates, calcium, phosphorus, iron, potassium, vitamin A, sodium, vitamin B1, vitamin B2, niacin, vitamin C, zinc, vitamin B6, folate, retinol, carotene, ash, fiber, vitamin E, cholesterol), adjusted.
[6]Sex, age, health behavior (smoking, drinking, BMI), and nutrition (energy, protein, fat, carbohydrates, calcium, phosphorus, iron, potassium, vitamin A, sodium, vitamin B1, vitamin B2, niacin, vitamin C, zinc, vitamin B6, folate, retinol, carotene, ash, fiber, vitamin E, cholesterol), adjusted.

Table 5. Relationships between income level and marital status

Income (unit: 1000 KRW)	Marital status	Total			Male			Female		
		Unadjusted	Sex, age adjusted[1]	Sex, age, health behavior nutrition adjusted[2,3]	Unadjusted	Age adjusted[4]	Age, health behavior nutrition adjusted[5,6]	Unadjusted	Age adjusted[3]	Age, health behavior nutrition adjusted[5,7]
≥3000	Married	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
	Unmarried	0.62 (0.45, 0.86)	0.75 (0.54, 1.05)	0.91 (0.51, 1.61)	0.79 (0.30, 0.79)	0.56 (0.34, 0.91)	0.89 (0.49, 1.63)	0.83 (0.53, 1.28)	0.96 (0.62, 1.50)	1.06 (0.68, 1.65)
	Separated	0.89 (0.83, 1.86)	0.92 (0.44, 1.94)	1.74 (0.36, 8.32)	1.17 (0.43, 3.16)	1.20 (0.45, 3.24)	1.95 (0.40, 9.60)	0.73 (0.23, 2.37)	0.69 (0.21, 2.23)	0.67 (0.21, 2.21)
	Divorced	1.08 (0.77, 1.53)	1.11 (0.78, 1.56)	1.33 (0.67, 2.61)	1.02 (0.63, 4.64)	1.05 (0.65, 1.70)	1.33 (0.65, 2.72)	1.19 (0.72, 1.97)	1.14 (0.69, 1.89)	1.29 (0.77, 2.15)
	Deceased spouse	1.37 (1.07, 1.76)	1.18 (0.91, 1.51)	2.69 (1.13, 6.40)	1.47 (0.82, 2.65)	1.32 (0.73, 2.39)	2.16 (0.81, 5.77)	1.91 (1.45, 2.53)	1.15 (0.86, 1.52)	1.05 (0.78, 1.42)
	Others	1.79 (1.26, 2.54)	1.51 (1.06, 2.16)	2.18 (0.86, 5.52)	1.34 (0.83, 2.18)	1.26 (0.78, 2.04)	2.20 (0.87, 5.57)	2.31 (1.38, 3.86)	1.89 (1.13, 3.18)	1.84 (1.06, 3.20)
1000-2999	Married	1.43 (1.38, 1.48)	1.31 (1.26, 1.35)	1.25 (1.15, 1.36)	1.24 (1.18, 1.30)	1.18 (1.12, 1.24)	1.26 (1.15, 1.37)	1.75 (1.66, 1.84)	1.48 (1.40, 1.56)	1.36 (1.28, 1.43)
	Unmarried	1.13 (1.00, 1.27)	1.31 (1.17, 1.47)	1.58 (1.24, 2.02)	1.13 (0.97, 1.32)	1.28 (1.09, 1.49)	1.65 (1.28, 2.12)	1.10 (0.92, 1.32)	1.22 (1.02, 1.47)	1.28 (1.06, 1.55)
	Separated	1.36 (1.09, 1.69)	1.31 (1.05, 1.64)	1.35 (0.74, 2.47)	1.35 (0.95, 1.92)	1.31 (0.92, 1.85)	1.41 (0.75, 2.66)	1.65 (1.25, 2.19)	1.37 (1.03, 1.82)	1.41 (1.05, 1.90)
	Divorced	1.05 (0.94, 1.19)	1.12 (0.99, 1.26)	1.55 (1.17, 2.04)	1.27 (1.06, 1.53)	1.29 (1.07, 1.55)	1.74 (1.29, 2.35)	1.17 (1.00, 1.37)	1.09 (0.93, 1.27)	1.11 (0.94, 1.31)
	Deceased spouse	1.71 (1.57, 1.85)	1.50 (1.38, 1.63)	1.47 (0.95, 2.28)	1.58 (1.24, 2.01)	1.35 (1.06, 1.72)	1.68 (1.06, 2.68)	2.53 (2.31, 2.77)	1.54 (1.40, 1.69)	1.37 (1.24, 1.52)
	Others	2.22 (1.91, 2.58)	1.85 (1.59, 2.15)	2.42 (1.50, 3.91)	1.95 (1.57, 2.41)	1.75 (1.41, 2.17)	2.55 (1.57, 4.15)	2.58 (2.08, 3.20)	2.05 (1.65, 2.55)	1.89 (1.50, 2.38)
<1000	Married	2.70 (2.59, 2.82)	1.97 (1.88, 2.06)	1.35 (1.15, 1.59)	1.99 (1.87, 2.12)	1.65 (1.54, 1.77)	1.36 (1.15, 1.60)	3.79 (3.57, 4.03)	2.27 (2.13, 2.43)	1.83 (1.71, 1.97)
	Unmarried	1.48 (1.22, 1.79)	1.45 (1.19, 1.76)	0.85 (0.40, 1.81)	1.42 (1.06, 1.90)	1.45 (1.09, 1.94)	0.82 (0.36, 1.85)	1.72 (1.32, 2.24)	1.43 (1.09, 1.86)	1.27 (0.94, 1.71)
	Separated	2.03 (1.56, 2.64)	1.77 (1.36, 2.32)	4.92 (1.50, 16.19)	1.90 (1.16, 3.12)	1.65 (1.01, 2.71)	2.30 (0.40, 13.33)	2.71 (1.98, 3.72)	1.92 (1.40, 2.65)	1.72 (1.23, 2.41)
	Divorced	1.81 (1.58, 2.07)	1.74 (1.52, 1.99)	1.83 (1.14, 2.92)	2.10 (1.62, 2.71)	1.92 (1.48, 2.48)	1.76 (1.01, 3.08)	2.30 (1.95, 2.71)	1.80 (1.52, 2.12)	1.54 (1.29, 1.84)
	Deceased spouse	2.64 (2.46, 2.82)	2.10 (1.95, 2.26)	1.13 (0.62, 2.06)	1.97 (1.54, 2.53)	1.57 (1.22, 2.02)	1.36 (0.68, 2.73)	4.02 (3.72, 4.35)	2.08 (1.91, 2.26)	1.74 (1.59, 1.91)
	Others	3.50 (2.76, 4.45)	2.63 (2.06, 3.36)	1.44 (0.45, 4.64)	3.01 (2.09, 4.34)	2.51 (1.74, 3.62)	1.86 (0.54, 6.44)	4.33 (3.14, 5.97)	2.89 (2.08, 4.01)	2.43 (1.70, 3.45)

