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Factors Associated with Controlled Hypertension by Sex and Macro Level:
A Systematic Review

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Factors affecting hypertension control may not be limited to the individual. In this study, we review existing studies of factors related to hypertension control and evaluate macro level of those factors. The effects of various factors on hypertension control were also analyzed according to sex. All studies investigating the factors related to hypertension control were searched. All factors were categorized according to macro level as individual, work/family, community, and social level. In addition, those factors were also analyzed by sex. Thirty-six studies met the inclusion criteria, and the factors associated with hypertension control varied across the four levels from individual to social. In the only six studies including sex-specific analysis, factors significant only for women included marital status, exercise, alcohol, waist circumference, and health insurance. To improve hypertension control, further studies are necessary to develop gender-specific, multidimensional interventions for hypertension control.

Keywords: Hypertension, Hypertension Control, Constrained Choice, Gender, Factor, Review

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Ⅰ. Introduction

Hypertension is estimated to have caused 9.4 million deaths in 2010 worldwide, and has emerged as a major health problem given that it can lead to cardiovascular disease (Van der Niepen & Verbeelen, 2011, p.69; WHO, 2014, p.66). In addition, the association of hypertension with the onset of renal failure or dementia underscores the importance of its proper management (Kaczorowski et al., 2013). Pursuant to preventing hypertension through healthy lifestyle choices, proper management can reduce the development of secondary diseases, which in turn can improve health and quality of life and reduce the socioeconomic burden (Ministry of Health & Welfare, 2011).

The rate of hypertension control is less than 60% in most countries (Ikeda et al., 2014, p.10), although considerable variation exists worldwide (Joffres et al., 2013). In a recent analysis, the hypertension control rate was 14.4% in Japan, 39.5% in Egypt, and 55.7% in the United States (Ikeda et al., 2014). Although hypertension control may be affected by a wide range of factors varying from marriage status to health insurance (Gillespie et al., 2013), previous guidelines suggest interventions that mostly focus on the individual level, such as pharmacologic treatment (James et al., 2014), lifestyle intervention, education, and comprehensive management (Chen et al., 2014). There is a need to review the factors associated with hypertension control on levels more expansive than the individual. In this regard, the constrained-choice model, which divides factors associated with health into three groups - work and family, community actions, and social policy factors - holds promise (Bird & Rieker, 2008).

According to this model, various factors contribute to men's and women's opportunities to create a different lifestyle. Individuals then make choices that affect their health based on those opportunities. These factors do not always work to achieve the best results because the same factors sometimes act as constraints (Bird & Rieker, 2008). For example, sex differences in exposure to role-related chronic

stressors such as caring for ill family members could cause differential health outcomes. Likewise, although hypertensive patients are encouraged to take antihypertensive medication and follow an appropriate lifestyle, many constraints prevent them from maintaining this regime. While some constraints can be improved by individual efforts, others may require a more macro community or social approach. To improve the rate of hypertension control, factors related to controlled hypertension need to be assessed on all levels, from individual to social.

Previous studies found a differences between men and women in the awareness, treatment, and control of hypertension (CDC, 2008). Various studies have shown that factors related to hypertension control vary between men and women (Chang et al., 2008; Ong et al., 2008). Considering these results, associated factors and methods to control hypertension might need to be differentiated by sex.

This study aimed (1) to investigate factors associated with hypertension control by means of a systematic review and assessment on various levels, and (2) to investigate the possible differences between men and women with regard to factors in hypertension control.

Ⅱ. Methods

We searched the relevant literature using key words (hypertension [title] and control and factor) from local (DBpia, Korea Research Information) and international (PubMed, Web of Science) databases. Among searched literature, studies having factors associated with hypertension control were included in this analysis. Studies just comparing factor prevalence between controlled group and non-controlled group rather than analyzing the factors affecting hypertension control, were excluded.

Relevant literature included human subject studies, while international literature was limited to studies in the English language from the last 10 years (from 2004

to June 2014); studies designed as “comparative study”, “observational study”, “review”, and “systematic review” were included.

Among the extracted studies, those containing data regarding hypertension control and treatment compliance were analyzed to derive associated factors. In this study, based on the constrained-choice model, factors associated with hypertension control were categorized into four levels: individual, work and family, community, and social.

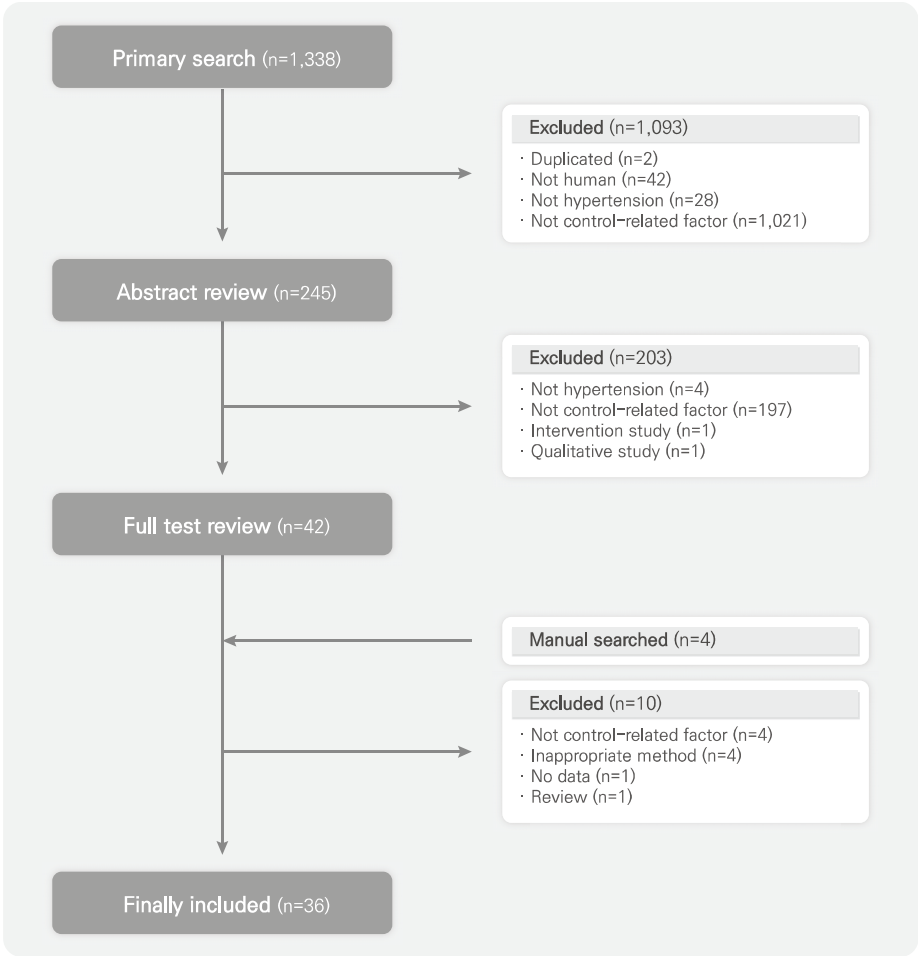
Sample size, study design, study subjects and their mean age, analyzed factors, whether analysis was conducted in relation to sex, and results were extracted from each eligible study. The study sample comprised the number of cases included in the analysis of factors associated with hypertension control. Studies simultaneously assessing hypertension control and associated factors were considered cross-sectional regardless of the overall design of the study.

