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ORIGINAL ARTICLE

Analysis of the Relationship between Physical or Mental Problems and Health Maintenance Methods by Personal Differences

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PURPOSE: This study aimed to investigate the differences in the association between physical or mental problems and health maintenance methods.

METHODS: This study used data from the 2019 Korea National Sports Participation Survey, conducted by the Ministry of Culture, Sports, and Tourism, as a nationally representative cross-sectional survey. This study included 7,863 participants (3,918 men, 3,945 women). A generalized linear model analysis was conducted and adjusted for sex, education, marital status, number of family members, children, monthly income, employment status, city type, residential type, and age. Additionally, we conducted a stratified analysis according to sex, monthly income, employment status, and city type.

RESULTS: For the "regular sports activities" item, only women had a statistically positive result regardless of monthly income. For the "stop drinking and smoking" item, men had a statistically significant positive result regardless of monthly income and employment status.

CONCLUSIONS: This study aimed to determine the differences in the relationship between physical or mental problems and health maintenance methods. The results confirm that the health maintenance method differs between men and women. Monthly income, employment status, and city type could also influence simultaneously. The health maintenance methods with differences between men and women were regular sports activities for monthly income and cessation of drinking and smoking for monthly income and employment status. Therefore, in future exercise physiology studies, the differences between men and women must be considered when selecting a method for maintaining health.

Key words: COVID-19, Mental health, Physical health, Sport activity , Stop smoking, Stop drinking

INTRODUCTION

COVID-19, a respiratory infectious disease, has had a global impact [1], and in January 2020, the World Health Organization (WHO) declared a public health emergency due to the COVID-19 pandemic [2]. Due to COVID-19, several countries implemented lockdowns and other restriction policies that could negatively affect mental and physical health. According to some studies, physical inactivity and poor mental health are critical risk factors in disease morbidity [3]. When focusing mental health, some studies have reported a relationship between COVID-19 pandemic and mental health although there is a neuropsychiatric linkage between the acute respiratory infectious disease and mental health [4]. People may feel boredom, anger, and loneliness during quarantine periods, and COVID-19 symptoms negatively affect cognitive distress and anxiety, including coughing, fever, hypoxia, and insomnia [5]. Several studies have investigated the relationship between COVID-19 and physical health. The restrictions on normal daily activities, sports activities, and other activities due to closed schools, shops, and restaurants and encouraging people

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to work from home are negatively associated with the ability to fight a virus, the functioning of the immune system, and cardiopulmonary function [6]. During the COVID-19 outbreak, sedentary behavior increased due to decreased sports activities [6]. Sports activities plays a significant role in the prevention of diseases. Our bodies need sports activities to benefit from healthy adaptations modulated by molecular mechanisms, like epigenetics, metabolic modulation, and reduced inflammation [7,8].

COVID-19 pandemic has negative effects on mental and physical health, the knowledge and daily application of health maintenance methods are now more important. According to the Korea National Sports Participation Survey, there are several ways to maintain health, such as 'regular sports activities', 'rest and sleep', 'regular diet and nutritional supplementation', and 'stop drinking and smoking' [9]. We focused on the four ways mentioned above to maintain health because people can use these to promote health even in situations where activity is limited, such as in some COVID-19 situations. In particular, regular sports activities is the focus of this study. The reason is that regular sports activities has a close impact on physical and mental health [10]. People who exercise regularly have an increase in the amount of endorphins, which makes them feel euphoria, which lowers the body's stress level or prevents the stress response [11-13]. It also stimulates neurotransmitters in the brain, affecting substances such as serotonin, dopamine, and noradrenaline [14]. In addition, it affects the function of the hypothalamic-pituitary-adrenal (HPA) axis to keep it healthy, which has a positive effect on mental health such as depression, self-harm, and suicidal thoughts [15]. In addition, regular sports activities lowers resting heart rate, blood pressure, and body weight, and improves lipid profiles and glucose tolerance through other metabolic changes [16]. Additionally, determinants of sports activities include age, gender, self-reported health, environmental factors, and socioeconomic status which is the main factor [17-23]. In the case of previous researches, there has been a large amount of research on the relationship between physical or mental problems and health maintenance methods. However, to our knowledge, there are little studies on the effect of determinants including sex, income, employment status, and city type on physical or mental problems by considering regular sports activities, rest and sleep, regular diet and nutritional supplementation, and stop drinking and smoking as health maintenance methods. The limitations of existing studies are also reinforcing the need to proceed with this study. With this background, the study's purpose is to examine the relationship between these four health promotion methods and physical or mental problems by individual characteristics.