Values are presented as odds ratio (95% confidence interval).
KRW, Korean won.
[1]Sex, age adjusted.
[2]Sex, age, health behavior (smoking, drinking, body mass index), and nutrition (energy, protein, fat, carbohydrates, calcium, phosphorus, iron, potassium, vitamin A, sodium, vitamin B1, vitamin B2, niacin, vitamin C, zinc, vitamin B6, folate, retinol, carotene, ash, fiber, vitamin E, cholesterol), adjusted.
[3]Test for trend (likelihood ratio tests) ($\triangle$-2logL=995.218, $\triangle$df=17, $p<0.001$).
[4]Age adjusted.
[5]Age, health behavior nutrition adjusted.
[6]Test for trend (likelihood ratio tests) ($\triangle$-2logL=944.668, $\triangle$df=17, $p<0.001$).
[7]Test for trend (likelihood ratio tests) ($\triangle$-2logL=70.461, $\triangle$df=16, $p<0.001$).

this study, the risk of hypertension was found to be higher in the low-income group, and the effect was stronger in male. The relationship between average monthly income and hypertension remained statistically significant even after adjustments for sex, age, health behaviors, and nutritional factors. Similar to this study, in domestic studies, a low-income level was related to the risk of hypertension [15,16], and low SES combined with education and income level was also reported as a risk factor for hypertension [17].

