

# The Positive Effect of Physical Activity on Health and Health-related Quality of Life in Elderly Korean People—Evidence from the Fifth Korea National Health and Nutrition Examination Survey

Kang-Ok Cho\*

Department of Physical Education, Seoul National University, Seoul, Korea

**Background:** The proportion of elderly people in the population is growing, and Korea has one of the fastest growing populations among the world's major regions. The objective of this study was to examine the effects of physical activity on the health and quality of life of elderly Korean people.

**Methods:** A nationally representative sample of 2,853 elderly Korean people (1,239 males and 1,614 females) aged more than 65 years was evaluated to determine whether they met guidelines for vigorous PA (VPA), moderate PA (MPA), and low PA (LPA) and how those results were associated with self-rated health (SRH) and health-related quality of life (HRQoL).

**Results:** The adjusted odds ratio (AOR) of males and females who reported very good SRH significantly decreased with VPA (males: AOR = 0.42, females: AOR = 0.44), MPA (males: AOR = 0.46, females: AOR = 0.48), and LPA (males: AOR = 0.44, females: AOR = 0.32). Subjects who met the guidelines for VPA (males: AOR = 0.40, females: AOR = 0.43), MPA (males: AOR = 0.49, females: AOR = 0.45), and LPA (males: AOR = 0.33, females: AOR = 0.39) and reported no problems with their HRQoL showed significantly decreased AORs compared with subjects who reported HRQoL problems.

**Conclusion:** Elderly Korean people were fairly inactive, but participation in vigorous, moderate, or low PA was positively associated with SRH and HRQoL.

**Key Words:** Physical activity, Quality of life, Self-rated health, Elderly people, Korea

## INTRODUCTION

During the past several decades, South Korea has experienced rapid socioeconomic growth and one of the highest growth rates in the world. Korea has also undergone dramatic changes in its demography and lifestyle. The pro-

portion of elderly people is growing, and Korea also has one of the fastest growing elderly populations among the world's major regions. According to Statistics Korea, the proportion of the population aged more than 65 years in Korea will dramatically increase from 7.2% in 2000 to 20.8% in 2020 [1]. The increase in the elderly population in Korean society threatens the national health. With an increase in the number of chronic patients with diabetes, cerebral apoplexy, and hypertension, social concern has been triggered [2].

Physical activity (PA) is one of the most important factors in long-term weight loss, and regular PA is associated

Received: July 4, 2014, Accepted: August 20, 2014

\*Corresponding author: Kang-Ok Cho

Department of Physical Education, Seoul National University,  
1 Gwanak-ro, Gwanak-gu, Seoul 151-070, Republic of Korea  
Tel: 82-2-884-7616, Fax: 82-2-880-7794  
E-mail: okcho1@snu.ac.kr

with a reduced risk of cardiovascular disease, coronary heart disease, type 2 diabetes mellitus, depression, anxiety, and all-cause mortality [3,4]. Cho [5] reported that PA is an effective prevention measure because it improves sleep quality and mental health. Apart from considerable physical health-related benefits, a number of psychological benefits have been identified, with the most evidence concerning depression and anxiety [6]. For this reason, national health-promotion programs have been recommended to increase PA in South Korea [7-9]. However, PA declines continuously with age [10]. Therefore, helping elderly people who do not have established patterns of PA to acquire healthy habits is useful to the public health.

Self-rated health (SRH) provides only a subjective assessment of individual health status, but it is also a good predictor of mortality and functional loss independent of objective health and psychosocial and demographic variables [11]. In addition, although the decision to rate health is driven by psychological factors, it appears that respondents mainly consider physical health problems when rating their health status [9]. In practical terms, SRH is readily measured using single-item questions and is thus often included in health surveys and as an outcome in many studies [9-11].

Studies performed during the past few decades have indicated that health-related quality of life (HRQoL)—which refers to physical, psychological, and social functioning as reported by the patients themselves—has become an important component of chronic disease evaluation and monitoring, in addition to conventional objective indicators, such as morbidity, mortality, and clinical measurements [12]. The EuroQol questionnaire (EQ-5D) has been used in large surveys to measure HRQoL in both general and specific populations [13,14]. Because of the ease with which it can be administered, scored, and interpreted, EQ-5D has gained widespread popularity, especially in large-scale face-to-face health surveys conducted by interview. It also imposes a minimal burden on the respondents because it is brief and easy for most people to understand and complete [15].

