The effect of age on life satisfaction of older adults - Moderating effect of exercise participation

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SUMMARY

This study was conducted to determine the moderating effect of regular exercise on the relationship between age and life satisfaction, employing data from the 8th Korean Longitudinal Study of Aging (KLoSA). This study utilized the statistical program SPSS 29 for data analysis. To explore the demographic characteristics of the 8th KLoSA data, frequency analysis and descriptive statistics were conducted. Differences in life satisfaction based on general characteristics were examined using t-tests and ANOVA. Correlation analysis was performed to investigate the relationship between life satisfaction, age, and total household income. Additionally, to explore the moderating effect of exercise on the impact of age on life satisfaction, the presence of moderation effects was verified using Process Macro Model 1. Analysis results revealed that being female (p=.011), having a spouse (p<.001), graduating from high school (p=.001) and university (p<.001), residing in a medium-sized city (p=.004) and rural area (p<.001), considering one's health to be poor (p<.001), engaging in alcohol consumption (p=.004), having perceived cognitive impairment (p=.001), and with a higher household income (p=.019) significantly influenced life satisfaction. The explanatory power for life satisfaction was found to be 12.0%, with perceived poor health (β=-.274) emerging as the most influential factor. The moderating effect of physical activity on the impact of age on life satisfaction (B=-.260, p=.008) revealed that among those engaged in physical activity, life satisfaction tends to decrease with higher age. These findings could serve as fundamental data for the development of exercise programs tailored for individuals aged 65 and above in the future.

Key words: life satisfaction, exercise participation, Moderating effect

I. Introduction

1. Significance of Research

According to Statistics Korea's press release, the population aged 65 and older surpassed 14% of the total population in 2017, marking the entrance into an aging society in South Korea. The proportion of elderly population in Korea is projected to increase from 17.5% in 2022, a sixfold increase compared to 3.1% in 1970, to an estimated 46.4% by 2070[1]. Furthermore, while the global life expectancy reached 72.0 years in 2020, showing an increase of 15.9 years compared to 56.1 years in 1970, South Korea experienced a more substantial rise. In 2020, life expectancy in South Korea reached 83.5 years, marking a 21.2-year increase from 62.3 years in 1970. It is anticipated that by 2025, the population aged 65 and above will constitute 20.6%, indicating an imminent shift towards a super-aged society[1]. This highlights the pressing need for systematic management of the elderly population aged 65 and above.

As a consequence of age-related deterioration in cardiovascular, respiratory, musculoskeletal, nervous, endocrine, and immune systems, seniors are susceptible to a range of health issues. Notably, a pronounced decrease in muscular strength within the musculoskeletal system is evident, carrying with it several associated risks [2,3]. As a result of decreased muscular strength, functional capacity diminishes, independence is compromised, and manifestations such as physical disabilities, reduced metabolic and insulin sensitivity and bone density, increased body fat, cardiovascular diseases, elevated blood pressure, and diabetes become apparent [4]. In 1998, the American College of Sports Medicine (ACSM) emphasized the importance of elderly exercise based on physiological changes in the elderly, striving for systematic management [5].

Diverse forms of research related to the elderly have also been conducted in Korea. Research on the elderly encompasses various aspects, including cognitive function, mild cognitive impairment, dementia, depression, life satisfaction, and quality of life[6-8].   Numerous scholarly publications[10-13] exist that not only utilize big data[9] and survey research[10] but also demonstrate the effects through exercise programs. However, survey findings from research conducted before, during, and after participation in exercise programs indicate discomfort among individuals aged 65 and above. This discomfort arises from the fact that most exercises applied to this age group do not adequately consider the health status and functional characteristics of older adults. In many cases, exercise routines are either not tailored to reflect the unique needs of elderly individuals, or methods originally designed for healthy adults are applied without considering the safety of seniors [2].

Therefore, exercise programs designed for the elderly should be tailored to reflect their health status and functional characteristics. Even when implementing such programs, it is necessary to analyze the satisfaction experienced by individuals aged 65 and above and investigate how it influences life satisfaction based on age. Though there are studies examining the trends in domestic research[13] on elderly exercise programs and presenting results on program effectiveness[10,11,13], it was found challenging to locate research specifically exploring the age-related satisfaction of individuals aged 65 and above participating in exercise programs. This difficulty extended to finding studies that could offer fundamental data for such research.