In an international study, for each increase in SES, the risk of hypertension increased by 1.31 times [24]. There was no difference in hypertension between male with higher and lower economic statuses, whereas female showed a 1.6-2.6 times higher risk of hypertension than the low or middle-economic groups [18]. Female with poor SES had a 1.67 times higher risk of hypertension, unlike what was found in this study because of the more sedentary lifestyle and less physically active workers [5].

Low SES may increase sympathetic nervous system activity due to occupational and financial stress, increasing the risk of hypertension [25]. Hypertension risk factors associated with low SES include health care access and the quality of care [26], the lack of early screening and access to medicine [27,28], poor living conditions, social support, emotional stress [29], high salt consumption [30], and a diet low in vegetables [31,32]. For example, the proportion of hypertension increased with decreasing levels of individual patient wealth [19,20]. Other studies showed that the prevalence of hypertension increased with lower SES (education, occupation, and social environment) [18], as well as education and income [17].

We found that although income was a factor influencing hypertension, lower income was a more important risk factor in male. The income level was an important determinant of cardiovascular mortality in the treatment of hypertension [13], suggesting the need to establish policies suitable for health equity to prevent health inequalities in low-income groups in Korea.

Marital Status and Hypertension

Single male have a higher risk of hypertension than married male, and unmarried female have a lower risk of hypertension than married female; thus, health status differs according to marital status and sex [6]. The prevalence of hypertension was higher in married female or female who were separated, divorced or widowed than in female living together with their spouses, and the prevalence of hypertension differed according to marital status and sex [8]. Economic difficulties and low SES, as well as divorce or a deceased spouse, were important risk factors for hypertension in female [5].

The marital status that most strongly affected hypertension was divorce. No Korean studies have investigated the risk of hypertension according to marital status. However, some studies have reported results different from those in this study, finding that the risk of hypertension was 1.76 times higher [33] in unmarried and single groups and 2.34 times higher [24] in married individuals.

In this study, divorce had a strong association with high blood pressure in male. However, in female, marital status did not show a statistically significant association with hypertension. The results of this study are different from the reported effects of marital status and sex on hypertension. In a study on the effect of male marital status on hypertension, unmarried male had a high risk of hypertension [6,9]. A study on the effect of female's marital status on hypertension found that separation, divorce, and a deceased spouse affected hypertension in female [8]. In some studies, divorced female had a higher risk of hypertension [6].

The Combined Effect of Income Level and Marital Status on Hypertension

When looking at the combined effect of income level and marital status, low income (<1.0 million KRW) and separation had the greatest impact on hypertension in the entire population, whereas low-income and divorce in male and low-income and married status in female were most associated with hypertension. Similar to our study, a previous study found a higher incidence of hypertension in male with a prior spouse than in unmarried and married male, with additional effects of employment status and educational background [7]. In an Indonesian study, female were economically highly dependent on male, and being divorced and poor were found to be important risk factors for hypertension in female, unlike our study, in which being poor and married were identified as risk factors for hypertension in female [5]. In this study, as a result of confirming the interaction effect that combines income and marital status as socioeconomic factors affecting high blood pressure, in male, lower income levels were associated with stronger the interactions between income, marital status, and hypertension. In the future, based on the results of this study, individualized intervention studies for each group with low socioeconomic factors are needed to prevent health inequality from occurring.

