ORIGINAL ARTICLE

J Korean Acad Community Health Nurs (지역사회간호학회지)

ISSN 1225-9594 (Print) / ISSN 2288-4203 (Online)
Vol. 31 No. S, 534-548, December 2020
https://doi.org/10.12799/jkachn.2020.31.S.534

A Comparison of the Prevalence of Cardiovascular Disease and Lifestyle Habits by Disability Status and Type of Disability in Korean Adults: A Propensity Score Matching Analysis

Choi, Oh Jong[1] · Hwang, Seon Young[2]

[1]Graduate Student, Graduate School of Nursing, Hanyang University, Seoul
[2]Professor, School of Nursing, Hanyang University, Seoul, Korea

Purpose: This study was conducted to evaluate the prevalence and lifestyle habits of cardiovascular disease (CVD) according to the type of disability in Korean adults compared to adults without disability. **Methods:** This study was secondary data analysis using the National Health check-up database from 2010 to 2013. Among the total 395,627 adults aged 30~80, the physically disabled (n=21,614) and the mentally disabled (n=1,448) who met the diagnosis criteria were extracted and compared with non-disabled (n=372,565) through 1:2 propensity score matching for nine characteristics. **Results:** Prior to matching, the prevalence of CVD was 34.4% in individuals without disabilities, accounting for 53.8% in those with physical disabilities and 22.4% in those with mental disabilities, showing significant differences between groups ($p<.001$). After matching, compared to the individuals without disability, those with physically disabled had significantly higher prevalence of CVD and the average number of CVD ($p<.001$). The prevalence of hypertension, diabetes, and vascular disease was significantly higher in the physically disabled ($p<.05$). Drinking was significantly higher in the non-disabled than in the physically and mentally disabled, and smoking was more in the non-disabled than in the mentally disabled. Physical activity was found to be significantly less in both the physically and mentally disabled than in the non-disabled ($p<.01$). **Conclusion:** It is necessary to confirm the differences in the prevalence of CVD risk factors and lifestyle according to the type of disability, suggesting the development and verification of health promotion programs including physical activity for CVD prevention in the disabled with CVD risk factors.

Key Words: Cardiovascular diseases; Disabled persons; Health behavior; Life style; Propensity score

INTRODUCTION

1. Background

Cardiovascular disease (CVD) is the leading cause of death in the world as a single disease, accounting for 12.8% of total deaths worldwide [1], and it refers to a group of disorders that include heart diseases, such as coronary artery disease, myocardial infarction, angina pectoris, cerebral infarction, and peripheral artery disease, and cerebrovascular disease [2]. In the United States, about one in three people die of CVD each year [3]. As in other countries, in Korea, CVD is one of the diseases which carry a large disease burden and is also one of the major causes of death, and the number of deaths from CVD is 53,150 annually, accounting for 19% of total deaths. Regarding the annual mortality rate per 100,000 population, the rate of mortality from heart diseases is estimated to be 60.2 per 100,000 population and the rate of mortality from cerebrovascular diseases is reported to be 44.4 per 100,000 population [4]. In particular, the rate of mortality from heart diseases has increased steadily over the past 10 years, and although the rate of mortality from cerebrovascular diseases is on the decline, it still exceeds the mean mortality rate of the Organization for Economic Cooperation and Development (OECD) [4,5]. In Korean adults, the mortal-

Corresponding author: Hwang, Seon Young
School of Nursing, Hanyang University, 222 Wangsimni-ro, Seondong-gu, Seoul 04763, Korea.
Tel: +82-2-2220-0702, Fax: +82-2-2220-1163, E-mail: seon9772@hanyang.ac.kr

Received: May 23, 2020 / Revised: Aug 31, 2020 / Accepted: Oct 5, 2020

ity rate of people with disabilities is 2,813 per 100,000 population as of 2016, which is 5.1 times higher than the mortality rate of the total population [4]. CVD is ranked second or third as the cause of death, following cancer, in the population with disabilities, as in the population without disabilities, and the rates of mortality from heart diseases and cerebrovascular diseases in the population with disabilities in Korea were reported to be 6.4 and 6.1 times higher, respectively, compared to the rates in the total population [4]. A foreign study of people with intellectual disabilities reported that 22% of deaths in people with intellectual disabilities were premature deaths before the age of 50 and that the amenable mortality rate was also 13% higher than in the population without disabilities [6]. CVD is a serious chronic disease that deteriorates the quality of life of individuals and incurs socioeconomic burdens, but it is a preventable disease [5]. The risk factors for CVD include high blood pressure, diabetes, blood cholesterol level, smoking, the lack of physical activity, and obesity [7], and the improvement of lifestyle habits that are harmful to health is known to be a crucial element of interventions that can reduce the risk of cardiovascular disease [8,9]. In Korean adults aged 30 and older, the prevalence rates of the underlying chronic diseases of CVD, such as obesity, high blood pressure, and diabetes, are reported to be more than twice higher among those who have unhealthy lifestyle habits such as heavy drinking and the lack of physical activity than among those who practice healthy lifestyle habits, and these findings suggest that healthy lifestyles are important for the prevention of CVD [9].

According to the Welfare Law for Persons with Disabilities, a person with a disability is defined as a person who has considerable limitations in performing daily activities or social roles due to a disability for a long time, and disabilities are classified into physical disabilities and mental disabilities [10]. A physical disability is a disability in major external physical functions or internal organs, and a mental disability refers to a disability caused by a developmental disorder or mental disorder [10]. In Korea, the total number of registered people with disabilities, including people with physical and mental disabilities, was about 2.6 million as of 2018, accounting for 5% of the total population [11]. According to the World Health Organization (WHO), as of 2018, about 15% of the world's population or more than 1 billion are estimated to be people with disabilities, and the number of people with disabilities has been continuously increasing [12]. In Korea, the estimated number of people with disabilities has grown rapidly from 2.14 million in 2005 to 2.67 million in 2017. In particular, considering that the incidence rate of disability due to acquired causes such as the aging population and various accidents resulting from industrialization is 88.1% [13], there is a need to make efforts to address the health problems of the growing population of people with disabilities.

With respect to foreign studies of people with disabilities, a study based on the data of the US National Health Interview Survey reported that people with disabilities had a 1.8 times higher prevalence of obesity, a 2.92 times higher prevalence of coronary artery disease, a 2.57 times higher prevalence of diabetes, and 2.18 times higher prevalence of hypertension, compared to people without disabilities [14]. Furthermore, a study using data from the Behavioral Risk Factor Surveillance System conducted in the United States found that people with disabilities are more likely to be current smokers and show a lower level of physical activity than people without disabilities, the percentage of people with low subjective health status was 6 times higher in people with disabilities, and the level of dissatisfaction with life was also 4 times higher in people with disabilities [15]. According to the results of the 2017 National Survey of Persons with Disabilities in Korea, the number of people with chronic diseases among people with disabilities aged 19 and older increased from 77.2% in 2014 to 81.1% in 2017[5,16]. Previous studies also reported that the prevalence of hypertension in the population aged 30 and older was higher in people with disabilities (46.9%) than in the total population (33.5%), the prevalence of diabetes was also higher in people with disabilities (21.9%) than in the total population (13.0%), and the mean number of chronic diseases was also higher in people with disabilities (2.2 diseases) than in the total population (1.3 diseases) [5,16]. In addition, a study of diabetic patients reported that the incidence of diabetic complications between 2 and 5 years after diabetic diagnosis was higher in diabetic patients with disabilities (56.7%) compared to diabetic patients without disabilities (52.4%) [17]. In particular, in a study of unmet healthcare needs, which refers to cases of not being able to visit a hospital or clinic when there is a need to go there, the annual percentage of people experiencing unmet healthcare needs, was 17.2% in people with disabilities, almost twice higher than 8.8% in the total population [16]. As described so far, compared to people without disabilities, people with disabilities have higher disease susceptibility than people without disabilities and have a greater risk of exposure to secondary health problems such as the earlier onset of chronic diseases, and these problems can be expanded to social and mental health problems. Therefore, promotion of healthy lifestyle habits for the prevention for CVD and the

prevention and management of underlying chronic diseases of CVD are essentially required [16].