This study utilized data from the 8th Korean Longitudinal Study of Aging (KLoSA) and measured exercise satisfaction by substituting it with the survey variable of life satisfaction. Through this, the study aims to identify the impact of exercise on life satisfaction for individuals aged 65 and above as their age increases and to provide foundational data to develop appropriate exercise programs tailored to the age of the elderly in the future.

2. Purpose

The purpose of this study is to understand the impact of exercise participation on life satisfaction as age increases and to provide fundamental data for developing appropriate exercise programs tailored to the age of the elderly.

The study categorizes the general characteristics of participants into sociodemographic, economic status, health status, psychological traits, etc.

The study identifies differences in life satisfaction based on these general characteristics.

The study determines factors influencing life satisfaction.

The study examines the moderating effect of age on life satisfaction.

II. Research Methodology

1. Research Design

This study is a secondary data analysis using the '8th Korean Longitudinal Study of Aging (KLoSA)'data collected by the Korea Employment Information Service in 2020, aiming to investigate the impact of exercise participation on life satisfaction as age increases.
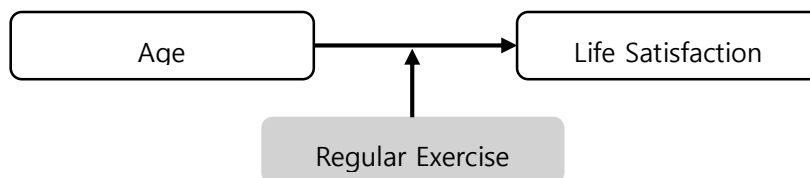
<Figure 1>.   Research Design

2.   Research Subject

The purpose of KLoSA[14] is to measure and understand the social, economic, psychological, demographic, and health-related aspects of the elderly to generate foundational data that can be utilized in formulating effective social and economic policies for the elderly [14]. The target population of KLoSA includes individuals aged 45 and above residing nationwide, excluding Jeju Island, with a sample size goal of approximately 10,000 individuals. A panel of 10,254 individuals was constructed, and in 2014, an additional 920 individuals, primarily born in 1962-1963, were included. The sampling frame is based on the survey districts from the 2005 Population and Housing Census, excluding island areas and facility-based survey districts. Among the total survey districts, 261,237 ordinary and apartment survey districts were designated as the extraction units for the survey.

The baseline survey of KLoSA has been consistently carried out using face-to-face interviews with laptops, centering on the same set of survey items every even year since 2006. For the 8th KLoSA, the analysis was conducted on a subset of the total 6,488 participants, specifically focusing on the 4,347 individuals aged 65 and above.

3. Research Instruments

In this study, variables were defined based on the survey items of the '8th KLoSA' conducted by the Korea Employment Information Service as follows.

1) Sociodemographic Characteristics

The sociodemographic variables utilized in this study encompass gender, age, marital status, spouse status, highest level of education, and residential area. Gender was dichotomized into male and female, while age was calculated at the time

of the survey (2020 - year of birth + 1). Marital status was categorized as married, separated, divorced, widowed or missing, and never married. Spouse status was classified as having or not having a spouse. The highest level of education was stratified into elementary school graduation or less, middle school graduation, high school graduation, and college graduation or higher. Residential area was delineated into large cities and small to medium-sized cities or rural areas.

2) Economic Status Characteristics
This study utilized current employment status and last year's total household income as economic status variables. Current employment status was categorized as either yes or no, while last year's total household income, based on after-tax income, encompassed total earned income, total asset income, total public transfer income, total private transfer income, personal pension income, and other income.

3) Health Status Characteristics
In this study, health status variables include overall health status, diagnosis of high blood pressure, diagnosis of diabetes or high blood sugar, diagnosis of cancer or malignant tumor, presence of chronic lung disease, diagnosis of liver disease, diagnosis of heart disease, diagnosis of cerebrovascular disease, diagnosis of psychiatric disorders, diagnosis of arthritis or rheumatism, number of chronic diseases, smoking status, drinking status, regular exercise habits, and presence of cognitive impairment. Health status in the dataset is categorized as excellent, very good, good, average, and poor. However, for subsequent analyses, the 'excellent' category was combined with 'very good.' Diagnosis of high blood pressure, diagnosis of diabetes or high blood sugar, diagnosis of cancer or malignant tumor, presence of chronic lung disease, diagnosis of liver disease, diagnosis of heart disease, diagnosis of cerebrovascular disease, diagnosis of psychiatric disorders, diagnosis of arthritis or rheumatism, smoking and drinking status, regular exercise habits, and cognitive impairment were dichotomized into 'no' or 'yes.' The number of chronic diseases was classified into 0, 1, 2, and 3.

