JTS

The Journal of Transdisciplinary Studies, 7(2): 143-154, 2023
https://doi.org/10.22685/JTS.2023.7.2.143

The Association between Regular Physical Exercise and Self-Rated Health in the Late Middle-Aged and Older Population: Results of Korean Longitudinal Study of Aging

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ARTICLE INFO

Article history:
Received 15 May 2023
Revised 16 August 2023
Accepted 19 August 2023

Keywords:
Exercise Duration,
Exercise Time,
Regular Exercise,
Self-Rated Health

ABSTRACT

The purpose of this study was to analyze the relationship between regular exercise and self-rated health (SRH) in the late middle-aged and older Koran population.

In this study, the 1st to 6th Korea Longitudinal Study of Aging (KLoSA) was used to analyze 3,871 participants excluding missing values, multivariate logistic regression analysis and the generalized estimating equation (GEE) model were used to identify the association between regular physical exercise and SRH.

Among individuals with less than a year or between 1-2 years of regular physical exercise, negative health reports were 1.465 or 1.29 times higher, respectively, than reports from those who had been exercising for more than five years, and these differences existed even after simultaneously correcting for weekly exercise times and durations of physical activity. Furthermore, among males and females who had less than a year of regular exercise, negative health self-reports were 1.693 and 1.287 times higher, respectively, than reports from males and females who had been exercising for more than five years.

In this study, the research results revealed that while regular physical exercise affected SRH, weekly exercise hours did not exert any influence on the same. Lower regularity and continuity of exercise correlated with greater risk of negative SRH, and this association was more prevalent in men than in women. To increase the utilization of existing and planned sports facilities, it is necessary to plan and actively promote various sports programs for residents.

1. Introduction

According to Statistics Korea's "Estimated Future Population" report released by the National Statistical Office, the proportion of senior citizens aged 65 or older in Korea was 16.4% in 2021. This exceeds the 14% threshold and Korea is currently an aged society. This proportion is expected to reach 20.3% in 2025 and 46.5% in 2067 (KOSIS, 2017). Korea is expected to take 26 years to become a super-aged society, nine years faster than Japan. Japan is a country that already has a significant amount of super-aged people, indicating the seriousness of Korea's aging rate (Choi, 2017). When entering a super-aged society, the burden of medical expenses increases due to increased numbers of people aged 65 or older who require additional medical resources. According to a prior study by Arai (Arai, 2015), adequate and appropriate changes in the medical system in the super-aged society are also required and important, as is personal health care for the middle-old aged.

To prepare for an aging society, Korea established a basic plan in 2006 to improve the conditions caused by low birth and high aging rates, based on the 2005 Framework Act on Low Birth Rate and Aging Society. This plan includes establishing countermeasures for an aging society in the first round, developing a response system in the second round, and pursuing the cultivation of a productive and vibrant aging society in the third round (Hwan & Kim, 2020). In addition, the National Sports Survey has been conducted annually to accurately identify the demand for and actual conditions of sports activities and promote and maximize participation in sports activities. Asan-si in south Korea, has been conducting a project to promote stretching and health gymnastics activities weekly in senior citizens' health centers. Similarly, the Paju City Health Center provides activities such as the middle-old aged health gymnastics, senior line dancing, and senior balance walking programs twice a week for 120 senior citizens aged 60 or older.

Old age is a time when physical weaknesses diminish the body's power and capacity, physiological dysfunctions and chronic diseases occur more frequently, and other experiences such as retirement and spouses' deaths, degrade quality of life (Choi & Lee, 2013). Chronic diseases are related to lifestyles and healthy habits and can be prevented or reduced through consistently engaging in beneficial lifestyle activities. Regular exercise is the most effective health-enhancing habit, along with other habits such as diet control, smoking cessation, weight control, and stress management (Phan, Jia, & Kamper, 2016). Exercise is a generic term for all physical activities performed to maintain or enhance the body's adaptability and healthy organ and muscle functioning, and to improve bodily deformities. Effective exercise delivers oxygen and nutrients to the heart by the expansion of capillaries, which increases oxygen demand, supply as well as utilization, reducing the risk of complications due to reduced blood flow. It also lowers bad cholesterol and blood mass, increases good cholesterol, lowers blood pressure, and reduces obesity. Exercise has been found to improve cardiovascular and other physiological functions to help older people lead their daily lives without physical barriers, improve their life expectancy, and prevent adult diseases (Brellenthin et al., 2019). At the same time, lack of regular exercise can have an adverse effect on health. According to a prior study, health risk factors and chronic diseases are strongly linked with the following factors in decreasing order: physical inactivity, high blood pressure, smoking in the past, current smoking,

