RESEARCH



A psycho-behavioral perspective research for elderly leisure sports participation via bigdata and comparative analyses



Chulhwan Choi¹, Sung-Un Park^{2*†} and Dong-Kyu Kim^{3*†}

Abstract

Background The health of the elderly and the need for research to support them has never been more important. This study aims (a) to analyze the participation behavior of the elderly in leisure sports through big-data analysis and (b) to compare and analyze the motivations, limitations, and satisfaction of participation in leisure sports by age group.

Methods First, big-data analysis using text-mining technique was conducted using the TEXTOM program to collect and analyze data between May 1, 2023 and November 24, 2024. Next, a survey was conducted among adults aged 20 years and older who regularly participate in leisure sports to determine their motivations, limitations, and satisfaction with leisure participation. From June to December 2024, the data of 301 participants were collected and analyzed using SPSS 28.0. Specifically, this study analyzed the validity and reliability of the data and then compared and analyzed the three age groups through multivariate analysis of variance.

Results Big-data analysis identified key terms and four clusters related to senior leisure sports participation: (a) Policy, (b) Welfare, (c) Senior Sports, and (d) Employment. The results of the comparative study through the questionnaire showed that compared to younger participants in leisure sports, the elderly showed higher results in the factors of self-challenge motive, social interaction motive, and leisure participation satisfaction, but lower results in the factor of cost constraints. This means that the elderly participate in leisure sports for challenge and social interaction, are more satisfied, and are less constrained by cost.

Conclusions The scientific and objective results of this study could be used as a resource to specifically understand the leisure sports participation behavior of the elderly.

Keywords Elderly, Leisure sports, Big data, Motivation, Constraints, Satisfaction

[†]Sung-Un Park and Dong-Kyu Kim contributed equally to this work.

*Correspondence: Sung-Un Park psu@hsmu.ac.kr Dong-Kyu Kim dkkim2050@sch.ac.kr ¹Department of Physical Education, Gachon University, Seongnam-si 13120, Republic of Korea ²Department of Sports Science, Hwasung Medi-Science University, Hwaseong-si 18274, Republic of Korea ³Department of Sport, Leisure, & Recreation, Soonchunhyang University, Asan-si 315358, Republic of Korea



© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creative.commons.org/licenses/by-nc-nd/4.0/.

Introduction

Leisure is the experience of joy, satisfaction, and selfactualization in any activity of one's own free choice, outside of physiologically required time and working hours [1]. Additionally, leisure sports are a class of leisure activities that refers to sports or physical activities taking place during leisure time. In general, leisure sports are considered a type of hobby for all ages, including infants, young adults, and the elderly in that they are practiced on weekends or after the end of an individual's workday and are separate from daily life. Motivation has been regarded as the most important concept in participating in leisure sports. Motivation has been defined as the decision to perform or not to perform a certain action, because aimless behavior is not triggered, and human behavior pursues a certain goal [2]. In other words, motivation is to perform an action to get closer to a goal. Participating in sports activities in one's spare time not only helps to acquire motor skills, but it also contributes significantly to improving health and physical fitness [3]. Moreover, it plays an important role in relieving stress and psychological anxiety, helping to maintain a healthy psychological state [4]. The social role of leisure sports is especially important for the elderly, who often have fewer social relationships after retirement [5]. Therefore, leisure sports should be considered an essential element of modern life.

First and foremost, regular participation in leisure sports has physical benefits. It improves muscle strength, flexibility, and cardiorespiratory endurance and prevents chronic diseases such as obesity and cardiovascular disease [6]. Physical fitness plays an important role in helping older adults lead healthy daily lives, and the decline in physical fitness with aging leads to changes such as loss of muscle mass, increased body fat, decreased oxygen utilization, and decreased respiratory function [7]. These changes can increase the risk of adult diseases and related conditions that can be caused by lack of exercise; thus, strengthening physical fitness in older adults is important for disease prevention and health promotion [8]. Participation in leisure sports is one of the most essential activities for older adults to prevent the inevitable decline in physical abilities that occurs with aging and live independently.

In terms of mental benefits, leisure sports provide exposure to different environments and relaxation, and self-efficacy through physical activity has a positive impact on psychological well-being [9]. Therefore, for older adults, leisure sports have many benefits in the process of leading a healthy life. A study analyzing the relationship between types of leisure activities and leisure satisfaction among the elderly found that active leisure activities, such as sports and outdoor activities, have a greater impact on increasing leisure satisfaction and promoting happiness in the elderly compared to passive leisure activities [10]. Additionally, among the various types of leisure activities, sports activities contribute significantly to the leisure satisfaction of the elderly [11]. Ajmiri and Bahir [12] argued that leisure sports activities are the most effective way to adapt to old age by alleviating economic, mental, and psychological problems arising in such age. As important as the physical benefits of participating in leisure sports are, the mental benefits are just as important.

Finally, the social benefits of physical activity for older adults are also gaining attention. In modern society, loneliness and isolation are important issues for older people, and the importance of social relationships through leisure sport participation has been emphasized as a way to combat this [13]. Participation in leisure sports provides the most basic environment for older adults to remain active members of society, which can help them overcome the losses associated with social retirement and form new social connections. Physical activities have a positive impact on restoring social relationships among the elderly, contributing to their overall quality of life [14]. The elderly's social isolation causes negative mental states, which can be solved through leisure immersion and participation in physical activity [15]. The research on senior leisure sports participation is worth noting, especially in light of recent social calls for increased attention to older adults living alone.

