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Original Article

Correlation between physical function, cognitive function, and health-related quality of life in elderly persons

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Abstract. [Purpose] This study aimed to assess the quality of life of elderly people related to physical function, cognitive function, and health, and devised methods to enhance their health-related quality of life. [Subjects and Methods] This study was conducted from November 2014 to January 2015 in 140 people over 65 registered at welfare centers. Those with a functional psychological disorder or difficulty communicating were excluded. Data were collected for physical function, cognitive function, and health-related quality of life (HRQOL) using an assessment tool and questionnaire for healthy elderly people over 65. Physical function was measured using muscle strength muscle endurance, reaction time, and balance. [Results] Correlations were observed between cognitive function and endurance, reaction time, and balance. Physical HRQOL showed correlations with all domains of physical function; mental HRQOL showed correlations with all items of physical function except muscle strength. Among factors that influence HRQOL, all items except educational background were significant variables. Educational background had no influence on HRQOL. [Conclusion] Interventions will correct factors with a negative influence on HRQOL, utilizing regular checks on physical, cognitive, and other functions of elderly people, with early detection and intervention to enhance HRQOL. Cognitive intervention related to physical and other functions will be applied.
Key words: Physical function, Cognitive function, Health-related quality of life

INTRODUCTION

There has been a dramatic worldwide increase in the population of elderly people over 65. The elderly population is increasing in both absolute numbers and as a percentage of the larger population. Elderly people over 65 accounted for about 5.2% of the world population (143 million) in 1955, but are estimated to grow to 9.7% (822 million) by 2025[1]. Rapid population aging is also occurring in Korea, which is already an aging society with an elderly population of 7.2% in 2002. It will become an aged society in 2018 with 14.3% and a super-aged society in 2026 with 20.8%. Therefore, attention has been drawn to the increase in the elderly population, along with the emergence of aging as a social issue and the unique health issues of elderly people.

The most severe problems associated with the aging process are decreased physical and cognitive function[2]. In general, older people experience weight loss due to changes in cells and tissues, deterioration in cartilage, and declining function of blood vessels, lungs, and other organs. There is also an increase in vulnerability to various diseases as muscle strength and bone structure deteriorate[3].

Cognitive function includes learning, perception, deduction, problem solving, memory, and others. With aging, there is a gradual decline of cognitive function and difficulty in conducting daily life activities, and severe mental illness related to senility can develop[4].

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Associated with the decline of physical and cognitive function and increase in depression, the elderly face an increased risk of senile disorders such as cerebrovascular disease, degenerative disease, or dementia[2]. Accordingly, in order to maintain and improve physical function and promote active social participation in the elderly, strategies are required to improve performance in various fields[5].

According to the World Health Organization, quality of life refers to "recognition of standing in one's life in relation to goals, expectations, standards, and interests within the culture and value system each individual occupies." This is a broad concept in which each individual is influenced by various factors such as physical health, mental state, self-reliance, social relations, and relationship with the environment[6]. Particularly, since quality of life in the senile stage is directly related to happiness and the accomplishment of life goals, it is very important to determine whether the life of an individual was successful or not. In other words, it is significant to the general well-being of an individual[7]. Quality of life for elderly people can be obtained by successfully adapting to the fact that an individual is going through the aging process. Thus, it is necessary to conduct studies on quality of life in the elderly, focusing on the senile stage[8].

With the increase in life expectancy, there has been an increase in the desire to be free of disability, leading not just to a long but also a healthy life[4]. To enhance quality of life, health activities in elderly people are important. Positive health activity can enhance the state of health and well-being, lengthen life expectancy, and promote successful aging. As such, it is important to understand factors that influence the health-related quality of life (HRQOL) of elderly people, such as lowered cognitive and physical function. However, there is a lack of existing studies on the correlations between these factors.

Therefore, this study aimed to describe cognitive function, physical function, and HRQOL of elderly people and to devise a method to enhance HRQOL based on the analysis of correlations between factors.

SUBJECTS AND METHODS

This study was conducted from November 1, 2014 to January 1, 2015. In order to carry out the research using surveys and assessment measurements, all details of study procedures were submitted to the Science Research Council of Inje University, which approved the study protocol.

The subjects were 140 individuals over 65 years old who were registered with welfare centers for the elderly. Those diagnosed with functional psychological disorders such as dementia and difficulty communicating were excluded from data collection. General traits of subjects are shown in Table 1.

Data collection on cognitive function, physical function, and HRQOL was conducted with the use of an assessment tool and questionnaire. The subjects voluntarily agreed to participate in the study after obtaining information on the study purpose and participation methods.