obesity, dangerous drinking, nutritional imbalance, and lipid metabolic disorder in men; and for women the factors were: physical inactivity, high blood pressure, obesity, lipid metabolic disorder, nutritional imbalance, current smoking, past smoking, and dangerous drinking (Jeong, 2014). The World Health Organization (WHO) has also announced that the fourth most common global cause of death is lack of physical activity (Seo, 2019). Garrett's previous study (Garrett et al., 2004) analyzed the contribution of physical activity to the medical expenses of certain diseases, and found that 31% of colon cancer, heart disease, osteoporosis, and stroke incidents were caused by lack of physical activity. In particular, heart disease has been shown to be the most expensive medical expense caused due to lack of physical activity. In addition, health conditions such as chronic diseases are a major determinant of medical expenditure (Kim & Kim, 2002). Restrictions on physical functioning due to chronic diseases tend to negatively affect SRH (Choi et al., 2004). According to a prior study, higher numbers of chronic diseases correlated with increasingly negative subjective health assessments (Ahn & Lee, 2008; Hong, 2008).

Therefore, this study aimed to study the relationship between exercise activities and self-reported health, in order to establish institutional and policy measures to provide regular exercise activities to the middle and old-aged demographics who are more vulnerable to chronic health conditions but less engaged in exercise, in order to improve their health behaviors and perceptions.

2. Materials and Methods

2.1 Data source

The data used for the following analyses were derived from the Korean Longitudinal Study of Aging (KLoSA) from 2006 to 2016. As a type of study that possesses both the strengths of cross-sectional data and time series data, the KLoSA was constructed by repeatedly surveying the identical content for the same respondents every year. Thus, all variables surveyed by the KLoSA were repeatedly measured from the 1st wave to the 4th wave to collect observation cases at multiple points in time. This biennial survey involves multistage stratified sampling based on geographical areas and housing types across Korea. Participants were selected randomly using a multistage, stratified probability sampling design to create a nationally representative sample of community-dwelling Koreans 45 years of age and older. Participant selection was performed by the Korea Labor Institute for these rapidly growing populations, including individuals from both urban and rural areas. In case of refusal to participate, another subject was selected from an additional, similar sample from the same district.

In the first baseline survey in 2006, 10,254 individuals in 6,171 households (1.7 per household) were interviewed. There were 292 individuals with cancer. The second survey, in 2008, followed up with 8,675 subjects, who represented 86.6% of the original panel. The third survey, in 2010, followed up with 8,229 subjects, who represented 81.7% of the original panel, the fourth survey, in 2012, followed up with 7,813 subjects, who represented 80.1% of the original panel and the fifth survey, in 2014, followed up with 8,387 subjects (including 920 new participated sample),

who represented 80.4% of the original panel. The sixth survey, in 2016, followed up with 9,913 subjects (including 878 new participated sample), who represented 79.6% of the original panel.

2.2 Independent variables

2.2.1 The weekly exercise times

The independent variable in this study is the weekly exercise time at baseline (1st KLoSA). “How many times a week do you exercise? And how many minutes do you exercise once you exercise?” The questionnaire was divided into “less than 3 hours”, “3-4 hours”, “4-5 hours”, and “more than 5 hours”.

2.2.2 Exercise duration(year)

Another independent variable is the exercise duration. The questionnaire “How long have you been exercising regularly?” was divided into “less than one year”, “1-2 years”, “3-4 years”, and “more than 5 years”.