The United Nations (UN) defines older people as those aged 65 and over and categorizes societies into three categories based on the proportion of older people in the total population [16]. A society with 7% or more older adults is classified as an aging society, 14% or more as an aged society, and 20% or more as a super-aged society [17]. People aged 65 and older in 2024 were 19.2% of the total population of the Republic of Korea, which can be currently considered an aged society but is on the verge of becoming a super-aged society. Additionally, the proportion of the elderly population in the Republic of Korea is expected to continue increasing in the future, exceeding 20% in 2025, 30% in 2036, and 40% in 2050 [18]. The main reasons for this approaching elderly and ultraelderly society are the decline in the number of births and the increase in life expectancy. The rapidly changing age structure of our society is not only a social change but a social problem, and preparing for an ultra-elderly society should be essential.

Life expectancy in the Republic of Korea was 52.4 years in the 1960s, 16 years lower than the Organization for Economic Cooperation and Development (OECD) average, but it increased steeply to 62.2 years in 1970 and 78.5 years in 2005 [19]. As of 2017, it was 82.7 years, increasing by an average of 0.46 years per year from 1970 to 2017. This is one of the highest rates in the world among OECD countries, along with Turkey (0.54 years on average) and Chile (0.40 years on average) [20]. The rise in life expectancy could be largely due to advances in medical technology [21]. The development of the latest imaging diagnostic technology (Magnetic Resonance Imaging, MRI and Computed Tomography, CT) and gene analysis technology has allowed to detect and prevent diseases at an early stage, enabling the early detection and treatment of serious diseases such as cancer, heart disease, and pneumonia [22]. This improvement in medical technology has led to a rise in life expectancy, coupled with a declining birthrate, leading to a super-elderly society.

Taken together, the participation of older people in leisure and physical activity sports has useful physical, mental, and social consequences. In this regard, this study aims to specifically analyze the leisure activities of the elderly in an aging society. To this end, this study first collected and analyzed extensive data by big data analysis through text mining techniques [23] to analyze the recent overall trends of leisure sports for the elderly. Next, this study will compare the leisure participation motivation, leisure participation constraints, and leisure participation satisfaction of the elderly who actually regularly participate in leisure sports with other age groups (quantitative study through questionnaires) to derive meaningful results on the characteristics of the elderly's leisure sports participation behavior. The two different methods of analysis are expected to yield more specific and comprehensive results than existing studies. The research questions designed to achieve the purpose of this research are as follows:

- 1. What are the key attributes associated with older adults' participation in leisure sports in an aging society? (study 1)
- 2. What are statistically significant differences in leisure participation motivators, leisure participation constraints, and leisure participation satisfaction factors by age? (study 2)

Methods

Text-mining big-data analysis (Study 1) Data collection

An objective of this study was to analyze the current situation of older adults' participation in leisure sports using text-mining techniques. To achieve this purpose, a period of about one year was set from May 1, 2023 to November

Table 1 Data-collection procedure

Category	Content
Collection channel	Naver, Google
Collection period	From May 1, 2023 to July 24, 2024
Collection tool	TEXTOM, UCINET 6.0, Netdraw
Search keywords	Elderly, Sports, Leisure, Health

24, 2024, after the end of COVID-19, and big data were collected using the search keywords "elderly + sports + leisure + health." Specifically, data were collected from all web documents, news, and blogs provided by Naver (the most popular internet search engine in the Republic of Korea) and Google (a global online platform). The bigdata analysis in this study utilized the TEXTOM, UCI-NET 6.0, and Netdraw, programs for text-mining analyses [24]. The details of data collection are shown in Table 1.

Text-mining analysis is an analysis method that extracts useful words from unstructured texts based on natural language processing and morphological analysis, analyzes their frequency, and finds the meaning of the context [25]. In this study, "elderly + sports + leisure + health" were set as keywords; words that were not directly related to the collected sentences were deleted, and those with the same meaning were consolidated. Words were refined by, for example, checking spacing. To minimize the researchers' subjective views in this process, experts (professors and doctoral level researchers) in sport management were consulted. More specifically, with regard to the words used to clean the data, words with the same meaning but referred to differently were combined into one, and words that did not have a complete meaning were removed as they were deemed unnecessary for the analysis.

Data analysis procedure

This study used a big-data solution, TEXTOM, to collect data related to "elderly + sports + leisure + health," and the analysis procedure was as follows. First, text frequency analysis was conducted to check how often the keyword was included in the keywords. Second, this study conducted Term Frequency-Inverse Document Frequency (TF-IDF) analysis to identify the importance of keywords by considering the frequency of a specific word in a document (TF) and in multiple documents (IDF). Third, this study utilized degree-centrality analysis to understand the interconnection structure of the identified keywords. Finally, network visualization using UCINET6.0 and CONCOR analysis was conducted to present words with similar characteristics as a cluster.

Comparative analysis using multivariate analysis of variance (Study 2)

Study participants

This second study was implemented with 324 participants who had been regularly taking part in leisure sports activities in the Republic of Korea. Participants under the age of 20 or those who did not regularly participate in leisure sports were excluded from the study. Among the non-probability sampling techniques, convenience sampling and intercept survey technique were applied. All survey respondents were informed about the purpose of this study. From June to December 2024, on/offline surveys were performed based on voluntary oral consents from the survey respondents. The online survey platform provided by Google was used to collect online data for this study, and offline data collection was conducted at leisure sports facilities located in two cities in the Republic of Korea.

Subsequently, after 23 incomplete surveys were excluded, 301 responses were utilized for this statistical analysis. The sample size of 301 used in this study met the statistical criteria calculated using G*power 3.1.9.7. As an independent variable to segment the study participants, age was applied for comparative analysis. Based on the collected demographic information, the study sample was segmented into three groups based on age by the U.S. Census Bureau: (a) Group 1: younger adults between 20 and 45 years; (b) Group 2: middle-aged adults between 46 and 65 years; and (c) Group 3: older adults over 66 years [26].