Subjective health status, such as SRH or HRQoL, is strongly associated with successful aging [10], and its association with PA has been studied in some populations [11-14]. However, it has not been adequately described in elderly people. As South Korea has experienced rapid economic de-

velopment, Koreans' physical activity and dietary habits have undergone significant changes. Because of the rapid changes in demography and lifestyle, the importance of PA and health has been emphasized [7-9]. To the best of my knowledge, no study has examined the association among PA, SRH, and HRQoL in a nationally representative sample of elderly Korean people. Therefore, this study aims to investigate whether PA is associated with SRH and HRQoL status in elderly Korean people using national data from the Fifth Korean National Health and Nutrition Examination Survey (KNHANES-V) taken in 2010 and 2011.

## MATERIALS AND METHODS

### 1. Study population

Raw, cross-sectional data from the KNHANES-V were used for this study. KNHANES-V was divided into four parts; the Health Interview Survey, the Health Behavior Survey, the Nutrition Survey, and the Health Examination Survey. KNHANES-V was conducted using a systematic stratified cluster sampling design. The sampling framework was based on the 2009 National Census Registry. 1,052 districts were selected and enumerated considering administrative districts and habitation sites (apartment houses/general houses). The study protocol was approved by the Korean Ministry of Health and Welfare and was conducted in accordance with the Ethical Principles for Medical Research Involving Human Subjects, as defined by the Helsinki Declaration. The study participants provided written informed consent. For this study sample, the subjects were 2,853 elderly people (1,239 males and 1,614 females) aged more than 65 years who completed the Health Interview Survey and the Health Behavior Survey (response rate: 89.8%).

### 2. Dependent variables

KNHANES-V contains six questions about PA. The PA information was obtained in interviews using questions from the self-administered International Physical Activity Questionnaire (IPAQ) [16]. Reported PA was compared with the guidelines of the American College of Sports Medicine (ACSM). The ACSM recommends 20 minutes of vigorous PA (e.g., soccer, basketball, aerobics, running, fast

cycling, and fast swimming) 3 days/week, 30 minutes of moderate PA (e.g., cycling or swimming at a regular pace, noncompetitive volleyball, and doubles tennis) at least 5 days/week, and 30 minutes of walking at least 5 days/week for adults [17]. Participants were divided into two groups, one that met the requirements and one that did not.

### 3. Independent variables

The EQ-5D [15] was used to assess HRQoL in KNHANES-V. The EQ-5D consists of five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has three levels of response or severity (no problems, some problems, and extreme problems). The ability to convert the self-classifications into a single index score makes the EQ-5D a practical evaluation, corresponding to no problems (0.501-1.000), some problems (0.001-0.500), and extreme problems (-0.560-0.000). This index score ranges from -0.560 to 1.000, where full health is 1.000 and being dead is 0 (a negative value represents a health condition considered worse than death). The SRH information in KNHANES-V was obtained in interviews. The participants were asked to rate their health as very good, good, fair, poor, or very poor.

### 4. Covariate variables

The covariates were evaluated for each subject on the basis of responses to seven questions from the self-reported data. The questions and their responses are as follows:

1. Age: Self-reported age was used without modification. For this study, age groups were categorized as 1) 65-74 years and 2) older than 75 years.

2. Body mass index (BMI): Height and weight were measured with the subjects wearing light clothing and no shoes. BMI was then calculated as their weight (kg) divided by the square of their height. In accordance with the WHO Asia-Pacific standard of obesity, individuals were classified into underweight, normal, and obese groups based on 1) BMIs of < 18.5, 2) 18.5-24.9, and 3)  $\geq$  25.0, respectively.

3. Education: Self-reported education was categorized as 1) less than an elementary school graduate, 2) elementary school graduate, 3) middle school graduate, or 4) high school or higher.

4. Family members: Self-reported family members were

categorized as 1) 1, 2) 2-3, 3) 4-5, and 4) 6 or higher.

