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Factors Affecting the Risk of Cardiovascular Disease in Postmenopausal Women: A Postmenopausal Period-Stratified Analysis

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Purpose: This study aimed to investigate the factors affecting the risk of cardiovascular disease among postmenopausal Korean women.
Methods: This postmenopausal period-stratified analysis used secondary data from the Korea National Health and Nutrition Examination Survey from 2016 to 2018. We selected 1,465 participants with all the relevant data for analysis. The Chi-square test and multiple logistic regression analysis were used to analyze the data.
Results: Age, subjective health status, body mass index, and triglyceride level were the factors that influenced the risk of cardiovascular disease for women with a postmenopausal period ≤5 years, whereas age, subjective health status, household income, body mass index, and triglyceride level were the factors that influenced the risk of cardiovascular disease for women with a postmenopausal period >5 years and ≤10 years.
Conclusion: Planning health promotion strategies to lower the risk of cardiovascular disease in women must consider the differences among women according to the menopausal status and postmenopausal period.

Keywords: cardiovascular diseases; menopause; postmenopause; nutrition surveys; socioeconomic factors

Introduction

Cardiovascular disease (CVD), including ischemic heart disease and stroke, is the leading global cause of death in women [1]. It remains a major cause of disease burden and contributor to disability and increasing health care costs [2]. The Global Burden of Disease Study 2019 reported that the total number of CVD cases among women was approximately 275 million, which is almost twice that in 1990, and 35% of women died of CVD in 2019 [3]. However, women with CVD have been understudied, under-recognized, underdiagnosed, and undertreated [4]. Prior studies have reported that middle-aged women have low risk awareness of CVD, and despite having risk factors for CVD, the health practices for prevention are insufficient [4,5]. Recognizing female-specific CVD risk factors could help with early detection and increased screening of at-risk women [4]. Additionally, early detection and management of CVD risk factors are important for reducing the CVD prevalence and CVD-related premature mortality among women [6].

Menopause increases CVD risk in women and is possibly associated with a complex menopausal transition and aging process [7], especially in those aged 55 years and older [8]. Critical traditional risk factors for CVD are age, high blood pressure, diabetes, dyslipidemia, smoking, alcohol consumption, obesity, and inactivity [9]. However, the severities of sex-specific CVD risk factors in women, such as mental factors, socioeconomic factors, cultural factors, and menopause, are less known and their importance understudied [4,10].

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Female-specific CVD risk factors include gestational diabetes, polycystic ovary syndrome, preeclampsia, and menopause [8]. Among traditional CVD risk factors, there are factors that disproportionately affect men and women. Diabetes and hypertension further increase the CVD mortality risk in women, and obesity further increases the prevalence of CVD in women [8]. Before menopause, the action of estrogen protects against CVD, but after menopause, dyslipidemia occurs due to the decrease in estrogen levels and the increase in follicle-stimulating hormone and progesterone levels, which are risk factors for CVD [11,12]. The younger the age at the start of menopause, and in the case of artificial menopause, the longer the menopausal period, the significantly higher the risk of CVD [6,13,14].

According to the Stages of Reproductive Aging Workshop, the stages of menopause are divided into seven stages: stages -5, -4, and -3 are categorized as premenopausal periods; stage -2 and -1 are the menopause transition period; and stages +1 and +2 are categorized as postmenopausal periods [15]. As the average age increases, women spend more than one-third of their lifespan in the postmenopausal stage, during which the risk of CVD continues to increase [14,16]. The postmenopausal period is divided into early postmenopausal (early postmenopausal periods ≤ 5 years after final menstrual period) and late postmenopausal (late postmenopausal periods > 5 years after final menstrual period) periods [15]. According to prior studies, there are differences in CVD symptoms and risk factors depending on the stage of menopause [6,17]. The early postmenopausal stage is associated with a marked reduction in vascular function and hypertension, while the risks of decreased executive function (planning and mental flexibility), CVD, and bone density reduction are increased more in the late postmenopausal stage [17-19].