4) Psychological Characteristics
In this study, psychological characteristics were measured using life satisfaction. A scale from '0,' indicating low life satisfaction, to '100,' indicating high life satisfaction, was employed.

4. Data Analysis Methods
This study utilized the statistical program SPSS 29 for data analysis. To explore the demographic characteristics of the 8th KLoSA data, frequency analysis and descriptive statistics were conducted. Differences in life satisfaction based on general characteristics were examined using t-tests and ANOVA. Correlation analysis was performed to investigate the relationship between life satisfaction, age, and total household income. Additionally, to explore the moderating effect of exercise on the impact of age on life satisfaction, the presence of moderation effects was verified using Process Macro Model 1."

5. Ethical Considerations
This study was conducted after submitting a research plan to and receiving exemption approval from the Institutional Review Board at University W (Approval No. 202307-033-02).
Data for this study were obtained from the official website of the Korea Employment Information Service. The raw data, questionnaire, and codebook for the 8th KLoSA were downloaded following the specified procedures after signing the agreement to comply with the regulations for data utilization. The KLoSA data are collected with unique identifiers and without any personal information, ensuring non-identifiability of individual information and protecting confidentiality.
The data from the 8th KLoSA can be utilized for research purposes by registering on the Korea Employment Information Service's employment survey website (https://survey.keis.or.kr/), providing information about the researcher, stating the purpose of use, agreeing to comply with the management regulations, and then downloading the raw data, questionnaire, and codebook for the 8th KLoSA for analysis.

III. Research Results

1. General Characteristics of the Elderly
The sociodemographic characteristics of the study participants are presented in Table 1. The sample consisted of 2,526 females (58.1%) and 1,821 males (41.9%), with an average age of 75.90 ± 7.37 years. Marital status indicated that 2,933 individuals (67.5%) were currently married, 1,281 (29.5%) were widow or missing, 87 (2.0%) were divorced, 24 (0.6%) were separated, and 22 (0.5%) had never been married. Regarding the presence of a spouse, 2,933 (67.5%) had a spouse, while 1,414 (32.5%) did not. The highest level of education showed that 2,172 (50.0%) had completed elementary school or less, 1,038 (23.9%) had graduated from high school, 761 (17.5%) had graduated from middle school, and 376 (8.6%)

had graduated from college or higher. Residential areas were categorized as large cities for 1,726 individuals (39.7%), small and medium-sized city for 1,480 individuals (34.0%), and rural area for 1,141 individuals (26.2%). Economic status characteristics indicated that 3,357 individuals (77.2%) were not currently employed, while 990 (22.8%) were. The average total household income for the previous year was 25037.00 (±40534.80) thousand won.

Health status showed that 1,862 individuals (42.8%) reported being in average health, 1,210 (27.8%) reported being in very good health, 1,121 (25.8%) reported being in poor health, 131 (3.0%) reported being in very good health, and 23 (0.5%) reported being in excellent health. The average life satisfaction score was 62.02. Health status characteristics indicated that 126 individuals (6.1%) had been diagnosed with high blood pressure, 91 (2.8%) with diabetes or high blood sugar, 54 (1.3%) with cancer or malignant tumors, 9 (0.2%) with chronic lung disease, 5 (0.1%) with liver disease, 55 (1.4%) with heart disease, 41 (1.0%) with cerebrovascular disease, 4 (0.1%) with transient ischemic attack, 22 (0.5%) with psychiatric disorders, and 63 (2.1%) with arthritis or rheumatism. The number of chronic diseases was distributed as follows: 3,928 individuals (90.4%) with 0 chronic diseases, 368 (8.5%) with 1, 43 (1.0%) with 2, and 8 (0.2%) with 3. The average number of chronic diseases was 0.11 ± 0.36. Among them, 6.3% were observed to be smokers (272 individuals), 24.1% alcohol consumers (1047 individuals), 39.9% engaged in regular exercise (1733 individuals), and 2.2% experienced cognitive function problems (96 individuals). For subsequent general characteristic analyses, marital status was excluded; only the presence or absence of a spouse was considered, and health status was analyzed using a 4-point scale† that combined excellent and very good.