5. Marital status: The four possible responses of marital status were 1) married, 2) separated, 3) widowed, and 4) divorced.

6. Family socio-economic status: The four possible responses of family socio-economic status were 1) low, 2) average, 3) middle high, and 4) high.

7. Stress: The five possible responses for self-reported stress level in everyday life were 1) very much, 2) much, 3) moderate, 4) very little, and 5) not at all.

8. Depression: Participants were asked whether feelings of sadness or hopelessness had interrupted their lives for more than two weeks in the past year and could answer 1) no or 2) yes.

### 5. Statistical analyses

The statistical software SPSS version 18.0 was used in all analyses. All descriptive statistics are presented as frequencies and percentages for the categorical variables. A Chi-square test was performed to test level differences in all variables. To assess associations between the reference group and the other groups, multiple logistic regression methods were implemented using logistic regression analysis. However, the ratio of the subjects with extreme problems of HRQoL and very poor SRH was not fit to perform logistic regression, so I merged the variables of extreme problems and some problems of HRQoL and very poor and poor SRH. Adjustments were successively made for age, BMI, education, number of family members, marital status, stress, depression, and HRQoL (Model 1) or SRH (Model 2). A score of  $p < 0.05$  was considered statistically significant.

## RESULTS

### 1. General characteristics of study participants

The general characteristics of study participants are summarized in Table 1. Of the total of 2,853 elderly Korean people, 1,239 were male (43.4%) and 1,614 were female (56.6%). Males showed higher levels of education, number of family members, likelihood of living with spouse, and family socio-economic status and less stress and depression than females.

**Table 1.** General characteristics of elderly Korean people

Characteristics	Males (n = 1,239)	Females (n = 1,614)	Total (n = 2,853)	X <sup>2</sup> value	p-value
Age (years)					
65-74	867 (70.0)	1,064 (63.9)	1,931 (67.7)	7.749	0.048
75 ≤	372 (30.0)	550 (35.1)	992 (22.3)		
BMI (kg/m <sup>2</sup> )					
BMI < 18.5	64 (5.2)	67 (4.2)	131 (4.6)	55.974	< 0.001
18.5 ≤ BMI < 25.0	840 (68.2)	930 (57.7)	1,780 (62.2)		
25.0 ≤ BMI	329 (26.7)	614 (38.1)	943 (33.2)		
Education					
≤ Elementary school	791 (63.9)	1,473 (91.6)	2,264 (79.5)	461.388	< 0.001
Middle school	285 (23.0)	116 (7.2)	401 (14.1)		
High school ≤	162 (13.1)	19 (1.2)	181 (6.4)		
Family members					
1	90 (7.3)	410 (25.4)	500 (17.5)	209.944	< 0.001
2-3	954 (77.0)	879 (54.5)	1,833 (64.3)		
4-5	139 (11.2)	257 (16.0)	396 (13.9)		
6 ≤	56 (4.5)	68 (4.1)	124 (4.3)		
Marital status					
Married	1,126 (91.2)	783 (48.8)	1,909 (67.3)	594.313	< 0.001
Separated	7 (0.6)	13 (0.8)	20 (0.7)		
Widowed	81 (6.6)	778 (48.5)	859 (30.3)		
Divorced	20 (1.6)	30 (1.9)	50 (1.7)		
Family socio-economic status					
Low	608 (49.1)	894 (55.4)	1,502 (52.7)	14.692	0.002
Average	333 (26.9)	350 (21.7)	683 (23.9)		
Middle high	169 (13.6)	203 (12.6)	372 (13.0)		
High	129 (10.4)	167 (10.3)	296 (10.3)		
Stress					
Very much	75 (6.1)	52 (3.2)	127 (4.5)	79.860	< 0.001
Somewhat	351 (8.3)	317 (9.6)	668 (3.4)		
Moderate	480 (38.7)	592 (36.7)	1,072 (37.6)		
Very little	254 (0.5)	445 (7.6)	699 (24.5)		
Not at all	79 (6.4)	208 (12.9)	287 (10.1)		
Depression					
No	32 (2.5)	110 (6.8)	142 (5.0)	83.308	< 0.001
Yes	1,207 (97.5)	1,504 (93.2)	2,701 (85.0)		

Data are presented as n (%).