The Framingham Risk Score (here in after referred to as FRS) is one of the most used cardiovascular disease risk assessment tools worldwide because it can evaluate the risk of cardiovascular disease 10 years later in subjects who are not diagnosed with cardiovascular disease [20]. The FRS is composed of variables such as gender, age, cholesterol, smoking, systolic blood pressure, and diabetes [21]. Variable risk factors excluding gender and age are ones we can influence by changing bad habits and therefore, it is very important to investigate and timely intervene the comprehensive CVD risk factors such as socioeconomic characteristics, health-related characteristics, and lifestyle factors [22]. FRS is a tool that is mainly estimated based on body measurements and it has been considered less sensitive to healthy subjects. Therefore, it is required to identify additional CVD risk factors for healthy subjects [23]. This study aimed to provide basic data for the early detection and customized management of CVD in menopausal women by identifying comprehensive CVD risk factors according to the postmenopausal period. The specific objectives of the study are as follows:

1. To present the CVD risk classified according to the criteria of the FRS sorted by each postmenopausal period.
2. To compare the differences in the risk of CVD among postmenopausal period ≤ 5 years and those with a postmenopausal period > 5 years and ≤ 10 years, according to the comprehensive variables
3. To identify factors affecting the risk of CVD according to the postmenopausal period.

Methods

1. Study design

This study is a cross-sectional study to provide basic data for early detection and customized management of cardiovascular disease in postmenopausal women by identifying comprehensive cardiovascular risk factors according to postmenopausal period.

2. Participants

We analyzed data from the Korea National Health and Nutrition Examination Survey(KNHANES) conducted from 2016 to 2018 [24]. The KNHANES is a nationally representative survey conducted by the Korean Ministry of Health and Welfare. We recruited 1,528 participants with a natural menopausal period < 10 years who participated in a health examination of the KNHANES from 2016 to 2018. Patients with missing values were excluded (n = 63). In total, 1,465 participants were included finally. In this study, women with a postmenopausal period ≤ 5 years were referred to as group 1, and those with a postmenopausal period > 5 years but ≤ 10 years were referred to as group 2.

3. Measurements

Framingham risk score

The variables of the FRS included age, high-density lipoprotein cholesterol (HDL-C), total cholesterol, systolic blood pressure (SBP), smoker, diabetics [21]. Blood pressure was measured by a skilled nurse. Serum total and HDL cholesterol levels were determined with standardized enzymatic methods. Cigarette smoking status was ascertained by self-report. Diabetes was defined as diagnosed with diabetes by a physician. Antihypertensive medication use was ascertained based on self-report.

General characteristics

The general characteristics were age (< 55 years, 55–59 years, or ≥ 60 years), marital status (married or single), subjective body shape recognition (thin, normal, or fat), and subjective health status (good, normal, or poor).

Socioeconomic characteristics

Socioeconomic characteristics were level of education (graduated from elementary school or lower, graduated from middle school, or graduated from high school or higher), household income (low, mid-low, mid-high, or high), and employment (no or yes).

Health behaviors

Health behaviors included exercise (less than moderate physical activity, moderate physical activity, or intense physical activity), sleep duration (< 8 hours or ≥ 8 hours), and frequency of breakfast consumption (< 5 times a week or ≥ 5 times a week).

Physical health condition

The physical health variables were body mass index (BMI) [normal (< 23 kg/m^2), pre-obese (23 to < 25 kg/m^2), obese (≥ 25 kg/m^2), or high obesity (≥ 30 kg/m^2)] according to the Asia-Pacific obesity guidelines [25], waist circumference (WC) (< 85 cm or ≥ 85 cm), and triglyceride (TG) level (< 150 mg/dL or ≥ 150 mg/dL). Height and body weight were measured using a standardized protocol, and the BMI was calculated as weight (kg)/height (m^2). WC was measured at a point midway between the tenth rib and the iliac crest and recorded in centimeters [26]. WC and TG were defined in accordance with the criteria from the National Cholesterol Education Program Adult Treatment Panel III modified for the Asian population [27].