<Table 1> General Characteristics   (n=4347)

			n	%	M±SD
Sociodemographic Characteristics	Gender	Male	1821	41.9	
		Female	2526	58.1	
	Age				75.90±7.37
	Marital Status	Married	2933	67.5	
		Separated	24	0.6	
		Divorced	87	2.0	
		Widowed or Missing	1281	29.5	
		Never Married	22	0.5	
	Spouse†	Yes	2933	67.5	
		No	1414	32.5	
	Highest Level of Education	Elementary School Graduation or Less	2172	50.0	
		Middle School Graduation	761	17.5	
		High School Graduation	1038	23.9	
		College Graduation or Higher	376	8.6	
	Residential Area	Large City	1726	39.7	
		Small to Medium-sized City	1480	34.0	
		Rural Area	1141	26.2	
Economic Status Characteristics	Current Employment Status	Yes	990	22.8	
		No	3357	77.2	
	Last Year's Total Household Income				2503.70±4053.48
Health Status Characteristics	Health Status	Excellent	23	0.5	
		Very Good	131	3.0	
		Good	1210	27.8	
		Average	1862	42.8	
		Poor	1121	25.8	
	Health Status†	Very Good	154	3.5	
		Good	1210	27.8	
		Average	1862	42.8	
		Poor	1121	25.8	
	Diagnosis of High Blood	No	1936	93.9	

	Pressure			
		Yes	126	6.1
	Diagnosis of Diabetes or High Blood Sugar	No	3218	97.2
		Yes	91	2.8
	Diagnosis of Cancer or Malignant Tumor	No	3973	98.7
		Yes	54	1.3
	Presence of Chronic Lung Disease	No	4182	99.8
		Yes	9	0.2
	Diagnosis of Liver Disease	No	4212	99.9
		Yes	5	0.1
	Diagnosis of Heart Disease	No	3787	98.6
		Yes	55	1.4
	Diagnosis of Cerebrovascular Disease	No	3983	98.9
		Yes	41	1.0
		Transient Ischemic Attack	4	0.1
	Diagnosis of Psychiatric Disease	No	4079	99.5
		Yes	22	0.5
	Diagnosis of Arthritis or Rheumatism,	No	2877	97.9
		Yes	63	2.1
	Number of Chronic Diseases	0	3928	90.4	0.11±0.36
		1	368	8.5
		2	43	1.0
		3	8	0.2
	Smoking Status	No	272	6.3
		Yes	4075	93.7
	Drinking Status	No	1047	24.1
		Yes	3300	75.9
	Regular Exercise Habits	No	2614	60.1
		Yes	1733	39.9
	Cognitive Impairment	No	4251	97.8
		Yes	96	2.2
Psychological Characteristics	Life Satisfaction				62.02±16.71

Later analyzed with †

2. Differences in Life Satisfaction by General Characteristics

Differences according to general characteristics are as follows (Table 2). Males (63.23±16.31) had higher life satisfaction than females (61.15±16.93) ($p<.001$), and individuals with a spouse (63.77±15.92) had higher life satisfaction than those without a spouse (58.39±17.70) ($p<.001$). There was a significant difference among the highest education levels ($p<.001$). Post-hoc analysis revealed that life satisfaction was higher for those with a college degree or higher (68.75±15.31), high school graduates (65.00±15.49), and middle school graduates (62.97±15.38), while elementary school graduates or lower (59.10±17.31) showed lower life satisfaction. There was a significant difference according to the residential area ($p<.001$). Post-hoc analysis showed that life satisfaction was highest in rural areas (63.40±16.05) and small to medium-sized cities (62.49±16.07), followed by large cities (60.71±17.56). Those currently employed (65.05±14.58) had higher life satisfaction than those not working (61.13±17.18) ($p<.001$). There was a significant difference among health statuses ($p<.001$), and post-hoc analysis revealed that life satisfaction was the highest among those in very good health followed by average health and poor health, in the given order. Those who had not been diagnosed with diabetes or high blood

sugar (62.75±16.39) had higher life satisfaction than their counterpart (59.23±17.72) (p=.044). Similarly, individuals without a diagnosis of cancer or malignant tumor (62.35±16.62) had higher life satisfaction than those with a diagnosis (55.19±20.44) (p=.002). Those without a diagnosis of psychiatric disorders (62.41±16.46) had higher life satisfaction than those diagnosed (47.27±22.51) (p=.005), and individuals without a diagnosis of arthritis or rheumatism (63.73±16.05) had higher life satisfaction than those diagnosed (57.62±17.20) (p=.003). Those with zero chronic diseases (62.41±16.45) had higher life satisfaction than those with three or more chronic diseases (46.25±22.00) (p<.001). Those who engaged in regular exercise (65.68±14.91) had higher life satisfaction than those who did not (59.59±17.38) (p<.001), and individuals without cognitive impairment (62.31±16.49) had higher life satisfaction than those with cognitive impairment (49.17±20.76) (p<.001). Based on these results, the variables found to influence life satisfaction were used as control variables in subsequent analyses.