Instruments

The study instruments as dependent variables (e.g., leisure participation motivations, leisure participation constraints, and leisure participation satisfaction) were applied to the questionnaires. First, factors used to understand the leisure participation motivations were applied to the survey questionnaires modified by Chang et al. [27] exploring participation behaviors of outdoor leisure sports, including four sub-factors: (a) self-challenge (three items); (b) social interaction (three items); (c) learning new knowledge (three items); and (d) release pressure (three items). Next, factors for leisure participation constraints were utilized from the study of Choi et al. [17] analyzing constraints of leisure sports through virtual reality for older adults, including four sub-factors: (a) cost (three items); (b) health (three items); (c) confidence (three items); and (d) social (three items). Last, the factor of leisure participation satisfaction in this study was a single-scale factor [28] including five items. All survey items applied a 5-point Likert scale ranging from 1 (not at all) to 5 (very much).

Data analysis

The collected data were statistically analyzed with SPSS 28.0 version. First, descriptive statistics were performed to check the demographic characteristics of the survey respondents. Second, to test the scale validity of the collected data, two exploratory factor analyses (EFAs) were conducted for leisure participation motivators and leisure participation constraints factors. The factor of leisure participation satisfaction was waived from the EFA as a single-scale factor. Third, Cronbach's alpha coefficients were analyzed to verify the scale's reliability. Last, a multivariate analysis of variance (MANOVA)

and post-hoc analysis with an independent variable (age) and three dependent variables (leisure participation motivators, leisure participation constraints, and leisure participation satisfaction) were performed to verify statistically significant differences among three age groups. Prior to application of the MANOVA, this study verified three assumptions (a) independence, (b) normality, and (c) equality of covariance [29, 30]. First, for the assumption of independence, each survey respondent took part in only one survey independently. Next, for the assumption of normality, the frequency distribution was utilized in advance to test the assumption visually. Last, for the assumption of homogeneity of covariance, the Box's test was implemented via SPSS 28.0 version.

Results

Results of big-data analysis using TEXTOM (Study 1) Results of big-data analysis

This study conducted text-mining analysis from May 1, 2023 to November 24, 2024 with the keywords "elderly+sports+leisure+health." The total extracted texts from NAVER and Google had 18,262 hits; as a result, 30 frequently occurring terms were extracted. Based on the results of simple frequency analysis, the TF-IDF analysis results show how important the keyword is in the document. Additionally, the result of degree centrality analysis (DCA) shows the centrality of the words in the network, and the higher the result, the higher the influence in the network. Specifically, the results of (a) frequency, (b) TF-IDF, and (c) SNA results are shown in Table 2.

Results of network visualization and CONCOR analyses

To understand the level and pattern of connectivity between words, this study performed network visualization analysis based on degree centrality analysis using word frequency and node size. The results showed that a network of connections in various directions formed around the top frequency words: elderly, health, news, support, public, business, welfare, participation, residents, education, culture, and society. Next, the results of CONCOR analysis in this study revealed four distinct clusters. The detailed results of network visualization and CONCOR analyses are shown in Figs. 1 and 2; Table 3.

Results of comparative analysis using MANOVA (Study 2) Descriptive statistics

Data were collected through a quantitative research design from 301 survey questionnaires. The sociodemographic characteristics of the three age groups (sex, age, leisure activity type, leisure activity duration, and frequency of participants in leisure activities) are reported in Table 4 below.

Table 2 Results of frequency, TF-IDF, and SNA

No.	Term	Freq.	No.	Term	TF-IDF	No.	Term	DCA
1	Information	9199	1	Information	13,305	1	Information	1
2	Elderly	8539	2	Disclosure	12540.1	2	Seniors	1
3	Health	6194	3	Elderly	10152.36	3	Health	1
4	News	6194	4	Business	10152.36	4	News	1
5	Support	5820	5	Support	10137.03	5	Support	1
6	Public	5724	6	News	10005.77	6	Public	0.932
7	Business	5605	7	Welfare	9354.441	7	Business	1
8	Welfare	5584	8	Residents	9067.133	8	Welfare	1
9	Engagement	4197	9	Education	9032.459	9	Engagement	1
10	Residents	4111	10	Health	8728.262	10	Residents	1
11	Education	4101	11	Recruitment	8131.505	11	Education	0.983
12	Culture	4075	12	Culture	7869.151	12	Culture	1
13	Social	4020	13	Social	7769.223	13	Social	1
14	Administration	3440	14	Engagement	7461.987	14	Administration	1
15	Leisure	3440	15	Facilities	7147.254	15	Leisure	1
16	Recruitment	4101	16	Administration	6966.489	16	Recruitment	0.983
17	Facilities	3440	17	Programs	6571.415	17	Facilities	1
18	Programs	2716	18	Leisure	5950.308	18	Programs	1
19	Policies	2463	19	Policies	5885.196	19	Policies	0.983
20	Service	1778	20	Recruitment	5431.911	20	Service	1
21	Employment	1675	21	Services	4873.214	21	Recruitment	0.966
22	Exercise	1411	22	Budget	4263.739	22	Athletics	0.983
23	Family	1372	23	Exercise	4219.81	23	Family	1
24	Budget	1367	24	Family	4047.167	24	Budget	0.983
25	Happiness	1367	25	Prevention	3886.369	25	Happiness	0.983
26	Promotion	1234	26	Park Golf	3793.046	26	Promotion	1
27	Prevention	1234	27	Cost	3658.697	27	Prevention	0.983
28	Park Golf	1015	28	Happiness	3652.733	28	Park Golf	0.949
29	Public	993	29	Promotion	3495.487	29	Public	1
30	Cost	937	30	Public	3133.469	30	Cost	0.898

Validity and reliability of study instruments

The two EFAs were performed separately on leisure participation motivations and constraints. Considering the fact that EFA could be pointless for single-scale factor, leisure participation satisfaction as a single-scale factor ($\alpha = 0.955$) including five items ("I find something that will make me happy in my leisure time," "I have been feeling very good about the way I spent my leisure time," "Leisure time after work is very important to me," "I usually spend my free time quality," and "I am the kind of person who knows how to enjoy leisure time") was excluded from this EFA.

