

# Factors Affecting Self-Care Among Hypertensive Older Adults Dwelling in the Community: A Cross-Sectional Study

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## Research Article

**Keywords:** hypertension, elderly, cognitive function, self-care

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**Factors affecting self-care among hypertensive older adults dwelling in the community: A  
cross-sectional study**

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## Abstract

**Background:** Hypertension is a prevalent health problem in older adults, with better outcomes expected through proper self-care. However, little is known about the effects of cognitive function level on self-care in older adults living in the community.

**Methods:** This cross-sectional study, conducted from October 2019 to January 2020, analyzed the effect of cognitive function on self-care in elderly individuals aged > 65 years with hypertension who visited a local general hospital for the treatment of hypertension. The Korean versions of the Mini-Mental State Examination (K-MMSE) and Montreal Cognitive Assessment (MoCA-K) were used to assess cognitive function. The Hypertension Self-Care Behavior Scale (HBP-SC Behavior Scale) was used to analyze the subjects' self-care, which was divided into diet behavior and health behavior (except diet). The general characteristics and degrees of self-care of the subjects were analyzed using descriptive statistics, and multiple regression analysis was used to analyze the factors affecting self-care.

**Results:** Factors influencing HBP-SC diet behavior scores were religion ( $\beta = .27$ , SE = 0.69,  $p = .007$ ) and MoCA-K scores ( $\beta = .31$ , SE = 0.08,  $p = .002$ ). HBP-SC health behavior (except diet) scores were associated with comorbidities ( $\beta = -.20$ , SE = 0.60,  $p = .032$ ), and the power of the model was 20%. However, there were no variables that significantly affected the total HBP-SC score, which included the diet behavior and health behavior (except diet) scores.

**Conclusions:** Although there was no significant factor influencing the total HBP-SC score, religion, MoCA-K scores, and comorbidities were factors influencing diet behavior and health behavior (except diet). Therefore, tailored education takes into account religion, MoCA-K domains, and comorbidities is necessary to promote self-care in hypertensive older adults.

**Key words:** hypertension, elderly, cognitive function, self-care

## Background

Hypertension is a risk factor for cardio-cerebrovascular disease, and its prevalence is increasing in the aging population due to poor lifestyle habits, which poses an important health concern [1]. The prevalence of hypertension in older adults is 64.3% in South Korea, 74.5% in the U.S., and 53.2% in China, indicating a high prevalence worldwide. In particular, the prevalence of hypertension among people aged 65 years or older in South Korea was 5.5 and 3.1 times higher than that of adults in their 30s and 40s, respectively, indicating that the prevalence of hypertension increases with age, affecting more than half of the population aged 65 years or older [2-5].

The predominant type of hypertension in older adults is isolated systolic hypertension, in which the elasticity of blood vessels decreases due to aging and the resulting stiffness increases systolic blood pressure and decreases diastolic blood pressure [6]. Therefore, older adults with hypertension are at a high risk of complications such as cardio-cerebrovascular and kidney diseases. Lowering the blood pressures of these patients who are prone to complications associated with hypertension may reduce mortality. Therefore, practicing healthy lifestyle habits and maintaining good medication compliance are important [6,7].

Mild cognitive impairment (MCI), as defined by the National Institute on Aging-Alzheimer's Association (NIA-AA), refers to a symptomatic but nondemented state that has a primary underlying pathophysiology, such as Alzheimer's disease, and is characterized by memory impairment and longitudinal cognitive decline. However, there is a lack of evidence on whether cognitive impairments result from vascular, traumatic, or other medical reasons [8,9]. The prevalence of mild cognitive impairment in older adults aged 65 years or older in South Korea was 22.7% as of 2020, and its prevalence has been steadily increasing annually [10-12], suggesting that it is necessary to consider the level of cognitive function of older adults for the management of MCI and chronic diseases [13].

Hypertension is a chronic disease; hence, it is important for patients with hypertension to implement preventive self-care measures to prevent and treat complications associated with this chronic disease [14]. The self-care behaviors of patients with hypertension included diet management, smoking cessation, drinking in moderation, home blood pressure monitoring, weight control, physical activity,

medication compliance, and stress management. Moreover, it is necessary for them to continuously engage in self-care behaviors [15,16]. Indeed, some previous studies have reported that self-care behaviors, including diet management, were adopted well by elderly patients with hypertension [17,18]. However, it is necessary to identify the factors essential for promoting self-care behavior in elderly patients with hypertension.

Factors affecting self-care behavior in patients with hypertension, as found in previous studies, include familial support, age, sex, economic activity, comorbidities, exercise, drinking, smoking, obesity, living with family, number of children, education level, and duration of hypertension [19-21]. However, studies elucidating self-care behaviors based on cognitive function in elderly patients with hypertension are scarce. This study investigated factors affecting self-care behavior in community-dwelling older adults with hypertension based on their cognitive function.