2.3 Dependent variables

2.3.1 Self-rated health

SRH was measured on a five-point scale (very good, good, normal, bad, very bad) through the subjective question of “What do you think is your normal level of health?”. For logistic regression, the analysis was conducted by dividing very good, good, and moderate into “good” and very bad, bad into “bad”.

2.4 Control variables

This study established the model through a review of similar prior research (Kim, 2022). The number of age, educational background, gender, marriage, work restrictions, drinking status, health insurance, and chronic diseases were selected as control variables. In the case of age, 54 years of age or younger, 55-64 years of age, 65-74 years of age, and 75 years of age or older were divided into elementary, middle, high school, and college graduates. Gender was divided into men and women, and marriage was divided into married, separated, divorced, and single. Work restrictions were classified as yes or no, and health insurance was classified as national health insurance and medical benefits. The number of chronic diseases was divided into zero, one, and two or more.

2.5 Analytical approach and statistics

In this study, chi-square test and t-test were used to investigate the association between regular

physical exercise and SRH. We also conduct multiple regression analysis and multiple regression analysis to identify the association of exercise time, exercise duration and SRH. For all analyses, the criterion for statistical significance was $p \leq 0.05$, two-tailed. All analyses were conducted using the SAS statistical software package, version 9.4 (SAS Institute Inc., Cary, NC, USA).

3. Results

Table 1 showed that the general characteristics of participants at each survey point at baseline. The total number of respondents was 3,871, and 282 (22.9%) of 1,232 respondents who said weekly exercise time was less than three hours said they had a negative SRH.

Of the 682 respondents who answered 3-4 hours, 191 (28%) said they had a negative SRH, of the 413 respondents who answered 4-5 hours, 74 (17.9%) said they had a negative SRH and of the 1,544 respondents who said it was more than five hours, 355 (23%) said they had a negative SRH. Of the 455 respondents who said exercise duration was less than one year, 142 (31.2%) said they had a negative SRH.

Of the 721 respondents who answered 1-2 years, 194 (26.9%) said they had a negative SRH. Of the 764 respondents who answered 3-4 years, 188 (24.6%) said they had a negative SRH, and of the 1,931 respondents who answered more than 5 years, 378 (19.6%) said they had a negative SRH.

Table 1. General characteristics of subjects included for analysis

Variables	Total		poor SRH		P-value
	N	%	N	%	
Exercise time per week (hour)					0.002
< 3	1,232	31.8	282	22.9	
3-4	682	17.6	191	28.0	
4-5	413	10.7	74	17.9	
≥ 5	1,544	39.9	355	23.0	
Exercise duration (year)					<.0001
< 1	455	11.8	142	31.2	
1-2	721	18.6	194	26.9	
3-4	764	19.7	188	24.6	
≥ 5	1,931	49.9	378	19.6	
Age					<.0001
≤54	1,434	37.0	157	11.0	
55-64	1,148	29.7	275	24.0	
65-74	961	24.8	328	34.1	
≥65	328	8.5	142	43.3	

Variables	Total		poor SRH		P-value
	N	%	N	%	
Education level					<.0001
≤ Elementary school	1,225	31.7	500	40.8	
Middle school	691	17.9	164	23.7	
High school	1,300	33.6	175	13.5	
≥ College	655	16.9	63	9.6	
Gender					<.0001
Male	1,880	48.6	345	18.4	
Female	1,991	51.4	557	28.0	
Marital status					<.0001
Married	3,263	84.3	654	20.0	
Separated, divorced	592	15.3	245	41.4	
Single	16	0.4	3	18.8	
Working restriction					<.0001
Yes	1,040	26.9	655	63.0	
No	2,831	73.1	247	8.7	
Alcohol consumption					<.0001
Yes	1,626	42.0	256	15.7	
No	2,245	58.0	646	28.8	
Health insurance					<.0001
National Health Insurance	3,692	95.4	806	21.8	
Medical aid	179	4.6	96	53.6	
Number of chronic disease*					<.0001
0	2,032	52.5	160	7.9	
1	1,100	28.4	302	27.5	
≥2	739	19.1	440	59.5	
Total	3,871	100.0	902	23.3	

Table 2 showed the result of correcting other control variables to determine the correlation between weekly exercise, duration of exercise and SRH. The analysis was conducted by building three models. <Model 1> is correlation between weekly exercise hours and SRH. <Model 2> is analysis of the relationship between exercise duration and SRH, <Model 3> is a model that corrects the weekly exercise time and duration of the exercise at the same time.