Ⅲ. Results

Search results yielded a total of 1,338 studies, of which 1,039 were excluded. Of the excluded studies, 2 were duplicates, 42 were non-human studies, 28 were not related to hypertension, and 1,021 were studies without factors associated with hypertension control. Of 245 studies whose abstracts were reviewed, 203 were additionally excluded (4 were not related to hypertension, 197 did not include control-related factors, 2 were an intervention study or qualitative study), leaving 42 for thorough review. Although 4 studies were added via manual search, total 10 studies were excluded because they did not follow methodologies exploring factors associated with hypertension control, but instead verified factor differences between control and non-control groups using Chi-square and t tests. Therefore, a total of 36 studies were finally included (Figure 1), and of 36 studies, five were

prospective studies, one was case-control study, and the remaining 26 were cross-sectional. Of 36 studies, 28 studies used blood pressure as criterion of hypertension control and another seven used adherence to antihypertensive medication.

Figure 1. Flow chart of this study



A total of 25 influencing factors were found categorized into the aforementioned four levels. Of the 25 factors identified in the included studies, 12 showed contrasting results that were significant in some studies but not significant in other studies. In the present study, all factors were considered as potential factors and analyzed. Those factors associated with hypertension control and the results were described (Table 1). These potential factors also were categorized into the aforementioned four levels (Table 2).

Table 1. Characteristics of included studies

Author (year)	Sample size (M/F) / Study design	Study subjects/ Mean age	Analysis by sex	Analyzed factor	Criteria of HT control	Result (significant factor)	
						Male	Female
Choi 2003(Choi et al., 2003)	193(68/125) / Cross-sectional	Korean hypertensive participants aged ≥40/62.0±11.7	Analyzed by sex	Sex, age, education, occupation, income, marital status, family history, smoking	BP	None	Marital status, family history of HT
Wong 2004 (Wong et al., 2004)	66 (n.r.)/ Cross-sectional	Chinese continuous ambulatory peritoneal dialysis patients with hypertension/ 56.7±1.27	Not analyzed by sex, sex was included as independent variable	Sex,age, body weight, dialytic and clinical parameter	BP	Volume expansion (SBP), age (DBP)	
Perreault 2005 (Perreault et al., 2005)	21,011 (n.r.)/ Cohort	Canadian hypertensive participants/58±4	Not analyzed by sex, sex was included as independent variable	Sex, age, therapeutic class, switch drugs, social assistance, rural environment, diabetes, dyslipidemia, respiratory disease, antidepressive, anxiolytic, number of drug class, drug dose, number of dispensing pharmacies, number of physicians, number of medical visit, hospitalization	Adherence to antiHT medication	Sex, age, social assistance, diabetes, dyslipidemia, respiratory disease, antidepressive, anxiolytics, living area, number of pharmacies, number of physicians, number of medical visit, hospitalization	
Senior 2006 (Senior et al., 2006)	1,552 (n.r.)/ Cross-sectional	Hypertensive participants aged ≥80 living in New Zealand/n.r	Not analyzed by sex, sex was included as independent variable	Sex, age, medical history (stroke, heart disease, diabetes, high cholesterol, peripheral vascular disease)	BP	Stroke history, heart isease history, high cholesterol history	
Choi2006 (Choi & Kim, 2006)	189 (21/168)/ Cross-sectional	Korean hypertensive participants aged	Not analyzed by sex, sex was included as	Sociodemographic (sex, age, spouse, family structure, education, religion, living expense, medical insurance),	BP	Salt food control	