## **Methods**

### **Study design**

This cross-sectional study aimed to investigate the level of self-care behaviors and factors affecting self-care behaviors based on cognitive function in community-dwelling elderly patients with hypertension who were aged 65 years or older.

### **Setting**

The participants in this study were recruited from S General Hospital, with an average of 800 outpatients per day located in S City, South Korea.

### **Participants**

The participants in this study were older adults aged 65 years or older who visited the outpatient clinic at S General Hospital, received treatment for hypertension, and agreed to participate in this study after the purpose of this study was explained. The data collection period was from October 2019 to May 2020 and was conducted after explaining the purpose of this study to the hospital. Permission was obtained for data collection. After receiving participant written informed consent, the survey was

conducted in a counseling room next to the internal medicine outpatient clinic. The survey was conducted one-on-one by the study researcher through a survey questionnaire that examined the participants' characteristics, cognitive function, and hypertension-related self-care behavior.

#### *Inclusion criteria*

- Older adults aged 65 years or older who were able to communicate verbally and nonverbally
- Patients who had a systolic blood pressure  $\geq 140$  mmHg or a diastolic blood pressure  $\geq 90$  mmHg, had been diagnosed with hypertension by an internist, and had been taking antihypertensive drugs for more than 6 months.

#### *Exclusion criteria*

- Those with secondary hypertension were not included in the study.

### **Measurements**

#### *Characteristics of the participants*

The participant characteristics that were collected comprised a total of 12 items. Specifically, the general characteristics section included seven items regarding age, sex, education level, religion, marital status, living with family and primary caregiver, while the hypertension-related characteristics section consisted of four items regarding the duration of hypertension, the number of hypertensive drugs used, comorbidities, and body mass index (BMI).

#### *Cognitive function*

Cognitive function in older adults was measured using the Korean Mini-Mental State Examination (K-MMSE), which is useful in screening for dementia, and the Korean version of the Montreal Cognitive Assessment (MoCA-K), which is useful in screening for mild cognitive impairment.

The K-MMSE is a tool for screening dementia that was modified and translated into Korean by Kang et al. (1997) [22] from the Mini-Mental State Examination (MMSE) developed by Folstein et al. (1975) [23]. The K-MMSE consists of orientation to time (5 points), orientation to place (5 points), memory registration (3 points), attention and calculation (5 points), memory recall (3 points), language (8 points), and drawing (1 point). A score of 24 points or more (out of 30 points) indicates normal

cognition, a score of  $\geq 18$  points to  $\leq 23$  points indicates mild cognitive impairment, and a score of  $\leq 17$  points indicates dementia. The reliability of the K-MMSE showed a Cronbach's  $\alpha = .85$  in a recent study [24], and its reliability revealed a value of Cronbach's  $\alpha = .74$  in this study.

The MoCA-K is a tool for screening mild cognitive impairment that was modified and translated into Korean to be suitable for Korean culture and linguistic characteristics by Kang et al. (2009) [25] from the Montreal Cognitive Assessment (MoCA) developed by Nasreddine et al. (2005) [26]. This tool consists of visuospatial ability/executive function (5 points), language abilities (3 points), memory/delayed recall (5 points), attention (6 points), abstraction (2 points), and orientation (6 points), with a total score of 30 points. One point is added to an individual's score if he/she has six years or less of formal education. A score of 23 points or higher was considered normal, and a score of 22 points or less was considered mild cognitive impairment. The reliability of the MoCA-K was Cronbach's  $\alpha = .84$  at the time of its translation and modification, and its reliability was Cronbach's  $\alpha = .79$  in this study.

#### ***HBP-SC behavior scale (hypertension self-care)***

The Hypertension Self-Care Behavior Scale (HBP-SC Behavior Scale) was translated and modified for Korean older adults by An et al. (2017) [27] based on the Hypertension Self-Care Profile developed by Han et al. (2014) [28]. This tool consists of a total of 20 items, including 11 items on diet that assessed the subjects' habits regarding checking nutrition labels, sodium intake, total calories, and alcohol consumption, as well as nine except diet items regarding exercise, smoking cessation, antihypertensive medication compliance, and regular health screening. Each item is rated on a 4-point Likert scale, with scores ranging from a minimum score of 20 points to a maximum score of 80 points. Higher scores indicate higher self-care behavior.