The analysis showed that the risk of negative SRH in groups with a exercise duration of less than one year was 1.465 times higher (OR: 1.453, 95% CI: 1.268-1.694, P-value<0.0001) compared to groups with a duration of more than five years and those in groups with a exercise duration of 1-2 years was 1.29 times higher (OR: 1.290, 95% CI: 1.145-1.452, P-value<0.0001) compared to groups with a duration of more than five years.

According to the analysis, the weekly exercise time and duration of the exercise were not statistically significant. For exercise duration, the risk of negative SRH for groups with a duration of less than one year was 1.453 times higher (OR: 1.452, 95% CI: 1.256-1.682, P-value<0.0001) and with a duration of 1-2 year was 1.281 time higher (OR: 1.281, 95% CI: 1.137-1.444, P-value<0.0001).

Table 2. Adjusted effect between exercise time per week, exercise duration and self-rated health

Variables	Model 1				Model 2				Model 3			
	OR	95% CI		P-value	*OR*	95% CI		P-value	*OR*	95% CI		P-value
Exercise time per week (hour)												
< 3	1.094	0.983	1.219	0.100					1.040	0.933	1.161	0.477
3-4	1.126	0.999	1.269	0.051					1.097	0.973	1.238	0.130
4-5	1.046	0.895	1.222	0.572					1.022	0.874	1.195	0.782
≥ 5	1.000								1.000			
Exercise duration (year)												
< 1					1.465	1.268	1.694	<.0001	1.453	1.256	1.682	<.0001
1-2					1.290	1.145	1.452	<.0001	1.281	1.137	1.444	<.0001
3-4					1.112	0.990	1.249	0.073	1.107	0.985	1.244	0.088
≥ 5					1.000				1.000			
Age												
≤54	1.000				1.000				1.000			
55-64	1.318	1.126	1.542	0.001	1.338	1.143	1.567	0.000	1.338	1.143	1.566	0.000
65-74	1.924	1.639	2.258	<.0001	1.991	1.695	2.339	<.0001	1.990	1.694	2.337	<.0001
≥75	2.224	1.856	2.666	<.0001	2.346	1.955	2.815	<.0001	2.342	1.952	2.810	<.0001
Education level												
≤ Elementary school	2.616	2.219	3.085	<.0001	2.573	2.181	3.035	<.0001	2.566	2.175	3.027	<.0001
Middle school	1.979	1.663	2.355	<.0001	1.967	1.652	2.341	<.0001	1.966	1.652	2.340	<.0001
High school	1.398	1.188	1.646	<.0001	1.392	1.183	1.639	<.0001	1.392	1.182	1.639	<.0001
≥ College	1.000								1.000			
Gender												
Male	1.000				1.000				1.000			
Female	1.021	0.919	1.135	0.701	1.011	0.909	1.124	0.840	1.007	0.906	1.120	0.894
Marital status												
Married	1.000				1.000				1.000			
Separated, divorced	1.008	0.896	1.134	0.896	1.007	0.895	1.133	0.906	1.007	0.895	1.133	0.908
Single	0.708	0.364	1.379	0.311	0.710	0.366	1.379	0.312	0.710	0.366	1.379	0.312
Working restriction												
Yes	9.616	8.796	10.512	<.0001	9.548	8.734	10.437	<.0001	9.525	8.712	10.413	<.0001
No	1.000				1.000				1.000			
Alcohol consumption												
Yes	1.000				1.000				1.000			
No	1.489	1.342	1.652	<.0001	1.487	1.340	1.650	<.0001	1.486	1.339	1.649	<.0001
Health insurance												
National Health Insurance	1.000				1.000				1.000			
Medical aid	1.976	1.621	2.409	<.0001	1.955	1.603	2.383	<.0001	1.958	1.606	2.387	<.0001