Author (year)	Sample size (M/F) / Study design	Study subjects/ Mean age	Analysis by sex	Analyzed factor	Criteria of HT control	Result (significant factor)	
						Male	Female
		≥65 years/n.r.	independent variable	risk factor (illness period, family history, hospitalization, helper other disease), self-care behaviors (smoking, drinking, exercise, coffee, salt control, fat diet, rest, sleep, stress)			
Chang 2008 (Chang et al., 2008)	1,316 (639/677)/ Cross-sectional	Korean hypertensive participants aged ≥20/n.r.	Analyzed by sex	Age, income, education, job, health insurance, living area, marriage, family history of HT, health status, BMI, smoking, exercise, alcohol, health check-up, stress	BP	Age, family history of HT, health status, health check-up	Health insurance, BMI, alcohol, exercise, health check-up
Chun 2008 (Chun et al., 2008)	25,507 (9,605/15,902)/ Cross-sectional	Korean hypertensive participants/n.r.	Not analyzed by sex, sex was included as independent variable	Sex, age, doctor factor(degree of training, clinic/visiting care), hospital factor (center/subcenter, rebuilt)	BP	Sex, age, hospital rebuilt, doctor's degree of training	
Fang 2008 (Fang et al., 2008)	164,701,000 visits/Cross-sectional	Americans with hypertension-related visits/63.4 in controlled and 62.8 in uncontrolled group	Not analyzed by sex, sex was included as independent variable	Sex, age, race, health insurance status, prescription of antiHT type, hypertension as 1stdiagnosis, diabetes, CHD, hyperlipidemia, primarycarephysicians, referredbyotherdoctor, initialvisitforHT, physicians'specialty, antiHTtherapy	BP	Hypertension as 1stdiagnosis,CHD,hyperlipidemia,primarycarephysician,initialvisitforHT,physicians' specialty,antiHTtherapy	
Naik 2008 (Naik et al., 2008)	212 (209/3)/ Cross-sectional	American primary care patients with DM and HT aged 50-90 years/66.4 in controlled and 67.4	The effect of sex was not analyzed	Patient characteristics (BMI, Deyo comorbidity score), self-management behaviors (intention to control HT index, home BP self-monitoring, poor adherence, number of primary	BP	• Self-management behaviors: poor adherence with pharmacy refills • Health communication measures: decision-making	

Author (year)	Sample size (M/F) / Study design	Study subjects/ Mean age	Analysis by sex	Analyzed factor	Criteria of HT control	Result (significant factor)	
						Male	Female
		in uncontrolled group		care provider visits), health communication measures (collaborative care for HT index, decision-making style, proactive communication after self-monitoring)		style, proactive communication after self-monitoring	
Li 2008 (Li et al., 2008)	144 (75/69)/ Cross-sectional	Chinese immigrants aged ≥65, taking antiHT medications/ 75.2±5.7	Not analyzed by sex, sex was included as independent variable	Susceptibility to specific disease, perceived benefits of Chinese herbs in general, perceived benefits of Western medications, health-related social support, gender, length of stay in the USA Controlling for demographic factors (living alone, religion, economic status)	Adherence to antiHT medication	Sex, length of stay in the USA (men)	
Ong 2008 (Ong et al., 2008)	3,475 (1,657/1,858)/ Cross-sectional	American hypertensive participants/ 57.7 in men and 62.3 in women	Analyzed by sex	Age, race, diabetes, last BP reading, methods of BP control, total cholesterol, smoking, menopause	BP	Age, race, diabetes, methods of BP control, smoking	Age, race, diabetes, last BP reading, methods of BP control, total cholesterol
Chen 2009 (Chen et al., 2009)	277 (166/111)/ Cross-sectional	Taiwan hypertensive patients aged ≥18/ 65.96±12.3	The effect of sex was not analyzed	Age, living alone, drug number, history of hypertension, SBP, history of hyperlipidemia, identity, symptoms, illness perception questionnaire (timeline, cyclical, consequence, personal control, treatment control, coherence, emotional representation),	Adherence to antiHT medication	Marital status, history of hyperlipidemia, beliefs of treatment control, causal attribution to psychological attribution, attribution to causality of risk factors	

Author (year)	Sample size (M/F) / Study design	Study subjects/ Mean age	Analysis by sex	Analyzed factor	Criteria of HT control	Result (significant factor)	
						Male	Female
				balanced and cultural attribution, psychological, risk factor			
Andersen 2010 (Andersen & Jensen, 2010)	3,306 (n.r.)/ Cohort	Dane participants aged ≥20, taking antiHT therapy/ 60.4±9.3	Not analyzed by sex, sex was included as independent variable	Sex, age, family-life, socioeconomic status, smoking, diabetes, exercise, medicine, drinking, diagnosis of myocardial infarction and stroke, sex, BMI, cholesterol.	BP	Age, myocardial infarction	
Pereira 2010 (Pereira et al., 2010)	121 (82/39)/ Cross-sectional	Portuguese hypertensive participants aged ≥ 18/n.r.	Analyzed by sex	Age, education, BMI, waist circumference, clinical parameter (LDL, HDL, Triglycerides), diabetes, smoking, alcohol, physical activity, family history, marital status, health care	BP	Age, BMI	Age, BMI, waist circumference, alcohol
Lee 2010 (Lee et al., 2010)	1,610 (532/1,078)/ Cross-sectional	Korean hypertensive participants aged ≥ 60/69.6 in controlled and 69.7 in uncontrolled	Analyzed by sex	Age, antiHT medication, BMI, waist circumference, FPG, metabolic syndrome, history of CVD, monthly living cost, occupation, smoking, alcohol intake, exercise, dietary habit	BP	BMI, fasting plasma glucose, history of CVD	Waist circumference
Alsuwaida 2011 (Alsuwaida & Alghonaim, 2011)	814 (400/414)/ Cross-sectional	Saudi national hypertensive participants aged ≥ 18/36.5 in men and 35.1 in women	Not analyzed by sex, sex was included as independent variable	Age, sex, BMI	BP	Age	
Firmo 2011 (Firmo et al., 2011)	672 (203/469)/ Cohort	Brazilian hypertensive participants aged from 71 to 81 years/75.1±3.1	Not analyzed by sex, sex was included as independent variable	Sex, schooling, leisure-time physical activity, smoking, BMI, number of medical appointment	BP	Schooling	