The reliability of the HBP-SC behavior scale had a Cronbach's  $\alpha = .92$  for HBP-SC behavior (total), a Cronbach's  $\alpha = .91$  for HBP-SC diet behavior, and a Cronbach's  $\alpha = .85$  for HBP-SC health behavior (except diet) in a study by An et al. (2017) [27]. The Cronbach's  $\alpha$  value was  $= .73$  for HBP-SC behavior (total),  $\alpha = .77$  for HBP-SC diet behavior, and  $\alpha = .65$  for HBP-SC health behavior (except diet) in this study.

### **Sample size**

The number of participants required for this study was calculated to be 103 after performing a multiple regression analysis with a significance level of .05, a power of .80, an effect size of .15, and using 7 predictors. Considering a dropout rate of 10%, 110 participants were selected. Of them, five participants had incomplete information, and 105 participants were finally included in this study.

### **Statistical methods**

The data collected in this study were analyzed using IBM SPSS Statistics for Windows version 22.0. The reliability of the HBP-SC behavior scale, K-MMSE, and MoCA-K were analyzed using Cronbach's  $\alpha$  values. Descriptive statistical analysis was used to investigate the general characteristics, hypertension-related characteristics, and cognitive function of subjects. The differences in their self-care behaviors based on their characteristics and cognitive function were analyzed using a t-test and an analysis of variance. A post hoc test was performed using a Scheffé post hoc test. The correlations between the participants' characteristics and hypertension-related self-care behaviors were analyzed using Pearson's correlation coefficients. Multiple regression analysis was used to analyze the factors affecting the subjects' hypertension self-care behaviors.

### **Ethical considerations**

This study was approved by the Institutional Review Board at K University located in D City, South Korea (40525-201906-HR-029-02), for the protection of the participants. After the purpose, procedure, and time required for this study were explained to the participants, they provided written informed consent to participate in this study. The participants were informed that the collected data would be used only in this study and not for any other purpose. They were also informed in advance that to protect their rights as participants, their anonymity would be guaranteed, that they could refuse to participate in this study at any time and that if they decided to withdraw their participation from this study or failed to complete the questionnaire during the survey, then they would not be disadvantaged and could do so without prejudice. All methods were carried out in accordance with relevant guidelines and regulations under Ethics approval and consent to participate



## Results

Of the participants, 46 (43.8%) were men and 59 (56.2%) were women. In terms of age, the number of those in their 70s was the highest at 52 (49.5%), and the mean age was  $76.17 \pm 6.54$  years. In terms of education level, 78 (74.3%) had received no or primary education, and 27 (25.7%) had received more than secondary education. In terms of religion, 65 (61.9%) had religious affiliations, whereas 40 (31.8%) did not. In terms of marital status, 60 (57.1%) were married, 3 (2.9%) were separated, and 42 (40.0%) were widowed. In addition, 69 (65.7%) lived with their families. In terms of primary caregiver type, 36 (34.3%) and 46 (43.8%) reported their spouses and themselves, respectively, as their primary caregivers.

In terms of hypertension duration, the number of those diagnosed with hypertension  $\leq 10$  years prior was the highest at 63 (60.0%), and the mean duration of hypertension was  $10.85 \pm 7.66$  years. In terms of the number of antihypertensive medications, 68 (64.8%) took one (1) drug, with an average of  $1.46 \pm 0.68$  drugs. Diabetes was the most common comorbidity (in multiple responses) found in 48 subjects (45.7%), followed by cerebrovascular disease ( $n=25$ , 23.8%), cardiovascular disease ( $n=14$ , 13.3%), kidney disease ( $n=8$ , 7.6%), and others ( $n=62$ , 59.0%). In terms of BMI, 39 subjects (37.1%) had normal weight, 35 (33.4%) were overweight, and 29 (27.6%) were obese.

In terms of K-MMSE scores, 43 subjects (41.0%) were normal, 56 (53.3%) had mild cognitive impairment, 6 (5.7%) had dementia, and the mean K-MMSE score was  $22.83 \pm 4.06$  points. MoCA-K scores were obtained for 99 participants, which excluded the six subjects with dementia as identified by the K-MMSE. The results showed that 31 (29.5%) were normal and 68 (64.8%) had mild cognitive impairment; the mean MoCA-K score was  $19.82 \pm 6.32$  points (Table 1).