Variables	Model 1				Model 2				Model 3			
	OR	95% CI		P-value	*OR*	95% CI		P-value	*OR*	95% CI		P-value
Number of chronic diseases*												
0	1.000				1.000				1.000			
1	2.633	2.345	2.957	<.0001	2.593	2.309	2.912	<.0001	2.597	2.312	2.917	<.0001
≥2	6.958	5.763	8.401	<.0001	6.850	5.671	8.274	<.0001	6.856	5.675	8.282	<.0001
Year												
2006	0.914	0.760	1.098	0.336	0.918	0.763	1.103	0.360	0.917	0.763	1.103	0.358
2008	1.344	1.129	1.599	0.001	1.310	1.100	1.560	0.003	1.311	1.100	1.561	0.003
2010	1.613	1.351	1.926	<.0001	1.596	1.336	1.907	<.0001	1.596	1.335	1.907	<.0001
2012	1.177	0.986	1.404	0.071	1.158	0.970	1.383	0.104	1.160	0.972	1.386	0.101
2014	1.027	0.858	1.229	0.771	1.037	0.866	1.241	0.693	1.035	0.865	1.239	0.708
2016	0.962	0.803	1.153	0.678	0.974	0.813	1.167	0.777	0.972	0.811	1.164	0.755
2018	1.000				1.000				1.000			

Table 3 showed an analysis of the association of weekly exercise times, exercise duration and negative SRH by gender. Analysis showed that the risk of negative SRH in groups with less than one year of exercise duration within the male population was 1.693 times higher (OR: 1.693, 95% CI: 1.334-2.150, and P-value<0.0001) than those with more than five years, those with groups with a 1-2 year was higher 1.424 times (OR: 1.424, 95% CI: 1.183-1.714, P-value: 0.000) and those groups with a 3-4 year was higher 1.22 times (OR: 1.220, 95% CI: 1.022-1.456, P-value: 0.028) than those with more than five years. In the case of women, the risk of negative SRH in groups with a duration of less than one year was higher 1.287 times (OR: 1.287, 95% CI: 0.008, P-value: 0.008) compared to groups with a duration of more than five years.

Table 3. An analysis of the association of weekly exercise times, exercise duration and negative self-rated health by gender

Variables	Male				Female			
	OR	95% CI		P-value	*OR*	95% CI		P-value
Exercise time per week (hour)								
< 3	0.986	0.832	1.168	0.868	1.104	0.955	1.275	0.182
3-4	1.127	0.938	1.355	0.203	1.083	0.923	1.271	0.328
4-5	1.033	0.819	1.303	0.787	0.997	0.805	1.234	0.976
≥ 5	1.000				1.000			
Exercise duration (year)								
< 1	1.693	1.334	2.150	<.0001	1.287	1.069	1.550	0.008
1-2	1.424	1.183	1.714	0.000	1.161	0.991	1.360	0.064
3-4	1.220	1.022	1.456	0.028	1.011	0.865	1.181	0.895
≥ 5	1.000				1.000			

* Adjusted for age, gender, education, marital status, working restriction, alcohol consumption, national health insurance, number of chronic disease and year

4. Discussion

This study aims to identify the relationship between regular physical exercise and SRH by using the 1st–6th KLoSA conducted on people aged 45 and over in Korea.

In summary, the risk of negative SRH increased consistently with decreases in regularity and continuity of exercise, with this correlation being more prevalent among men than women. Interestingly, weekly exercise times and exercise regularity were not statistically significantly related, indicating that regular exercise is more important than weekly exercise times.