First, regarding the factor structure of leisure participation motivation, the Kaiser–Meyer–Olkin test showed sample adequacy (0.693). Additionally, Bartlett's test of sphericity met statistical significance ($\chi^2 = 2065.567$ df = 66, p < 0.01). The remaining four sub-factors accounted for 80.062% of the total variance. Moreover, the result found acceptable eigenvalues and factor structure coefficients. For scale reliability, all factors had satisfactory (greater than 0.70) Cronbach's alpha coefficients: social interaction ($\alpha = 0.895$), release pressure ($\alpha = 0.889$), learning knowledge ($\alpha = 0.874$), and self-challenge ($\alpha = 0.824$) [31] (Table 5).

Second, regarding the factor structure of leisure participation constraints, the Kaiser–Meyer–Olkin test showed sample adequacy (0.717). Additionally, Bartlett's test of sphericity showed statistically significance result ($\chi^2 = 1807.528$, df = 66, p < 0.01). This EFA retained four sub-factors, explaining 78.018% of the total variance. Furthermore, the result showed a greater than 1 eigenvalue and greater than 0.40 factor structure coefficients. For scale reliability, the factors met acceptable internal consistency for cost ($\alpha = 0.870$), health ($\alpha = 0.847$), confidence ($\alpha = 0.855$), and social ($\alpha = 0.837$) [31], as reported in Table 6. Finally, the factor of leisure participation satisfaction ($\alpha = 0.955$) excluded from this EFA had acceptable factor reliability.

Results of MANOVA

A MANOVA was performed to find mean differences in nine dependent variables. First, the homogeneity of covariance was tested (Box's M = 204.744, F = 2.177, p < 0.01). Next, statistically significant differences among three age



Fig. 1 Network visualization analysis

groups were revealed (Wilks' Lambda = 0.749, F = 5.001, p < 0.01, $\eta^2 = 0.134$). Specifically, the MANOVA found statistically significant mean differences in the (a) selfchallenge of participation motivation, (b) social interaction of participation motivation, (c) cost of participation constraints, and (d) participation satisfaction. Additionally, to verify which of the three groups reported statistically significant differences, a post-hoc analysis was implemented. First, on self-challenge of motivation factor and leisure participation satisfaction, the older adult group (G3) showed higher mean scores than the other two age groups (G1 and G2). Next, in terms of social interaction of motivation factor, this study found higher mean scores in the middle-aged adult (G2) and olderaged adult (G3) groups than in the youngest age group (G1). Last, regarding cost of motivation factor, this study found higher mean score in the young adult (G1) and middle-aged (G2) groups than in the older age group (G3). The detailed results of MANOVA and post-hoc analysis is shown in Tables 7 and 8.

Discussion

Leisure sports participation of older adults through big data analysis (Study 1)

This study aims to analyze the overall sports participation of older adults. Big-data analysis was utilized to accomplish this goal, and four clusters were identified: (a) *Policy*, (b) *Welfare*, (c) *Senior Sports*, and (d) *Employment*.

The first cluster, consisting of the keywords public, price, administration, public, satisfaction, public benefits, finance, fine dust, information, budget, health, and satisfaction, was named *policy*. In the Republic of Korea, the number of elderly people aged 65 and over was 6,537 as of 1995, and the projected number of elderly people aged 65 and over in 2050 is 61,293 [32]. Although the number of elderly people is about 10 times higher, it is increasing year by year; therefore, policies should follow suit. The elderly spends most of their waking hours in leisure, which is why leisure welfare policies are so important. However, differences exist in the scope of access and enjoyment depending on physical, ability, and income levels; thus, establishing elderly welfare policies is crucial. Examples are strengthening long-term care guarantees, developing community integrated care models, and expanding health promotion infrastructure without discrimination so that there are no blind spots and everyone can benefit from them [33]. As a result, it could be seen that due to the rapid increase in the elderly population, leisure sports for the elderly is no longer the domain of individuals, but has been expanding into an area that requires policy support from the government.



Fig. 2 CONCOR analysis

Table 3 Results of CONCOR analysis

Cluster	Term
Policy	public, price, administration, public, satisfac- tion, public benefit, policy, finance, information, budget, health, satisfaction
Welfare	social class, business, services, learning, program, lifelong, course, vulnerable, digital, support, social, healthcare, care, culture, family, education
Senior Sports	rehabilitation, entertainment, fitness, old, hap- piness, aging, body, leisure, active, wellness, elderly, hospital, health, healthcare, facility, exercise, government, senior, certificate, park golf, care, gate ball, golf course
Employment	news, legislation, jobs, residents, engagement, recruitment, COVID-19

The second cluster, consisting of the keywords class, business, service, learning, program, lifelong, course, vulnerable, digital, support, social, medical, interest, culture, family, and education, was named *welfare*. As an extension of the policy cluster, the increase in the life expectancy of the elderly may cause the problem of the burden of supporting the elderly and bring about various social changes. Therefore, welfare policy for the elderly is expected to occupy an important priority among social policies [34] as it creates the conditions for the elderly to be independent and have a high quality of life. Elderly welfare services are intended to improve the functional