Tests were conducted to measure physical function in relation to muscular strength, muscle endurance, reaction, and balance. Muscle strength testing was measured twice using a Jamar dynamometer, which was grasped in both hands, indicating maximum power in kilograms. Muscle endurance was measured through sit-ups that tested the dynamic endurance of the abdominal muscles. Subjects were also asked to reach their elbow to their thigh, and success was indicated by maintaining the position for 30 seconds. Reaction was measured through a standing-jump test. The study used the duration of time in the air to measure how high a participant had jumped, using a mat with a sensor attached. The subjects performed two trials, and the maximum scores were recorded in centimeters. Balance response was measured by standing on one leg, which is a measurement of static balance, represented by the ability to maintain a body in space stably[9].

The Korean mini-mental state examination (MMSE-K) was used for the assessment of cognitive function. This tool consists of 12 questions to measure orientation, memory registration, memory recall, attention, calculation, language, understanding, and judgment of time and space. With a highest possible point total of 30, a higher score indicates higher cognitive functioning, with total points of 19 or lower indicating definite dementia, 20–23 points suspicious for dementia, and 24 or higher as normal[10].

The SF-36 Health Status Scale tool that the study used to assess HRQOL was originally developed by Ware and Sherbourne. It consists of a total of 36 questions, and its eight subdomains cover physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health. In addition, these subdomains can be further categorized as either "physical health" (which would include the perception of physical functioning, physical role, bodily pain, general health, and changes in health) or "mental health" (which includes vitality, social functioning, emotional role, and mental health)[11].

SPSS 21.0 software was used for analysis of the collected data. Frequency analysis was conducted for general traits of subjects, while analysis of the correlations between the 3 variables of cognitive function, physical function, and HRQOL was conducted using Pearson's correlation coefficient. In order to examine the influence of general traits on HRQOL, multiple regression analysis was used. Statistical significance level was set as $\alpha=0.05$.

RESULTS

General traits are shown in Table 1. There were 74 women (52.9%) and 66 men (47.1%), and the mean age was 73.2 ± 6.19 years. High school graduates represented the largest group at 41 (29.2%). A total of 67 lived with their spouse (47.8%),

Table 1. General characteristics of subjects (n=140)

Categories	N (%)
Gender	
Male	66 (47.1)
Female	74 (52.9)
Age (years)	
65–69	43 (30.7)
70–74	46 (32.8)
75–79	27 (19.3)
80–84	18 (12.8)
≥85	6 (4.4)
Educational level	
No education	17 (12.1)
Elementary school	40 (28.5)
Middle school	33 (23.5)
High school	41 (29.2)
College (2–3 years)	4 (2.8)
University (4 years) or more	5 (3.9)
Marital status	
Single	26 (18.5)
Married	114 (81.5)
Living situation	
Alone	42 (30.0)
with a spouse	67 (47.8)
with eldest son's family	16 (11.4)
with other family	7 (5.0)
etc.	8 (5.8)
Monthly income (10,000 won)	
<20	57 (40.7)
20–50	21 (15.0)
50–80	32 (22.8)
≥80	30 (21.5)

Table 2. Correlation between cognitive function, physical function and HRQOL (n=140)

	Cognitive function	Strength	Endurance	Reaction	Balance	Physical HRQOL	Mental HRQOL	Total HRQOL
Cognition function	1	0.03	0.39**	0.51**	0.33**	0.23*	0.24**	0.21*
Strength		1	0.63**	0.33**	0.41**	0.35**	0.15	0.20*
Endurance			1	0.13	0.38**	0.23*	0.35**	0.14
Reaction				1	0.35**	0.71**	0.41**	0.35**
Balance					1	0.33**	0.31**	0.50**
Physical HRQOL						1	0.75**	0.96**
Mental HRQOL							1	0.90**
Total HRQOL								1

*Significant difference (p<0.05), **Significant difference (p<0.01).
HRQOL: health-related quality of life

followed by 42 living alone (30.0%), and 16 living with first-born children (11.4%); 40.7% earned an income of less than 200,000 won and more than half had an income of less than 800,000 won.

Correlation analysis was conducted for cognitive function, physical function, and HRQOL, and the results are shown in Table 2. There was a correlation between cognitive function and the physical function categories of muscle endurance,

Table 3. Analysis of factors affecting HRQOL (n=140)

Variable	Physical HRQOL			Mental HRQOL			Total HRQOL		
	B	S.E	β	B	S.E	β	B	S.E	β
Gender	4.56[a]	0.056[b]	0.33[c]**	0.14	0.07	0.04	6.73	0.04	0.17*
Age	−4.11	1.34	−0.22**	0.25	0.11	0.08	−7.12	1.93	−0.25**
Living situation	2.92	0.44	0.17*	2.59	0.34	0.47**	2.74	0.45	0.18*
Income	2.15	0.48	0.47**	2.34	0.35	0.42**	2.57	0.54	0.40**
Educational level	0.74	0.08	0.04	0.28	0.07	0.05	0.23	0.14	0.08
Marital status	2.95	0.40	0.56**	2.37	0.23	0.67**	4.85	0.56	0.59**