**Table 1. The clinical and sociodemographic characteristics of the participants (N=105)**

Variables		N (%)	M±SD
Sex	Female	59 (56.2)	
	Male	46 (43.8)	
Age (years)	65–69	21 (20.0)	76.17±6.54
	70–79	52 (49.5)	
	≥ 80	32 (30.5)	
Education	Primary or none	78 (74.3)	
	Secondary	27 (25.7)	
Religion	Yes	65 (61.9)	
	No	40 (31.8)	
Marital status	Married	60 (57.1)	
	Divorced	3 (2.9)	
	Widowed	42 (40.0)	
Living with family	Yes	69 (65.7)	
	No	36 (34.3)	
Caregiver types	Spouse	36 (34.3)	
	Children	21 (20.0)	
	Employed caregiver	2 (1.9)	
	Self-care	46 (43.8)	
Duration of HBP (years)	≤ 10	63 (60.0)	10.85±7.66
	≥11	42 (40.0)	
No. of HBP Medication	1	68 (64.8)	1.46±0.68
	2	26 (24.8)	
	≥	11 (10.4)	
Comorbidities (Multiple response)	Diabetes	48 (45.7)	
	Cerebrovascular	25 (23.8)	
	Cardiovascular	14 (13.3)	
	Kidney	8 (7.6)	
	Others	62 (59.0)	
BMI (kg/m <sup>2</sup> )	Normal	41 (39.0)	23.72±3.43
	Overweight	35 (33.4)	
	Obese	29 (27.6)	
K-MMSE scores	Normal	43 (41.0)	22.83±4.06
	MCI	56 (53.3)	
	Dementia	6 (5.7)	
MoCA-K scores	Normal	31 (29.5)	19.82±6.32
	MCI	68 (64.8)	
	Known dementia	6 (5.7)	

BMI (body mass index): normal, BMI < 23 kg/m<sup>2</sup>; overweight, 23 ≤ BMI < 25 kg/m<sup>2</sup>; obese, ≥ 25 kg/m<sup>2</sup> BMI; K-MMSE (Korean Mini-Mental State Examination): normal = K-MMSE ≥ 24, MCI (mild cognitive impairment) = 18 ≤ K-MMSE < 23, dementia = K-MMSE ≤ 17; MoCA-K (Montreal Cognitive Assessment–Korean version): normal = MoCA-K ≥ 23, MCI (mild cognitive impairment) = MoCA-K ≤ 22.

Comparisons of hypertension self-care behaviors based on the characteristics of the participants are shown in Table 2. The HBP-SC diet behavior scores for those with and without religious affiliations were 29.35±3.81 points and 27.70± 2.89 points, respectively (F=2.36, p=.020). The HBP-SC health behavior (except diet) scores were higher in those with secondary education or higher (F=-3.20,

p=.001), married persons (F=3.81, p=.025), and those living with family (t=3.16, p=.002). In terms of comorbidities, the HBP-SC health behavior (except diet) score was higher in those with cerebrovascular disease (F=2.72, p=.008). In terms of cognitive function comparisons, the HBP-SC health behavior scores were higher in those with dementia based on the K-MMSE (F=3.57, p=.032) and in those with normal cognitive function on the MoCA-K (F= 3.25, p=.043).

The HBP-SC behavior (total) scores were higher in those with secondary education or higher (t=3.28, p=.004), those living with family (F=2.08, p=.040), those with cerebrovascular disease among other comorbidities (F=2.13, p=.036), and those with dementia based on the K-MMSE (F=3.03, p=.053).

**Table 2. Comparison of the HBP-SC behavior scale scores based on participants' demographics and cognitive functions (N=105)**

Variables	HBP-SC diet behavior		HBP-SC health behavior (except diet)		HBP-SC behavior (total)	
	t (F)	p	t (F)	p	t (F)	p
	M±SD				M±SD	