Table 4	Sociodemographic characteristics	of the	three	age
groups				

		Group 1 (20–45 years)	Group 2 (46–65 years)	Group 3 (over 66 years)
Sex	Male Female	35 (31.5%) 76 (68.5%)	63 (60.6%) 41 (39.4%)	56 (65.1%) 30 (34.9%)
Leisure activity duration	Less than 1 yr 1–10 yrs 10–20 yrs Over 20 yrs Unknown	19 (17.1%) 38 (34.2%) 16 (14.4%) 8 (7.2%) 30 (27.0%)	11 (10.6%) 44 (42.3%) 23 (22.1%) 8 (7.7%) 18 (17.3%)	5 (5.8%) 26 (30.2%) 22 (25.6%) 21 (24.4%) 12 (14.0%)
Frequency of Participat- ing in leisure activity	Once a month 2–3 times per a month Once a week 2–3 times per a week Everyday	33 (29.7%) 36 (32.4%) 17 (15.3%) 16 (14.4%) 9 (8.1%)	41 (39.4%) 36 (34.6%) 13 (12.5%) 13 (12.5%) 1 (1.0%)	30 (34.9%) 39 (45.3%) 11 (12.8%) 1 (1.2%) 5 (5.8%)
Total		111 (100.0%)	104 (100.0%)	86 (100.0%)

level of older adults or reduce difficulties related to adequate income, health care, housing, transportation, or social participation [35]. They include health-related, emotional, and social services, and the higher the satisfaction with these services, the higher the psychological well-being of the elderly [36]. In this respect, this result shows that participation in leisure sports, which can

Items of leisure participation motivation	1	2	3	4
(Social interaction)				
Exchange experience with other	0.932	-0.024	-0.068	-0.046
Promote the affection with friends	0.93	-0.030	-0.056	-0.056
Let me meet like-minded friends	0.864	0.046	-0.004	0.065
(Release pressure)				
To release emotion	-0.013	0.916	0.004	0.048
To gain self-confidence	-0.024	0.908	-0.032	0.049
To relieve the stress	0.031	0.887	0.034	0.057
(Learning knowledge)				
To find new ways of training	-0.066	-0.004	0.941	0.027
To see my usual exercise results	-0.056	0.072	0.897	-0.064
To increase knowledge and skills for exercise	-0.005	-0.056	0.837	0.02
(Self-challenge)				
Let me challenge myself	-0.010	0.033	-0.011	0.909
Help me increase willpower	-0.041	0.014	-0.065	0.878
Improve and maintain body shape	0.018	0.096	0.056	0.785
Eigenvalues	2.71	2.611	2.238	2.049
Variance (%)	22.584	21.755	18.647	17.075

Table 5 Results of exploratory factor analysis (validity) for leisure participation motivation

 Table 6
 Results of exploratory factor analysis (validity) for leisure participation constraints

Items of leisure participation constraints	1	2	3	4
(Cost)				
I don't have enough money to participate in leisure sports.	0.902	0.029	-0.020	0.061
The fee for leisure sports is too expensive.	0.896	-29	0.016	0.006
I cannot afford the fee for leisure sports.	0.874	-0.038	0.027	0.075
(Health)				
I am not fit enough to participate in leisure sports.	0.029	0.907	0.141	0.04
I don't have the energy to participate in leisure sports.	-0.044	0.868	0.164	0.021
Health problems prevent me from leisure sports.	-0.026	0.818	0.209	0.047
(Confidence)				
l am not experienced.	-0.013	0.09	0.915	-0.052
My leisure sport is too inconsistent.	-0.041	0.207	0.863	0.017
The leisure sport is too difficult.	0.081	0.233	0.809	0.019
(Social)				
My friends/family don't want to participate in leisure sports.	0.068	0.034	0.018	0.913
My friends have different interests other than leisure sports.	-0.002	0.055	0.027	0.889
I don't have friends to participate with leisure sports.	0.07	0.014	-0.054	0.793
Eigenvalues	3.253	2.582	2.102	1.425
Variance (%)	27.112	21.513	17.52	11.873

Table 7 Results of MANOVA by three age groups

	df	F	p	η²	Post-hoc	Mean		
						Group 1	Group 2	Group 3
Self-challenge	2	6.686	0.001***	0.043	a, b <c< td=""><td>3.40</td><td>3.36</td><td>3.72</td></c<>	3.40	3.36	3.72
Social interaction	2	13.306	< 0.001****	0.082	a <b,c< td=""><td>3.13</td><td>3.63</td><td>3.64</td></b,c<>	3.13	3.63	3.64
Learning knowledge	2	0.414	0.661	0.003	-	2.83	2.79	2.71
Release pressure	2	0.012	0.988	0.000	-	3.43	3.43	3.41
Cost	2	12.257	< 0.001***	0.076	a, b>c	3.71	3.60	3.15
Health	2	0.740	0.478	0.005	-	1.39	1.44	1.50
Confidence	2	1.339	0.264	0.009	-	2.35	2.22	2.14
Social	2	1.114	0.329	0.007	-	3.47	3.29	3.38
Satisfaction	2	13.150	< 0.001****	0.064	a, b <c< td=""><td>3.70</td><td>3.44</td><td>4.03</td></c<>	3.70	3.44	4.03

Note. *** *p* < 0.001, ** *p* < 0.01, * *p* < 0.05

		Motivation				Constraints				LS
		M1	M2	M3	M4	C1	C2	C3	C4	_
G1	G2	0.921	< 0.001****	0.952	1.000	0.608	0.842	0.571	0.329	0.101
	G3	0.011**	< 0.001****	0.666	0.991	< 0.001****	0.478	0.282	0.794	0.042
G2	G1	0.921	< 0.001****	0.952	1.000	0.608	0.842	0.571	0.329	0.101
	G3	0.004**	0.992	0.837	0.991	< 0.001***	0.810	0.845	0.767	< 0.001***
G3	G1	0.011***	< 0.001****	0.666	0.991	< 0.001****	0.478	0.282	0.794	0.042
	G2	0.004**	0.992	0.837	0.991	< 0.001***	0.810	0.845	0.767	< 0.001***

Table 8 Results of post-hoc analysis

Note: *** p < 0.001, ** p < 0.01, * p < 0.05; G1 = Young adult group; G2 = Middle-aged adult group; G3 = Older adult group; M1 = Self-challenge, M2 = Social interaction, M3 = Learning knowledge, M4 = Release pressure, C1 = Cost, C2 = Health, C3 = Confidence, C4 = Social, LS = Leisure participation satisfaction

improve the health of older people, has evolved into a concept of welfare, which is a basic social security that all older people should be able to enjoy without being neglected.