METHODS

1. Data source and Study population

The present study used the Korea National Sports Participation Survey, conducted by the Ministry of Culture, Sports and Tourism. This cross-sectional survey was conducted from September to November in 2019 with 9,000 people. Out of the participants, this study excluded those with missing data on marital status (n=4), number of family members (n=27), and under 20 years old (n=1,106). Finally, data from a total of 7,863 participants (3,918 men and 3,945 women) were utilized for analysis.

2. Variables

As an independent variable, this study selected participants with physical or mental problems in the last month, which was assessed by asking the question, 'Have you had any physical or mental problems in the last month?'. The responses were (1) yes and (2) no. In previous studies, there is a study using a scale that includes both health/mental problems like our study [24]. If we ask questions by classifying physical and mental problems, we could derive more detailed results. However, this study utilized the secondary data from the Korea National Sports Participation Survey, and the question was designed in the form of asking two questions at once. Therefore, it was not possible to distinguish between the two problems, which are physical and mental health, in this study.

Health maintain methods were utilized as the dependence variable. This variable was assessed by asking the question, 'How do you maintain your health and fitness? Please choose among the following options'. The responses were (1) Regular sports activities, (2) Rest and sleep, (3) Regular diet and nutritional supplementation, and (4) Stop drinking and smoking. Each item was measured on a five-point Likert scale, where 1=very poor, 2=poor, 3=fair, 4=good, and 5=very good.

3. Covariates

This study included several covariates: sex, education, marital status, number of family members, number of children, monthly income, employment status, city type, residential type, and age. Education was classified into no education or elementary school, middle school, high school, and college or higher. Marital status was categorized into married, single, widowed, and divorced. The number of family members was divided into categories from 1 to 5. The number of children was divided into categories from 0 to 4. Monthly income was classified into quartiles (Q1: ≤2,900,000, Q2: ≤4,000,000, Q3: ≤5,000,000, and Q4: >5,000,000

KRW). Employment status was classified into yes or no. City type was categorized into metropolitan, mid-sized, and small. The residential type was divided into no apartment and apartment. Sex was divided into men and women, and age was classified into seven groups (20-30, 31-40, 41-50, 51-60, 61-70, and 71 ≤).

4. Statistical analysis

We conducted a descriptive analysis regarding all variables by sex, and a generalized linear model (GLM) analysis was conducted by adjusting for sex, education, marital status, number of family members, number of children, monthly income, employment status, city type, residential type, and age. Additionally, we examined the characteristically differences between men and women to investigate the relationship between physical or mental problems and each health maintenance method using the GLM.

We also conducted stratified analyses by monthly income, employment status, and city type. In the stratified analyses, monthly income was classified into quartiles, employment status was classified as yes or no, and city type was defined as metropolitan, mid-sized, or small. All data were represented as n (%) or mean ± SD, and statistical significance was set at $p < .05$. SAS version 9.4 (SAS Institute, Cary, NC, USA) was used for the data analysis.

RESULTS

1. Sex differences

Table 1 illustrates the baseline characteristics of the study participants by sex. For age, more men were less than or equal to 50. The same number of women and men were aged 51-60, and more women were over 61.

In the socioeconomic aspect, for education, more men had a higher rate of college or higher education, and women had a higher rate of from no education or elementary school to high school education. In the case of income, men had a monthly income in the 3rd and 4th quartile more often than women, and women more often had a monthly income in the 1st and 2nd quartile. Regarding employment status, men reported employment more than women. For family structure or type, regarding marital status, men were more often single and divorced, and women were more often married and widowed. Men more often had one to two family members, and women more often had three to five family members. Men more often had no children, and women more often had one to four children.

For geography, men lived in mid-sized and small cities more often, and women lived in metropolitan cities more than men. Men and women had similar data regarding living in an apartment. In the case of physical or mental problems and health maintenance methods, a similar number of both groups reported problems due to physical or mental problems in the last month. The mean health maintenance methods scores were higher among men for 'regular sports activities' and 'regular diet and nutritional supplementation', and higher among women for 'rest and sleep' and 'stop drinking and smoking'.