Author (year)	Sample size (M/F) / Study design	Study subjects/ Mean age	Analysis by sex	Analyzed factor	Criteria of HT control	Result (significant factor)	
						Male	Female
Oteh 2011 (Oteh et al., 2011)	950 (548/402)/ Cross-sectional	Malaysian hypertensive participants aged ≥ 30/60.3±10.5	Not analyzed by sex, sex was included as independent variable	Sex, age, antiHT medication, diabetes, Ischemic heart disease, revascularization, renal failure, smoking, hyperlipidemia	BP	Sex, number of antiHT medication	
Kim 2011 (Kim et al., 2011)	5,334 (n.r.)/ Cross-sectional	Korean hypertensive participants/n.r.	Not analyzed by sex, sex was included as independent variable	Sex, age, region, family, health insurance, education, job, income, disability, chronic disease	Adherence to antiHT medication	Age, education	
Niepen 2011 (Van der Niepen & Verbeelen, 2011)	11,562 (5,871/5,691)/ Cross-sectional	Belgium hypertensive patients/61.3 in men and 64.9 in women	Analyzed by sex	Age, BMI, smoking, hypercholesterolemia, family history, abdominal obesity, diabetes, left ventricle hypertrophy, carotid thickening, slight increased serum creatinine, microalbuminuria, cerebrovascular disease, cardiac disease, renal disease, peripheral artery disease, retinopathy, antiHT drug, duration of HT	BP	Age, BMI, smoking, hypercholesterolemia, abdominal obesity, cerebrovascular disease, cardiac disease, number of antiHT medication, duration of HT	BMI, hypercholesterolemia, family history of CVD, abdominal obesity, left ventricle hypertrophy, cardiac disease, peripheral artery disease, number of antiHT medication
Bulatova 2012 (Bulatova et al., 2012)	181 (107/74)/ Cross-sectional	Jordanian renal transplants recipients with hypertension/	Not analyzed by sex, sex was included as independent variable	Sex, number of antiHT medications, creatinine clearance	BP	Creatinine clearance	

Author (year)	Sample size (M/F) / Study design	Study subjects/ Mean age	Analysis by sex	Analyzed factor	Criteria of HT control	Result (significant factor)	
						Male	Female
		34.6±10.5					
Cai 2012 (Cai et al., 2012)	733 (303/430)/ Cross-sectional	Chinese adults aged 18-79 years/n.r.	Sex is adjusted	Family history, smoking, drinking, physical activity, BMI, waist circumference, diabetes, dyslipidemia	BP	Physical activity, BMI, waist circumference	
Ma 2012 (Ma et al., 2012)	744 (n.r.)/ Cross-sectional	Chinese hypertensive participants aged ≥ 20/n.r.	Not analyzed by sex, sex was included as independent variable	Sex, age, region, education, BMI, smoking, drinking, physical exercise, family history, frequency of BP measurement	BP	Smoking	
Marcia 2012 (Macia et al., 2012)	500 (263/237)/ Cross-sectional	Senegalese hypertensive participants aged ≥ 50/n.r.	Not analyzed by sex, sex was included as independent variable	Sex, age, education, marital status, BMI, doctor visit in previous year	Visiting doctor at least once during a year	• Control among hypertensive: doctor visit in previous year (≥1) • Control among treated: none	
Cheong 2013 (Cheong et al., 2013)	10,389 (4,457/5,932)/ Cohort	Korean hypertensive participants/64.1 in controlled and 62.6 in uncontrolled	Sex is adjusted	Experience of education, mandatory laboratory test	BP	Experience of education, mandatory laboratory test	
Dave 2013 (Dave et al., 2013)	2,663 (816/1,840)/ Cross-sectional	American participants ≥18 years taking BP-lowering medication/n.r.	Not analyzed by sex, sex was included as independent variable	Age, race, adherence to antiHT medication, triglycerides, blood glucose, history of atrial fibrillation, smoking	Adherence to antiHT medication	• SBP: age, race, adherence to hypertensive medication, triglycerides, blood glucose • DBP: age, sex, race, adherence to BP medication. History of atrial fibrillation, smoking	
Ko 2013 (Ko&Park, 2013)	268 (77/191)/ Cross-sectional	Korean hypertensive participants aged ≥ 40/71.9±10.6	Not analyzed by sex, sex was included as	Sex, age, marital status, education, occupation, economic status, BMI, disease period, other disease,	BP	Marital status, low sodium diet, stress, rest	

Author (year)	Sample size (M/F) / Study design	Study subjects/ Mean age	Analysis by sex	Analyzed factor	Criteria of HT control	Result (significant factor)	
						Male	Female
			independent variable	experience of HT education, medication compliance, physical activity, dietary habit, low sodium diet, smoking, stress, rest, BP measurement			
Yip 2013 (Yip et al., 2013)	1,267 (n.r.)/ Cross-sectional	Singaporean hypertensive participants/n.r.	Not analyzed by sex, sex was included as independent variable	Sex, age, education, smoking, alcohol, hypercholesterolemia, obesity, diabetes	BP	Age (urban)/ none (rural)	
Park 2013 (Park et al., 2013)	241 (144/97)/ Cross-sectional	Korean hypertensive participants aged ≥ 65/n.r.	The effect of sex was not analyzed	Employed, SBP, DBP, time since diagnosis, time since beginning medication, adherence to antiHT lifestyle, metamemory	Adherence to antiHT medication	Employed, adherence to antiHT lifestyle, metamemory	
Abu-Saad 2014 (Abu-Saad et al., 2014)	315 (n.r.)/ Cross-sectional	Israeli hypertensive participants aged 25-74/n.r.	Not analyzed by sex, sex was included as independent variable	Sex, age, race, marital status, education, number of physician visit, family history, CVD, hypercholesterol	BP	• Control among aware: age • Control among unaware: race, marital status, number of physician visits, family history, CVD, hypercholesterol	
Khanam 2014 (Khanam et al., 2014)	29,960 (15,759/14201)/ Cross-sectional	Bangladeshi hypertensive adults aged ≥25/ 44.6±15.8	Not analyzed by sex, sex was included as independent variable	Sex, age, education, asset index, comorbidity, diagnosing provider	Adherence to antiHT treatment	Age, sex, qualified doctor, education, asset	
Almas 2014 (Almas et al., 2014)	590 (229/361)/ Case-control study	Pakistan participants aged >18 with uncontrolled (case) or controlled (control)	Not analyzed by sex, sex was included as independent variable	sex, age, ethnicity, education, smoking diabetes, dyslipidemia, stroke, ischemic heart disease, hospitalization for HT, BMI, anxiety and depression scale	BP	Anxiety and depression scale, history of smoking, history of ischemic heart disease.	

