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The relationship between cognitive function and physical activity, functional status and social participation in older adults: a cross-sectional study

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ABSTRACT

Aims: Cognitive function in older adults has been a topic of growing interest in recent years. This study aimed to investigate the relationship between cognitive function and physical activity, functional status, and social participation in older adults.

Methods: A cross-sectional study was conducted involving 123 older adults aged 65 years and older who met the study's inclusion criteria. The inclusion criteria for the study were as follows: who were aged 65 years or older, literate, volunteering to participate in the study, had no hearing or vision defects that prevented the measurement of the scales used in the study, had no chronic disease that prevented the scales used in the study. The data in the study were collected with sociodemographic form, Montreal cognitive assessment, international physical activity questionnaire, timed-up-and-go test, 10-meter walk test, and Keele assessment of participation.

Results: The average age of the participants was 69.5±4.6. The study included 46.3% women and, 57.7% primary school graduates. A positive and moderate relationship was found between cognitive functions and physical activity level, functional status, and social participation in older adults. Additionally, there was a moderate positive relationship found between the level of physical activity, functional status, and social participation. In the cognitive function risk model, it was found that age, education level, and social participation significantly impact cognitive functions in older adults.

Conclusion: Increasing physical activity, functionality, and especially social participation in older adults can be considered an important intervention to protect and improve the cognitive functions of older adults.

Keywords: Aged, cognitive function, physical activity, social participation

INTRODUCTION

Understanding the factors influencing cognitive function among older adults is essential in addressing the challenges posed by an aging population worldwide. Cognitive decline is a significant concern associated with aging, affecting independence, quality of life, and healthcare demands. Recent research has increasingly focused on the role of lifestyle factors such as physical activity, functional status, and social participation in influencing cognitive health in older individuals.[1,2]

Physical activity has consistently been shown to have beneficial effects on cognitive function, potentially enhancing both brain structure and function.[3] Regular exercise positively influences various cognitive domains, including global cognition, attention, executive function, and memory.[4] Additionally, maintaining a high functional status, which includes mobility, physical independence, and the ability to perform daily activities, is crucial for sustaining cognitive abilities in older adults.[5] Functional status is closely linked to cognitive resilience, as greater physical independence often correlates with better cognitive performance.[5]

In addition to physical activity and functional status, social participation plays a critical role in cognitive health. Social engagement through participation in activities and social networks has been associated with cognitive resilience and a reduced risk of cognitive decline.[6] Active involvement in social relationships and leisure activities has been identified as a protective factor against cognitive decline and dementia in longitudinal studies.[7,8] Fostering an active and socially integrated lifestyle in late life may serve as a significant protective measure against dementia.[8]

Despite these insights, there remains a need for comprehensive studies that elucidate the interplay between physical activity, functional status, social participation, and cognitive function in older adults. Such research is pivotal for developing targeted interventions and policies aimed at promoting healthy aging and preserving cognitive abilities in aging populations.

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This study aims to contribute to the expanding field of research by investigating the correlations between cognitive function and physical activity, functional status, and social participation among older adults. By providing a deeper understanding of these relationships, the study seeks to inform strategies that could preserve cognitive health and enhance the quality of life for aging populations worldwide.

METHODS

Study Design and Participants

A cross-sectional study was conducted between August 2022 and February 2023 and approved by the Akdeniz University Clinical Researches Ethics Committee (Date: 08.06.2022, Decision No: KAEK-403). The entire study was conducted in accordance with the Helsinki Declaration of 1975. The study enrolled 123 older adults aged 65 years and older who presented at Kuzeykent Family Medicine Polyclinic and Private Şelale Termesos Hospital Physical Therapy and Rehabilitation Polyclinic, meeting the predefined inclusion criteria. Participants were required to be aged 65 or older, literate, voluntarily consenting to participate, and free from hearing or vision impairments that could interfere with the study's measurement scales, as well as without chronic diseases that would affect the assessment scales.