		M±SD									
Sex	Female	28.73±3.34	0.02	.987	28.66±2.15	-1.96	.053	57.41±4.22	-0.90	.372	
	Male	28.72±3.88			29.52±2.34			58.26±5.54			
Age (years)	65–69	29.85±4.99	1.58	.210	29.00±2.27	0.44	.645	58.85±6.33	1.19	.308	
	70–79	28.71±3.30			29.23±2.24			57.98±4.60			
	≥ 80	28.06±2.83			28.76±2.33			56.82±4.10			
Education	Primary or none	28.24±3.19	-2.40	.063	28.64±2.20	-3.20	.001	56.91±4.34	-3.28	.004	
	Secondary	30.11±4.26			30.19±2.06			60.30±5.37			
Religion	Yes	29.35±3.81	2.36	.020	28.86±2.39	-1.02	.310	58.22±5.16	1.18	.242	
	No	27.70±2.89			29.33±2.03			56.90±4.41			
Marital status	Married <sup>a</sup>	28.95±3.86	0.67	.516	29.55±2.10	3.81	.025	58.52±5.13	1.80	.171	
	Separated <sup>b</sup>	26.67±0.58			28.67±0.58		a>c*	55.33±0.57			
	Widowed <sup>c</sup>	28.55±3.24			28.33±2.40			56.90±4.41			
Living with family	Yes	28.94±3.91	0.86	.388	29.52±2.17	3.16	.002	58.48±5.05	2.08	.040	
	No	28.31±2.80			28.11±2.16			56.44±4.14			
Caregiver types	Spouse	28.94±4.24	0.31	.817	29.47±2.30	1.05	.373	58.44±5.74	0.41	.747	
	Children	28.14±3.62			29.24±2.32			57.38±4.58			
	Employed caregiver	30.00±0.00			29.00±2.83			59.00±2.83			
	Self-care	28.76±3.06			28.61±2.19			57.39±4.27			
Duration of HBP (years)	≤ 10	28.52±3.47	-.70	.485	29.05±2.51	.053	.958	57.60±4.86	-.46	.647	
	11 ≤	29.02±3.74			29.02±1.85			58.05±4.85			
No. of HBP medications	1	28.91±3.71	0.46	.635	29.00±2.42	0.15	.858	57.93±5.10	0.29	.749	
	2	28.62±2.83			29.23±1.48			57.85±2.91			
	3 ≤	27.82±4.38			28.82±2.89			56.73±6.81			
Comorbidities	Diabetes	29.23±3.56	1.11	.271	28.83±2.30	2.72	.008	58.10±5.00	2.13	.036	
	Cerebrovascular	28.96±2.98			29.72±1.77			58.72±3.82			
		29.07±3.61			29.00±2.51			58.14±5.05			
	Cardiovascular	29.00±4.18			29.00±2.51			58.00±5.73			
		28.48±3.43			28.77±2.10			57.27±4.56			
BMI (kg/m <sup>2</sup> )	Normal	28.66±3.69	0.66	.521	29.24±2.44	1.21	.301	57.93±4.89	1.16	.317	
	Overweight	29.23±3.67			29.26±2.17			58.51±5.00			
	Obese	29.23±3.67			28.48±2.09			56.69±4.53			
K-MMSE score	Normal <sup>a</sup>	29.28±4.37	2.82	.064	29.56±2.13	3.57	.032	58.85±5.82	4.44	.014	
	MCI <sup>b</sup>	28.05±2.74			28.65±2.21		a>b*	56.87±3.66			
	Dementia <sup>c</sup>	31.40±2.83			30.20±1.30			60.80±2.95			
MoCA-K score	Normal	29.10±4.39	1.78	.173	29.81±2.30	3.25	.043	58.90±5.90	3.03	.053	
	MCI	28.35±3.14			28.63±2.21			57.00±4.26			
	Known dementia	31.00±2.83			29.67±1.75			60.83±2.64			

\*Scheffé test; HBP-SC, Hypertension Self-Care; BMI, body mass index; K-MMSE, Korean Mini-Mental State Examination; MoCA-K, Montreal Cognitive Assessment–Korean version; MCI, mild cognitive impairment

The characteristics of each item on the HBP-SC behavior scale are shown in Table 3. With respect to HBP-SC diet behavior, the score for the item 'Practice moderate alcohol drinking daily' was the

highest at  $3.76 \pm 0.60$  points, whereas the score for the item 'Read nutrition labels to check information on sodium content' was the lowest at  $1.15 \pm 0.41$  points. With respect to HBP-SC health behavior (except diet), the score for the item 'Not forgetting to fill your prescriptions' (reverse scored) was the highest at  $3.90 \pm 0.48$  points, whereas the score for the item 'Do you check your blood pressure at home?' was the lowest at  $2.17 \pm 0.98$  points. The mean score for HBP-SC diet behavior was  $28.72 \pm 3.57$  points, that for HBP-SC health behavior (except diet) was  $29.04 \pm 2.26$  and that for HBP-SC behavior (total) was  $57.78 \pm 4.84$  points.

**Table 3. Comparison of the means obtained with the HBP-SC behavior items**

Domain	Items	M $\pm$ SD
HBP-SC diet	1. Read nutrition fact labels to check for information on sodium content?	$1.15 \pm 0.41$