Author (year)	Sample size (M/F) / Study design	Study subjects/ Mean age	Analysis by sex	Analyzed factor	Criteria of HT control	Result (significant factor)	
						Male	Female
		hypertension/ 54.98±12.4					
Unni 2014 (Unni et al., 2015)	225,608 (55,365/60,243)/ Cross-sectional	Americans aged ≥18 with chronic kidney disease and hypertension / 70.3±10.9	Not analyzed by sex, sex was included as independent variable	Sex, age, BMI, diabetes, number of antiHT therapy, antiHT medication class	BP	Age	
Abdul-Razak 2016 (Abdul-Razak et al., 2016)	621 (n.r.)/ Cohort	Malaysian adults aged ≥30/n.r.	Not analyzed by sex, sex was included as independent variable	Sex, age, living area, ethnicity, education, smoking, BMI	BP	Sex, living area, ethnicity	
Borghi 2016 (Borghi et al., 2016)	5,220 (2,498/2,722)/ Cross-sectional	Europeans receiving an antiHT medication/ 64.5±9.0	Not analyzed by sex, sex was included as independent variable	Sex, age, BMI, Diabetes, SCORE, smoking, use of statins, lipid-lowering treatment, use of antiHT medications	BP	Sex, age, BMI, smoking, use of statins, SCORE	
Sarganas 2016 (Sarganas & Neuhauser, 2016)	15,112 (n.r.)/ Cross-sectional	German adults aged 18-79	Not analyzed by sex, sex was included as independent variable	Sex, socioeconomic status, smoking, exercise, diabetes, obesity, stroke, therapy type	BP	Sex, therapy type, diabetes, stroke	

BMI: body mass index, BP: blood pressure, CHD: coronary heart disease, CVD: cardiovascular disease, DBP: diastolic blood pressure, DM: diabetes mellitus, HDL: high density lipoprotein, HT: hypertension, LDL: low density lipoprotein, SBP: systolic blood pressure, SCORE: systematic coronary risk evaluation.

Table 2. The level of factors associated with hypertension control

Level	Factor
Social level	Social assistance, Health insurance
Community level	Living area, Health check-up, Character of doctor and hospitala
Work and family level	Marital status, Family history of HT/CVD, Employment, Asset, Health communication, Health behaviorb
Individual level	Age, Sex, Race, Education, Chronic diseasec, Healthstatusd, Durationofhypertension, Diagnosis, HT as 1stdiagnosis/initialvisitforHT, Obesitye, Beliefsoftreatmentcontrol, Attribution to risk factors, Metamemory

BMI: body mass index, BP: blood pressure, HT: hypertension.
a: Character of doctors and hospital – number of medical visit, physician's specialty, primary care physician, number of pharmacies/physician, hospital rebuilt, hospitalization, method to BP control, educational program for HT, mandatory laboratory test, last BP reading, number of antiHT medication
b: Health behavior – smoking, alcohol, exercise, low sodium diet, stress management, rest, adherence with pharmacy refills, coronary risk evaluation
c: Control disease – diabetes, dyslipidemia, respiratory disease, cardiovascular disease, myocardial infarction, stroke, heart disease, hyperlipidemia, hypercholesterolemia, peripheral artery disease, ventricle hypertrophy, taking antidepressive/anxiolytics, anxiety and depression.
d: Health status – health status, total cholesterol, volume expansion, fasting plasma glucose, creatinine clearance.
e: Obesity – BMI, waist circumference, abdominal obesity

1. Individual level

The influential factors of hypertension control on the individual level were age, sex, race, educational level, chronic disease, health status, duration of hypertension, diagnosis, hypertension as first diagnosis/initial visit for hypertension, obesity, belief in treatment, attribution to causality of risk factors, and metamemory which is self-knowledge and self-belief in one's memory function.

Having chronic disease was significantly associated with hypertension control, and included diabetes (Ong et al., 2008; Perreault et al., 2005; Sarganas & Neuhauser, 2016), dyslipidemia (Perreault et al., 2005), respiratory disease (Perreault et al., 2005), cardiovascular disease (Abu-Saad et al., 2014; Almas et al., 2014; Andersen & Jensen, 2010; Borghi et al., 2016; Lee et al., 2010; Sarganas & Neuhauser, 2016;

Senior et al., 2006; Van der Niepen & Verbeelen, 2011), heart disease (Fang et al., 2008; Senior et al., 2006; Van der Niepen & Verbeelen, 2011), hyperlipidemia (Chen et al., 2009; Fang et al., 2008), hypercholesterolemia (Abu-Saad et al., 2014; Senior et al., 2006; Van der Niepen & Verbeelen, 2011), peripheral artery disease (Van der Niepen & Verbeelen, 2011), ventricle hypertrophy (Wenner & Stachenfeld, 2012), and taking antidepressive and anxiolytics (Perreault et al., 2005) or anxiety and depression score (Almas et al., 2014).