2. The relationship between physical or mental problems and health maintenance methods

Tables 2 and 3 illustrates the crude GLM results and the results adjusted for the physical or mental problems and health maintenance methods. The crude and adjustment results were 0.35 and 0.28 in regular sports activities, 0.44 and 0.43 in rest and sleep, 0.38 and 0.35 in regular diet and nutritional supplementation, and 0.19 and 0.26 in stop drinking and smoking. All the results were statistically significant.

3. The relationship between physical or mental problems and health maintenance methods by sex

Tables 4 and 5 illustrates the GLM results adjusted for the physical or mental problems and health maintenance methods by sex. The results were 0.19 ($p < .0001$) in men and 0.37 ($p < .0001$) in women in regular sports activities, 0.44 ($p < .0001$) and 0.42 ($p < .0001$) in rest and sleep, 0.37 ($p < .0001$) and 0.34 ($p < .0001$) in regular diet and nutritional supplementation, and 0.41 ($p < .0001$) and 0.1 ($p = .09$) in stop drinking and smoking.

4. Sex differences in the relationship between physical or mental problems and health maintenance methods by stratification

Table 6 illustrates the GLM results adjusted for physical or mental problems and health maintenance methods by sex, stratified by monthly income, employment status, and city type. In the results of 'regular sports activities' and monthly income, only women had a statistically positive, significant result. Men and women had a statistically positive, significant result regardless of employment status. Men and wemen who lived in metropolitan and mid-sized cities had positive results.

In the results of 'stop drinking and smoking' and monthly income, men had statistically significant, positive result regardless of monthly income, and women in the 4th quartiles had statistically significant positive result. Regarding employment status, men had statistically signifi-

Table 1. Characteristics of Subjects

Variables	Men (n = 3,918)	Women (n = 3,945)	Total (N = 7,863)	
	n (%) or Mean ± SD	n (%) or Mean ± SD	n (%) or Mean ± SD	*p*-value
Education				< .0001*
No education or elementary school	165 (4.2)	388 (9.8)	553 (7)	
Middle school	299 (7.6)	368 (9.3)	667 (8.5)	
High school	1,298 (33.1)	1,510 (38.3)	2,808 (35.7)	
College or higher	2,156 (55)	1,679 (42.6)	3,835 (48.8)	
Marital status				< .0001*
Married	2,676 (68.3)	2,868 (72.7)	5,544 (70.5)	
Single	1,109 (28.3)	791 (20.1)	1,900 (24.2)	
Widowed	84 (2.1)	239 (6.1)	323 (4.1)	
Divorced	49 (1.3)	47 (1.2)	96 (1.2)	
Number of family members				< .0001*
1	339 (8.7)	281 (7.1)	620 (7.9)	
2	979 (25)	933 (23.7)	1,912 (24.3)	
3	965 (24.6)	979 (24.8)	1,944 (24.7)	
4	1,518 (38.7)	1,625 (41.2)	3,143 (40)	
5	117 (3)	127 (3.2)	244 (3.1)	
Number of children				< .0001*
0	1,297 (33.1)	937 (23.8)	2,234 (28.4)	
1	723 (18.5)	862 (21.9)	1,585 (20.2)	
2	1,518 (38.7)	1,677 (42.5)	3,195 (40.6)	
3	300 (7.7)	388 (9.8)	688 (8.7)	
4	80 (2)	81 (2.1)	161 (2)	
Monthly income				< .0001*
Q1 (Low)	1,031 (26.3)	1,125 (28.5)	2,156 (27.4)	
Q2	1,170 (29.9)	1,232 (31.2)	2,402 (30.5)	
Q3	975 (24.9)	967 (24.5)	1,942 (24.7)	
Q4 (High)	742 (18.9)	621 (15.7)	1,363 (17.3)	
Employment status				< .0001*
No	713 (18.2)	1,792 (45.4)	2,505 (31.9)	
Yes	3,205 (81.8)	2,153 (54.6)	5,358 (68.1)	
City type				< .0001*
Metropolitan	1,943 (49.6)	1,980 (50.2)	3,923 (49.9)	
Mid-sized	1,669 (42.6)	1,663 (42.2)	3,332 (42.4)	
Small	306 (7.8)	302 (7.7)	608 (7.7)	
Residential type				< .0001*
No apartment	2,151 (54.9)	2,115 (53.6)	4,266 (54.3)	
Apartment	1,767 (45.1)	1,830 (46.4)	3,597 (45.7)	
Age				< .0001*
20–30	723 (18.5)	665 (16.9)	1,388 (17.7)	
31–40	673 (17.2)	641 (16.3)	1,314 (16.7)	
41–50	727 (18.6)	721 (18.3)	1,448 (18.4)	
51–60	745 (19)	744 (18.9)	1,489 (18.9)	
61–70	588 (15)	627 (15.9)	1,215 (15.5)	
71 ≤	462 (11.8)	547 (13.9)	1,009 (12.8)	
Physical or mental problems in the last month				< .0001*
Yes	3,682 (94)	3,695 (93.7)	7,377 (93.8)	
No	236 (6)	250 (6.3)	486 (6.2)	
Regular sports activities	3.27 ± 0.95	3.11 ± 0.97	3.19 ± 0.96	< .0001*
Rest and sleep	3.59 ± 0.76	3.6 ± 0.76	3.6 ± 0.76	< .0001*
Regular diet and nutritional supplementation	3.67 ± 0.72	3.66 ± 0.71	3.66 ± 0.71	< .0001*
Stop drinking and smoking	3.12 ± 1.03	3.98 ± 0.93	3.55 ± 1.07	< .0001*