The third cluster, consisting of the keywords, rehabilitation, entertainment, fitness, happiness, body, leisure, active, welfare, elderly, hospital, hobby, health, facility, exercise, government, promotion, senior, certificate, park golf, care, gate ball, and golf course, was named senior sports. Leisure sports activities have a positive impact on the physical and mental health of the elderly, as well as on their social interaction with others, increasing interaction in the leisure sports group, individual self-esteem, and psychological stability [15]. As the social isolation of the elderly has recently emerged as a social problem, participation in leisure sports could be one of the most effective solutions [37]. Participation in leisure sports by the elderly could provide mental health benefits, prevent social isolation, and improve their quality of life by taking care of their physical health and reducing social costs. The results showed that older adults have indeed participated in leisure sports more actively than in the past, causing changes to existing traditional sports and even creating new ones. The elderly has created and expanded their own leisure sports, and that the elderly, who have long been considered the underdogs in leisure sports, has become active participants.

The fourth cluster, comprising the keywords news, legislation, recruitment, residents, participation, recruitment, and corona, was named *employment*. Elderly employment is an essential element of healthy aging by providing older adults with stable jobs that meet their needs [38]. To do so, providing continuous information to the target population and solutions to problems and training services and having a workforce that can specialize in these services is necessary. Participation of the elderly in jobs strengthens social relationships and leads to a higher overall quality of life, including health and economic status, compared to those who do not participate in jobs [39]. In other words, employment for the elderly is not just an economic activity, but it can enhance their psychosocial health, improving life

satisfaction, social support, and geriatric depression and enabling them to think more positively about their lives and continue to participate in society, leading to a productive life [40]. Taken together, and in contrast to the clusters mentioned above, this result suggests that, rather than improving the health of older people through participation in leisure sports, older people have been entering the leisure sports industry as employers. This would be a desirable phenomenon as it signifies the expanding role of older people in society in an ageing society.

Comparative analysis on leisure participation for the elderly by age groups (Study 2)

The secondary objective of this study is to analyze statistically significant differences in leisure participation motivation, leisure participation constraints, and leisure participation satisfaction by age. This research effort will help to identify leisure sports participation behaviors that are unique to the elderly and provide objective data for future elderly health policies. The interpretation of this study's results is as follows.

First, the social interaction factor among the motivators for participating in leisure sports was statistically significantly higher in the two relatively older groups (G2 and G3). These two groups, which include people in their 40s and older, are in the prime of their lives and should be preparing for retirement. This can be interpreted as a sign that women are most active in their 40s and 50s, when they are most socially engaged. However, the results of this study show that people still participate in leisure sports for socialization after the age of 65. Most people experience a change in social roles and a breakdown in social relationships after retirement [41]. This disconnection from society can lead to psychological problems, which in turn can lead to social problems [42]. Therefore, the results show the importance of the role of leisure sports for social activity among people aged 65 and older. The next statistically significant motivating factor for participation in leisure sports was selfchallenge. Specifically, the highest result was found in the oldest group, group 3. This suggests that older adults are more likely to participate in leisure sports to improve

their health compared to other age groups. The physical health of the elderly is of interest because life expectancy is higher than in the past owing to advances in medical technology and improved living standards [43]. In particular, the development of various leisure sports along with social changes has expanded the choices of the elderly and created a culture of leisure sports that can be enjoyed at an affordable cost and psychological accessibility. The development of digital technology is helping to increase the efficiency and accessibility of exercise participation for the elderly by utilizing virtual reality (VR), wearable devices, and smart home care services [44].

Second, among the factors that constrained participation in leisure sports in this study, cost was the only factor that showed statistically significant group differences. Specifically, two relatively younger age groups (G1 and G2) showed relatively high results. This suggests that younger and middle-aged adults have experienced a financial burden in participating in leisure, while older adults (65+) have experienced a relatively low financial burden in participating in leisure. In the past, older adults were considered socially disadvantaged owing to their declining physical or mental health, as well as the disconnection from economic activity due to retirement [45]. However, the results of this study contradict this common perception. This might be due to the fact that the economic situation of the elderly may be better than in the past and that older people might be more concerned about their health and more active in spending on leisure sports. Conversely, younger and middle-aged adults may be less likely to participate in leisure sports owing to lower employment rates, increased debt, and lower incomes. Young people are actually participating in leisure sports less than in the past owing to the increasing cost of participation [5]. Furthermore, none of the factors in the health, confidence, and social category of constraints to leisure participation, with the exception of cost, were statistically significant by age. These findings are positive from the perspective of this study's objective, which is to increase participation in leisure sports among older adults. No significant barriers to participation in leisure sports were identified for those aged 65 and over.

Finally, the results for satisfaction with participation in leisure sports among older adults (group 3) aged 65 and older were the highest compared to the other two groups. Increased life expectancy and changes in the choice of leisure sports may affect participation rates and leisure satisfaction among older adults. Active participation in leisure sports is one of the most effective ways to promote healthy aging in older adults [46, 47]. The highest leisure satisfaction among older adults may be due to the fact that their physical health is better than in the past, which allows them to invest more time and money in participating in leisure sports and gain emotional and social stability as a result. Specifically, Kwak [48] found that participation in leisure sports has a positive effect on psychological satisfaction for male seniors and on educational satisfaction for female seniors. Furthermore, the positive effects of participation in leisure sports were social and physiological satisfaction for the elderly in their 60s, educational satisfaction and physiological satisfaction for the elderly in their 70s, and psychological and educational satisfaction for the elderly in their 80s [48]. In other words, the elderly are the most satisfied with participation in leisure sports than other groups, and policies for leisure sports programs for the elderly are needed in the future.