<Table 2> Difference Analysis in Life Satisfaction by General Characteristics (n=4347)

		M	SD	t or F	p	Scheffe
Gender	Male	63.23	16.31	4.059	<.001	
	Female	61.15	16.93			
Spouse	Yes	63.77	15.92	9.702	<.001[†]	
	No	58.39	17.70			
Highest Level of Education	Elementary School Graduation or Less[a]	59.10	17.31	56.405	<.001[†]	d>b,c>a
	Middle School Graduation [b]	62.97	15.38			
	High School Graduation [c]	65.00	15.49			
	College Graduation or Higher [d]	68.75	15.31			
Residential Area	Large City[a]	60.71	17.56	9.603	<.001[†]	b,c>a
	Small to Medium-sized City [b]	62.49	16.07			
	Rural Area [c]	63.40	16.05			
Current Employment Status	Yes	65.05	14.58	6.527	<.001[†]	
	No	61.13	17.18			
Health Status	Very Good[a]	68.05	15.47	135.978	<.001[†]	a,b>c>d
	Good[b]	66.07	14.17			
	Average[c]	64.36	14.80			
	Poor[d]	52.93	18.84			
Diagnosis of High Blood Pressure	No	62.87	16.15	1.188	.235	
	Yes	61.11	15.76			
Diagnosis of Diabetes or High Blood Sugar	No	62.75	16.39	2.014	.044	
	Yes	59.23	17.72			
Diagnosis of Cancer or Malignant Tumor	No	62.35	16.62	3.134	.002	
	Yes	55.19	20.44			
Presence of Chronic Lung Disease	No	62.14	16.71	-.214	.831	
	Yes	63.33	11.18			
Diagnosis of Liver Disease	No	62.09	16.65	.281	.779	
	Yes	60.00	21.21			
Diagnosis of Heart Disease	No	62.36	16.58	1.365	.172	

	Yes	59.27	19.61			
Diagnosis of Cerebrovascular Disease	No	62.56	16.34	3.167	.101[†]	
	Yes	55.12	23.57			
	Transient Ischemic Attack	45.00	20.82			
Diagnosis of Psychiatric Disease,	No	62.41	16.46	3.151	.005[†]	
	Yes	47.27	22.51			
	No	63.73	16.05	2.985	.003	
Arthritis or rheumatism Diagnosis	Yes	57.62	17.20			
Number of Chronic Diseases	0[a]	62.41	16.45	8.970	<.001[†]	a>d
	1[b]	58.70	18.38			
	2[c]	57.67	18.75			
	3[d]	46.25	22.00			
Smoking Status	Yes	62.43	16.05	.415	.678	
	No	61.99	16.75			
Drinking Status	Yes	65.27	14.64			
	No	60.99	17.18			
Regular Exercise Habits	No	59.59	17.38	7.898	<.001[†]	
	Yes	65.68	14.91			
Cognitive Impairment	No	62.31	16.49	6.160	<.001[†]	
	Yes	49.17	20.76			

†: Homoscedasticity assumption not met

3. Correlation Analysis between Continuous Variables and Life Satisfaction

The results of the correlation analysis between the continuous variables, age, total household income, and life satisfaction are presented in Table 3. Life satisfaction showed a negative correlation with age (r=-.137) and a positive correlation with total household income (r=.096). As total household income was also found to influence life satisfaction, it was used as a control variable in subsequent analyses.