behavior	2. Replace traditional high-salt foods (e.g., canned soups, Oodles of Noodles) with low-salt products (e.g., homemade soups, fresh vegetables)?	2.70±0.76
	3. Limit use of high-salt condiments (e.g., ketchup)?	2.60±0.68
	4. Eat less than 1 teaspoon of table salt per day (6 grams)?	2.58±0.68
	5. Eat less food that is high in saturated fats (e.g., red meat, butter) and trans fats (e.g., shortening, lard)?	2.93±0.58
	6. Use broiling, baking, or steaming instead of frying when cooking?	3.04±0.57
	7. Read nutrition labels to check info on saturated fats (e.g., butter, red meat) and trans fats (e.g., lard, shortening)?	1.19±0.54
	8. Replace traditional high-fat foods (e.g., deep fried chicken) with low-fat products (e.g., baked chicken)?	3.01±0.49
	9. Limit total calorie intake from fat (less than 65 grams) daily?	3.01±0.61
	10. Eat 5 or more servings of fruits and vegetables daily?	2.63±0.67
	11. Practice moderation in drinking alcohol daily (2 glasses or less for men; 1 glass or less for women)?	3.76±0.60
		12. Take part in regular physical activity (e.g., 30 minutes of walking 4–5 times per week)?
	13. Practice nonsmoking?	3.80±0.66
	14. Check your blood pressure at home?	2.17±0.98
	15. Not forgetting to take your blood pressure medicine?*	3.88±0.51
HBP-SC Health behavior (except diet)	16. Not forgetting to fill your prescriptions?*	3.90±0.48
	17. Keep your weight down?	2.93±0.67
	18. Monitor situations that cause a high level of stress (e.g., arguments, death in the family) resulting in blood pressure elevation?	2.94±0.39
	19. Engage in activities that can lower stress (e.g., deep breathing, meditation)?	3.02±0.37
	20. See a doctor regularly?	3.85±0.46
HBP-SC Diet behavior score	M±SD	28.72±3.57
HBP-SC health behavior (except diet) score	M±SD	29.04±2.26
HBP-SC Behavior (total) score	M±SD	57.78±4.84

\* reverse

MoCA-K scores were significantly correlated with HBP-SC diet behavior scores ( $r=.27$ ,  $p<.010$ ),

HBP-SC health behavior (except diet) scores ( $r=.32$ ,  $p<.010$ ), and HBP-SC behavior (total) scores ( $r=.35$ ,  $p<.001$ ) in older adults with hypertension. K-MMSE scores were significantly correlated with HBP-SC health behavior (except diet) scores ( $r=.26$ ,  $p<.010$ ) (Table 4).

**Table 4. Correlations of cognitive function and participants' characteristics with HBP-SC behavior scores (N=105)**

Variables	HBP-SC diet behavior		HBP-SC health behavior (except diet)		HBP-SC behavior (total)	
	r	p	r	p	r	p
MoCA-K	.27	<.010	.32	<.010	.35	<.001
K-MMSE	.13	.175	.26	<.010	.22	<.050
Age	-.10	.324	-.04	.699	-.09	.360
Duration of HBP	.08	.397	-.03	.764	.05	.646
Number of antihypertensive drugs	-.09	.361	.00	.991	-.06	.524

HBP-SC, Hypertension Self-Care; MoCA-K, Montreal Cognitive Assessment–Korean version; K-MMSE, Korean Mini-Mental State Examination

**Table 5. Results of multivariate analysis for HBP SC behavior scale scores in older adults with hypertension (N=105)**

Variables	Categories	B	SE	$\beta$	p	$R^2$	Adj $R^2$	F (p)
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HBP-SC diet behavior	Religion *	1.93	0.69	.27	.007	.14	.13	8.05 (.001)
	MoCA-K	0.24	0.08	.31	.002			
	Education *							
	Marital status*	0.46	0.63	.09	.468	.25	.20	4.97(<.001)
HBP-SC health behavior (except diet)	Living with family *	0.18	0.59	.04	.769			
	Comorbidities*	1.10	0.58	.23	.060			
	K-MMSE scores	-1.31	0.60	-.20	.032			
	MoCA-K scores	0.22	0.15	.35	.137			
		-0.08	0.12	-.16	.513			
	Education *							
HBP-SC behavior (total)	Living with family	1.60	1.36	.15	.243	.18	.14	4.11(.002)
	Comorbidities	1.32	1.04	.13	.208			
	K-MMSE scores	-1.95	1.33	-.14	.145			
	MoCA-K scores	0.11	0.33	.08	.733			
		0.14	0.27	.13	.600			

\*Dummy variables: religion (no religion: 0; Christian, Catholic, and Buddhist: 1), education level (below primary school: 0; middle school graduate or above: 1), marital status (separated and bereaved: 0; married: 1), living with family (no: 0; yes: 1), and comorbidities (no: 0; yes: 1).

The results of the multiple regression analysis to investigate factors affecting self-care behavior in older adults with hypertension revealed that religion ( $\beta = .27$ ,  $SE = 0.69$ ,  $p = .007$ ) and MoCA-K scores ( $\beta = .31$ ,  $SE = 0.08$ ,  $p = .002$ ) significantly affected HBP-SC diet behavior in older adults with hypertension, and the explanatory power of these factors was 13%. Among the factors affecting HBP-SC health behavior (except diet) scores, having comorbidities ( $\beta = -.20$ ,  $SE = 0.60$ ,  $p = .032$ ) was significant, whereas education, marital status, living with family, K-MMSE scores, and MoCA-K scores were not significant. The explanatory power of the model was 20% (Table 5).