Conclusions

Rapid social changes have had a profound impact on our lives. One of the biggest social changes that our society must prepare for is the aging of the elderly owing to advances in medical technology and improved living standards. This demographic shift has raised the need for research on the physical, mental, and social health of the elderly. Especially after the recent experience of COVID-19, people's interest in the importance of health awareness and government policies has increased [49, 50]. In this situation, this study aimed to promote the most effective leisure sports participation for the health of the elderly in an aging society.

First, the big data analysis identified key terms and four clusters related to senior leisure sports participation: (a) policy, (b) welfare, (c) senior sports, and (d) employment. These results showed that leisure sports participation has gained prominence as a concept of welfare in the senior sports industry due to the growing concern for the health of the elderly due to aging. This means that the participation of the elderly in leisure sports has become more than just a leisure activity, but a welfare that should be applied to all people. Furthermore, the welfare has been guaranteed by government policies, which is leading to the support and employment of new senior sports.

Next, the results of the survey showed that compared to younger leisure sports participants, seniors showed higher results in the self-challenge motivation, social interaction motivation, and leisure participation satisfaction factors, but lower results in the cost constraint factor. This means that seniors participate in leisure sports for challenge and social interaction, have been more satisfied, and less constrained by cost. These results showed that seniors over 65, who have long been considered the underdogs in the leisure sports industry, have changed into active participants.

Despite the significant findings of this study mentioned above, based on the research limitations experienced in this study, the following suggestions are made for future research on geriatric health. First, to overcome the research limitations of a single research method, this study adopted a quantitative research method using big-data analysis by relying on text-mining technology and questionnaire survey research. Individuals' perceptions of participation in leisure sports may vary. In particular, the physical, mental, and social health of older adults (65+) may be more complex than that of younger people. Therefore, qualitative research methods that allow for more in-depth study of individual situations may be recommended for future research. Second, this study focused on older adults' leisure sports participation behaviors after the end of COVID-19 as leisure sports participation behaviors before and after COVID-19 may differ across age groups. In this context, future research on older adult health should continue to analyze and respond to such changes. Finally, while this study analyzed the motivations, constraints, and satisfaction of leisure sports participation, future studies should include more factors. This is because an individual's leisure sports participation behavior can be significantly influenced by various external factors. Such research efforts will lead to more objective results.

Acknowledgements

The authors express their sincere gratitude to the study participants.

Author contributions

C.C conceptualized, designed the study. C.C. collected the data. C.C., S.U.P and D.K.K wrote the main manuscript. C.C. performed the statistical analysis. C.C., S.U.P and D.K.K wrote the results depart of manuscript. All authors read, reviewed and approved the final manuscript.

Funding

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2024S1A5A8028899).

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Institutional review board statement

This study was approved by the Institutional Review Board of Gachon University (IRB No. 1044396-202405-HR-077-01). All methods performed in studies involving human participants were in accordance with the ethical standards of the Institutional Review Board of the Gachon University and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 6 January 2025 / Accepted: 26 February 2025 Published online: 14 April 2025

References

- 1. Shaw SM. The meaning of leisure in everyday life. Leis Sci. 1985;7:1–24.
- Ragheb MG, Tate RL. A behavioral model of leisure participation, based on leisure attitude, motivation and satisfaction. Leis Stud. 1993;12:61–70.
- Kim DK, Lee I, Choi C, Park SU. Mental health and governmental response policy evaluation on COVID-19 based on vaccination status in Republic of Korea. BMC Public Health. 2023;23:1628.
- Blanchet S, Chikhi S, Maltais D. The benefits of physical activities on cognitive and mental health in healthy and pathological aging. Geriatr Psychol Neuropsychiatr Vieillissement. 2018;16:197–205.
- Kim S-Y. Study on the leisure sports participation behavior of the elderly through comparative analyses by age: focusing on leisure participation constraints and price sensitivity. Behav Sci. 2024;14:803.
- Karapetov A, Lysenko I, Kazumova A, Zakirova I, Kuzmina K, Islivanova A. The role of physical activity and sports in the prevention and treatment of chronic diseases: modern scientific data and practical recommendations. J Complement Med Res. 2023;14:66.
- Setty P, Padmanabha BV, Doddamani BR. Correlation between obesity and cardio respiratory fitness. Int J Med Sci Public Health. 2013;2:300–4.
- Brawley LR, Rejeski WJ, King AC. Promoting physical activity for older adults: the challenges for changing behavior. Am J Prev Med. 2003;25:172–83.
- Orsega-Smith EM, Payne LL, Mowen AJ, Ho CH, Godbey GC. The role of social support and self-efficacy in shaping the leisure time physical activity of older adults. J Leis Res. 2007;39:705–27.
- Bhangaokar R, Mohammedi ZZ, Kapoor K. Leisure activities and life satisfaction in late adults. Indian J Gerontol. 2021;35:441–55.
- Jun M-G, Choi C. Perspective on leisure sports participation among older adults in a super-aging society: focusing on health concern, athletic passion, leisure satisfaction, and intent to continue participating in leisure sports. Healthcare. 2025;13:41.
- 12. Ajmiri MY, Bahir H. Impact of physical exercise on the mental health of the elderly. Sustain Sports Sci J. 2023;1:46–52.
- Robins LM, Hill KD, Finch CF, Clemson L, Haines T. The association between physical activity and social isolation in community-dwelling older adults. Aging Ment Health. 2018;22:175–82.
- Tak E, Park S. The effect of exercise commitment on the quality of life according to motivation for participation in leisure sports. Int J Adv Smart Converg. 2021;10:125–33.
- 15. Toepoel V. Ageing, leisure, and social connectedness: how could leisure help reduce social isolation of older people? Soc Indic Res. 2013;113:355–72.
- Rudnicka E, Napierała P, Podfigurna A, Męczekalski B, Smolarczyk R, Grymowicz M. The world health organization (WHO) approach to healthy ageing. Maturitas. 2020;139:6–11.
- Choi C, Kim D-K, Lee I. Virtual golf, exergaming, using virtual reality for healthcare in older adults: focusing on leisure constraints, participation benefits, and continuous participation intention. Healthc (Basel). 2024;12:962.
- Statistics Korea. Statistics of the elderly. 2024. https://kostat.go.kr/board.e s?mid=a10301060500%26;bid=10820%26;act=view%26;list_no=432917. Accessed 2 Dec 2024.
- Yang S, Khang YH, Harper S, Davey Smith G, Leon DA, Lynch J. Understanding the rapid increase in life expectancy in South Korea. Am J Public Health. 2010;100:896–903.
- 20. OECD, Elderly. population; 2019. https://www.oecd.org/en/data/indicators/el derly-population.html. Accessed 20 Dec 2024.
- 21. Terry Sharrer G. Extending health expectancy. Mol Front J. 2019;3:147-65.
- 22. Estapé T. Cancer in the elderly: challenges and barriers. Asia Pac J Oncol Nurs. 2018;5:40–2.
- Park SU, Jang DJ, Kim DK, Choi C. Key attributes and clusters of the Korean exercise healthcare industry viewed through big data: comparison before and after the COVID-19 pandemic. Healthc (Basel). 2023;11:2133.
- 24. Lee SS. Network analysis methods applications and limitations. Seoul, Republic of Korea: Chungram; 2012.
- 25. Wiedemann G. Text mining for qualitative data analysis in the social sciences. Wiesbaden: Springer VS; 2016.
- U.S. Census Bureau. Decennial Census; 2023. https://data.census.gov/. Assessed 10 Feb 2025.
- Chang HM, Huang YC, Chou CL. A study on participation motivation, satisfaction, and leisure benefit of road runner-case study of 2016 Taiwan Maoli road race. Asian J Bus Manag. 2017;5.
- Argan M, Argan MT, Dursun MT. Examining relationships among well-being, leisure satisfaction, life satisfaction, and happiness. Int J Med Res Health Sci. 2018;7:49–59.