<Table 3> Correlation Analysis

	Life Satisfaction		Age		Total Household Income
Life Satisfaction	1.000				
Age	-.137 (<.001)	***	1.000		
Total Household Income	.096 (<.001)	***	-.140 (<.001)	***	1.000

**p<.001, **p<.01, *p<.05

4. Relationship between Age and Life Satisfaction, and the Moderating Effect of Regular Exercise

To understand the impact on life satisfaction, multiple regression analysis was conducted for the influence of age on life satisfaction while controlling for significant variables in sociodemographic characteristics, including gender, presence of spouse, highest level of education, residential area, current employment status, health status, diagnosis of diabetes or high blood sugar, diagnosis of cancer or malignant tumor, diagnosis of psychiatric disease, diagnosis of arthritis or rheumatism, number of chronic diseases, cognitive function, and total household income as dummy variables (Table 4). Prior to conducting the regression analysis, autocorrelation of the dependent variable and multicollinearity among independent variables were examined respectively using the Durbin-Watson statistic and VIF index.

The Durbin-Watson statistic for life satisfaction was 1.952, indicating no autocorrelation, and the VIF index ranged from

1.064 to 5.454, all below 10, indicating the absence of multicollinearity among independent variables. Therefore, the data were deemed suitable for conducting regression analysis.

The results of multiple regression analysis revealed that being female (p=.011), having a spouse (p<.001), graduating from high school (p=.001) and university (p<.001), residing in a medium-sized city (p=.004) and rural area (p<.001), considering one's health to be poor (p<.001), engaging in alcohol consumption (p=.004), having perceived cognitive impairment (p=.001), and with a higher household income (p=.019) significantly influenced life satisfaction. The explanatory power for life satisfaction was found to be 12.0%, with perceived poor health (β=-.274) emerging as the most influential factor(Table 4, step2).

The moderation effect of exercise on the impact of age on life satisfaction was tested using the Process Macro Model 1. The analysis results indicated that exercise moderates the influence of age on life satisfaction (Table 4, step 3)

The moderating effect of exercise on the impact of age on life satisfaction (B=-.260, p=.008) revealed that in the group engaged in exercise, life satisfaction tends to decrease with increasing age.

<Table 4> Analysis of the Impact on Life Satisfaction

	Step1				Step2				Step3		
	B	SE	β	p	B	SE	β	p	B	SE	p
Constant	60.272	1.865		<.001	51.460	4.959		<.001	41.590	5.596	<.001
Gender (Female)	1.684	0.800	.053	.035	2.097	0.828	.066	.011	2.057	0.823	.013
Marital Status (Yes)	3.501	0.863	.095	<.001	3.971	0.896	.108	<.001	3.956	0.892	<.001
Highest Level of Education (Middle School Graduation)	1.149	0.960	.029	.232	1.490	0.976	.037	.127	1.168	0.972	.230
Highest Level of Education (High School Graduation)	2.659	0.901	.076	.003	3.080	0.927	.088	.001	2.434	0.929	.009
Highest Level of Education (College Graduation)	6.625	1.192	.137	<.001	6.988	1.206	.144	<.001	5.872	1.217	<.001
Residential Area (Small to Medium City)	2.225	0.783	.066	.005	2.238	0.782	.066	.004	2.199	0.777	.005
Residential Area (Rural)	3.854	0.867	.108	<.001	3.777	0.867	.105	<.001	4.079	0.864	<.001
Current Employment Status (Yes)	-1.070	0.779	-.030	.170	-0.683	0.804	-.019	.396	0.174	0.815	.831
Health Status (Good)	-1.910	1.567	-.058	.223	-1.966	1.567	-.059	.210	-1.916	1.556	.218
Health Status (Average)	-2.529	1.562	-.079	.106	-2.760	1.566	-.086	.078	-2.623	1.555	.092
Health Status (Poor)	-11.472	1.755	-.264	<.001	-11.908	1.768	-.274	<.001	-11.647	1.761	<.001
Diagnosis of Diabetes (Yes)	-0.047	2.792	.000	.987	0.120	2.792	.001	.966	0.076	2.774	.978
Diagnosis of Malignant Tumor (Yes)	0.451	3.231	.003	.889	0.758	3.233	.006	.815	0.925	3.213	.773
Diagnosis of Psychiatric Disorders (Yes)	-7.018	5.113	-.031	.170	-6.950	5.109	-.031	.174	-5.148	5.087	.312
Diagnosis of Arthritis (Yes)	-1.625	2.643	-.016	.539	-1.528	2.642	-.015	.563	-1.313	2.625	.617
Number of Chronic Diseases (1)	-1.849	1.596	-.033	.247	-1.825	1.595	-.033	.252	-2.034	1.585	.199
Number of Chronic Diseases (2)	2.166	3.982	.015	.587	2.286	3.980	.016	.566	1.836	3.956	.643
Number of Chronic Diseases (3)	3.563	7.078	.011	.615	3.614	7.074	.011	.609	3.630	7.026	.605
Engaging in Alcohol Consumption (Yes)	2.088	0.803	.061	.009	2.304	0.810	.067	.004	2.200	0.805	.006
Cognitive Impairment (Yes)	-9.064	2.749	-.071	.001	-9.572	2.760	-.075	.001	-9.504	2.744	.001
Total Household Income	0.000	0.000	.047	.028	0.000	0.000	.051	.019	0.000	0.000	.028
Age (x)					0.107	0.056	.049	.055	0.220	0.066	.001
Exercise Participation (mo)									22.622	7.258	.002
x×mo									-0.260	0.097	.008
F(p)	14.029(<.001)				13.576(<.001)				13.830(<.001)		
R^2(adjR^2)	.128(.119)				.129(.120)				.142		
d	1.952				1.959						