However, despite the urgent need to prevent CVD, which is the leading cause of death as a single disease, there has been a lack of studies to investigate the relationship between lifestyle habits and the prevalence of diseases in people with disabilities through the comparison between people with and without disabilities. Above all, although the government has implemented the Comprehensive Management Plan for Cardio- and Cerebrovascular Diseases since 2006 [5] and the Act on Prevention and Management of Cardiovascular Diseases since 2017 [18] for the prevention and management of CVD, people with disabilities were not included in the main target population, the characteristics of disabilities were not considered, and differentiated disease management items tailored to people with disabilities were not presented. In particular, people with disabilities have difficulty in performing activities of daily living and self-care, and depending on the type of disability, they may have various health problems due to complex factors, such as the risk of secondary disability due to primary disability and comorbid conditions [11]. In addition, it is necessary to discuss specific action plans for the health promotion of people with disabilities in relation to the enforcement of the Act on Guarantee of Right to Health and Access to Medical Services for Persons with Disabilities enacted in 2017 [18].

Therefore, this study aimed to investigate differences in the prevalence of CVD and lifestyle habits by type of disability through the comparison between persons with and without disabilities by using the National Health Checkup data of the National Health Insurance Service, which is a statistical data of national samples. The results of this study are expected to be utilized as basic data for the development of nursing intervention programs for the prevention of CVD in persons with disabilities.

2. Purpose

The purpose of this study was to examine the prevalence of CVD by disability status (presence or absence of disability) and by type of disability among korean adults, and to compare the prevalence of CVD and lifestyle habits between people with and without disabilities. The specific goals of this study are as follows:

- To identify the prevalence and specific types of CVD in people with physical disabilities and those with mental disabilities and examine the differences between people with and without disabilities;
- To investigate differences in the prevalence of CVD and lifestyle habits between people with physical disabilities and those without disabilities after performing propensity score matching (PSM);
- To investigate differences in the prevalence of CVD and lifestyle habits between people with mental disabilities and those without disabilities after conducting PSM.

METHODS

1. Study Design

This study is a secondary analysis study using the National Health Check-up Database (NHCD) of the National Health Insurance Service (NHIS) and is a descriptive research to investigate differences in the prevalence of CVD and lifestyle habits between people with and without disabilities in Korean adults by comparing the physically disabled and the mentally disabled with people without disabilities.

2. Subjects

Out of 480,317 people who participated in the national health check-up for four years from 2010 to 2013, 418,173 people aged 30~79 were first extracted. To prevent the distortion of research results and carry out accurate analysis, those who received treatment at a medical institution for pregnancy/delivery (2,215 people) or malignant neoplasms (10,650 people), those who died (284 people), those with brain lesions and other disabilities (2,610 people), and those who could not be included in the analysis due to missing data (6,787 people) were excluded from the study. A total of 395,627 people were finally included in the analysis and they consisted of 200,183 males (50.6%) and 195,444 females (49.4%). Among them, 23,062 people (5.8%) were people with disabilities, people with physical disabilities, including those with physical disabilities, hearing impairments, renal diseases, and visual impairments, were 21,614 people (5.5%), and people with mental disabilities, including intellectually and mentally disabled people, were 1,448 People (0.3%). In this study, persons with disabilities are defined as people registered as disabled in the local governments of cities (si), counties (gun) and districts (gu). Based on the Welfare Law for Persons with Disabilities, physical disabilities, visual impairments, hearing impairments, and renal diseases were classified as physical disabilities, and intellectual and mental disabilities were categorized as mental disabilities (Figure 1).

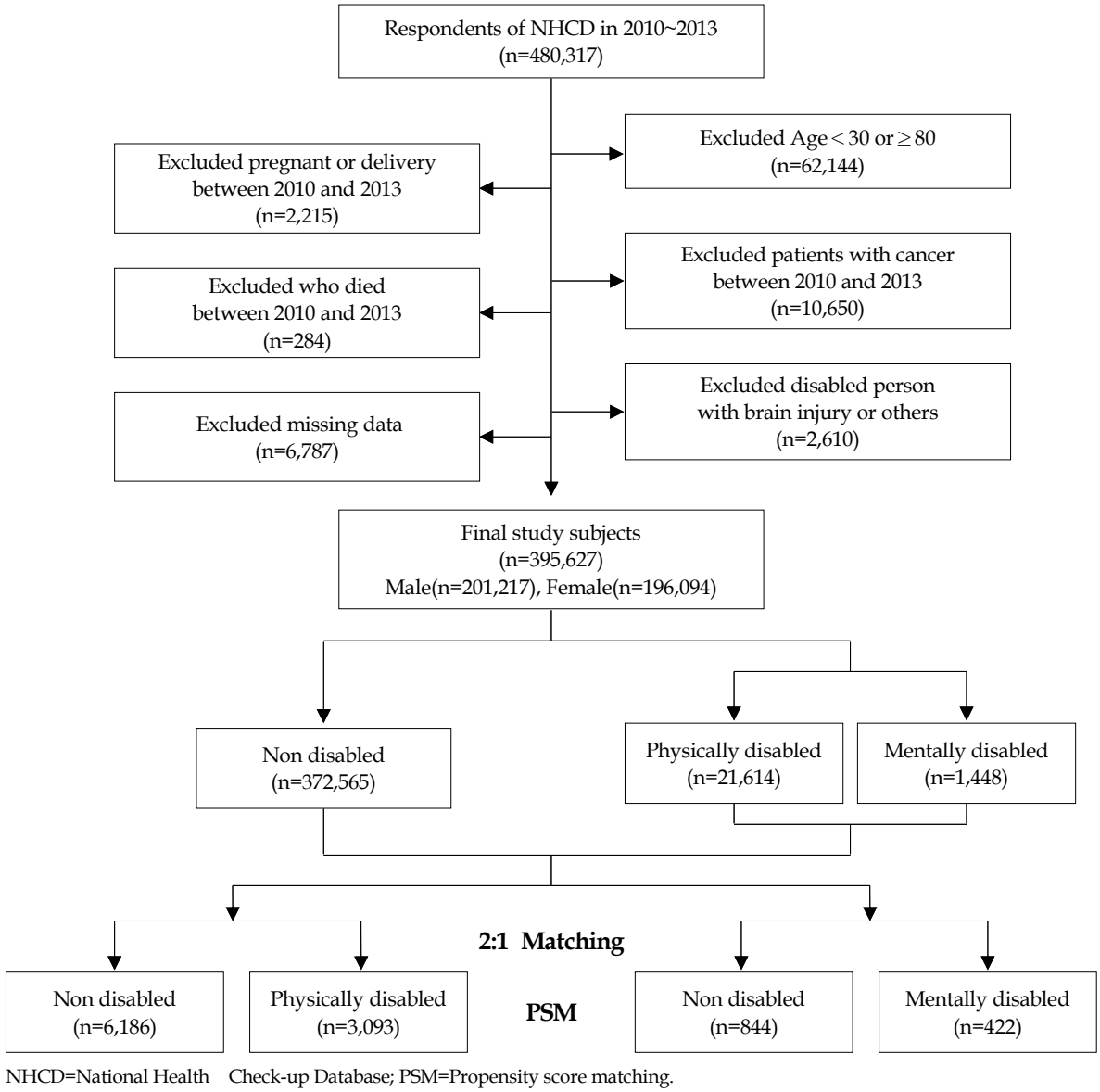


Figure 1. Flow chart of the study population.