*significant based on planned analysis strategy ($p < .05$).

Table 2. GLM results (crude and adjusted) by health maintenance methods between regular sports activities and Rest and sleep

Variables	Regular sports activities				Rest and sleep			
	Crude		Adjusted		Crude		Adjusted	
	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value
Education								
No education or elementary school	-0.43*	<.0001	-0.27*	<.0001	-0.06	.11	-0.04	.38
Middle school	-0.38*	<.0001	-0.34*	<.0001	-0.04	.26	-0.08	.05
High school	-0.18*	<.0001	-0.18*	<.0001	-0.01	.64	-0.03	.23
College or higher	Ref		Ref		Ref		Ref	
Marital status								
Married	0.39*	<.0001	0.28*	.01	0.29*	<.0001	0.11	.17
Single	0.47*	<.0001	0.27*	.01	0.3*	<.0001	0.18*	.04
Widowed	-0.04	.74	0.14	.22	0.12	.17	0.09	.31
Divorced	Ref		Ref		Ref		Ref	
Number of family members								
1	0	.98	0.24*	<.0001	-0.08	.14	0.01	.85
2	0.15*	.02	0.38*	<.0001	0.17*	<.0001	0.26*	<.0001
3	0.22*	<.0001	0.33*	<.0001	0.14*	.01	0.23*	<.0001
4	0.29*	<.0001	0.31*	<.0001	0.18*	<.0001	0.25*	<.0001
5	Ref		Ref		Ref		Ref	
Number of children								
0	0.19*	.02	-0.18	.06	-0.02	.76	-0.13	.08
1	0.07	.4	-0.24*	.01	-0.05	.46	-0.1	.14
2	0.14	.08	-0.15	.06	-0.02	.74	-0.07	.25
3	-0.01	.88	-0.08	.32	0.04	.58	0.05	.43
4	Ref		Ref		Ref		Ref	
Monthly income								
Q1 (Low)	-0.27*	<.0001	-0.09	.05	-0.03	.2	0	1
Q2	-0.11*	<.0001	-0.05	.15	0.01	.84	0.02	.4
Q3	-0.02	.6	0	1	0.03	.24	0.03	.21
Q4 (High)	Ref		Ref		Ref		Ref	
Employment status								
No	-0.08*	<.0001	0.09*	<.0001	0.07*	<.0001	0.07*	<.0001
Yes	Ref		Ref		Ref		Ref	
City type								
Metropolitan	0.18*	<.0001	0.08	.05	0.11*	<.0001	0.1*	<.0001
Mid-sized	0.15*	<.0001	0.07	.09	0.16*	<.0001	0.15*	<.0001
Small	Ref		Ref		Ref		Ref	
Residential type								
No apartment	-0.08*	<.0001	-0.05*	.03	0.03	.14	0.03	.05
Apartment	Ref		Ref		Ref		Ref	
Sex								
Men	0.16*	<.0001	0.14*	<.0001	-0.01	.49	0	.8
Women	Ref		Ref		Ref		Ref	
Age								
20–30	0.38*	<.0001	0.15*	.03	0.08*	.01	0.03	.61
31–40	0.29*	<.0001	0.1	.1	-0.02	.5	-0.04	.46
41–50	0.35*	<.0001	0.19*	<.0001	-0.01	.77	-0.03	.57
51–60	0.32*	<.0001	0.22*	<.0001	0.01	.74	0	1
61–70	0.25*	<.0001	0.21*	<.0001	0.04	.17	0.04	.24
71 ≤	Ref		Ref		Ref		Ref	
Physical or mental problems in the last month								
Yes	0.35*	<.0001	0.28*	<.0001	0.44*	<.0001	0.43*	<.0001
No	Ref		Ref		Ref		Ref	

*significant based on planned analysis strategy ($p < .05$).