## Discussion

This study identified factors affecting HBP-SC behavior based on cognitive function in older adults with hypertension, analyzed overall HBP-SC behavior, and stratified these behaviors into HBP-SC diet behavior and HBP-SC health behavior (except diet) categories. The factors affecting HBP-SC diet behavior in elderly adult hypertensive patients were religion and MoCA-K performance, and that affecting HBP-SC health behavior (except diet) was having a comorbidity.

Religion was a factor affecting HBP-SC diet behavior, similar to a study that reported that older adults who frequently attend religious events were more likely to practice health-promoting behaviors [29]. This study revealed that lower MoCA-K scores were associated with lower HBP-SC diet behavior scores, which is comparable to the results of a study by Harkness et al. (2014) [30] showing that lower MoCA scores indicated poorer self-care behavior in older adults with cardiovascular disease. However, the aforementioned study did not compare self-care behavior after evaluating cognitive function using the MoCA in patients, unlike in the present study, and thus, it is difficult to make a direct comparison between the two.

With respect to having a comorbidity as a factor affecting HBP-SC health behavior (except diet), the results of a previous study reported that the presence of comorbidities in old adult patients with heart failure and cognitive impairment negatively affected self-care behavior, which was similar to the results of this study, but the present study differed in terms of the participants by including only older adults with hypertension [31]. Nevertheless, when comparing the aforementioned results, it is thought that the presence of comorbidities (including hypertension) in older adults is a factor affecting self-care behavior.

In this study, the K-MMSE and MoCA-K were used to assess HBP-SC behavior in relation to the participants' cognitive function. The results showed that the mean K-MMSE score in the participants was 22.83 points, indicating that the participants in this study had mild cognitive impairment on average. In terms of self-care behavior based on K-MMSE scores, lower K-MMSE scores were associated with lower levels of self-care behavior assessed with both HBP-SC health behavior (except diet) and HBP-SC behavior (total). There are a limited number of previous studies that evaluated cognitive function using the MMSE or MoCA and then compared HBP-SC behaviors

based on cognitive function status. However, a study involving patients with heart failure reported that lower MMSE scores were associated with lower medication adherence [32], and another study involving patients undergoing hemodialysis reported that lower MMSE scores were associated with lower levels of self-care behavior [33], suggesting that older adults with chronic diseases primarily need to have their cognitive function assessed and then have their self-care behavior analyzed based on cognitive function status. In addition, the mean MoCA-K score was 19.82 points, indicating that the participants had mild cognitive impairment on average, which was similar to the K-MMSE results. In this study, those who were judged to have normal cognitive function from the K-MMSE results but were at the boundary of mild cognitive impairment were identified as having mild cognitive impairment through the secondary measurement, the MoCA-K, which is a distinctive feature of this study.

The results of the item analysis of the HBP-SC diet behavior domain showed that the score for the item 'Read nutrition labels to check information on sodium content when purchasing food' was the lowest, indicating that it is necessary to enhance awareness among Korean older adults to check nutrition labels when purchasing food. However, the results of a study by Han et al. (2014) [28] found that the score for the item 'Read the nutrition labels when purchasing food' was the highest, indicating a difference in this item between Korean and American older adults. Considering a study showing that the use of nutrition labels developed in an easy format for older adults had positive effects on label knowledge, usage, and attitudes [34], it is necessary to conduct various studies regarding nutrition labeling for older adults with hypertension in South Korea.

The results of the item analysis of the HBP-SC health behavior (except diet) domain revealed that the score for the item 'Check my blood pressure at home' was the lowest. In a study by Buis et al. (2020) [35], continuous blood pressure monitoring at home with data entry into a mobile machine and the provision of personalized interventions were effective in controlling blood pressure levels. Thus, a national health care approach that provides home blood pressure monitors can be explored.

With respect to MoCA-K scores, which affected contextual HBP-SC diet behavior, lower MoCA-K scores were found to be associated with lower levels of HBP-SC diet behavior, and a tablet PC using IoT can be installed in the kitchen to help those with impaired cognitive function prepare meals [36]. In addition, self-care behavior was found to be low in older adults with hypertension and comorbidities.

Previous studies have reported that self-care behavior was poorer in hypertensive patients with cardiovascular disease or diabetes with more severe comorbid states [31,37]. In light of these findings, comorbidities in older adults with hypertension should be taken into consideration when attempting to improve self-care behavior [38]

In the multiple regression analysis, significant influencing variables were not found, but variables that were found to have a difference in hypertension self-care behavior included education level, marital status, living with family, and the K-MMSE score. In other words, a higher education level and married persons living with family were associated with higher self-care behavior, and lower K-MMSE scores were associated with poorer levels of self-care behavior [13,39,40]. Therefore, replicating this study and including a large number of participants to examine variables such as education level, marital status, living with family, and K-MMSE score will be meaningful.