Metabolic risk factors such as high systolic blood pressure, high lactate dehydrogenase and cholesterol levels, and high BMI have historically been viewed as problems in high-income settings, but now a trend toward increased exposure to these metabolic risk factors is also being seen in middle-income and low-income settings [34]. Some reports have stated that health behavior factors affected hypertension [34-39], but it is necessary to understand the magnitude of the influence of health behavioral variables on the relationship between socioeconomic factors and hypertension. Singh et al. [24] suggested that female, unmarried people, young people, and highly educated people avoid all kinds of addictions, including tobacco and alcohol, which are risk factors for hypertension. SES is an important determinant of health status and the outcome of various diseases, and low SES, which contributes to chronic stress such as discrimination, crime, noise, and other risk factors affects the prevalence of health problems [40]. In our study, marriage in female and divorce in male with low-income levels were also found to be important risk factors for hypertension. Economic hardship and poor marital status may contribute to chronic stress and affect hypertension. Prior studies have reported that health behavior factors affected hypertension [34-39]. Smoking and drinking in male have been correlated with poor control of hypertension [38], and in another study, smoking [35,36], drinking, and BMI were associated with the presence of hypertension [37,39].

However, it is necessary to understand the difference between marital status and sex in how health behavior variables affect the relationship between socioeconomic factors and hypertension. Health care policies should be established that consider health equity, including socioeconomic factors such as marital status and income level. A limitation of this study is that the variables related to the prevalence of hypertension used in this study were self-reported, which may have led to under-reporting or over-reporting due to recall errors affecting the subject's questionnaire entry process. Despite these limitations, it is meaningful that this study used long-term cohort data from a large group of ≥210 000 people for 10 years, and the risk of developing hypertension varied depending on demographic characteristics such as sex, age, income level, and marital status. In addition, this study is makes a meaningful contribution by confirming the interaction effect of combined income and marital status with socioeconomic factors affecting hypertension. In this study, ORs were calculated through various analyses to identify influencing factors such as income, marriage, and sex. In the future, it will be necessary to develop a customized intervention program according to sex with adequate consideration of income level and marital status.

DATA AVAILABILITY

Data in this study were from the Korean Genome and Epidemiology Study (KoGES; 4851-302), National Research Institute of Health, Centers for Disease Control and Prevention, Ministry for Health and Welfare, Republic of Korea.

CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

FUNDING

This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant No. HI19C1320). This study was supported by 2016 Research Grant from Kangwon National University (No. 520160280). This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2017R1D1A1B03035890).

ACKNOWLEDGEMENTS

We thank the Department of Genome Dynamics of the Centers for Disease Control and Prevention for providing raw data.

AUTHOR CONTRIBUTIONS

Conceptualization: Son M. Data curation: Son M. Formal analysis: Son M. Funding acquisition: Son M. Methodology: Son M, Heo YJ. Project administration: Son M. Visualization: Son M, Heo YJ. Writing – original draft: Son M, Heo YJ. Writing – review & editing: Son M, Heo YJ, Hyun HJ, Kwak HJ.

ORCID

Mia Son *https://orcid.org/0000-0001-7943-532X*
Yeon Jeong Heo *https://orcid.org/0000-0002-5328-7194*

Hye-Jin Hyun https://orcid.org/0000-0002-5597-6962
Ho Jong Kwak https://orcid.org/0000-0002-2270-0759