## 2. Patterns of physical activity during the past seven days

The patterns of PA during the preceding seven days according to gender are presented in Table 2. The participation ratios of no vigorous PA and no moderate PA in the past 7 days were, respectively, 84.7% and 73.3% for elderly people, and that for no walking was 24.7%. In addition, significant differences were noted in the meeting of vigorous and low PA guidelines according to gender: significantly fewer females than males met the PA guidelines.

## 3. Relationship between self-rated health and health-related quality of life

Table 3 shows the relationship between SRH and HRQoL in the participants. Males and females who self-reported their HRQoL as having no problems were also the most likely to report very good SRH (39.4% in males and 38.5% females), whereas subjects who reported their HRQoL as having some problems and extreme problems were more likely to report very poor SHR (57.1% and 100.0% in males and 47.1% and 50.0% in females, respectively). Significant level differences of SRH status according HRQoL level were ob-

**Table 2.** Patterns of physical activity during the past seven days

Variables	Males (n = 1,239)	Females (n = 1,614)	Total (n = 2,853)	X <sup>2</sup> value	p-value
Q1. How many days did you perform vigorous physical activity?					
1. No vigorous physical activity	1,003 (81.4)	1,397 (87.3)	2,400 (84.7)	23.431	0.001
2. Once or twice per week	92 (7.5)	83 (5.7)	175 (6.2)		
3. Thrice or 4 times per week	58 (4.7)	64 (3.5)	122 (4.4)		
4. More than 5 times per week	79 (6.4)	57 (3.1)	136 (4.7)		
Q2. How many days did you perform moderate physical activity?					
1. No moderate physical activity	895 (72.7)	1,183 (73.8)	2,078 (73.3)	8.749	0.271
2. Once or twice per week	122 (9.9)	128 (8.0)	250 (8.8)		
3. Thrice or 4 times per week	74 (6.5)	111 (6.9)	185 (6.6)		
4. More than 5 times per week	150 (11.3)	180 (11.3)	320 (11.3)		
Q3. How many days did you walk as low physical activity?					
1. No walking	231 (18.7)	470 (29.4)	701 (24.7)	55.563	< 0.001
2. Once or twice per week	129 (10.5)	189 (11.8)	318 (11.3)		
3. Thrice or 4 times per week	204 (16.5)	262 (16.4)	466 (16.5)		
4. More than 5 times per week	669 (54.2)	680 (42.5)	1,349 (47.7)		
Q4. Did you meet vigorous physical activity guidelines? <sup>1)</sup>					
1. Met the criterion	137 (11.1)	121 (8.6)	258 (9.8)	84.425	< 0.001
2. Not met the criterion	1,102 (88.9)	1,493 (91.4)	2,595 (90.2)		
Q5. Did you meet moderate physical activity guidelines? <sup>2)</sup>					
1. Met the criterion	150 (12.1)	180 (11.2)	330 (11.6)	.353	0.965
2. Not met the criterion	1,089 (87.9)	1,434 (88.8)	2,523 (88.4)		
Q6. Did you meet low physical activity guidelines? <sup>3)</sup>					
1. Met the criterion	669 (54.2)	680 (42.5)	1,349 (47.3)	31.261	< 0.001
2. Not met the criterion	570 (45.8)	934 (57.5)	1,504 (52.7)		

Data are presented as n (%).

- 1) 20 minutes vigorous physical activity ≥ 3 times/week.
- 2) 30 minutes moderate physical activity ≥ 5 times/week.
- 3) 30 minutes walking ≥ 5 times/week.

**Table 3.** Relationship between health-related quality of life and self-rated health

Variables	Males			X <sup>2</sup> value	p-value	Females			X <sup>2</sup> value	p-value
	Extreme problems (n = 3)	Some problems (n = 29)	No problems (n = 1,207)			Extreme problems (n = 8)	Some problems (n = 102)	No problems (n = 1,504)		
Self-rated health										
Very good	0 (0.0)	1 (3.6)	476 (39.4)	178.660	< 0.001	0 (0.0)	1 (1.0)	579 (38.5)	183.803	< 0.001
Good	0 (0.0)	2 (7.1)	349 (28.9)			0 (0.0)	7 (6.9)	405 (26.9)		
Fair	0 (0.0)	4 (14.7)	248 (20.5)			2 (25.0)	9 (8.8)	310 (20.6)		
Poor	0 (0.0)	5 (17.9)	75 (6.2)			2 (25.0)	37 (36.3)	154 (10.2)		
Very poor	3 (100.0)	17 (57.1)	16 (5.1)			4 (50.0)	48 (47.1)	56 (3.7)		

Data are presented as n (%).