3. Research Variables

Factors affecting CVD were identified by referring to previous studies [7-9]. The preventive and influencing factors for CVD are reported to include individual characteristics such as gender, age, and residential area, socioeconomic characteristics such as education level and income level, health behavior characteristics such as the family history of CVD, obesity, stress, depression and periodontal disease, and lifestyle characteristics such as alcohol consumption, smoking and physical activity. In recent years, research on the relationship between periodontal disease and CVD has been actively conducted. Considering that the risk for CVD was found to be 1.38 times higher in people with periodontal disease in a study using data from the National Health and Nutrition Examination Survey [19], this study included the presence or absence of dental disease among the covariates.

1) Sociodemographic and health-related characteristics

Based on previous studies, a total of 9 variables were used as the variables of subject characteristics for PSM, and the variables included sociodemographic characteristics of gender, age, residential area, and income level, family history of CVD, obesity, depression, and dental disease. The qualification data of people enrolled into the

NHIS program were used to classify subjects according to gender, age, residential area, and income level, and the survey results of the National Health Check-up Database were used to examine the family history of CVD of subjects. Also, subjects were classified in terms of obesity, depression, and presence or absence of dental disease by using medical statement data. For age, subjects were classified based on western age, and residential areas were divided into urban and rural areas in consideration of administrative characteristics and population size. The income level was classified into high, upper middle, lower middle, and low, based on the income quintile groups of national health insurance premiums paid by each household.

Health-related characteristics included the family history of CVD, Body Mass Index (BMI), waist circumference, diagnosis of depression, and presence of dental disease. The family history of CVD was defined as the presence of at least one person diagnosed with hypertension, diabetes, myocardial infarction, angina pectoris, and cerebrovascular disease among the subject's immediate family members. The BMI was calculated using the height and body weight. As for depression, people who were diagnosed with sleep disorder or depression and received treatment for the disease at a medical institution were classified as persons with depression, and those who were not were classified as people without depression. Similarly, regarding dental disease, individuals who were diagnosed with dental caries or periodontal disease and received treatment at a medical institution were classified as people with dental disease and those who were not were classified as people without dental disease.

2) Variables related to the presence or absence of CVD of subjects

With respect to the presence or absence of CVD, when the subject was diagnosed with at least one of the seven diseases of hypertension, dyslipidemia, diabetes, heart disease, peripheral vascular disease, cerebrovascular disease, and vascular disease between 2010 and 2013, the individual was classified as a person diagnosed with CVD, and the subjects not diagnosed with any of them were classified as people not diagnosed with CVD. More specifically, when the principal or subsidiary diagnosis based on the three-level codes of the 10th revision of the KCD in the diagnosis codes of the medical statement data of the sample cohort was hypertensive disease (I10~I15), dyslipidemia (E78), diabetes (E10~E14), heart disease (I20~I25: ischemic heart disease; I50: heart failure), peripheral vascular disease (I73), cerebrovascular disease (I61~I68), and vascular disease (I70~I72: atherosclerosis/aneurysm; I74: arterial embolism; I77, I79: disorders of arteries and arterioles), the subjects were classified as persons diagnosed with CVD. In this study, the seven diseases listed above were regarded as the specific diseases comprising CVD. Then, the mean number of the diseases the subjects were diagnosed with among the seven diseases was calculated, and the presence or absence of the diagnosis of each of the seven diseases was examined.

3) Characteristics related to lifestyle habits

With respect to the subjects' characteristics related to lifestyle habits, drinking status, smoking status, and the degree of physical activity were investigated. Regarding drinking status, those who answered 0 days in response to the question 'How many days do you drink alcohol on average per week?' were classified as non-drinkers, and those who answered they drank alcohol at least once per week were classified as drinkers. In this study, the prevalence of drinking was significantly lower in people with mental disabilities (13.4%), compared to people without disabilities, so the criterion for drinking status was set as at least once a week. As for smoking status, persons who answered negatively to the question 'Have you ever smoked 5 packs or more of cigarettes (100 cigarettes) in total in your lifetime?' were classified as non-smokers. Regarding physical activity, persons who performed moderate or high intensity exercise at least three times a week were classified as the exercise group, and those who did not were classified as the non-exercise group.

4. Data Collection and Ethical Considerations

This study was conducted using the data from the National Health Checkup Database (NHCD) of the National Health Insurance Service (NHIS) in accordance with the regulations on the public access and management of raw data of the NHIS of Korea. From the database, the national health checkup data, medical statement data, and qualification data of people enrolled in the NHIS program were used. The NHCD is a sample research database that can be used for the analysis of medical service uses and health checkup results mainly in the participants of the national health checkup. It is representative data obtained by extracting 10% of the population by stratified sampling according to the gender, age, and income level of subjects [20]. In Korea, the National Health Insurance Service (NHIS) is a social insurance system in which all citizens have been required to enroll since 1989, and the participation rate in the national health check-up conducted every two years by

the NHIS is generally high (72.1% in 2013). The major health check-up procedures have been standardized [20], so the data has high reliability and validity. The national health checkup data of the NHIS used in this study is collected in compliance with the Personal Information Protection Act and the Statistics Act, and is collected by using unidentifiable unique numbers so that the individuals cannot be identified during research analysis, so no personal information of the participants are included, and anonymity and confidentiality are guaranteed. This study was conducted after receiving an exempt determination from the IRB of Hanyang University to which the investigator belongs (IRB No. HYI-17-235-1).

5. Statistical Analysis

The subjects of this study consisted of 372,565 persons without disabilities (94.2%) and 23,062 persons with disabilities (5.8%). Since there was a large difference between the numbers of people with and without disabilities and the specificity of disability was involved, the PSM method for controlling for confounding variables was used to increase causality in analysis. Regarding PSM variables, in the comparison between people with physical disabilities and those without disabilities, 9 sociodemographic and health-related variables, that is, gender, age, residential area, income level, CVD family history, BMI, waist circumference, depression, and dental disease, were used as covariates. In the comparison between persons with mental disabilities and those without disabilities, 8 variables were used excluding depression that reflects the characteristics of mental disabilities. In the comparison of persons without disabilities (the control group) with those with physical disabilities and those with mental disabilities (case groups), 2:1 matching was carried out using the nearest neighbor matching method. The selected matching variables are probability values summarized as single numbers, and can be estimated by logistic regression. After controlling for confounding variables by PSM, to examine whether the covariates used for matching were equal in the control group and case groups, a test for differences between the variables used as confounding variables for the presence of physical or mental disability of each case group was performed. In this case, the x^2 test was conducted for categorical variables, and the t-test was performed for continuous variables. Collected data were analyzed using SAS (Statistical Analysis System) 9.4 version and SPSS (Statistical Package for Social Science) 21.0 version. The prevalence of CVD and specific types of CVD in people with disabilities and those without disabilities in the raw data were analyzed by calculating descriptive statistics. The categorical variables were analyzed by the x^2 test, and the continuous variables by the t-test. After adjustment for sociodemographic and health-related confounding variables used as covariates by PSM, the x^2 test and t-test were performed to examine differences in the prevalence of CVD and lifestyle habits between people with and without disabilities by comparing each case group with the control group.

RESULTS

1. Prevalence and Specific Types of CVD in Subjects

Before PSM, the prevalence of CVD among subjects was 34.4% (128,014 people) in people without disabilities, 53.8% (11,634 people) in people with physical disabilities, and 22.4% (324 people) in people with mental disabilities ($p <$ .001). With respect to the prevalence of CVD by type of disability, in the case of people with physical disabilities, the prevalence of CVD was 53.9% among those with physical disabilities, 53.9% among those with hearing impairments, 61.6% among those with renal diseases, and 52.0% among those with visual impairments. As for people with mental disabilities, the prevalence of CVD was 21.8% among people with intellectual disabilities (IQ of 70 or below) and 23.0% among people with mental disabilities, such as schizophrenia and schizoaffective disorder. In terms of the percentage of each specific type of CVD, the percentage of hypertension was highest, followed by dyslipidemia, diabetes, heart disease, cerebrovascular disease, and peripheral vascular disease in descending order in people without disabilities and those with physical disabilities, but they were ranked in the order of hypertension, dyslipidemia, diabetes, cerebrovascular disease, heart disease, and peripheral vascular disease in people with mental disabilities (Figures 2, 3).