d: Durbin-Watson's auto-correlation statistic
Dummy Variable with 0 Gender: Male, Spouse: No, Highest Level of Education: Elementary School Graduation or Less, Residential Area: Large City, Current Employment Status: No, Health Status: Very Good, Diabetes Diagnosis: No, Malignant Tumor Diagnosis: No, Psychiatric Diagnosis: No, Arthritis diagnosis: No, Number Of Chronic Diseases: 0, Drinking Status: No, Cognitive Function: No.

IV. Discussion

In the current context, with a sharp rise in the aging population[1,15], the responsibility for the health management of the elderly can be deemed a national responsibility. Aging emerges as a crucial factor, contributing to a range of chronic diseases, impairment of daily life functions, and a decline in overall quality of life [3]. In particular, muscle strength tends to weaken with age, and it has been reported that muscle strength decreases by approximately 30%[16] between the ages of 50 and 70. Muscle weakness accounts for about 50% of the incidence rate of disabilities in the elderly[17]. Exercise that can enhance muscle strength is a key factor for maintaining and improving health in individuals aged 65 and older.

Thus, this study categorized participants' general characteristics into sociodemographic, economic, health, and psychological aspects. It conducted an analysis on life satisfaction based on these general characteristics, identified factors influencing life satisfaction, and verified the moderating effect of exercise on the relationship between age and life satisfaction using Process Macro Model 1.

In this study, life satisfaction according to general characteristics showed that men had higher life satisfaction than women, and individuals with a spouse exhibited higher life satisfaction compared to those without a spouse. Higher levels of education were associated with higher life satisfaction, and elderly individuals living in small to medium-sized cities or rural areas reported higher life satisfaction than those in large cities. Those currently employed expressed higher life satisfaction than those not engaged in work, and individuals perceiving their health as good reported higher life satisfaction than those perceiving their health as poor. Those without a diagnosis of diabetes or high blood pressure had higher life satisfaction than those diagnosed, and individuals without a diagnosis of psychiatric disorders reported higher life satisfaction than those diagnosed with such disorders. Moreover, those without perceived cognitive impairment had higher life satisfaction than those perceiving cognitive dysfunction. The results of this study, showing higher life satisfaction in elderly individuals with higher education levels and those without chronic illnesses, align with findings presented by Lee et al. (2023) [18]. However, the difference in life satisfaction between urban and rural elderly individuals observed in this study contrasts with their result. The difference seems to be that Lee et al. (2023) [18] conducted a study on the life satisfaction derived from the utilization skills of information devices, suggesting that life satisfaction is higher among participants residing in urban areas, where there are more opportunities for utilizing information devices. However, Park et al. (2023) [19] compared the average life satisfaction of elderly individuals in 2022 and 2019, and the results support the findings from the current study by showing higher life satisfaction in non-metropolitan areas than in metropolitan areas.

The results of correlation analysis among age, total household income, and life satisfaction showed a negative correlation between age and life satisfaction, indicating that life satisfaction tends to decrease with higher age. Additionally, there was a positive correlation between life satisfaction and total household income, indicating that higher income is associated with higher life satisfaction. This aligns with previous studies, such as the analysis of data from the 1st to 16th Korean Welfare Panel Studies (Koweps), supporting the findings that as age increases, life satisfaction tends to decrease, and higher income levels are associated with higher life satisfaction[20].