**Table 4.** Level of health-related quality of life and self-rated health according to physical activity level

Variables	Males			p-value	Females			p-value
	Vigorous physical activity <sup>1)</sup> (n = 137)	Moderate physical activity <sup>2)</sup> (n = 150)	Low physical activity <sup>3)</sup> (n = 669)		Vigorous physical activity <sup>1)</sup> (n = 121)	Moderate physical activity <sup>2)</sup> (n = 180)	Low physical activity <sup>3)</sup> (n = 680)	
Health-related quality of life								
No problems	127 (92.7)	131 (87.3)	586 (87.6)	< 0.001 <sup>4)</sup>	105 (86.8)	137 (76.1)	606 (89.1)	< 0.001 <sup>4)</sup>
Some problems	10 (7.3)	18 (12.0)	81 (12.1)	< 0.001 <sup>5)</sup>	16 (13.2)	43 (23.9)	73 (10.7)	< 0.001 <sup>5)</sup>
Extreme problems	0 (0.0)	1 (0.7)	2 (0.3)	< 0.001 <sup>6)</sup>	0 (0.0)	0 (0.0)	1 (0.2)	< 0.001 <sup>6)</sup>
Self-rated health								
Very good	56 (40.9)	70 (46.7)	293 (44.2)	0.003 <sup>4)</sup>	35 (28.9)	80 (44.4)	305 (44.9)	0.109 <sup>4)</sup>
Good	46 (33.6)	43 (28.7)	207 (30.8)	0.001 <sup>5)</sup>	32 (26.5)	41 (22.8)	169 (24.9)	0.001 <sup>5)</sup>
Fair	21 (15.3)	20 (13.3)	106 (15.8)	0.011 <sup>6)</sup>	28 (23.1)	30 (16.7)	119 (17.5)	< 0.001 <sup>6)</sup>
Poor	12 (8.8)	12 (8.0)	38 (5.4)		20 (16.5)	18 (10.0)	59 (8.7)	
Very poor	2 (1.4)	5 (3.3)	25 (3.8)		6 (5.0)	11 (6.1)	28 (4.1)	

Data are presented as n (%).

1) 20 minutes vigorous physical activity  $\geq$  3 times/week.

2) 30 minutes moderate physical activity  $\geq$  5 times/week.

3) 30 minutes walking  $\geq$  5 times/week.

4) Significant level difference according to meet vigorous physical activity guideline.

5) Significant level difference according to meet moderate physical activity guideline.

6) Significant level difference according to meet low physical activity guideline.

served in both males and females.

#### 4. Level of health-related quality of life and self-rated health according to physical activity levels

Table 4 shows the levels of HRQoL and SRH according to PA levels in elderly Korean people. Males and females who reported no problems in their HRQoL were most likely to meet the guidelines for vigorous, moderate, and low PA (92.7%, 87.3%, and 87.6% in males, and 86.8%, 76.1%, and 89.1% in females, respectively). Significant differences in HRQoL with vigorous, moderate, and low PA were observed in males and females. In addition, males and females who self-reported their health as very good were most likely to meet guidelines for vigorous, moderate, and low PA (40.9%, 46.7%, and 44.2% in males, and 28.9%, 44.4%, and 44.9% in females, respectively). Significant differences in levels according to meeting PA guidelines were noted between SHR status and vigorous, moderate, and low PA in males, and moderate and low PA in females.