2. Comparison of the Prevalence of CVD and Lifestyle Habits between People with Physical Disabilities and People without Disabilities after PSM

In order to compare the prevalence of CVD and lifestyle habits between people with physical disabilities and those without disabilities, 9 characteristic variables were used as covariates and 1:2 matching was performed with propensity scores. As a result, 3,093 people with physical disabilities and 6,186 people without disabilities were extracted (Table 1). Before PSM, there were significant differences between the two groups in the covariates mentioned above ($p <$.001), whereas after PSM, there was no statisti-

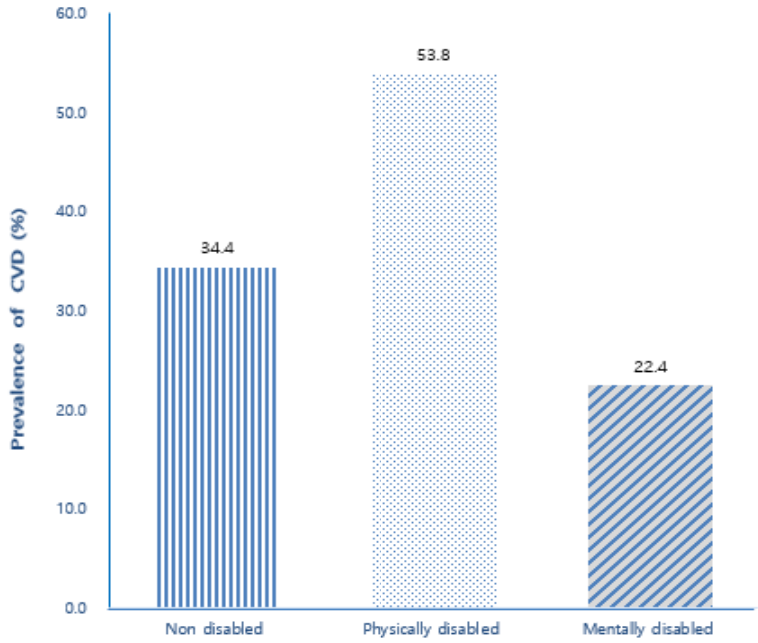
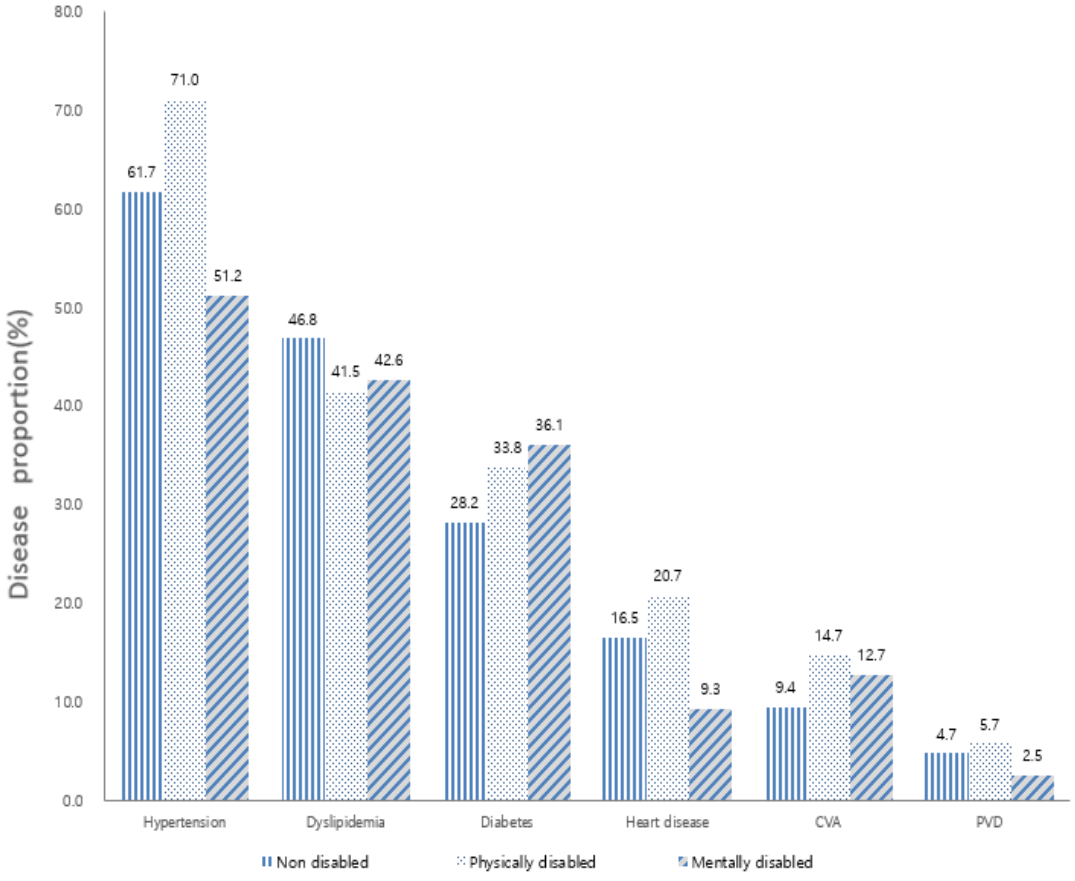


Figure 2. Prevalence of cardiovascular disease (CVD) according to disability type before propensity score



Disease proportions are the result of multiple responses; CVA=Cerebrovascular accident; PVD=Peripheral vascular disease.

Figure 3. Cardiovascular disease proportion according to disability type before propensity score matching.

Table 1. Comparison of Sample Characteristics Before and After Propensity Score Matching between the Physically Disabled and Non-disabled