REFERENCES

1. World Health Organization. Noncommunicable diseases; 2021 [cited 2022 Jan 30]. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.
2. Statistics Korea. 2018 National Health and Nutrition Survey; 2022 [cited 2022 Feb 17]. Available from: https://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1438 (Korean).
3. Korean Academy of Medical Sciences. Evidence-based guideline for hypertension in primary care; 2019 [cited 2022 Feb 17]. Available from: https://www.guideline.or.kr/chronic/view.php?number=88%EF%BF%BD%C3%87 (Korean).
4. Marmot MG, Shipley MJ, Rose G. Inequalities in death--specific explanations of a general pattern? Lancet 1984;1(8384):1003-1006.
5. Defianna SR, Santosa A, Probandari A, Dewi FS. Gender differences in prevalence and risk factors for hypertension among adult populations: a cross-sectional study in Indonesia. Int J Environ Res Public Health 2021;18(12):6259.
6. Ramezankhani A, Azizi F, Hadaegh F. Associations of marital status with diabetes, hypertension, cardiovascular disease and all-cause mortality: a long term follow-up study. PLoS One 2019;14(4):e0215593.
7. Li K, Ma X, Yuan L, Ma J. Age differences in the association between marital status and hypertension: a population-based study. J Hum Hypertens 2022;36(7):670-680.
8. Segawa HK, Uematsu H, Dorji N, Wangdi U, Dorjee C, Yangchen P, et al. Gender with marital status, cultural differences, and vulnerability to hypertension: findings from the national survey for noncommunicable disease risk factors and mental health using WHO STEPS in Bhutan. PLoS One 2021;16(8):e0256811.
9. Manfredini R, De Giorgi A, Tiseo R, Boari B, Cappadona R, Salmi R, et al. Marital status, cardiovascular diseases, and cardiovascular risk factors: a review of the evidence. J Womens Health (Larchmt) 2017;26(6):624-632.
10. Lim AR. Analysis of the relationship between socioeconomic status and hypertension control in Korea [dissertation]. Seoul: Yonsei University; 2010 (Korean).
11. He J, Muntner P, Chen J, Roccella EJ, Streiffer RH, Whelton PK. Factors associated with hypertension control in the general population of the United States. Arch Intern Med 2002;162(9):1051-1058.
12. Shah S, Cook DG. Inequalities in the treatment and control of hypertension: age, social isolation and lifestyle are more important than economic circumstances. J Hypertens 2001;19(7):1333-1340.
13. Shin JH, Jung MH, Kwon CH, Lee CJ, Kim DH, Kim HL, et al. Disparities in mortality and cardiovascular events by income and blood pressure levels among patients with hypertension in South Korea. J Am Heart Assoc 2021;10(7):e018446.
14. Kang S, Kim HC. Effects of income level on the association between hypertension and depression: 2010-2017 Korea National Health and Nutrition Examination Survey. J Prev Med Public Health 2020;53(6):439-446.
15. Kim OS, Jeon HO, Kim DH, Kim BH, Kim HJ. Risk factors of prehypertension in Korean adults: the Korean National Health and Nutrition Examination Survey 2005. Korean J Adult Nurs 2009;21(3):281-292 (Korean).
16. Lee EK. Factors associated with hypertension control in Korean adults: the fifth Korea National Health and Nutrition Examination Survey (KNHANES V-2). J Korean Data Anal Soc 2013;15(6):3203-3217 (Korean).
17. Byeon JH, Lee HJ, Chong HU, Choi JH, Choi YE, Cho KH. The analysis between the socioeconomic factor and the atherosclerotic cardiovascular disease risk: the 7th Korea National Health and Nutrition Examination Survey (1st Year), 2016. Korean J Fam Pract 2019;9(2):224-229 (Korean).
18. Grotto I, Huerta M, Sharabi Y. Hypertension and socioeconomic status. Curr Opin Cardiol 2008;23(4):335-339.
19. Antignac M, Diop IB, Macquart de Terline D, Kramoh KE, Balde DM, Dzudie A, et al. Socioeconomic status and hypertension control in sub-Saharan Africa: the Multination EIGHT Study (Evaluation of Hypertension in Sub-Saharan Africa). Hypertension 2018;71(4):577-584.
20. O' Donnell M, Hankey GJ, Rangarajan S, Chin SL, Rao-Melacini P, Ferguson J, et al. Variations in knowledge, awareness andtreatment of hypertension and stroke risk by country income level. Heart 2021;107:282-289.
21. Korean Diabetes Association. Treatment guidelines for diabetes 7th edition; 2021 [cited 2022 Jul 22]. Available from: https://www.diabetes.or.kr/bbs/?code=guide&mode=view&number=853&page=1&code=guide (Korean).
22. World Health Organization. More than 700 million people with untreated hypertension; 2021 [cited 2022 Jul 22]. Available from: https://www.who.int/news/item/25-08-2021-more-than-700-million-people-with-untreated-hypertension.
23. Lee H, Park JH, Floyd JS, Park S, Kim HC. Combined effect of