#### 5. Multiple logistic regression models of physical activity with self-rated health and health-related quality of life

Table 5 presents adjusted multiple logistic regression models of PA levels with SRH (Model 1) and HRQoL (Model 2). In Model 1, the adjusted odds ratio (AOR) that males and females would report very good SHR decreased significantly as they met PA guidelines: vigorous (males: AOR = 0.42, females: AOR = 0.44), moderate (males: AOR = 0.46, females: AOR = 0.48), and low (males: AOR = 0.44, females: AOR = 0.32). In addition, the AOR that females would report their SRH to be fair (AOR = 0.45), good (AOR = 0.36), and very good (AOR = 0.32) was significantly lower among those who met the guideline for low PA compared to those who reported poor SRH. In Model 2, males and females who reported no problems in their HRQoL showed significantly decreased AORs as they met the guidelines for vigorous PA (males: AOR = 0.40, females: AOR = 0.43), moderate PA (males: AOR = 0.49, females: AOR = 0.45), and low PA (males: AOR = 0.33, females: AOR = 0.39) compared with subjects who reported

**Table 5.** Adjusted multiple logistic regression models of physical activity levels with self-rated health and health-related quality of life reported as AORs and 95% CI

Variables	Males			Females		
	Vigorous physical activity <sup>5)</sup>	Moderate physical activity <sup>6)</sup>	Low physical activity <sup>7)</sup>	Vigorous physical activity <sup>5)</sup>	Moderate physical activity <sup>6)</sup>	Low physical activity <sup>7)</sup>
Model <sup>1)</sup>						
Self-rated health						
Poor <sup>3)</sup>	Reference	Reference	Reference	Reference	Reference	Reference
Fair	0.66 (0.32-1.38)	0.93 (0.20-1.19)	0.99 (0.61-1.65)	0.98 (0.16-1.05)	0.93 (0.14-1.09)	0.45* (0.25-0.80)
Good	0.57 (0.25-1.26)	0.80 (0.22-1.93)	0.55 (0.44-1.28)	0.50 (0.20-1.29)	0.61 (0.27-1.40)	0.36 <sup>†</sup> (0.19-0.69)
Very good	0.41 <sup>†</sup> (0.04-0.86)	0.46* (0.14-0.98)	0.44 <sup>†</sup> (0.30-0.94)	0.44 <sup>†</sup> (0.37-0.86)	0.48* (0.18-0.94)	0.32 <sup>†</sup> (0.18-0.59)
Model <sup>2)</sup>						
Health-related quality of life						
Problems <sup>4)</sup>	Reference	Reference	Reference	Reference	Reference	Reference
No problems	0.40 <sup>†</sup> (0.40-0.93)	0.49* (0.14-0.92)	0.33 <sup>†</sup> (0.31-0.95)	0.43 <sup>†</sup> (0.11-0.88)	0.45* (0.02-0.90)	0.39 <sup>†</sup> (0.17-0.60)

\*, <sup>†</sup> and <sup>‡</sup> denote  $p < 0.05$ ,  $p < 0.01$  and  $p < 0.001$ .

1) Adjusted for age, body mass index, education, family members, family socio-economic status, marital status, stress, depression, and health-related quality of life.

2) Adjusted for age, body mass index, education, family members, family socio-economic status, marital status, stress, depression, and self-rated health.

3) Merged group of very poor and poor group.

4) Merged group of extreme problems and some problems.

5) 20 minutes vigorous physical activity  $\geq 3$  times/week.

6) 30 minutes moderate physical activity  $\geq 5$  times/week.

7) 30 minutes walking  $\geq 5$  times/week.

problematic HRQoL.

## DISCUSSION

A cross-sectional study was conducted in a randomly selected population of 2,853 people older than 65 years to examine and compare any association among PA, SRH, and HRQoL in elderly Korean people.

I found that elderly Korean people were fairly inactive. Few of them met the guidelines for vigorous and moderate PA (9.8% and 11.6%, respectively). Elderly women were less active than elderly men: vigorous PA (11.6% of males, 8.6% of females), moderate PA (12.1% of males, 11.2% of females), and low PA (54.2% of males, 42.5% of females). This tendency was found in almost all previous studies and is thought to result from Korean cultural and social environments that encourage women to be more inactive than men

[5]. Higher BMI status and lower PA in elderly women show their tendency not to comply with PA recommendations. The effects of PA on health are well documented. Regular PA is associated with a lower risk of all-cause mortality [18,19]. I found that PA is significantly associated with obesity in elderly Korean women. These results suggest that programs to promote PA among elderly Korean women are necessary to help this segment of the population to lose weight.