Psychological health condition

The psychological health conditions included counseling for a psychiatric problem for 1 year (no or yes) and stress (low or high).

4. Data collection

We analyzed data from the KNHANES conducted from 2016 to 2018. The KNHANES is a nationally representative survey conducted by the Korean Ministry of Health and Welfare. Data are available from the Korea National Health and Nutrition Examination Survey (KNHANES), conducted by the Korea Centers for Disease Control and Prevention (KCDCP), and are freely available from KCDCP [24].

5. Ethical consideration

All participants voluntarily agreed to take part in the study prior to the start of the survey and provided informed consent. The Korea National Health and Nutrition Examination Survey (KNHANES) was approved by the institutional review board of the KCDC (approval number: 2018-01-03-P-A). This study was exempted from the IRB review by the Ansan university ethics committee (2022-10-0003).

6. Data analysis

The CVD risk was classified according to the criteria of the FRS [21]. The higher the score on the FRS, the higher the risk of CVD. In this study, the group was classified into a low cardiovascular disease risk group (less than 10%) and a high cardiovascular disease risk group (more than 10%) [20]. The number and proportion of women in each category were analyzed using descriptive statistics. Differences in the CVD risk during the postmenopausal periods (≤ 5 years, > 5 years, and ≤ 10 years) were analyzed using the Chi-square test. Multiple logistic regression analysis was performed to assess the association of CVD factors with the postmenopausal period, and the following variables were included in the analysis: general characteristics, socioeconomic status, health behaviors, physical health condition, and psychological health condition (age, marital status, subjective body shape recognition, subjective health status, level of education, household income, employment, exercise, sleep hours, frequency of breakfast consumption, BMI, WC, TG level, counseling for a psychiatric problem, and stress). In the multiple logistic regression analysis, the dependent variable for encoding was set to 0 for CVD low risk and 1 for CVD high risk.

SPSS, version 26.0 (IBM Corp., Armonk, NY, USA) was used to analyze the data. Differences were considered statistically significant at $p < .05$.

Results

Table 1 presents the CVD risk according to the variable results of the FRS [21] sorted by each postmenopausal period. Most women in group 1 (postmenopausal period ≤ 5 years) were 55–54 years of age (43.0%, 7 points), whereas those in group 2 (5 < postmenopausal period ≤ 10 years) were 55–59 years of age (46.0%, 8 points). Most women in group 1 had high-density lipoprotein cholesterol (HDL-C) levels > 60 mg/dL (31.9%, -2 points), whereas most women in group 2 had HDL-C levels of 50–59 mg/dL (31.6%, -1 point). The total cholesterol levels of participants in groups 1 and 2 were mostly 200–239 mg/dL

Table 1. Cardiovascular Disease Risk According to the Variable Results of the Framingham Risk Score (N = 1,465)