However, it was found that in many cases the same factors influenced hypertension control in contrasting ways. Of 27 studies analyzing the influence of age, this was not significant in eleven studies (Abdul-Razak et al., 2016; Almas et al., 2014; Chen et al., 2009; Choi & Kim, 2006; Choi et al., 2003; Fang et al., 2008; Lee et al., 2010; Ma et al., 2012; Oteh et al., 2011; Senior et al., 2006; Van der Niepen & Verbeelen, 2011), and of the remaining 16 studies, nine showed that older age negatively affected hypertension control (Abu-Saad et al., 2014; Alsuwaida & Alghonaim, 2011; Andersen & Jensen, 2010; Chun et al., 2008; Dave et al., 2013; Ong et al., 2008; Pereira et al., 2010; Wong et al., 2004; Yip et al., 2013), whereas seven showed that it had a positive effect (Borghi et al., 2016; Chang et al., 2008; Khanam et al., 2014; Kim et al., 2011; Perreault et al., 2005; Unni et al., 2015; Van der Niepen & Verbeelen, 2011).

The influence of sex was analyzed in 26 studies; in 17, it was not found to be significant, whereas in 7 (Abdul-Razak et al., 2016; Chun et al., 2008; Dave et al., 2013; Khanam et al., 2014; Li et al., 2008; Perreault et al., 2005; Sarganas & Neuhauser, 2016), women were more likely to maintain good control over blood pressure. The remaining study showed that men were more likely to control hypertension (Borghi et al., 2016; Oteh et al., 2011). Hypertension control was different by race (Abdul-Razak et al., 2016; Abu-Saad et al., 2014; Dave et al., 2013; Ong et al., 2008). Education level and wealth was shown to have a positive effect on hypertension control, with educated or wealthy subjects exhibiting increased control of hypertension (Firmo et al., 2011; Khanam et al., 2014; Kim et al., 2011).

The influence of disease presence on hypertension control varied across studies. In 4 studies, those without diabetes (Ong et al., 2008; Sarganas & Neuhauser, 2016) or hypercholesterolemia (Abu-Saad et al., 2014) or cardiovascular disease (Almas et al., 2014) had a high hypertension control rate. However, in other studies diabetes (Perreault et al., 2005), hypercholesterolemia (Van der Niepen & Verbeelen, 2011), cardiovascular disease (Abu-Saad et al., 2014; Fang et al., 2008; Lee et al., 2010; Sarganas & Neuhauser, 2016; Van der Niepen & Verbeelen, 2011), myocardial infarction (Andersen & Jensen, 2010), and stroke (Senior et al., 2006) were shown to have a positive effect on hypertension control.

Health status (Chang et al., 2008), total cholesterol (Ong et al., 2008), volume expansion (Wong et al., 2004), fasting plasma glucose (Lee et al., 2010), and creatinine clearance (Bulatova et al., 2012) also significantly affected hypertension control. Bad health status, low total cholesterol, low fasting plasma glucose was positively associated with hypertension control, and volume overload was associated with poor blood pressure control. The longer duration of hypertension (Van der Niepen & Verbeelen, 2011) and those diagnosed with hypertension (Andersen & Jensen, 2010; Fang et al., 2008) were likely to maintain control of their hypertension. Patients with hypertension as the first diagnosis and patients with initial visit for hypertension were less likely to control hypertension (Fang et al., 2008).

Previous studies reported that hypertension control is achieved by lower BMI (Borghi et al., 2016; Cai et al., 2012; Chang et al., 2008; Lee et al., 2010; Pereira et al., 2010; Van der Niepen & Verbeelen, 2011) and lower waist circumference (Cai et al., 2012; Lee et al., 2010; Pereira et al., 2010). A high belief in therapy (Chen et al., 2009), attribution to risk factors (Chen et al., 2009) were more likely to influence the control of hypertension. Metamemory (Park et al., 2013) were more likely to influence the control of hypertension.

2. Work and family level

On this level, influential factors included marital status, family history of hypertension or cardiovascular disease, employment, asset, health communication, and health behavior such as smoking, drinking alcohol, exercise, low sodium diet, stress management and rest, and adherence to medication.

With respect to marital status, in 2 studies those who were married (Abu-Saad et al., 2014; Choi et al., 2003) were more likely to control hypertension; however, one study demonstrated that those without a spouse were more likely to control hypertension (Ko & Park, 2013). Those having a family history of hypertension (Abu-Saad et al., 2014; Chang et al., 2008; Choi et al., 2003) or family history of cardiovascular disease (Van der Niepen & Verbeelen, 2011) were found to have good hypertension control. Being employed was associated with high rate of hypertension control (Park et al., 2013). Related to health communication, person with shared decision-making style and proactive communication after self-monitoring was more likely to control hypertension (Naik et al., 2008).

Health behavior was considered to be one of factor in work and family level, cause those could be affected by work environment and family life. Even if people want to lower sodium in their diets or quit drinking, it could be hard to conduct without support from family or workplace such as change of cuisine and atmosphere not drinking.

Looking at past research exploring the relationship between hypertension-related lifestyle and hypertension control, results have consistently shown that non-drinker or low drinker (Chang et al., 2008; Pereira et al., 2010), a low-salt diet (Choi & Kim, 2006; Ko & Park, 2013), and stress management (Ko & Park, 2013) or moderate physical activity (Cai et al., 2012; Chang et al., 2008) was associated with a high rate of hypertension control. However, regarding smoking, studies have reported both smoking (Borghi et al., 2016; Ma et al., 2012; Van der Niepen & Verbeelen, 2011) and not smoking (Almas et al., 2014; Dave et al., 2013; Ong et al., 2008) to be related to good hypertension control.

3. Community level

The factors related to hypertension control at the community level were area of residence, health checkup, and character of clinician and hospital, which included the number of pharmacies/physicians, physician's specialty, primary care physician, number of medical visits, hospital rebuilt, hospitalization, method used to achieve control of blood pressure, educational programs for hypertension, mandatory laboratory tests, and last blood pressure reading, and the number of antihypertensive medications.

With respect to the area of residence, those living in rural areas were more likely to control hypertension than those living in cities (Perreault et al., 2005), whereas one study reported contrary result (Abdul-Razak et al., 2016). Health check-up and character of doctor/hospital were also affected by type of available hospital in view of distance and cost, so it was considered as a factor of community level factor. Among factors related to medical institutions, those who had a health checkup (Chang et al., 2008) were likely to maintain hypertension control.