[a]Values are means (Unstandardized Coefficients).
[b]Values are means (Standard Error).
[c]Values are means (Standardized Coefficients).
*Significant difference ($p<0.05$), **Significant difference ($p<0.01$).
$R^2=0.286$, Adjusted $R^2=0.297$.

reaction, and balance. Physical HRQOL was correlated with all domains of cognitive function and physical function, and Mental HRQOL was correlated with all items except the physical function domain of muscle strength. Total HRQOL was correlated with all items except the physical function domain of muscle endurance, and showed significant correlation with cognitive function.

The results of multiple regression analysis on factors influencing HRQOL are shown in Table 3. In regards to Physical HRQOL, gender (β=0.33), age (β=−0.22), cohabitation with family (β=0.17), income (β=0.47), and marital status (β=0.56) were all significant variables; Physical HRQOL was high for males, and those who were relatively young, cohabiting, with relatively high income, and married. Cohabitation with family (β=0.47), income (β=0.47), and marital status (β=0.67) were all significant variables for Mental HRQOL. For Total HRQOL, all items except educational background were significant variables. Educational background had no influence on HRQOL.

DISCUSSION

There is a worldwide trend towards an aging society with longer average life expectancy resulting from advances in medical technology, improvements in health, increased agricultural productivity, etc. Alongside the increase of the elderly population, there has been an increase in the numbers of elderly committing suicide after suffering from chronic diseases or depression. According to the Korean Ministry of Health and Welfare, the elderly suicide rate per 100,000 has doubled in 10 years from 43.2 in 2000 to 80.3 in 2010, thus giving Korea the highest elderly suicide rate among Organization for Economic Co-operation and Development (OECD) countries[12]. Although active studies on the elderly population have been conducted in Korea based on the interest in social issues caused by aging, most of those studies are on elderly people with diseases and there are few studies on the HRQOL of healthy elderly people. Therefore, the objective of this study is to understand the correlation between physical function, cognitive function, and HRQOL of normal elderly people, in order to devise a method to enhance the HRQOL of the elderly.

In this study, there were more female than male, the mean age was 73.2 years, and the most common educational level was high school graduate. Although the highest proportion of subjects lived with a spouse, income in general was found to be very low, ranging from 200,000 to 800,000 won. This is due to the fact that there are few means to earn income except a retirement pension or allowance after retirement.

There were significant correlations between cognitive function & physical function, cognitive function and HRQOL, and physical function and HRQOL. With an increase in cognitive function, there was a corresponding increase in physical function and HRQOL. However, there was no correlation between the physical function domain of muscle strength and cognitive function. In a study of 1,231 normal elderly people over 60 without a diagnosis of dementia, Hwang, Lim, and Lee (2009) analyzed the factors influencing life satisfaction based on the cognitive function level of elderly people. Their study revealed that there is an increase in depression and lowered quality of life corresponding to lowered cognitive levels in the elderly[13]. Jung and Kim analyzed the correlation between physical function and HRQOL, and found that quality of life improves with better physical function[14].

Sex, age, living situation, income, and marital status were factors influencing Physical HRQOL. Living situation, income, and marital status were also shown to be factors influencing Mental HRQOL. Conversely, educational background does not influence HRQOL. Kim and Seok suggested that there is a difference in quality of life based on age and economic status[7]. Lee reported a difference in quality of life based on marital status, cohabitation status, and income level, similar to the results in this study[15].

Finally, a higher correlation was found between cognitive function and HRQOL, in contrast with the relationship between physical function and HRQOL, which supports the research of Kim and Seok that suggests factors influencing the HRQOL

of elderly people are cognitive function and depression[7]. Although a healthy body plays an important role in enhancing the quality of life, lowered cognitive function, and consequent depression act as factors with the greatest influence on the HRQOL in the elderly.

In keeping with the above results, an intervention plan will be established to remove factors with a negative influence on HRQOL. This plan will feature regular checks of physical function, cognitive function, and other functions in the elderly, as well as early detection and intervention to enhance the HRQOL of elderly people. A cognitive intervention program related to physical function will actively be applied. Although not addressed in this study, an assessment of depression in elderly individuals will also be conducted.

A limitation of this study is that the results do not reflect the traits of elderly people in all regions, as the residence of subjects was limited to Busan. Moreover, certain environmental and functional factors in elderly people have been overlooked, as age, gender, and other factors were not evenly distributed. Therefore, future studies should emphasize environmental factors in regards to area of residence.

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