Points	Age, y		HDL-C		Total Cholesterol		SBP Not Treated		SBP Treated		Smoker		Diabetic	
	1 (n = 784)	2 (n = 681)	1 (n = 784)	2 (n = 681)	1 (n = 784)	2 (n = 681)	1 (n = 663)	2 (n = 497)	1 (n = 121)	2 (n = 184)	1 (n = 784)	2 (n = 681)	1 (n = 784)	2 (n = 681)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
–3							427 (64.4)	259 (52.1)						
–2			250 (31.9)	203 (29.8)										
–1			239 (30.5)	215 (31.6)					39 (32.2)	57 (31.0)				
0			125 (15.9)	111 (16.3)	77 (9.8)	83 (12.2)	120 (18.1)	126 (25.4)			748 (95.4)	654 (96.0)	721 (92.0)	588 (86.3)
1			142 (18.1)	128 (18.8)	238 (30.4)	240 (35.2)	59 (8.9)	59 (11.9)						
2			28 (3.6)	24 (3.5)			35 (5.3)	31 (6.2)	40 (33.1)	42 (22.8)				
3					313 (39.9)	238 (34.9)			19 (15.7)	40 (21.7)	36 (4.6)	27 (4.0)		
4	4 (0.5)				128 (16.3)	88 (12.9)	13 (2.0)	13 (2.6)					63 (8.0)	93 (13.7)
5	68 (8.7)	6 (0.9)			28 (3.6)	32 (4.7)	9 (1.4)	9 (1.8)	13 (10.7)	28 (15.2)				
6									9 (7.4)	10 (5.4)				
7	337 (43.0)	53 (7.8)							1 (0.8)	7 (3.8)				
8	327 (41.7)	313 (46.0)												
9	46 (5.9)	274 (40.2)												
10	2 (0.3)	33 (4.8)												
11														
12		2 (0.3)												
Total			1 (n = 784)		CVD high risk (risk ≥ 10%)				102 (13.0)				48.05***	
			2 (n = 681)		CVD high risk (risk ≥ 10%)				187 (27.5)					

1 = postmenopausal period ≤5 years; 2 = 5 < postmenopausal period ≤10 years; HDL-C = high-density lipoprotein cholesterol; CVD = cardiovascular disease; ***p <.001.

(39.9%, 3 points) and 160-199 mg/dL (35.2%, 1 point), respectively. In groups 1 (64.4%) and 2 (52.1%), the systolic blood pressure was < 120 (-3 points) in most women who did not undergo blood pressure management. Most women in group 1 receiving blood pressure treatment had a systolic blood pressure of 120-129 mmHg (33.1%, 2 points). However, the systolic blood pressure of most women in group 2 receiving blood pressure treatment was < 120 mmHg (31.0%, -1 point). In groups 1 and 2, most women were non-smokers (95.4% and 96.0%, respectively; 0 point each), and most of them were not diagnosed with diabetes (92.0% and 86.3%, respectively; 0 point each). In group 1, 13% of subjects were CVD high risk, whereas in group 2, 27.5% of subjects were CVD high risk. There was a significant difference in CVD high risk between the two groups. (p <.001) Table 2 shows the differences in the risk of CVD among postmenopausal periods ≤ 5 years (group 1) and 5 < to ≤ 10 years (group 2), according to comprehensive variables. Group 1 with a high risk of CVD were mostly aged 55–59 years (51.0%), married (95.1%), reported subjective body shape recognition as "fat" (70.6%), perceived subjective health status as "normal" (52.9%), graduated from high school or higher (55.9%), had a mid-high household income (32.4%), were employed (59.8%), did not exercise (81.4%), slept for < 8 hours (81.4%), ate breakfast ≥ 5 times a week (68.6%), had a BMI of 25-29.9 kg/m^2 (43.1%), WC < 85

Table 2. Difference in the Risk of Cardiovascular Disease According to Comprehensive Variables According to the Postmenopausal Period Stratified Analysis (*N*=1,465)