The significance of this study is as follows. First, cognitive function was assessed with both the K-MMSE and MoCA-K, which are validated tools for the assessment of older adults with hypertension, and the factors affecting hypertension self-care behavior based on cognitive function status were analyzed. Those who were found to have normal cognitive function using the K-MMSE were identified as having mild cognitive impairment using the MoCA-K. Then, these participants were classified as having mild cognitive impairment to analyze factors affecting their hypertension self-care behaviors. Previous studies have shown that hypertension in older adults not only causes complications but also reduces cognitive function [40] and that those with mild cognitive impairment have higher rates of progression to dementia than those with non-mild cognitive impairment [41-44]. Therefore, the management of hypertension in older adults is related to chronic disease management and deterioration of cognitive function in normal older adults, indicating that cognitive function in older adults is an important factor for improving self-care behavior in older adults with hypertension. Therefore, tailored intervention programs that carefully consider cognitive function status in older adults are needed for the management of hypertension in older adults.

Second, HBP-SC behavior was divided into two factors: HBP-SC diet behavior and HBP-SC health behavior (except diet). This was based on the results of a study [27] regarding the validity of the Korean version of the HBP-SC behavior scale [27], in which the Korean version was validated by dividing it into two categories of self-care diet behavior and self-care behavior except diet. In the

multiple regression analysis, no significant variable was identified for the HBP-SC behavior total score. However, when it was divided and analyzed into HBP-SC diet behavior and HBP-SC health behavior (except diet), the results derived significant variables such as religion and MoCA score in the HBP-SC diet behavior category and having a comorbidity in the HBP-SC health behavior except diet category. In the sense that individuals' active religious activities indicate socialization, they may affect their hypertension diet management, with those with higher MoCA scores or better cognitive function able to pay greater attention to their diet management. The presence of comorbidities in the HBP-SC health behavior (except diet) domain was found to be a factor affecting self-care because those with more chronic diseases face greater difficulties in practicing healthcare behaviors [39].

This study had the following limitations. First, the Cronbach's  $\alpha$  value of the HBP-SC behavior scale used in this study was lower than that at the time of the development of the original tool [27] and lower than that observed in another study that employed the same scale (Kim, 2019) [45]. At the time of development of the original scale, the study participants were generally older adults aged 65 or older, and their cognitive function statuses could not be identified as they were not measured. Another study (Kim, 2019) [45] that involved older adults with normal cognitive function included participants with a K-MMSE score of 25 points or higher, which was higher than that of the participants in the present study, who obtained a mean K-MMSE score of 22.83 points. Therefore, the differences in Cronbach's  $\alpha$  values may be due to the differences in the cognitive function of the participants between the two studies.

Second, the levels of self-care behavior in those diagnosed with dementia based on the K-MMSE results were found to be higher, which may be because the participants completed the questionnaire together with their respective primary caregivers and usually received direct help from their caregivers in treating their hypertension. In addition, future studies examining depression, self-efficacy, and social support, which have been found to be variables affecting self-care behavior, are needed. Because this study collected data randomly from hypertensive older adults who visited a single general hospital located in S City, it is difficult to generalize the results of this study.

## **Conclusions**

Factors affecting self-care behavior in older adults with hypertension based on cognitive function

included religion, MoCA-K scores, and comorbidities. Having a religion was associated with higher levels of self-care, and a lower MoCA-K score was associated with poorer HBP-SC diet behavior. HBP-SC health behaviors (except diet) were poorer in those with comorbidities. Therefore, to improve self-care behavior in older adults with hypertension, it is necessary to consider their religious practices and comorbidities, assess their cognitive function, and provide tailored education to them.

### **Abbreviations**

HBP-SC: Hypertension Self-Care

MoCA-K: Montreal Cognitive Assessment–Korean version

K-MMSE: Korean Mini-Mental State Examination

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### **Authors’ contributions**

Conceptualization or/and Methodology: JSY and KJM. Data collection or/and Analysis: JSY and KJM. Writing: original draft and/or review & editing: JSY and KJM. The authors read and approved the final manuscript.

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### **Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

### **Ethics approval and consent to participate**

The present study was approved by the Institutional Review Board (IRB, 40525-201906-HR-029-02) at Keimyung University in Daegu City. The participants provided written consent after the study purpose was explained to them. The consent form outlined that participation is voluntary, participant anonymity will be protected, participants may withdraw their participation whenever they desire with no repercussions, and the collected data will be used solely for research purposes.

### **Consent for publication**

Not applicable.

### **Competing interests**

The authors declare that they have no competing interests.

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