Variables	Categories	Before PSM			After PSM		
		Non disabled (n=372,565)	Physically disabled (n=21,614)	x^2 or t (p)	Non disabled (n=6,186)	Physically disabled (n=3,093)	x^2 or t (p)
		n (%) or M±SD	n (%) or M±SD		n (%) or M±SD	n (%) or M±SD	
Gender	Female	185,706 (49.9)	9,051 (41.9)	519.10 (< .001)	2,110 (34.1)	1,052 (34.0)	0.01 (.440)
	Male	186,859 (50.1)	12,563 (58.1)		4,076 (65.9)	2,041 (66.0)	
Age (year)	30~49	189,611 (50.9)	4,571 (21.2)	1,1617.21 (< .001)	2,852 (46.1)	1,432 (46.3)	0.11 (.996)
	50~59	98,906 (26.6)	5,897 (27.3)		2,051 (33.2)	1,017 (32.9)	
	60~69	55,443 (14.9)	6,361 (29.4)		993 (16.1)	496 (16.0)	
	70~79	28,605 (7.6)	4,785 (22.1)		290 (4.6)	148 (4.8)	
Residence	City	335,687 (90.1)	18,120 (83.8)	872.83 (< .001)	6,127 (99.1)	3,064 (99.1)	0.01 (.615)
	Rural	36,878 (9.9)	3,494 (16.2)		59 (0.9)	29 (0.9)	
Income	High	153,370 (41.2)	7,671 (35.5)	1,758.01 (< .001)	3,054 (49.4)	1,524 (49.3)	0.17 (.864)
	Middle	108,742 (29.2)	5,853 (27.1)		1,872 (30.3)	943 (30.5)	
	Middle_low	81,346 (21.8)	4,683 (21.7)		1,082 (17.5)	534 (17.3)	
	Low	29,107 (7.8)	3,407 (15.7)		178 (2.8)	92 (2.9)	
Family CVD history	No	277,733 (74.6)	16,663 (77.1)	70.13 (< .001)	5,415 (87.5)	2,704 (87.4)	0.02 (.530)
	Yes	94,832 (25.4)	4,951 (22.9)		771 (12.5)	389 (12.6)	
BMI (kg/m^2)		23.88±3.20	24.43±3.37	-23.26 (< .001)	23.89±2.15	23.89±2.14	0.00 (.663)
W · C (cm)		80.56±9.02	83.66±8.82	-50.26 (< .001)	81.48±6.48	81.46±6.41	0.10 (.760)
Depression	No	354,308 (95.1)	19,872 (91.9)	423.42 (< .001)	6,173 (99.8)	3,086 (99.8)	0.03 (.788)
	Yes	18,257 (4.9)	1,742 (8.1)		13 (0.2)	7 (0.2)	
Dental disease	No	366,107 (98.3)	20,885 (96.6)	306.71 (< .001)	6,177 (99.9)	3,088 (99.8)	0.04 (.157)
	Yes	6,458 (1.7)	729 (3.4)		9 (0.1)	5 (0.2)	
CVD history	No	244,551 (65.6)	9,980 (46.2)	3,383.83 (< .001)	4,160 (67.3)	1,926 (62.3)	22.65 (.002)
	Yes	128,014 (34.4)	11,634 (53.8)		2,026 (32.7)	1,167 (37.7)	
Number of CVD		0.61±1.00	1.08±1.25	-54.04 (< .001)	0.57±0.96	0.68±1.03	-4.95 (< .001)
Hypertension		78,952 (21.2)	8,262 (38.2)	3,440.12 (< .001)	1,173 (19.0)	716 (23.2)	22.29 (< .001)
Dyslipidemia		59,923 (16.1)	4,808 (22.2)	565.10 (< .001)	1,026 (16.6)	558 (18.0)	3.08 (.098)
Diabetes		36,137 (9.7)	3,937 (18.2)	1,622.02 (< .001)	566 (9.2)	327 (10.6)	4.80 (.042)
Heart disease		21,183 (5.7)	2,403 (11.1)	1,071.53 (< .001)	316 (5.1)	205 (6.6)	8.98 (.007)
Peripheral vascular disease		14,473 (3.9)	1,585 (7.3)	621.72 (< .001)	193 (3.1)	136 (4.4)	9.83 (.005)
Stroke		12,046 (3.2)	1,711 (7.9)	1,330.13 (< .001)	175 (2.8)	115 (3.7)	5.38 (.035)
Vascular disease		5,953 (1.6)	659 (3.1)	260.82 (< .001)	83 (1.3)	49 (1.6)	0.87 (.671)
Alcohol drinking	No	201,721 (54.1)	13,449 (62.2)	538.01 (< .001)	2,901 (46.9)	1,554 (50.2)	9.25 (.002)
	Yes	170,844 (45.9)	8,165 (37.8)		3,285 (53.1)	1,539 (49.8)	
Smoking	No	230,816 (62.0)	12,961 (60.0)	34.23 (< .001)	3,216 (52.0)	1,616 (52.3)	0.06 (.814)
	Yes	141,749 (38.0)	8,653 (40.0)		2,970 (48.0)	1,477 (47.7)	
Physical activity	No	121,063 (32.5)	8,431 (39.0)	392.82 (< .001)	1,907 (30.8)	1,040 (33.6)	7.44 (.006)
	Yes	251,502 (67.5)	13,183 (61.0)		4,279 (69.2)	2,053 (66.4)	

PSM=propensity score matching; CVD=cardiovascular disease; BMI=body mass index; W·C=waist circumference.

cally significant difference in all the covariates between the two groups, indicating that matching was carried out so that the two groups were equivalent. Before PSM, the prevalence of CVD was 53.8% in people with physical disabilities and 34.4% in those without disabilities, and after PSM, the prevalence of CVD was 37.7% in people with physical disabilities and 32.7% in those without disabilities, showing a statistically significant difference between the two groups ($p<.001$). This means that even after adjusting for other confounding variables, people with physical disabilities showed a 5.0% higher prevalence of CVD than those without disabilities. After PSM, the mean number of diseases categorized as CVD was significantly higher in people with physical disabilities (0.68±1.03) than people without disabilities (0.57±0.96) ($p<.001$). With respect to the prevalence of specific diseases classified as CVD, people with physical disabilities showed significantly higher prevalence than people without disabilities in each specific kind of CVD, such as hypertension (23.2% vs. 19.0%, $p<.001$), diabetes (10.6% vs. 9.2%, $p=.029$), heart disease (6.6% vs. 5.1%, $p=.003$), peripheral vascular disease (4.4% vs. 3.1%), $p=.002$) and cerebrovascular disease (3.7% vs. 2.8%, $p=.020$).

After PSM, among lifestyle variables, the prevalence of drinking or the percentage of current drinkers was significantly lower in people with physically disabilities (49.8%) than people without disabilities (53.1%) ($p=.002$). There was no significant difference in the smoking rate between people with physical disabilities and people without disabilities. The percentage of people performing physical activity at least 3 times a week was statistically significantly lower in persons with physical disabilities (66.4%) than persons without disabilities (69.2%) ($p=.006$).

3. Comparison of the Prevalence of CVD and Lifestyle Habits between People with Mental Disabilities and People without Disabilities after PSM

In order to compare the prevalence of CVD and lifestyle habits in the mentally disabled and non-disabled, 1:2 matching was carried out using the characteristics variables such as gender, age, residential area, income level, family history of CVD, BMI, waist circumference, and presence of dental disease as covariates (Table 2). Since persons with mental disabilities characteristically have depression-related mental disorders, such as schizophrenia, bipolar affective disorder, and recurrent depressive disorder, the variable of depression was not included among the covariates when matching people with mental disabilities with those without disabilities. Before PSM, there were 372,565 people without disabilities and 1,448 people with mental disabilities, but after PSM, 422 people with mental disabilities and 844 people without disabilities were extracted. Before PSM, there were significant differences between the two groups in age, residential area, income level, family history of CVD, BMI, and waist circumference ($p<.001$), but after PSM, there was no significant difference in all of the above mentioned covariates, showing that matching was carried out in a balanced way. Before PSM, the prevalence of CVD was significantly lower in people with mental disabilities (22.4%) than those without disabilities (34.4%) ($p<.001$), but after PSM, there was no significant difference in the prevalence of CVD between people with mental disabilities and those without disabilities (28.2% vs. 32.7%). This means that after adjusting for other influencing factors, there was no significant difference in the prevalence of CVD between people with mental disabilities and those without disabilities. After PSM, there was no significant difference in the mean number of diseases categorized as CVD between people with mental disabilities and those without disabilities (0.48±0.91 vs. 0.59±1.00). Regarding the prevalence rates of seven specific diseases categorized as CVD, only the prevalence of hypertension was significantly lower in people with mental disabilities (15.2%) than those without disabilities (19.9%) ($p=.040$).

After PSM, with respect to lifestyle habits, the percentage of current drinkers was statistically significantly lower in people with mental disabilities (17.5%), compared to people without disabilities (48.5%) ($p<.001$), and the percentage of current smokers was also significantly lower in people with mental disabilities (27.7%) than in people without disabilities (39.9%) ($p<.001$). The percentage of people performing physical activity at least 3 times a week was statistically significantly lower in people with mental disabilities (56.2%) than in people without disabilities (67.4%) ($p<.001$).

DISCUSSION

This study examined differences in the prevalence of CVD and lifestyle habits in people with physical and mental disabilities through the comparison between people with and without disabilities after adjusting for sociodemographic and health-related characteristics by the propensity score matching method, based on the data of adults aged 30~79 from the National Health Checkup of the National Health Insurance Service conducted from 2010 to 2013. The major study results will be discussed below.