Variable	Categories	Menopause period ≤ 5			5 < Menopause period ≤ 10		
		CVD low risk (risk < 10%) (n=682) n (%)	CVD high risk (risk ≥ 10%) (n=102) n (%)	χ^2	CVD low risk (risk < 10%) (n=494) n (%)	CVD high risk (risk ≥ 10%) (n=187) n (%)	χ^2
General Characteristics							
Age	< 55	376 (55.1)	33 (32.4)	32.53***	48 (9.7)	11 (5.9)	32.68***
	55–59	275 (40.3)	52 (51.0)		255 (51.6)	58 (31.0)	
	≥ 60	31 (4.5)	17 (16.7)		191 (38.7)	118 (63.1)	
Marital status	Married	670 (98.2)	97 (95.1)	4.13*	482 (97.6)	186 (99.5)	2.60
	Single	12 (1.8)	5 (4.9)		12 (2.4)	1 (0.5)	
Subjective body shape recognition	Thin	66 (9.7)	6 (5.9)	20.92***	56 (11.3)	15 (8.0)	8.46*
	Normal	300 (44.0)	24 (23.5)		214 (43.3)	64 (34.2)	
	Fat	316 (46.3)	72 (70.6)		224 (45.3)	108 (57.8)	
Subjective health status	Good	207 (30.4)	16 (15.7)	17.22***	118 (23.9)	28 (15.0)	7.65*
	Normal	362 (53.1)	54 (52.9)		282 (57.1)	112 (59.9)	
	Poor	113 (16.6)	32 (31.4)		94 (19.0)	47 (25.1)	
Socioeconomic characteristics							
Level of education	Graduated an elementary school or lower	68 (10.0)	25 (24.5)	20.98***	105 (21.3)	72 (38.5)	22.03***
	Graduated a middle school	106 (15.5)	20 (19.6)		121 (24.5)	42 (22.5)	
	Graduated a high school or higher	508 (74.5)	57 (55.9)		268 (54.3)	73 (39.0)	
Household income	Low	53 (7.8)	16 (15.7)	10.08*	63 (12.8)	42 (22.5)	17.25**
	Mid-low	142 (20.8)	21 (20.6)		133 (26.9)	61 (32.6)	
	Mid-high	190 (27.9)	33 (32.4)		141 (28.5)	47 (25.1)	
	High	297 (43.5)	32 (31.4)		157 (31.8)	37 (19.8)	
Employment	No	240 (35.2)	41 (40.2)	0.96	204 (41.3)	82 (43.9)	0.36
	Yes	442 (64.8)	61 (59.8)		290 (58.7)	105 (56.1)	
Health behaviors							
Exercise	No	482 (70.7)	83 (81.4)	6.37*	387 (78.3)	158 (84.5)	3.78
	Moderate physical activity	151 (22.1)	17 (16.7)		85 (17.2)	25 (13.4)	
	Intensity physical activity	49 (7.2)	2 (2.0)		22 (4.5)	4 (2.1)	
Sleep hours frequency of breakfast	< 8	517 (75.8)	83 (81.4)	1.53	382 (77.3)	125 (66.8)	7.83**
	≥ 8	165 (24.2)	19 (18.6)		112 (22.7)	62 (33.2)	
	< 5 times a week	196 (28.7)	32 (31.4)	0.29	96 (19.4)	38 (20.3)	0.06
	≥ 5 times a week	486 (71.3)	70 (68.6)		398 (80.6)	149 (79.7)	
Physical health condition							
BMI, kg/m^2	< 23	288 (42.2)	19 (18.6)	34.58***	211 (42.7)	45 (24.1)	42.32**
	23~ < 25	189 (27.7)	25 (24.5)		125 (25.3)	36 (19.3)	
	25~ < 30	171 (25.1)	44 (43.1)		139 (28.1)	82 (43.9)	
	≥ 30	34 (5.0)	14 (13.7)		19 (3.8)	24 (12.8)	
WC, cm	< 85	536 (78.6)	59 (57.8)	20.88***	369 (74.7)	103 (55.1)	24.53***
	≥ 85	146 (21.4)	43 (42.2)		125 (25.3)	84 (44.9)	
TG, mg/dl	< 150	545 (79.9)	53 (52.0)	38.30***	413 (83.6)	100 (53.5)	66.25***
	≥ 150	137 (20.1)	49 (48.0)		81 (16.4)	87 (46.5)	
Psychological health condition counseling for a psychiatric problem							
	No	660 (96.8)	98 (96.1)	0.13	480 (97.2)	180 (96.3)	0.37
	Yes	22 (3.2)	4 (3.9)		14 (2.8)	7 (3.7)	
Stress	Low	522 (76.5)	74 (72.5)	0.77	382 (77.3)	146 (78.1)	0.04
	High	160 (23.5)	28 (27.5)		112 (22.7)	41 (21.9)	

BMI = body mass index; WC = waist circumference, TG = triglyceride, CVD = cardiovascular disease.
*p <.05, **p <.01, ***p <.001.