Table 3. GLM results (crude and adjusted) by health maintenance methods between Regular diet and nutritional supplementation and stop drinking and smoking

Variables	Regular diet and nutritional supplementation				Stop drinking and smoking			
	Crude		Adjusted		Crude		Adjusted	
	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value
Education								
No education or elementary school	-0.21*	<.0001	-0.19*	<.0001	0.44*	<.0001	-0.09	.15
Middle school	-0.16*	<.0001	-0.2*	<.0001	0.23*	<.0001	-0.16*	<.0001
High school	-0.03	.1	-0.09*	<.0001	0.23*	<.0001	-0.01	.8
College or higher	Ref		Ref		Ref		Ref	
Marital status								
Married	0.19*	.01	0.03	.68	0.36*	<.0001	0.22*	.04
Single	0.16*	.03	0.1	.24	0.08	.45	0.05	.66
Widowed	-0.04	.6	0.03	.75	0.59*	<.0001	0.3*	.01
Divorced	Ref		Ref		Ref		Ref	
Number of family members								
1	-0.14*	.01	-0.02	.8	-0.23*	<.0001	-0.23*	.01
2	0.04	.36	0.18*	<.0001	0.09	.2	-0.02	.8
3	0.1	.05	0.18*	<.0001	-0.05	.52	0.03	.66
4	0.13*	.01	0.2*	<.0001	-0.02	.77	0.01	.9
5	Ref		Ref		Ref		Ref	
Number of children								
0	0.05	.38	-0.13	.05	-0.27*	<.0001	0.23*	.01
1	0.1	.09	-0.07	.27	-0.11	.22	0	.97
2	0.1	.08	-0.07	.25	-0.05	.58	0.08	.33
3	0.1	.11	0.07	.27	0.04	.7	0.05	.53
4	Ref		Ref		Ref		Ref	
Monthly income								
Q1 (Low)	-0.14*	<.0001	-0.04	.25	0.17*	<.0001	0.08	.08
Q2	0	.85	0.03	.24	0.06	.11	0.01	.83
Q3	-0.04	.16	-0.03	.19	0.01	.78	-0.01	.69
Q4 (High)	Ref		Ref		Ref		Ref	
Employment status								
No	-0.03	.12	0.02	.29	0.43*	<.0001	0.12*	<.0001
Yes	Ref		Ref		Ref		Ref	
City type								
Metropolitan	0.13*	<.0001	0.09*	<.0001	0.07	.11	0.08	.06
Mid-sized	0.18*	<.0001	0.15*	<.0001	0.08	.09	0.1*	.03
Small	Ref		Ref		Ref		Ref	
Residential type								
No apartment	-0.01	.74	0.01	0.45	0.04	.07	0.06*	.01
Apartment	Ref		Ref		Ref		Ref	
Sex								
Men	0.01	.38	0.01	.63	-0.86*	<.0001	-0.83*	<.0001
Women	Ref		Ref		Ref		Ref	
Age								
20–30	0.12*	<.0001	-0.07	.21	-0.37*	<.0001	-0.34*	<.0001
31–40	0.12*	<.0001	-0.05	.31	-0.32*	<.0001	-0.26*	<.0001
41–50	0.14*	<.0001	-0.02	.6	-0.35*	<.0001	-0.3*	<.0001
51–60	0.18*	<.0001	0.05	.22	-0.1*	.02	-0.05	.31
61–70	0.12*	<.0001	0.05	.13	-0.1*	.02	-0.08	.09
71 ≤	Ref		Ref		Ref		Ref	
Physical or mental problems in the last month								
Yes	0.38*	<.0001	0.35*	<.0001	0.19*	<.0001	0.26*	<.0001
No	Ref		Ref		Ref		Ref	

*significant based on planned analysis strategy ($p < .05$).