In this study, even after PSM for sociodemographic

Table 2. Comparison of Sample Characteristics Before and After Propensity Score Matching between the Mentally Disabled and Non-disabled

Variables	Categories	Before PSM			After PSM		
		Non disabled (n=372,565)	Mentally disabled (n=1448)	x^2 or t (p)	Non disabled (n=844)	Mentally disabled (n=422)	x^2 or t (p)
		n (%) or M±SD	n (%) or M±SD		n (%) or M±SD	n (%) or M±SD	
Gender	Female	185,706 (49.9)	687 (47.4)	3.33 (.068)	395 (46.8)	207 (49.1)	0.57 (.449)
	Male	186,859 (50.1)	761 (52.6)		449 (53.2)	215 (51.0)	
Age (year)	30~49	189,611 (50.9)	786 (54.3)	124.02 (<.001)	450 (53.3)	218 (51.7)	3.65 (.302)
	50~59	98,906 (26.6)	434 (30.0)		252 (29.9)	115 (27.3)	
	60~69	55,443 (14.9)	196 (13.5)		99 (11.7)	61 (14.5)	
	70~79	28,605 (7.6)	32 (2.2)		43 (5.1)	28 (6.5)	
Residence	City	335,687 (90.1)	1,133 (78.3)	226.39 (<.001)	781 (92.5)	387 (91.7)	0.27 (.082)
	Rural	36,878 (9.9)	315 (21.7)		63 (7.5)	35 (8.3)	
Income	High	153,370 (41.2)	135 (9.3)	6,943.91 (<.001)	274 (32.5)	132 (31.3)	1.96 (.582)
	Middle	108,742 (29.2)	138 (9.5)		271 (32.1)	125 (29.6)	
	Middle_low	81,346 (21.8)	200 (13.8)		241 (28.6)	136 (32.2)	
	Low	29,107 (7.8)	975 (67.4)		58 (6.8)	29 (6.9)	
Family CVD	No	277,733 (74.6)	1238 (85.5)	91.26 (<.001)	670 (79.4)	343 (81.3)	0.63 (.426)
	Yes	94,832 (25.4)	210 (14.5)		174 (20.6)	79 (18.7)	
BMI (kg/m^2)		23.88±3.20	24.27±4.21	3.52 (<.001)	23.88±3.10	24.18±3.97	1.49 (.459)
W C (cm)		80.56±9.02	82.65±10.71	7.43 (<.001)	80.87±8.62	81.31±10.09	0.62 (.802)
Dental disease	No	366,107 (98.3)	1420 (98.1)	0.34 (.560)	833 (98.7)	415 (98.3)	0.25 (.614)
	Yes	6,458 (1.7)	28 (1.9)		11 (1.3)	7 (1.7)	
CVD	No	244,551 (65.6)	1124 (77.6)	91.91 (<.001)	568 (67.3)	303 (71.8)	2.66 (.263)
	Yes	128,014 (34.4)	324 (22.4)		276 (32.7)	119 (28.2)	
Number of CVD		0.61±1.00	1.08±1.25	-12.32 (<.001)	0.59±1.00	0.48±0.91	-1.92 (.892)
Hypertensoion		78,952 (21.2)	166 (11.5)	81.83 (<.001)	168 (19.9)	64 (15.2)	4.20 (.007)
Dyslipidemia		59,923 (16.1)	138 (9.5)	45.96 (<.001)	140 (16.6)	54 (12.8)	3.12 (.078)
Diabetes		36,137 (9.7)	117 (8.1)	4.32 (.032)	88 (10.4)	42 (10.0)	0.07 (.875)
Heart disease		21,183 (5.7)	30 (2.1)	35.21 (<.001)	41 (4.9)	14 (3.3)	1.61 (.078)
Peripheral vascular disease		14,473 (3.9)	24 (1.7)	19.20 (<.001)	26 (3.1)	8 (1.9)	1.51 (.068)
Stroke		12,046 (3.2)	41 (2.8)	0.75 (.082)	22 (2.6)	17 (4.0)	1.91 (.089)
Vascular disease		5,953 (1.6)	8 (0.6)	10.05 (.008)	12 (1.4)	4 (1.0)	0.50 (.851)
Alcohol drinking	No	201,721 (54.1)	1254 (86.6)	612.32 (<.001)	434 (51.4)	348 (82.5)	114.80 (<.001)
	Yes	170,844 (45.9)	194 (13.4)		410 (48.6)	74 (17.5)	
Smoking	No	230,816 (62.0)	1069 (73.8)	86.30 (<.001)	507 (60.1)	305 (72.3)	18.22 (<.001)
	Yes	141,749 (38.0)	379 (26.2)		337 (39.9)	117 (27.7)	
Physical activity	No	121,063 (32.5)	697 (48.1)	160.71 (<.001)	275 (32.6)	185 (43.8)	15.41 (<.001)
	Yes	251,502 (67.5)	751 (51.9)		569 (67.4)	237 (56.2)	

PSM=propensity score matching; CVD=cardiovascular disease; BMI=body mass index; W C=waist circumference; †With disease.

characteristics such as age and gender and health-related characteristics, the prevalence of CVD, that is, the percentage of people with at least one disease among hypertension, dyslipidemia, diabetes, heart disease, peripheral vascular disease, cerebrovascular disease, and vascular disease was 37.7% in persons with physical disabilities, which was statistically significantly higher by 5.0% than 32.7% in people without disabilities. In particular, the prevalence rates of hypertension, diabetes, heart disease, peripheral vascular disease, and cerebrovascular disease were significantly higher in people with physical disabilities than people without disabilities, and the mean number of specific diseases categorized as CVD was also significantly higher in people with physical disabilities (0.68±1.03) than people without disabilities (0.57±0.96). Considering that the proportion of people with renal disease (61.6%) was highest among people with physical disabilities, it is thought that the number of diseases categorized as CVD was higher even after PSM because they actually suffered from various chronic diseases. These results are consistent with the results of the 2017 National Survey on Persons with Disabilities, which reported that the number and prevalence of chronic diseases were higher in people with disabilities than those without disabilities [5,16]. Also, the findings of this study are similar to the results of the 2013 Report of the US Centers for Disease Control and Prevention, which reported the prevalence of hypertension among adults aged 19 and older was 40.2% in people with disabilities and 29.0% in people without disabilities [21]. These findings show that more attention and efforts are needed to reduce the prevalence of chronic diseases in people with disabilities.

However, after PSM, the prevalence of CVD in people with mental disabilities was not significantly different from that of people without disabilities, but the prevalence of hypertension was significantly lower in people with mental disabilities (15.2%) than those without disabilities. A study comparing the levels of physical activity and physical fitness and risk factors for CVD between people with intellectual disabilities and those without disabilities in the population aged 20 to 49 [22] reported that people with intellectual disabilities showed lower levels of physical activity and physical fitness, compared to people without disabilities. The study also found that with respect to hypertension, both systolic and diastolic blood pressures were significantly lower in people with intellectual disabilities than those without disabilities in the 30~39 age group, but there was no significant difference in the 20~29 age group and the 40~49 age group. These differences in study results are thought to be the effects of adjustment for the major risk factors of CVD, such as age, BMI, and waist circumference, through PSM. As a result, there was no significant difference in the prevalence of CVD between people with mental disabilities and those without disabilities.

According to a research report on the healthcare programs for persons with disabilities [16], as of 2017, the level of knowledge about the characteristics of disabilities in doctors and nurses or medical staff was 60.9%, the degree of satisfaction among the disabled for the services of workers in medical institutions, such as kindness of staff and explanations that help to understand treatment and medication, was a low level of 65.14%, and the highest healthcare needs in people with disabilities were needs for rehabilitation (29.9%), followed by those for chronic diseases (29.1%). Taking these situations together, in order to increase the sustainability and effectiveness of the prevention and management of CVD, it is necessary to include persons with disabilities in the nursing interventions for CVD patients. In other words, when planning and implementing programs for disease prevention and management and health education, both persons with and without disabilities should be considered simultaneously, and persons with disabilities themselves should also make efforts to promote self-care.