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cm (57.8%), TG level < 150 mg/dL (52.0%), no history of counseling for psychiatric problems (96.1%), and low stress level (72.5%). Group 2 with a high risk of CVD were mostly aged 60 years or older (63.1%), married (99.5%), reported subjective body shape recognition as "fat" (57.8%), perceived subjective health status as "normal" (59.9%), graduated from high school or higher (39.0%), had a mid-low household income (32.6%), were employed (56.1%), did not exercise (84.5%), slept for < 8 hours (66.8%), ate breakfast > 5 times a week (79.7%), had a BMI of 25-29.9 kg/m^2 (43.9%), WC < 85 cm (55.1%), TG level < 150 mg/dL (53.5%), no history of counseling for psychiatric problems (96.3%), and low stress level (78.1%). There were significant differences in age (p < .001), marital status (p = .042) subjective body shape recognition (p < .001), subjective health status (p < .001), level of education (p < .001), household income (p = .018), exercise (p = .041), BMI (p < .001), WC (p < . 001), and TG level (p < .001) between women with low risk and high risk of CVD in group 1. There were also significant differences in age (p < .001), subjective body shape recognition (p = .015), subjective health status (p = .022), level of education (p < .001), household income (p = .001), sleep duration (p = .005), BMI (p < .001), WC (p < .001), and TG level (p < . 001) between the women with low risk and high risk of CVD in group 2.

Table 3 shows results of the multiple logistic regression analysis of factors that significantly affected the risk of CVD according to the postmenopausal period. For group 1, the risk of CVD was higher in those aged 55-59 years (odds ratio [OR] = 2.21, 95% confidence interval [CI] = 1.32–3.69) and ≥ 60 years (OR = 6.09, 95% CI = 2.60–14.24) than in those aged < 55 years. Group 1 with a poor subjective health status (OR = 2.32, 95% CI = 1.10–4.91) were more likely to have CVD than those with a good subjective health status. The risk of CVD was higher in group 1 with 25 kg/m^2 ≤ BMI < 30 kg/m^2 (OR = 2.72, 95% CI = 1.10–6.70) and a BMI ≥ 30 kg/m^2 (OR = 4.17, 95% CI = 1.22–14.28) than in those with a BMI < 23 kg/m^2. The risk of CVD was higher in group 1 with a TG level ≥ 150 mg/dL (OR = 3.08, CI = 1.87–5.04) than in those with a TG level < 150 mg/dL.

For group 2, the risk of CVD was higher in those aged ≥ 60 years (OR = 2.59, 95% CI = 1.18–5.68) than in those aged < 55 years. Group 2 with a poor subjective health status (OR = 2.05, 95% CI = 1.07–3.94) were more likely to have CVD than those with a good subjective health status. The risk of CVD was lower in group 2 with high household income (OR = 0.41, 95% CI = 0.21–0.79) than low household income. The risk of CVD was higher in group 2 with 25 kg/m^2 ≤ BMI < 30 kg/m^2 (OR = 2.83, 95% CI = 1.40–5.72) and a BMI ≥ 30 kg/m^2 (OR = 6.79, 95% CI = 2.44–18.93) than in those with a BMI < 23 kg/m^2. The risk of CVD was higher in group 2 with a TG level ≥ 150 mg/dL (OR = 3.90, 95% CI = 2.56–5.92) than in those with a TG level < 150 mg/dL.

Dicussion

The present study revealed that the factors that increase the risk of CVD in postmenopausal women include not only physical health conditions and health behaviors but also socioeconomic characteristics. This study also found that CVD risks and influencing factors differed between the early and late postmenopausal groups.