income and medication adherence on mortality in newly treated hypertension: nationwide study of 16 million person-years. J Am Heart Assoc 2019;8(16):e013148.
24. Singh S, Shankar R, Singh GP. Prevalence and associated risk factors of hypertension: a cross-sectional study in urban Varanasi. Int J Hypertens 2017;2017:5491838.
25. Hemingway H, Shipley M, Brunner E, Britton A, Malik M, Marmot M. Does autonomic function link social position to coronary risk? The Whitehall II study. Circulation 2005;111(23):3071-3077.
26. Trivedi AN, Zaslavsky AM, Schneider EC, Ayanian JZ. Relationship between quality of care and racial disparities in Medicare health plans. JAMA 2006;296(16):1998-2004.
27. Husain MJ, Datta BK, Kostova D, Joseph KT, Asma S, Richter P, et al. Access to cardiovascular disease and hypertension medicines in developing countries: an analysis of essential medicine lists, price, availability, and affordability. J Am Heart Assoc 2020;9(9):e015302.
28. Sorato MM, Davari M, Kebriaeezadeh A, Sarrafzadegan N, Shibru T, Fatemi B. Reasons for poor blood pressure control in eastern sub-Saharan Africa: looking into 4P's (primary care, professional, patient, and public health policy) for improving blood pressure control: a scoping review. BMC Cardiovasc Disord 2021;21(1):123.
29. Cozier YC, Palmer JR, Horton NJ, Fredman L, Wise LA, Rosenberg L. Relation between neighborhood median housing value and hypertension risk among black women in the United States. Am J Public Health 2007;97(4):718-724.
30. Ganguli MC, Grimm RH Jr, Svendsen KH, Flack JM, Grandits GA, Elmer PJ. Higher education and income are related to a better Na:K ratio in blacks: baseline results of the Treatment of Mild Hypertension Study (TOMHS) data. Am J Hypertens 1997;10(9 Pt 1):979-984.
31. James WP, Nelson M, Ralph A, Leather S. Socioeconomic determinants of health. The contribution of nutrition to inequalities in health. BMJ 1997;314(7093):1545-1549.
32. Ganguli MC, Grimm RH Jr, Svendsen KH, Flack JM, Grandits GA, Elmer PJ. Urinary sodium and potassium profile of blacks and whites in relation to education in two different geographic urban areas. TOMHS Research Group. Treatment of Mild Hypertension Study. Am J Hypertens 1999;12(1 Pt 1):69-72.
33. Satoh A, Arima H, Ohkubo T, Nishi N, Okuda N, Ae R, et al. Associations of socioeconomic status with prevalence, awareness, treatment, and control of hypertension in a general Japanese population: NIPPON DATA2010. J Hypertens 2017;35(2):401-408.
34. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. Lancet 2021;398(10304):957-980.
35. Bhadoria AS, Kasar PK, Toppo NA, Bhadoria P, Pradhan S, Kabirpanthi V. Prevalence of hypertension and associated cardiovascular risk factors in Central India. J Family Community Med 2014;21(1):29-38.
36. Dhungana RR, Pandey AR, Bista B, Joshi S, Devkota S. Prevalence and associated factors of hypertension: a community-based cross-sectional study in municipalities of Kathmandu, Nepal. Int J Hypertens 2016;2016:1656938.
37. Khanal MK, Dhungana RR, Bhandari P, Gurung Y, Paudel KN. Prevalence, associated factors, awareness, treatment, and control of hypertension: findings from a cross sectional study conducted as a part of a community based intervention trial in Surkhet, Mid-western region of Nepal. PLoS One 2017;12(10):e0185806.
38. Dastan I, Erem A, Cetinkaya V. Awareness, treatment, control of hypertension, and associated factors: results from a Turkish national study. Clin Exp Hypertens 2018;40(1):90-98.
39. Sison O, Castillo-Carandang N, Ann Ladia M, Sy R, Eduardo Punzalan F, Jasper Llanes E, et al. Prevalence of metabolic syndrome and cardiovascular risk factors among community health workers in selected villages in the Philippines. J ASEAN Fed Endocr Soc 2019;34(2):171-179.
40. Baum A, Garofalo JP, Yali AM. Socioeconomic status and chronic stress. Does stress account for SES effects on health? Ann N Y Acad Sci 1999;896:131-144.