The American College of Sports Medicine (ACSM) and the Centers for Disease Control and Prevention (CDC) recommend daily heavy physical activity to experience consistent health effects (Kim & Kong, 2009). Sedentary habits have been reported to have a negative effect on health during old age. More specifically, insufficient regular physical activity shortens lives, increases the incidence of disease, and degrades the quality of life (Cress, 2005). Therefore, with the growing emphasis on healthy living behaviors, regular exercise activities have been recognized as an important strategy for preventing diseases and improving health (Blair & Wei, 2000). Regular exercise increases good cholesterol significantly as long as exercise periods are sufficiently lengthy and intense (Ahn, 2000). It is also effective for conditions such as arteriosclerosis, high blood pressure, and diabetes, as well as issues related to the circulatory system (American College of Sports Medicine et al., 1995). Prior studies have also shown that regular physical activities have helped reduce the incidence and mortality of coronary artery disease, stroke, hypertension, hyperlipidemia, obesity, diabetes, osteoporosis, colorectal cancer, breast cancer, immune system issues (infectious cold), depression, and congestive heart disease (Muscella, Stefàno, & Marsigliante, 2020; Ruiz-Ramie, Barber, & Sarzynski, 2019).

Regular physical activity has been linked to relatively low medical expenditure, reducing the frequency of outpatient visits, and shortening the length of hospitalization (Oh, 2013; Shishido et al., 2003). Other positive economic effects include reduced health care costs, increased productivity through economic activities, as well as increased national income (Park & Heo, 2008).

However, according to the results of the 2019 National Sports Survey, older age groups are likelier to have a negative perception of health and fitness, with those in their 50s, 60s and 70s having the least participation in regular sports activities. Hence, it is even more important to promote participation in exercise because increased engagement in exercise leads to improved subjective strength outcomes (Lee & Young, 2015). The survey also reported that in terms of utilization and preference of sports facilities, private sports facilities are the most utilized by respondents (24.5%), followed by public sports facilities (21.6%), other sports facilities (14.4%), school sports facilities (11.2%), personal facilities (3.4%), and workplace sports facilities (1.7%) with 23.8% of respondents not using any facilities. The reasons for not using sports facilities included “lack of diverse sports programs”, “lack of getting information on sports facilities due to active promotion”, and “lack of having a preferred sports leader”. Hence, information about sports facilities and various programs should be provided to middle-aged and senior citizens to increase their utilization of sports facilities.

There is several strengths and limitations of this study. A major strength of the current study is that it can be generalized across Korea as it used a large-scale national dataset, with the longitudinal

data supporting the long-term temporal relevance of the relationship between hours exercised per week, regularity of exercise, and negative subjective health perceptions. Also, although there have been many previous studies on the association of exercise and negative subjective health conditions, and the effects of physical activity on the middle and old-aged people's lives and well-being, this study further contributes to the literature by specifically analyzing the association of weekly exercise times, exercise regularity, and SRH. Nevertheless, our study has several limitations as well. First, this study had a subjective bias due to the KLoSA used in the analysis, mixed with the respondents' opinions. It analyzed longitudinal data, but the results may reflect an inverse causal relationship between the regular physical exercise and SRH. Finally, we were unable to adjust for unknown confounding factors that were strongly associated with the investigated relationship. Despite these limitations, our study is predictive of preventing lower SRH in the middle-aged and elderly Korean population. These findings demonstrate the need for more studies that examine the mechanisms of this association and explore the potential of regular physical exercise and health condition as modifiable risk factors for healthy aging in Asian populations.

This study examined the relationship between regular physical exercise and SRH for Korean individuals aged 45 or older. Results revealed that while regular physical exercise affected SRH, weekly exercise hours did not exert any influence on the same. Lower regularity and continuity of exercise correlated with greater risk of negative SRH, and this association was more prevalent in men than in women. Considering that subjective health conditions can affect Korea's future national economy in a multi-dimensional manner, the government and local governments should create and promote customized exercise and fitness programs for middle-aged and senior citizens. In addition, to increase the utilization of existing and planned sports facilities, it is necessary to plan and actively promote various sports programs for residents.

Conflicts of Interest

No author has any other conflict of interest to declare.

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