In this study, with respect to the ratio of each of the diseases classified as CVD, the percentage of hypertension was highest, followed by dyslipidemia and diabetes, in all the groups of people without disability, those with physical disability, and those with mental disability. These disorders are chronic diseases that generally occur due to lifestyle habits, and require continuous management. According to the results of an in-depth interview survey on the safety medication use in the visually impaired in Korea [23], persons with visual disabilities complained of the problem of self-administration, difficulty in medication compliance, experiences related to side effects of drugs, and limitations on the communication of information on medical services and medications. In addition, according to the data from the National Health and Nutrition Examination Survey (2009~2013), among people with hypertension aged 30 and older, the rate of hypertension awareness by the diagnosis by a physician was 65.9%, and the rate of diabetes awareness in diabetic patients was 73.1%. Also, considering that among those diagnosed with hypertension, the percentage of people taking hypertension and diabetes medications for 20 or more days a month was reported to be only 60.9~64.0%[24], education on the management of hypertension and diabetes is urgently needed to prevent CVD in people with disabilities.

In this study, the comparison of lifestyle habits between people without disabilities and those with physical disabilities after PSM showed that the rates of alcohol consumption and physical activity were significantly lower in people with physical disabilities compared to people without disabilities. The comparison between people with mental disabilities and those without disabilities also showed that the rates of alcohol consumption, smoking, and physical activity were significantly lower in people with mental disabilities compared to those without disabilities. In particular, it should be noted that in the pre-matching data, among people with physical and mental disabilities, the percentages of people performing recommended physical activity at least three times a week were 61% and 52%, respectively, which were lower than about 68% in persons without disabilities. The lack of physical activity, that is, the lack of exercise, is a health risk behavior with characteristics different from smoking and drinking and it is an important factor contributing to the incidence of CVD, so physical activity should be regarded as the most important element for improving lifestyle habits [8,9]. The lack of physical activity in persons with disabilities shown by the results of this study is consistent with the study results of the report on the healthcare programs for persons with disabilities of the Ministry of Health and Welfare [16]. According to the report, 87.6% of people with disabilities require rehabilitation excercise and physical activity to improve their physical and mental functions and social abilities, and 78.0% of them need leaders for rehabilitation exercise and physical activity for people with disabilities [16]. Since regular physical activity has the effects of promoting health and preventing chronic diseases, the World Health Organization (WHO) has developed the Global Recommendations on Physical Activity for Health [25], and Korea also announced 'the Physical Activity Guide for Koreans' in 2013 to present the recommended levels of physical activity for health promotion [26]. However, these guidelines present recommended minimum levels of physical activity to prevent chronic diseases for healthy Koreans, and people with disabilities are not included in the main target population of the guidelines. In this connection, it was previously reported that people with disabilities are alienated from health information itself due to the lack of guidelines on physical activity or health information for people with disabilities in the overall Korean society, and they are facing difficulties in health management due to the lack of health information along with their physical and mental functional limitations [27]. The findings of a previous study [28] which reported that exercise programs for the disabled were effective in improving cardiovascular diseases and health substantiate the necessity for developing health promotion programs for people with disabilities. In other words, in order to reduce health disparities between people with and without disabilities, prevent secondary diseases in people with disabilities and improve the quality of life through health promotion of people with disabilities, there is a need to develop health promotion programs including physical activities tailored to the type and characteristics of disability and verify the effectiveness of the programs. In this study, after PSM, the prevalence of drinking was significantly lower in people with physical disabilities compared to those without disabilities, and people with mental disabilities showed significantly lower rates of drinking and smoking than people without disabilities. In a study which conducted PSM analysis using data from the National Survey on Persons with Disabilities and the National Health and Nutrition Examination Survey [29], the smoking rate in people with disabilities was 20.30%, showing no statistically significant difference from the smoking rate in people without disabilities, but the high-risk drinking rate in people with disabilities was 7.63%, which was 2.85% points lower compared to the rate in people without disabilities ($p<.001$). In a study which compared the smoking rates of people with and without disabilities by the PSM analysis method using data from the Panel Survey of Employment for the Disabled and the National Health and Nutrition Examination Survey [30], the smoking rate before PSM was significantly higher in people with disabilities (25.9%) than people without disabilities (19.0%) ($p<.001$). However, after PSM, the smoking rate was 20.1% in people with disabilities and 22.7% in people without disabilities, showing a significantly lower smoking rate in people with disabilities ($p=.040$). These differences in study results regarding the prevalence of smoking and alcohol drinking of people with and without disabilities are presumed to be due to different characteristics of analysis data or the failure to control for confounding variables that may affect the results.

For disabled people with physical and mental functional limitations, lifestyle habits can increase the risk of secondary disabilities and can interact inversely with primary disabilities, thereby exacerbating existing disabilities [16]. Since risk factors such as drinking, smoking, and a lack of exercise can have a decisive influence on the overall health status of people with disabilities whose health conditions are more vulnerable than people without disabilities, active interventions are essential for the formation of healthy lifestyle habits of people with disabilities.

This study has significance in that it is the first attempt to investigate causality compared to persons without disabilities through PSM for controlling confounding variables by using the National Health Check-up Database in order to examine the prevalence of CVD in people with disabilities, noting that there has been a lack of studies on CVD in people with disabilities in Korea, although the prevalence rates of physical and mental disorders are expected to increase due to the aging population and complex social changes. As a result, the prevalence of CVD including underlying diseases was significantly higher in people with physical disabilities than people without disabilities, and both the physically disabled and mentally disabled people showed significantly lower levels of physical activity than people without disabilities, indicating that there is a need for strategies and interventions to promote physical activity in people with disabilities. However, this study has some limitations. First, the data used in this study were based on the medical statements of medical institutions, and the lifestyle variables of smoking, drinking, and physical activity were based on the results of the self-reported questionnaire survey. Second, since this study aimed to examine and compare the prevalence of CVD and lifestyle habits in Korean adults by type of disability, people with brain lesions or heart disorders related to CVD were excluded from analysis, but 388 people with renal disease were included in analysis and thus there is the possibility that it may have influenced the results. In addition, this study was conducted only based on the presence or absence of CVD and subjects were not subdivided according to the severity of CVD. Therefore, further research is required to conduct analysis excluding patients with kidney disease, and there is also a need for a follow-up study to examine the health-related characteristics of people with disabilities by quantitative and qualitative research methods considering the severity of CVD. However, despite the limitations described above, the findings of this study can be utilized as basic data for establishing nursing interventions and suggesting directions to reduce health disparities between persons with and without disabilities, especially the disparity in the prevalence of CVD, which is the leading cause of death as a single disease.

CONCLUSION

In this study, we investigated the differences in the prevalence of CVD and lifestyle habits between people with physical and mental disabilities and those without disabilities in the Korean adult population after PSM, using the National Health Checkup Database of the National Health Insurance Service. Even after PSM for the sociodemographic and health-related variables, the prevalence of CVD was significantly higher in people with physical disabilities (37.7%), compared to people without disabilities (32.8%) and the mean number of diseases diagnosed among seven diseases categorized as CVD was also statistically significantly higher in people with physical disabilities. However, there was no significant difference in the prevalence of CVD between people with mental disabilities and those without disabilities. Regarding lifestyle habits, the practice rate of physical activity or exercise was significantly lower in both people with physical disability and those with mental disability than those without disabilities, and these results showed that strategies and interventions for physical activity promotion are required to prevent CVD in people with disabilities. The prevalence rates of smoking and drinking, which were risk factors for CVD, were lower in persons with disabilities than in those without disabilities and although it is a positive result, it is presumed to be due to the effects of chronic disease or social withdrawal. This study broadly classified people with disabilities into those with physical disabilities and those with mental disabilities to examine differences in measurement variables, but there is a need to conduct a follow-up study to investigate differences in the prevalence rates of risk factors for CVD and lifestyle habits by type of disability. In addition, there is a need to develop health promotion programs that include promotion of physical activity for the primary and secondary prevention of CVD in persons with disabilities with the risk factors or history of CVD and verify the effectiveness of the interventional programs.