Several studies have asserted that SRH and HRQoL are valid measures of subjective health status, being related to, for instance, the risk of death, psychological well-being, and overall health [11-13]. People with good or excellent SRH and high values of HRQoL tend to report higher vitality, a more positive attitude, less vulnerability to illness, more frequent regular exercise, and higher levels of education and income [13-15] than those who report poorer SRH and

HRQoL. Thus, a better understanding of the correlates of these subjective health statuses could help healthcare professionals tailor health promotion and disease prevention interventions for specific populations. This study found that elderly men in Korea tended to report higher values for SRH and HRQoL than elderly women. And more elderly men than women are meeting the guidelines for PA and reporting good or excellent SRH and high HRQoL statuses. These results indicate that better SRH and HRQoL are associated with higher PA in elderly Korean people. Recent studies have indicated that PA is associated with subjective and objective health status [20,21].

SRH and HRQoL are subjective and therefore depend on the interpretations and perceptions of individuals [12]. The present study showed that poorer SRH and HRQoL rates were significantly associated with lower PA. After adjusting for age, BMI, education, number of family members, marital status, stress, depression, and HRQoL (Model 1) or SRH (Model 2) status as confounding factors, elderly men and women who met the vigorous, moderate, and low PA recommendations had an AOR for the very good SRH that was significantly lower than the merged group of those who reported poor or very poor SRH. In addition, the AORs of elderly women who met the low PA recommendation and reported fair, good, and very good SHR were significantly lower than those of the women who reported poor SRH. Thus all levels of PA in elderly Korean people were positively associated with SRH. Particularly among females, meeting at least the guideline for low PA is recommended to improve their SRH status.

Furthermore, the AORs of elderly men and women who met the vigorous, moderate, and low PA recommendations and reported their HRQoL as having no problems were significantly lower than those of the merged subjects who reported their HRQoL to be extremely problematic or somewhat problematic. Thus meeting guidelines for all levels of PA significantly improved the quality of life of elderly men and women. The relationship between PA and mental health is important for planning public health interventions to promote PA and offer advice to people who are experiencing the adverse health consequences of a sedentary lifestyle [22-25]. The long-term effects of PA are well known, and such effects may not be sufficiently taken into account by

the general public. Highlighting that physically active people report better physical and mental health could be useful to encourage people to maintain and increase their PA. However, PA declines continuously with age [2,5,10]. From a public health perspective, it is also important to consider the environmental factors associated with PA, including PA levels for elderly Korean people.

In conclusion, the results of this study show that elderly Korean people were fairly inactive, but vigorous, moderate, and low PA were positively associated with SRH and HRQoL. Therefore, these results support the positive effect of PA on SRH and quality of life, which should be considered when developing public health programs for elderly Korean people.

The present study has several limitations. First, the study was cross-sectional, which makes it impossible to establish cause-effect relationships among PA, SRH, and HRQoL. Second, PA, SRH, and HRQoL were self-reported with a focus on lifestyle-related subjective opinions, which could have affected the level of information accuracy and weakened the effect of chronic disease on SRH and HRQoL. Third, it is difficult to compare these results with those of other studies because many studies of Koreans focus on adolescents and adults rather than on elderly people, and no other studies have examined PA levels in relation to SRH and HRQoL in a nationally representative sample of elderly Korean people.

## REFERENCES

1. Statistics Korea. The aged. Retrieved September 10, 2010, from [http://kostat.go.kr/potal/korea/kor\\_nw/2/1/index.board?bmode=read&aseq=61165](http://kostat.go.kr/potal/korea/kor_nw/2/1/index.board?bmode=read&aseq=61165). 2008.
2. Park H, Lee SK. Association of obesity with osteoarthritis in elderly Korean women. *Maturitas* 2011;70: 65-8.
3. Cho KO, Nam SN, Kim YS. Assessment of nutrient intake and metabolic profiles in Korean adolescents according to exercise regularity using data from the 2008 Korean National Health and Nutrition Examination Survey. *Nutr Res Pract* 2011;5:66-72.
4. Kim YS, Park YS, Allegrante JP, Marks R, Ok H, Ok Cho K, Barber CE. Relationship between physical activity and general mental health. *Prev Med* 2012;23: 367-75.
5. Cho KO. Sleep duration and self-rated health are in-