- Field A. Discovering statistics using SPSS. Thousand Oaks, CA: SAGE Publishing; 2009.
- Stevens JP. Applied multivariate statistics for the social sciences. New York, NY: Routledge/Taylor & Francis Group; 2009.
- Nunnally JC, Bernstein IH. Psychometric theory. 3rd ed. New York, NY, USA: McGraw-Hill; 1994.
- 32. Statistics Korea. Statistics of the elderly. 2022. https://www.kostat.go.kr/boar d.es?mid=a10301010000%26;bid=10820%26;act=view%26;list_no=420896. Accessed 15 Dec 2024.
- 33. Kaplan MA, Inguanzo MM. The social, economic, and public health consequences of global population aging: implications for social work practice and public policy. J Soc Work Glob Commun. 2017;2:1.
- Baldock J, Manning N, Vickerstaff S. Social policy, social welfare, and the welfare state. 7–2: Soc Policy; 2007.
- Farquhar M. Elderly People's definitions of quality of life. Soc Sci Med. 1995;41:1439–46.
- Kessler EM, Agines S, Bowen CE. Attitudes towards seeking mental health services among older adults: personal and contextual correlates. Aging Ment Health. 2015;19:182–91.
- Irvine KN, Fisher D, Marselle MR, Currie M, Colley K, Warber SL. Social isolation in older adults: A qualitative study on the social dimensions of group outdoor health walks. Int J Environ Res Public Health. 2022;19:5353.
- Marmot M, Banks J, Blundell R, Lessof C, Nazroo J. Health, wealth and lifestyles of the older population in England. London: Institute of Fiscal Studies; 2003.
- Jeon HO, Kim OS. Comparison of health status, sleep and depression by the employment status in the elderly. J Korea Acad-Ind Coop Soc. 2012;13:1203–11.
- Nam H, Yi Y, Hur J. The effect of employment status on the depression of the elderly. J Korean Public Health Nurs. 2017;31:492–504.
- 41. Comi SL, Cottini E, Lucifora C. The effect of retirement on social relationships. Ger Econ Rev. 2022;23:275–99.

- Odone A, Frascella B, Vigezzi G, Gaetti G, Gianfredi V. The impact of retirement on physical, mental health and wellbeing. Eur J Public Health. 2020;30:ckaa165–765.
- Erakhtina AA. Investments in healthcare, life expectancy, and economic growth. Probl Econ Transit. 2022;63:20–33.
- 44. Kim DK, Lee SE, Park SU, Choi C. The effect of technology-based service characteristics on relationship quality in metaverse exercise services: A questionnaire survey of bicycle simulator users in Korea. BMC Psychol. 2024;12:467.
- 45. Alvarenga LN, Kiyan L, Bitencourt B, Wanderley KDS. The impact of retirement on the quality of life of the elderly. Rev Esc Enferm USP. 2009;43:796–802.
- Kim E-J, Kim DH, Shin H-J. The effect of combined exercise program on stress and autonomic nervous system activity in older adults. Korean J Sport Psychol. 2021;32:71–80.
- Jeon SW, Shin JS, Kim AC. Exploring the social meaning and information of the elderly exercise in a pandemic era. Korean J Sport. 2021;19:249–60.
- Kwak MJ. The impact of leisure satisfaction on psychological well-being in the elderly. Korean Soc Welf Aged. 3:21–9.
- Choi C, Oh KR, Jun MG. COVID-19 obesity: differences in infection risk perception, obesity stress, depression, and intention to participate in leisure sports based on weight change. Healthc (Basel). 2023;11:526.
- Kim DK, Choi C, Park SU. Relationship between sports policy, policy satisfaction, and participation intention during COVID-19 in Korea. Sage Open. 2023;13.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.