As a result of this study, the risk of cardiovascular disease by menopause classified according to the criteria of the FRS was significantly higher in group 2 than in group 1. The average ages of women in the current study were 56.50 years overall, 54.21 years in group 1, and 59.14 years in group 2. It is thought that these data may have influenced the inclusion of age in the score items of the FRS [21]. As a result of comparing the differences in the risk of cardiovascular disease in each group according to the comprehensive variables, significant interventional variables were identified as exercise in group 1 and sleep in group 2. The result of group 1 was the same as those of previous studies that lack of physical activity increases the risk of CVD [28]. As a result of group 2, the risk of cardiovascular disease was confirmed in the group with more hours of sleep, which supports the results of previous studies that the risk of cardiovascular disease increased in those who slept more than 8 hours [29].

Age, subjective health status, BMI, and TG were included as in the final regression analysis as factors affecting CVD risk for both group 1 and 2. In addition, income was included in this analysis as a factor affecting CVD risk in group 2. In previous studies, low socioeconomic status was associated with significantly greater CVD risk in women [30,31]. Prior studies also reported that women with low incomes were more likely to develop CVD than those with high incomes. Moreover, socioeconomic status is inversely related to risk of cardiovascular disease and mortality [4,30], and low income is strongly associated with risk of cardiovascular disease in women [32]. These results of these previous studies are consistent with the results of the present study. The main characteristic of low-income women was reported as old age [33]. In the final regression analysis, we think the fact that income was analyzed as a significant influencing factor only in the group with group 2, as this was related to aging. As old age and low income are risk factors for CVD, a health management strategy for

Table 3. Odds Ratios and 95% Confidence Intervals for Cardiovascular Disease Risk Factors in the Multiple Logistic Regression Analysis (*N*=1,465).

Variable	Categories	Menopause period ≤ 5 (n = 784)		5 < Menopause period ≤ 10 (n = 681)	
		OR	95% CI	OR	95% CI
Age	< 55	1.00		1.00	
	55–59	2.21**	1.32–3.69	1.06	0.48–2.34
	≥ 60	6.09***	2.60–14.24	2.59*	1.18–5.68
Marital status	Married	1.00		1.00	
	Single	3.12	0.83–11.73	0.16	0.01–1.37
Subjective body shape recognition	Thin	1.00		1.00	
	Normal	0.51	0.18–1.45	0.89	0.43–1.86
	Fat	0.72	0.22–2.29	0.6	0.25–1.42
Subjective health status	Good	1.00		1.00	
	Normal	1.43	0.76–2.69	1.61	0.94–2.77
	Poor	2.32*	1.10–4.91	2.05*	1.07–3.94
Level of education	Graduated an elementary school or lower	1.00		1.00	
	Graduated a middle school	0.62	0.28–1.34	0.7	0.41–1.20
	Graduated a high school or higher	0.55	0.28–1.07	1.04	0.63–1.71
Household income	Low	1.00		1.00	
	Mid-low	0.65	0.28–1.52	0.66	0.36–1.18
	Mid-high	0.84	0.37–1.87	0.63	0.34–1.15
	High	0.71	0.31–1.62	0.41**	0.21–0.79
Employment	No	1.00		1.00	
	Yes	1.06	0.64–1.76	1.04	0.69–1.55
Exercise	No	1.00		1.00	
	Moderate physical activity	0.82	0.44–1.53	1.04	0.60–1.81
	Intensity physical activity	0.38	0.08–1.73	0.71	0.21–2.35
Sleep hours	< 8	1.00		1.00	
	≥ 8	0.56	0.31–1.02	1.39	0.91–2.13
Frequency of breakfast	< 5 times a week	1.00		1.00	
	≥ 5 times a week	0.85	0.51–1.42	0.78	0.48–1.28
BMI, kg/m^2	< 23	1.00		1.00	
	23~ < 25	2.03	0.94–4.37	1.19	0.65–2.17
	25~ < 30	2.72*	1.10–6.70	2.83**	1.40–5.72
	≥ 30	4.17*	1.22–14.28	6.79***	2.44–18.93
WC, cm	< 85	1.00		1.00	
	≥ 85	0.78	0.39–1.56	1.11	0.66–1.89
TG, mg/dl	< 150	1.00		1.00	
	≥ 150	3.08***	1.87–5.04	3.90***	2.56–5.92
Counseling for a psychiatric problem	No	1.00		1.00	
	Yes	0.72	0.21–2.47	1.54	0.49–4.82
Stress	Low	1.00		1.00	
	High	0.95	0.54–1.65	0.80	0.49–1.29