- dependently associated with physical activity level in the Korean population. *Iran J Public Health* 2014;43:590-600.
6. Abu-Omar K, Ruütten A, Lehtinen V. Mental health and physical activity in the European Union. *Soz Präventivmed* 2004;49:301-9.
  7. Cho KO, Jo YJ, Song BK, Oh JW, Kim YS. Colon transit time according to physical activity and characteristics in South Korean adults. *World J Gastroenterol* 2013;19:550-5.
  8. Baek SI, So WY. Association between times spent on the internet and weight status in Korean adolescents. *Iran J Public Health* 2011;40:37-43.
  9. Lee DC, Park IH, Jun TW, Nam BH, Cho SI, Blair SN, Kim YS. Physical activity and body mass index and their association with the development of type 2 diabetes in Korean men. *Am J Epidemiol* 2012;176:43-51.
  10. Roos NP, Havens R. Predictors of successful aging; a twelve-year study of Manitoba elderly. *Am J Public Health* 1991;81:63-8.
  11. Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J health Soc Behav* 1997;38:21-37.
  12. Scocco P, Fantoni G, Caon F. Role of depressive and cognitive status in self-reported evaluation of quality of life in older people: comparing proxy and physician perspectives. *Age Ageing* 2006;35:166-71.
  13. Huppert FA, Whittington JE. Evidence for the independence of positive and negative well-being: implications for quality of life assessment. *Br J Health Psychol* 2003;8:107-22.
  14. Saarni SI, Suvisaari J, Sintonen H, Pirkola S, Koskinen S, Aromaa A, Lonnqvist J. Impact of psychiatric disorders on health-related quality of life: general population survey. *Br J Psychiatry* 2007;190:326-32.
  15. EuroQol Group. EuroQol--a new facility for the measurement of health-related quality of life. *Health Policy* 1990;16:199-208.
  16. Craig CL, Marshall AL, Sjostram M, Bauman AE, Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, Sallis JF, Oja P. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003;35:1381-95.
  17. American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription 8th ed. *Lippincott Williams & Wilkins, USA*. 2010.
  18. Hamilton MT, Hamilton DG, Zderic TW. Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. *Diabetes* 2007;56:2665-77.
  19. Eaton DK, Kann L, Kinchen S, Shanklin S, Ross J, Hawkins J, Harris WA, Lowry R, McManus T, Chyen D, Lim C, Whittle L, Brener ND, Wechsler H. Youth Risk Behavior Surveillance--United States, 2009. *MMWR Surveill Summ* 2010;59:1-142.
  20. Brown DW, Balluz LS, Health GW, Moriarty DG, Ford ES, Giles WH, Mokdad AH. Association between recommended levels of physical activity and health-related quality of life. Findings from the 2001 Behavior Risk Factor Surveillance System (BRFSS) survey. *Prev Med* 2003;37:520-8.
  21. Okano G, Miyake H, Mori M. Leisure time physical activity as a determinant of self-perceived health and fitness in middle-aged male employees. *J Occup Health* 2003;45:286-92.
  22. Motl RW, McAuley E, Birnbaum AS, Lytle LA. Naturally occurring changes in time spent watching television are inversely related to frequency of physical activity during early adolescence. *J Adolesc* 2006;29:19-32.
  23. Driskell MM, Dymont S, Mauriello L, Castle P, Sherman K. Relationships among multiple behaviors for childhood and adolescent obesity prevention. *Prev Med* 2008;46:209-15.
  24. Mejía D, Berchtold A, Bélanger RE, Kuntsche EN, Michaud PA, Surís JC. Frequency and effects of meeting health behavior guidelines among adolescents. *Eur J Public Health* 2013;23:8-13.
  25. Wang J, Iannotti RJ. Patterns of physical activity, sedentary behavior, and diet in U.S. adolescents. *J Adolesc Health* 2013;53:280-6.