Table 4. GLM results for physical or mental problems and health maintenance methods by sex between Regular sports activities and Rest and sleep

Variables	Regular sports activities				Rest and sleep			
	Men		Women		Men		Women	
	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value
Education								
No education or elementary school	-0.36*	<.0001	-0.23*	.01	-0.05	.54	0.02	.74
Middle school	-0.35*	<.0001	-0.32*	<.0001	-0.16*	.01	0.01	.88
High school	-0.24*	<.0001	-0.14*	<.0001	-0.09*	.01	0.04	.25
College or higher	Ref		Ref		Ref		Ref	
Marital status								
Married	0.03	.82	0.46*	<.0001	0	.99	0.21	.07
Single	0.18	.23	0.33*	.04	0.1	.43	0.27*	.03
Widowed	0.12	.47	0.18	.26	0.05	.74	0.15	.22
Divorced	Ref		Ref		Ref		Ref	
Number of family members								
1	0.18	.12	0.25*	.04	-0.08	.4	0.13	.15
2	0.47*	<.0001	0.26*	.01	0.24*	<.0001	0.28*	<.0001
3	0.38*	<.0001	0.24*	.01	0.26*	<.0001	0.19*	.01
4	0.41*	<.0001	0.19*	.04	0.2*	.01	0.3*	<.0001
5	Ref		Ref		Ref		Ref	
Number of children								
0	-0.35*	.01	-0.06	.63	-0.22*	.03	-0.03	.79
1	-0.36*	<.0001	-0.16	.18	-0.18	.06	-0.01	.88
2	-0.24*	.04	-0.12	.3	-0.1	.28	-0.04	.63
3	-0.22	.07	0	1	-0.01	.88	0.12	.2
4	Ref		Ref		Ref		Ref	
Monthly income								
Q1 (Low)	-0.11	.06	-0.03	.64	0.05	.28	-0.06	.21
Q2	-0.03	.59	-0.05	.27	0.06	.13	-0.02	.63
Q3	0.03	.46	-0.03	.55	0.09*	.02	-0.02	.66
Q4 (High)	Ref		Ref		Ref		Ref	
Employment status								
No	-0.1	.05	0.13*	<.0001	0.01	.89	0.11*	<.0001
Yes	Ref		Ref		Ref		Ref	
City type								
Metropolitan	0.13*	.03	0.04	.5	0.05	.34	0.16*	<.0001
Mid-sized	0.14*	.02	0.01	.85	0.07	.14	0.23*	<.0001
Small	Ref		Ref		Ref		Ref	
Residential type								
No apartment	-0.03	.26	-0.06*	.04	0.02	.34	0.04	.07
Apartment	Ref		Ref		Ref		Ref	
Age								
20–30	0.06	.52	0.19	.06	-0.08	.31	0.15	.05
31–40	-0.02	.78	0.13	.14	-0.12	.09	0.06	.39
41–50	-0.01	.94	0.29*	<.0001	-0.13	.06	0.07	.24
51–60	0.07	.36	0.27*	<.0001	-0.11	.08	0.11	.07
61–70	0.03	.67	0.29*	<.0001	-0.06	.3	0.13*	.01
71 ≤	Ref		Ref		Ref		Ref	
Physical or mental problems in the last month								
Yes	0.19*	<.0001	0.37*	<.0001	0.44*	<.0001	0.42*	<.0001
No	Ref		Ref		Ref		Ref	

*significant based on planned analysis strategy ($p < .05$).

Table 5. GLM results for physical or mental problems and health maintenance methods by sex between Regular diet and nutritional supplementation and Stop drinking and smoking