OR = odds ratio; CI = confidence interval; BMI = body mass index; WC = waist circumference; TG = triglyceride.
*p < .05, **p < .01, ***p < .001.

high-age, low-income postmenopausal women should be established within the community and health management system.

In this study, as in a previous study, the BMI, WC, and TG levels were identified as factors showing a significant difference in CVD risk by postmenopausal period [34]. Among them, in the final regression analysis, the BMI and TG level were identified as

factors affecting CVD. Menopause directly increases the incidence of metabolic syndrome (MetS) [34], increases body fat, and decreases lean body mass in women [35]. Independent of aging, menopausal status is associated with elevated triglycerides [36]. These changes during menopause increase the risk of CVD. Therefore, managing dyslipidemia and obesity, which are components of MetS, is very important to lower the risk of CVD. Additionally, it is necessary to establish a health plan to thoroughly manage the components of MetS in postmenopausal women to prevent CVD. Perceived health status and body type were identified as factors that significantly influenced CVD risk, and perceived health status was ultimately analyzed as a factor influencing CVD risk.

It is important to provide intervention, but it is also meaningful to establish a social system that can offer continuous health management to groups who subjectively feel that their health status is poor. This means that perceived health status can serve as a basis for interventions based on the patient's subjective health status. Existing studies also confirmed that subjective health status is a valid surrogate variable that reflects actual health status [37], these studies have consistently shown that subjective health status is a valid predictor of mortality [38].

This study has several limitations. First, although the stratified clustering sampling method used to extract samples from the KNHANES ensured that the data were reliable, the method may not sufficiently represent the increasing number of postmenopausal women each year; hence, a better data extraction method is required. Second, we used a self-report method, which has limitations in measuring variables objectively and quantitatively, to measure smoking, exercise, and sleep duration. Third, information on hormone therapy, one of the variables that can influence CVD risk in women, was not collected in the KNHANES database; therefore, it was not reflected herein. Despite these limitations, this study is meaningful in that it is easy to generalize and apply the results since KNHANES data were used. In addition, this study showed that it is necessary to consider the differences in participants according to menopause and the postmenopausal period when preparing health promotion measures to lower the risk of CVD in women.

Conclusion

This study confirmed that factors that increase the risk of CVD in postmenopausal women include not only physical health status and health behavior, but also socioeconomic characteristics. Based on this study's results, it is necessary to prepare educational interventions or policies for the health management of low-income and high-age women after menopause. Furthermore, to reduce the risk of CVD in postmenopausal women, it is important to manage MetS-related factors in advance. Finally, our study's findings suggest that health education and publicity should be strengthened so that postmenopausal women who subjectively perceive their health as poor can immediately evaluate their health status through health checkups and receive appropriate medical services.

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Conflict of interest

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Authors' contributions

Kim, Jui contributed to the conceptualization, data curation, formal analysis, methodology, writing - original draft, and writing - review & editing. Choi, Hyungshim contributed to the conceptualization, methodology, writing - original draft, writing - review & editing, and supervision.

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Data availability

Describe the availability of the study data and the appropriate URL, if available. Or note how data can be made available such as follows: Data are available from the Korea National Health and Nutrition Examination Survey (KNHANES), conducted by the Korea Centers for Disease Control and Prevention (KCDCP), and are freely available from KCDCP (https:// knhanes.cdc.go.kr).

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