REFERENCES

1. World Health Organization. The Top 10 causes of death [Internet]. Geneva: World Health Organization 2018. [Cited 2019 July 2]. Available from: http://www.who.int/mediacentre/factsheets/fs310/en/
2. Korea Centers for Disease Control and Prevention. 2019 Standard practice guidelines for hypertension diabetes Registration Management Project [Internet] Osong: Korea Centers for Disease Control and Prevention. [Cited 2020 Feb 28] Available from: http://www.cdc.go.kr/board.es?mid=a20507020000&bid=0019&act=view&list_no=143906
3. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, et al. Executive summary: Heart disease and stroke statistics-2016 update: A report from the American Heart Asso-

ciation. Circulation. 2016;133(4):447-454. https://doi.org/10.1161/CIR.0000000000000366
4. Statistics Korea. 2017 Annual report on the causes of death statistics [Internet]. Daejeon: Statistics Korea. 2018 [Cited 2019. July 2]. Available from: http://kostat.go.kr/portal/korea/kor_nw/1/6/2/index.board
5. Korea Centers for Disease Control and Prevention. 2017 Disease administration white paper [Internet] Osong: Korea Centers for Disease Control and Prevention. 2018 [Cited 2019. July 8]. Available from: http://www.cdc.go.kr/menu.es?mid=a20602070000
6. Heslop P, Blair PS, Fleming P, Hoghton M, Marriott A, Russ L. The Confidential Inquiry into premature deaths of people with intellectual disabilities in the UK: A population-based study. The Lancet. 2014;383(9920):889-895. https://doi.org/10.1016/S0140-6736(13)62026-7
7. American Diabetes Association. Cardiovascular disease and risk management: Standards of medical care in diabetes-2018. Diabetes Care. 2018;41(Supplement 1):S86-S104. https://doi.org/10.2337/dc18-S009
8. World Health Organization. Physical Activity 2018 [Internet]. Geneva: World Health Organization 2018 [Cited 2019 Feb 28]. Available from: http:/www.who.int/topics/physical_activity/en/
9. Korea Centers for Disease Control & Prevention. 2014 Korea national health and nutrition examination survey result [Internet]. Osong: Korea Centers for Disease Control and Prevention 2015 [Cited 2020 Feb 28]. Available from: https://knhanes.cdc.go.kr/knhanes/sub04/sub04_06.do
10. Ministry of Government Legislation Korea. Welfare Law for the Disabled [Internet]. [Cited 2019. July 10]. Available from: http://www.law.go.kr/lsSc.do?tabMenuId=tab18&query=%EC%9E%A5%EC%95%A0%EC%9D%B8%EB%B3%B5%EC%A7%80%EB%B2%95#undefined
11. Ministry of Health and Welfare. Health and Welfare Statistical Year Book 2018: Publishing Registration No:11-1352000-000137-10 [Internet] Sejong: Ministry of Health and Welfare Korea. 2019 [Cited 2019. July 13]. Available from: http://www.mohw.go.kr/react/jb/sjb030301vw.jsp?PAR_MENU_ID=03&MENU_ID=032901&CONT_SEQ=351898
12. World Health Organization. World report on disability. 2018. [Internet]. [Cited 2019 Oct 6]. https://www.who.int/en/news-room/fact-sheets/detail/disability-and-health
13. Kim SH, Lee YH, Oh WC, Hwang JH, Oh MA, Lee NH, et al. 2017 Survey the actual condition of the disabled. Policy Report. Seoul: Korea Institute for Health and Social Affairs. 2017 November. Register No: 11-1352000-000568-12. Report No: 2017-90.
14. Dixon-Ibarra A, Horner-Johnson W. Disability status as an antecedent to chronic conditions: National health interview survey, 2006-2012. Preventing Chronic Disease. 2014;11:1-8. https://doi.org/10.5888/pcd11.130251
15. Froehlich-Grobe K, Jones D, Businelle MS, Kendzor DE, Balasubramanian BA. Impact of disability and chronic conditions on health. Disability and Health Journal. 2016;9(4):600-608. https://doi.org/10.1016/j.dhjo.2016.04.007
16. Ho SH, Kim YS, Yang JH, Eun SD, Park JM, Song ES, et al. 2018 Disabled healthcare public works. Public project report. Seoul; National Rehabilitation Center. 2018. Management No: IT-11-19-05. Registered No: 11-1352297-000271-10.
17. Shin SJ, Park JS, Kim YA, Park GH. Diabetes complications and medication adherence of patients with disability. Poster session presentated at: 2016 Academic conference by Korean Academy of Health Policy and Management. 2016 November 3. Ramada Plaza Hotel in Suwon. Korean Academy of Health Policy and Management.
18. Ministry of Government Legislation Korea. Cardiocerebrovascular Disease Act 2017 [Internet]. [Cited 2019 July 10]. Available from: http://www.law.go.kr/lsInfoP.do?lsiSeq=183745&efYd=20170530#0000
19. Hwang SY, Shim JL, Kang DY, Choi JS. Poor oral health predicts higher 10-year cardiovascular risk: A propensity score matching analysis. Journal of Cardiovascular Nursing. 2018;33(5):429-436.
20. National Health Insurance Service. 2016 National health screening statistical yearbook. Wonju: National Health Insurance Service. 2017. 924 p.
21. Gillespie CD, Hurvitz KA. Prevalence of hypertension and controlled hypertension-United States, 2007-2010. Morbidity and Mortality Weekly Report. 2013;62(3):144-148.
22. Yang DI, Suk MH, Lim KI, Shin YA. Comparison of physical activity and health fitness in adults with and without intellectual disability. Korean Journal of Adapted Physical Activity. 2014;22(2):99-117.
23. Koo HJ, Jang SM, Oh JM, Han NY, Han EA. Qualitative study for medication use among visually impaired in Korea. Korean Journal of Clinical Pharmacy. 2016;26(1):24-32.
24. Yang HG, Lee DH. Achievements and challenges in a community based registration and management programme for hypertension and diabetes. Public Health Weekly Report. KCDC 2015;8(35):827-834. [Internet]. Osong: Korea Centers for Disease Control and Prevention [Cited 2019 July 13]. Available from: http://www.cdc.go.kr/board.es?mid=a20602010000&bid=0034&act=view&list_no=65171
25. World Health Organization. Global action plan on physical activity 2018-2030: More active people for a healthier world. 2019. Geneva: World Health Organization; 2019. 101 p.
26. Ministry of Health and Welfare Korea. The physical activity

guide for Koreans. 2013 [Internet]. Sejong: Ministry of Health and Welfare Korea. 2014 [Cited 2019 July 13]. Available from: http://www.mohw.go.kr/react/jb/sjb030301vw.jsp?PAR_MENU_ID=03&MENU_ID=032901&CONT_SEQ=337139

27. Welfare TV. WBC Special documentary 2. 'For equal rights of health' Posted 2014. November 13 [Internet]. Seoul: Welfare TV [Cited 2019 July 13]. Available from: https://www.youtube.com/watch?v=6ZFKjEA6Ju0
28. Globas C, Becker C, Cerny J, Lam JM, Lindemann U, Forrester LW, et al. Chronic stroke survivors benefit from high-intensity aerobic treadmill exercise: A randomized control trial. Neurorehabilitation and Neural Repair. 2012;26(1):85-95. https://doi.org/10.1177/1545968311418675
29. Kim AR, Choi MH. Effects of disability on the prevalence of hypertension and diabetes: Using propensity score matching. Journal of the Korean Data Analysis Society. 2018;20(3):1503-1517.
30. Yeob KE, Kim SY, Park JE, Lee BH, Park JH. Current smoking rate and related factors of people with disability. Korean Public Health Research. 2018;44(4):51-65.