After setting gender, marital status, highest level of education, residential area, current employment status, health status, diagnosis of diabetes, diagnosis of malignant tumor, diagnosis of psychiatric disorders, diagnosis of arthritis, number of chronic diseases, engaging in alcohol consumption, cognitive impairment, total household income and etc. as controlling variables, the impact of age on life satisfaction was investigated. The results showed that being female, having a spouse, having a higher education level (high school graduation or above), residing in rural areas and small cities, engaging in alcohol consumption, and having a higher total household income were associated with higher life satisfaction. On the other hand, lower life satisfaction was observed among individuals with poorer health status and those who perceived themselves to have cognitive impairment. Notably, health status emerged as the most influential factor affecting life satisfaction. These findings are consistent with the results of a study by Park (2023) [20], which reported that being female, having a spouse, holding a college degree or higher, and having a higher income level were associated with higher life satisfaction. However, in the current study, individuals with a high school diploma also exhibited high satisfaction. In contrast, Park (2023)[20] reported that higher life satisfaction started with college graduates. This disparity is likely due to the fact that the results from the study of Park (2023)[20] were based on a total of 16 surveys (Koweps) between 2006 and 2021, while the current study focused solely on the results of the 8th KLoSA conducted in 2020.

While it was confirmed that life satisfaction tends to decrease with age, there was a need to investigate the impact of exercise programs on increasing life satisfaction, as suggested by previous studies. [7,13,21] Contrary to the findings of previous studies[7,13,21]. the analysis reveals that life satisfaction diminishes as age increases with regular exercise acting as a moderating factor and contributing to a decline in life satisfaction as individuals engage in consistent exercise with advancing age. As age increases, there is a decrease in muscle mass and changes in endurance that constitute the body [5,22]. The findings of this study indicate that individuals aged 65 and above, who perceive their health as poor, may experience a decrease in life satisfaction. When implementing exercise programs for older adults, it is crucial to consider the participants' age-related physical conditions. Failure to do so might result in a decline in life satisfaction due to physical discomfort during or after the programs[2]. Moreover, engaging in high-intensity exercises that do not align with the individual's physical condition may lead to abnormalities in physiological markers, such as elevated creatinine levels, significant changes in uric acid, or notable increase in cortisol levels, leading to an excessive sense of physical fatigue, as

suggested by previous research findings[23]. In light of the results of this study, the decline in life satisfaction with increasing age despite regular exercise is presumed to be a consequence of engaging in excessive physical activity that does not align with individual physical conditions, rather than an effect of aging per se[2,23]. Therefore, it can be inferred that implementing exercise programs tailored to the age and physical condition of the participants can lead to an improvement in perceived health status and, consequently, an increase in life satisfaction.

This study is a secondary analysis aimed at examining the moderating effect of exercise on the impact of age on life satisfaction using data from KLoSA to provide foundational information for developing appropriate exercise programs tailored to the age of older adults. The study utilized data from the 8th KLoSA, which is a cross-sectional data collection, imposing limitations on explaining causality between variables. Additionally, the analysis was restricted to the variables presented in the KLoSA data. Nevertheless, the significance of this study lies in its findings, which suggest the need for age- and health-appropriate exercise programs when planning for individuals aged 65 and above. The results of this study can be valuable for developing exercise programs tailored to the age and physical condition of participants among the elderly population; it is anticipated that the findings of this study can be utilized when developing exercise programs for individuals aged 65 and above in the future. Researchers should incorporate the physical conditions of study participants to tailor exercise programs that align with the age of the participants.

IV. Conclusion

This study utilized the 8th KLoSA data to examine the impact of age on life satisfaction, with regular exercise as a moderating variable. The results of multiple regression analysis revealed that factors such as being female, having a spouse, having a high school diploma or higher, residing in small to medium-sized cities or rural areas, engaging in alcohol consumption, and having a higher household income had a positive impact on life satisfaction. Conversely, individuals who perceived themselves to have cognitive impairment or poor health had a negative influence on life satisfaction. Additionally, when investigating the changes in life satisfaction with age, using regular exercise as a moderating variable, it was observed that the group participating in regular exercise experienced a decrease in life satisfaction with increasing age. Therefore, the findings of this study can serve as fundamental data for the development of exercise programs for individuals aged 65 and older in the future. Subsequent research should involve investigating perceived health status, fatigue due to exercise, and physiological indicators among participants based on the current study results to develop and implement exercise programs tailored for individuals aged 65 and older.

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