In terms of frequency of hospital visits, it was shown in two studies that frequent visits (Abu-Saad et al., 2014; Macia et al., 2012) were associated with a high rate of hypertension control. Specialist (Chun et al., 2008; Fang et al., 2008), qualified doctor (Khanam et al., 2014), or primary care physician (Fang et al., 2008) had a positive influence on hypertension control. Less number of pharmacies/physician (Perreault et al., 2005), rebuilt hospital (Chun et al., 2008), hospitalization (Perreault et al., 2005) was positively associated with high hypertension control. Taking drug as method to blood pressure control (Fang et al., 2008; Ong et al., 2008) or therapy type (Sarganas & Neuhauser, 2016), having educational program for hypertension and taking mandatory laboratory test (Cheong et al., 2013), last blood pressure reading within past 6 month (Ong et al., 2008) was also associated with a high rate of hypertension control. The effect of number of antihypertensive drug showed controversial results (Oteh et al., 2011; Van der Niepen & Verbeelen, 2011)

4. Social level

On the social level, social assistance and health insurance were reported to be significantly related to hypertension control. Chang et al. reported that people with medicare had a lower hypertension control rate than those with health insurance (Chang et al., 2008). In a study to assess persistence with antihypertensives and its determinants by Perreault et al., receiving social assistance was associated with a higher discontinuation rate (Perreault et al., 2005).

5. Factors analyzed by sex

Of the 36 studies, only 6 analyzed influential factors for hypertension control separately for men and women. It has been observed that the same factor may influence men and women differently. The following factors were included at the individual level: age (Chang et al., 2008; Ong et al., 2008; Pereira et al., 2010; Van der Niepen & Verbeelen, 2011), race (Ong et al., 2008), BMI (Chang et al., 2008; Lee et al., 2010; Pereira et al., 2010; Van der Niepen & Verbeelen, 2011), abdominal obesity (Van der Niepen & Verbeelen, 2011), waist circumference (Lee et al., 2010; Pereira et al., 2010), health status (Chang et al., 2008), and chronic disease (Table 3).

Table 3. The level of factors associated with hypertension control according to sex

Level	Male	Female
Social level		• Health insurance (having health insurance)*
Community level	• Methods of BP control (taking drug) • Number of antiHT medication (more) • Health check-up (taking) • Duration of HT (longer)†	• Methods of BP control (taking drug) • Number of antiHT medication (more) • Health check-up (taking) • Last BP reading (BP reading within past 6 month)*
Work and family level	• Family history of HT (having) • Smoking (current smoker/ non-smoker)†	• Family history of HT (having) • Family history of CVD (not having)* • Marital status (with partner)* • Alcohol (non-drinker/ lower)* • Exercise (doing exercise)*
	Individual level	• Age (controversial) • Race (non-Hispanic white) • Obesity - BMI (lower) - Abdominal obesity (not having) • Health status (bad)†

† : significant in only men, *:significant in only women,
BMI: body mass index, BP: blood pressure, HT: hypertension

In women, younger age was associated with a higher rate of hypertension control than older age; in men, however, the effect of age was controversial. In both sexes, non-Hispanic blacks were less likely to exhibit control of hypertension than were non-Hispanic whites (Ong et al., 2008). A lower BMI or lack of abdominal obesity were associated with a high rate of hypertension control in men and women, but a lower waist circumference was significant only in women. A poor health status was associated with good hypertension control, but this was significant only in men. Various diseases were associated with hypertension control; however, a kind of significant disease differed by sex.

The factors related to hypertension control at the work and family level also differed between men and women. Smoking was associated with hypertension control only in men. Male nonsmokers showed greater hypertension control than

did men who smoke, whereas no significant difference was observed in women. In women, a family history of cardiovascular disease, marital status (with a partner), no or low alcohol consumption, and engaging in exercise were significantly associated with controlled blood pressure.

At the community level, a longer duration of hypertension was associated with good hypertension control only in men, and a blood pressure reading within the past 6 month was associated with hypertension control only in women. At the social level, health insurance was related to hypertension control, and this association was significant only in women.

Ⅳ. Discussion

Previous studies reported that educational intervention was an important and effective influence on blood pressure control and lifestyle modification (Babaee Beigi et al., 2014; Warsi et al., 2004). However, based on the results of this study, education for individuals is not sufficient to control blood pressure because the factors associated with hypertension control are distributed variously across the individual, work/family, community, and social levels. This indicates that interventions at the social level, such as improvement in healthcare institutions or medical support, as well as interventions at the individual level, should be performed to increase the incidence of controlled hypertension.

Some previous studies have found a difference in hypertension control between men and women, several reporting that hypertension control rates were higher in women than in men (Chun et al., 2008; Ko & Park, 2013; Lee et al., 2010). Among our included studies, nine studies showed that sex affects hypertension control significantly, and in seven studies, female sex was associated with successful hypertension control.

The sex differences in health status are due to three differences in the influential factors: whether the influencing factor occurs typically only in men or only in women, whether the frequency of the influential factor differs between men and women, and whether related factors have differing impacts on men and women. First, the typical sex-related influential factors include sex hormones that contribute to differences in blood pressure and water regulation between men and women (Samad et al., 2008; Wenner & Stachenfeld, 2012). Moreover, male- or female-specific disease or therapy such as oral contraceptives are cited as factors affecting blood pressure (Drost et al., 2010; Samad et al., 2008). Second, some risk factors that routinely affect both sexes occur at different frequencies in men and women. For example, depression (Meng et al., 2012) or chronic stress (Sparrenberger et al., 2009), which are likely to cause hypertension, occur at different frequencies in men and women (Gu et al., 2013; Xu et al., 2015). Lastly, the impact of some factors may differ between men and women. Stegenga et al. showed that most risk factors for major depressive disorder had a greater impact in women than in men (Stegenga et al., 2012). In addition, Skaug et al. reported that in comparison with men, endothelial dysfunction in women was more strongly associated with cardiovascular disease (Stegenga et al., 2012).