Variables	Regular diet and nutritional supplementation				Stop drinking and smoking			
	Men		Women		Men		Women	
	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value
Education								
No education or elementary school	-0.16*	.03	-0.15*	.02	0	.98	-0.14	.09
Middle school	-0.29*	<.0001	-0.11	.05	-0.38*	<.0001	-0.01	.9
High school	-0.11*	<.0001	-0.05	.11	-0.02	.61	-0.04	.29
College or higher	Ref		Ref		Ref		Ref	
Marital status								
Married	0.07	.5	-0.03	.79	0.24	.12	0.21	.13
Single	0.11	.34	0.05	.68	0.08	.61	0.04	.82
Widowed	0.08	.53	-0.04	.74	0.22	.24	0.31	.05
Divorced	Ref		Ref		Ref		Ref	
Number of family members								
1	-0.05	.58	0.05	.58	-0.23	.07	-0.21	.07
2	0.18*	.02	0.19*	.01	0.06	.57	-0.12	.22
3	0.22*	.01	0.15*	.03	0.16	.15	-0.14	.15
4	0.17*	.02	0.24*	<.0001	0.14	.17	-0.13	.15
5	Ref		Ref		Ref		Ref	
Number of children								
0	-0.21*	.04	-0.05	.58	0.28	.05	0.14	.25
1	-0.2*	.03	0.05	.59	-0.08	.56	0.08	.49
2	-0.09	.33	-0.04	.6	0.11	.36	0.03	.8
3	0.01	.89	0.13	.13	0.04	.75	0.04	.72
4	Ref		Ref		Ref		Ref	
Monthly income								
Q1 (Low)	0	.93	-0.08	.07	0.25*	<.0001	-0.08	.2
Q2	-0.02	.63	0.07*	.04	0.1	.06	-0.08	.08
Q3	-0.08*	.02	0.03	.49	0.08	.11	-0.13*	.01
Q4 (High)	Ref		Ref		Ref		Ref	
Employment status								
No	0.02	.51	0.03	.22	0.09	.07	0.06	.06
Yes	Ref		Ref		Ref		Ref	
City type								
Metropolitan	0.04	.37	0.14*	<.0001	-0.02	.74	0.17*	<.0001
Mid-sized	0.1*	.03	0.21*	<.0001	0.03	.61	0.15*	.01
Small	Ref		Ref		Ref		Ref	
Residential type								
No apartment	-0.01	.8	0.03	.14	0.01	.81	0.1*	<.0001
Apartment	Ref		Ref		Ref		Ref	
Age								
20–30	-0.07	.37	-0.01	.88	-0.34*	<.0001	-0.4*	<.0001
31–40	0.03	.68	-0.07	.24	-0.38*	<.0001	-0.19*	.02
41–50	0.03	.68	-0.03	.58	-0.46*	<.0001	-0.19*	.02
51–60	0.03	.57	0.09	.1	-0.19*	.02	0.04	.54
61–70	0.04	.42	0.09	.06	-0.15*	.04	-0.02	.75
71 ≤	Ref		Ref		Ref		Ref	
Physical or mental problems in the last month								
Yes	0.37*	<.0001	0.34*	<.0001	0.41*	<.0001	0.1	.09
No	Ref		Ref		Ref		Ref	

*significant based on planned analysis strategy ($p < .05$).

Table 6. GLM results by health maintenance methods stratified by monthly income, employment status, and city type stratified in sex

Variables	Regular sports activities				Rest and sleep			
	Men		Women		Men		Women	
	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value
Monthly income								
Q1 (Low)	0.14	.19	0.32*	< .0001	0.35*	< .0001	0.34*	< .0001
Q2	0.17	.15	0.51*	< .0001	0.51*	< .0001	0.65*	< .0001
Q3	0.27	.05	0.3*	.04	0.59*	< .0001	0.39*	< .0001
Q4 (High)	0.21	.21	0.48*	.02	0.31*	.03	0.33*	.04
Employment status								
No	0.35*	.02	0.43*	< .0001	0.42*	< .0001	0.39*	< .0001
Yes	0.15*	.03	0.3*	< .0001	0.45*	< .0001	0.45*	< .0001
City type								
Metropolitan	0.24*	.02	0.34*	< .0001	0.38*	< .0001	0.36*	< .0001
Mid-sized	0.24*	.02	0.41*	< .0001	0.4*	< .0001	0.46*	< .0001
Small	0.11	.6	0.29	.13	0.8*	< .0001	0.47*	.01
Variables	Regular diet and nutritional supplementation				Stop drinking and smoking			
	Men		Women		Men		Women	
	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value
Monthly income								
Q1 (Low)	0.37*	< .0001	0.24*	< .0001	0.3*	.01	0.07	.45
Q2	0.38*	< .0001	0.4*	< .0001	0.32*	.01	0.19	.12
Q3	0.39*	< .0001	0.48*	< .0001	0.67*	< .0001	-0.03	.82
Q4 (High)	0.35*	.01	0.44*	< .0001	0.5*	.01	0.42*	.04
Employment status								
No	0.36*	< .0001	0.32*	< .0001	0.45*	< .0001	-0.02	.79
Yes	0.37*	< .0001	0.36*	< .0001	0.45*	< .0001	0.26*	.01
City type								
Metropolitan	0.41*	< .0001	0.3*	< .0001	0.52*	< .0001	0.21*	.02
Mid-sized	0.27*	< .0001	0.38*	< .0001	0.39*	< .0001	0.01	.92
Small	0.59*	< .0001	0.36*	.02	0.12	.5	-0.01	.97

*significant based on planned analysis strategy ($p < .05$).

cant, positive results regardless of employment status, and employed women group had positive results. Men who lived in metropolitan and mid-sized cities had statistically significant, positive results, and women in metropolitan cities had positive results.