Although sex-specific differences regarding factors associated with hypertension control can also be subdivided into the aforementioned three types, the purpose of this study was to focus on factors in the third category. The influential factors of hypertension control that manifested differently between the sexes were health status, fasting plasma glucose, cardiovascular disease, smoking, duration of hypertension for men, waist circumference, total cholesterol, peripheral artery disease, left ventricle hypertrophy, family history of cardiovascular disease, marital status, alcohol, exercise, last blood pressure reading, health insurance for women.

Men and women have different role in their work and social life. In this context, factors affecting their health status and how they deal with could be various. This present study showed that the effect of same factor was different on male and female.

It means that different interventions according to sex are needed to prevent and manage disease. Investigation of the sex-specific impact of risk factors for chronic disease management therefore appears to be required. In addition, to increase hypertension control, interventions and distribution of resources should be conducted on the basis of differences between men and women.

In a study investigating hypertension-associated factors for female caregivers compared with female non-caregivers, it was reported that 24-hour sodium emission and carbohydrate energy rate were associated with hypertension in caregivers while BMI was associated with hypertension in non-caregivers (Hoshino et al., 2013). This study showed that besides sex, factors influencing hypertension control might differ according to the gender-specific role, such as caregiver; therefore, continued studies will be necessary to explore how the development of a disease and associated factors differ according to sex-specific roles.

The main limitation of this study is the criteria for hypertension control. In previous studies, the concepts of treatment compliance and blood pressure control were mixed. Some studies assessed treatment compliance, in part by whether a patient keeps medical appointments (Bae et al., 1994; Lee et al., 2000) or follows pharmacologic instructions (Kim et al., 2011). In other studies, those who were under treatment and had blood pressure within the normal range were classified as the hypertension control group (Abu-Saad et al., 2014; Choi et al., 2003; Pereira et al., 2010; Tailakh et al., 2013). For comparison of study results and their link with related policies, it is important to clearly define the criteria for hypertension control and to use the criteria agreed upon when studies are conducted. In addition to these methodologies, since hypertension control rates may vary depending on subjects' characteristics such as residential district (Yip et al., 2013) or care environment (Axon et al., 2011), the particular study demographic should be clarified.

Another limitation is that this study included studies published from 2004. This is because to review factors associated with hypertension control through recent studies, but it might be a limitation that not included enough studies.

V. Conclusion

Numerous social and economic factors may affect the management of chronic diseases and may positively or negatively influence an individual's choices, particularly regarding management behavior. To streamline hypertension management policies, the differences in hypertension control behavior between men and women attributable to social roles and resource distribution should be considered. The results of this study may provide evidence for preparing appropriate management therapies according to sex, and may contribute to improving overall health status through selection of vulnerable groups and development of appropriate interventions.

박지은은 서울대학교 보건대학원에서 박사학위를 수료하였으며, 현재 한국한의학연구원에서 선임연구원으로 재직 중이다. 주요 관심분야는 역학 및 보건학에서의 건강영향과 결정요인이다.
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류연희는 경희대학교 침구경락학 박사학위를 받았으며, 한국한의학연구원에서 책임연구원으로 재직 중이다. 주요 관심분야는 경혈자극 신호전달체계이며, 침자극 생리반응을 연구하고 있다.
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김홍수는 미국 뉴욕대학교에서 보건학 박사학위를 취득하고, 현재 서울대학교 보건대학원에서 교수로 재직 중이다. 주요 관심분야는 보건 서비스와 장기요양이며, 노인 보건과 만성건강문제 연구를 수행하고 있다.
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성별 및 거시적 수준에 따른 고혈압 조절 영향요인:
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고혈압은 심혈관 질환의 주요 위험요인으로 적절한 관리가 중요하다. 고혈압 조절과 관련된 요인은 개인적 수준보다 높은 수준의 요인에도 영향을 받을 수 있다. 본 연구에서는 문헌고찰을 통해 고혈압 조절과 관련된 요인을 찾고, 이를 개인적, 직장 및 가족, 지역사회, 사회 수준으로 분류하고자 한다. 또한 성별에 따라 고혈압 조절 관련요인이 다르게 나타나는지 알아본다. 국내외 데이터베이스 검색을 통해, 고혈압 조절과 관련된 요인을 포함한 연구를 선정하였다. 관련요인은 개인적, 직장 및 가족, 지역사회, 사회의 4개 수준으로 분류되었고, 또한 성별에 따라 분류되었다. 36개의 연구가 선정되었으며, 고혈압 조절과 관련된 요인은 개인적, 직장 및 가족, 지역사회, 사회 수준으로 다양하게 나타났다. 각 요인이 고혈압 조절에 긍정 혹은 부정적 영향을 미치는지에 대해서는 연구마다 결과가 다르게 나타났다. 6개의 연구만이 고혈압 조절 관련요인을 성별에 따라 분석하였으며, 건강상태, 흡연, 심혈관질환, 고혈압 유병 기간은 남자에서만 유의한 반면, 결혼상태, 운동, 음주, 허리둘레, 건강보험 유형은 여자에서만 유의하게 나타났다. 고혈압 조절은 개인적 수준 외에도 지역사회나 사회 등 보다 고차원의 요인과도 관련성이 있다. 그러므로 고혈압 조절 향상을 위해 다양한 수준의 요인을 고려할 필요가 있다. 또한, 고혈압 조절 관련 요인은 남녀 간에 다르게 나타나므로 향후 성별을 고려한 중재가 필요하다.

주요용어: 고혈압, 고혈압 조절, 성별, 조절요인