DISCUSSION

The COVID-19 pandemic has changed lives and significantly affected mental and physical health. Previous studies have reported the association between physical or mental problems and health maintenance methods, but there is little research on the four health maintenance methods examined in this study, what people can utilize in this situation, to include a subgroup analysis based on personal differences.

Effective health maintenance methods should be applied differently based on these personal features. This study investigated the differences in the relationship between physical or mental problems and health maintenance methods based on sex and was stratified by income, employment status, and city type. Both the crude and adjusted results demonstrated a significant positive relationship between physical or mental problems and certain health maintenance methods. The subgroup analysis demonstrated that women of all monthly income levels had positive relationship with 'regular sports activities' and men of all monthly income levels and all employment statuses had positive relationships with 'stop drinking and smoking'. Therefore, regardless of income level, women are more likely than men to choose regular sports activities as a health maintenance method. Among men, 'stop drinking and smoking' was chosen as a health maintenance method regardless of income level or employment status.

Regular exercise increases endorphin, which makes feel good, creates a barrier against stress response, and has a positive effect on the hypothalamic-pituitary-adrenal (HPA) axis, which plays a role in preventing

mental health problems [11-15]. Also, it has effects such as reducing weight, blood pressure, and blood sugar [16]. Therefore, 'regular sports activities' can be selected as one of the health maintenance methods. In a situation where regular exercise is not possible, it can be confirmed that stop drinking or smoking is selected as one of the ways to maintain health. These results demonstrate the difference between men and women and their adherence to health maintenance methods. Choosing health maintenance methods is related to health behavior changes, such as the intention-planning-behaviour-chain. Previous studies have noted a difference in the intention-planning-behavior-chain based on sex and other social-cognitive variables [25]. Especially in planning, men are more likely to utilize action planning, which is planning for the initiation of behaviors, and focus on moving from planning to behavior change such as 'stop drinking and smoking'. However, women are more likely to use coping planning, which is the maintenance of behaviors, and focus on moving from intention to behavior change such as 'regular sports activities' [25,26]. Additionally, men were more influenced by social support, perceptions of autonomy beliefs, and circumstances than women [25,27,28]. Also, existing studies showing that age, gender, self-reported health, environmental factors, and socioeconomic status have important effects on exercise support our findings [17-23]. In our study, monthly income, employment status, and city type all had an effect on the choice of health maintenance methods for people with physical and mental problems.

Academic contributions through these results confirm that all four methods that people with physical or mental problems choose to maintain health are important, but regular exercise among them is one of the important ways to have a positive effect both physically and mentally, In addition, if exercise is not possible, health maintenance behaviors such as abstinence from drinking or smoking may be selected. In the choice of health maintain behaviors, consideration of exercise physiology and sociodemographic factors should be included at the same time.

CONCLUSION

The purpose of this study was to investigate the differences in the association between physical or mental problems and health maintenance methods by sex. Additionally, monthly income, employment status, and city type were important factors among both men and women.

This is the study that has investigated the effect of sex on the relationship between physical or mental problems and health maintenance methods by income, employment status, and city type. However, the study does have some limitations. The study population was small, and there was a lack of health and sports activities-related data to explain more details about the effects of health maintenance methods. Also, as this study was cross-sectional in design, it examined the interrelationship between physical or mental problems and health maintenance methods rather than causality issues.

This study is meaningful because it provides foundational information that can inform national sports activities and health care policies for the COVID-19 era. The results demonstrate that researchers in exercise physiology should consider sex and socioeconomic status (income, employment status, and city type) to determine the most effective health maintenance methods. Until now, exercise physiology researches for uniform health promotion have been implemented generally, but there is a need to apply research results suitable for specific target populations based on the results derived from this study.

CONFLICT INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHOR CONTRIBUTIONS

Conceptualization: KS Kwon; Data curation: JA Kwon; Formal analysis: TY Oh; Funding acquisition: KS Kwon; Methodology: TY Oh; Project administration: KS Kwon; Visualization: JA Kwon; Writing - original draft: JA Kwon; Writing - review & editing: KS Kwon.

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