Demographic Information Form

Researchers utilized a participant information form to gather sociodemographic data, including age, gender, education level, occupation, social security status, monthly income, marital status, smoking and alcohol habits, and medical history.

Montreal Cognitive Assessment (MoCA)

The MoCA served as a primary tool for screening mild cognitive impairment. This assessment evaluates multiple cognitive domains such as attention, executive function, memory, language skills, conceptual thinking, calculation abilities, and orientation. It typically requires 10-15 minutes to complete. Previous studies have demonstrated the MoCA's high sensitivity and specificity in detecting mild cognitive impairment compared to the Mini-Mental State Examination.[9] In this study, a MoCA cut-off score of 21 was used to identify any cognitive dysfunction within the Turkish population.[10] The Turkish version of the MoCA has been validated and found to be a reliable tool for assessing cognitive impairment in various populations.[11]

International Physical Activity Questionnaire (IPAQ)

The International Physical Activity Questionnaire (IPAQ) is a self-reported questionnaire for assessing physical activity. The short version provided information on the time spent walking, in vigorous- and moderate intensity activity and in sedentary activity.[12] The Turkish version of the IPAQ is a reliable and valid tool for assessing physical activity among Turkish-speaking populations. It can be effectively used in both research and clinical settings to evaluate physical activity levels. Additionally, it can inform public health initiatives aimed at reducing physical inactivity and its associated health risks.[13]

Timed Up and Go Test (TUG)

In the TUG test, participants were instructed to stand up from a chair with a seat, walk a distance of 3 meters at a normal pace, turn around, walk back to the chair, and sit down. The timing, measured in seconds, started when the word "go" was said and stopped when the participant's back touched the chair's backrest. A shorter time taken indicates better balance ability.[14]

10 Meter Walk Test (10mWT)

The 10 Meter Walk Test is a performance measure used to assess walking or gait speed in meters per second over a short distance. Participants were instructed to walk at their usual pace as they entered the acceleration zone. A space longer than 10 meters was designated for the test, with the start and end of the 10-meter section marked with tape. Timing commenced as the participant's foot crossed the tape at the beginning of the 10-meter course and concluded when the foot crossed the line at the end of the course. Two trials were carried out, and the average walking speed was calculated in meters per second (m/s).[15]

Keele Assessment of Participation (KAP)

KAP was developed by Ross Wilkie and his colleagues in 2005 to evaluate quality of life and participation for individuals aged 50 and over. KAP defines participation restriction as the problems experienced in participating in living conditions, as perceived by the individual.[16] The Turkish version of the Keele Assessment of Participation is considered a valid and reliable measurement tool for assessing social participation among older adults.[17]

Statistical Analysis

SPSS Statistics Base 23 version of SPSS Software was used for data analysis. Descriptive statistics, correlation analysis (Pearson Correlation Analysis), Mann Whitney U test, and the Kruskal Wallis test were used to evaluate the study data. The results were assessed at the 95% confidence interval and $p<0.05$ significance level.

The Windows-based SPSS 23.0 version software (Statistical Package for the Social Sciences, SPSS Inc., Chicago, IL, USA) analysis program was used for statistical analysis. The normal distribution of the data was examined using the Kolmogorov-Smirnov test. Descriptive characteristics were identified as a minimum, maximum, and "standard deviation (X±SD)" for the quantitative data, while number (N) and percentage (%) values were given for qualitative data. Kruskal-Wallis test and The Mann-Whitney U test were used for intergroup comparison of ordinal variables or abnormally distributed non-parametric data sets. Pearson correlation analysis was used to examine the relationship between cognitive function and physical activity, functional status, and social participation. Multiple linear regression analysis was performed to investigate the effects of age, education, physical activity, and mobility on social participation.

RESULTS

The sociodemographic characteristics of older adults are presented in Table 1. The study included 123 older adults, with

a mean age of 69.5±4.6 years (min 65 - max 91). The mean age for women was 68.8±4.4 years (min 63 - max 86), and for men, it was 70.1±4.7 years (min 65 - max 91).

Table 1. Sociodemographic characteristics of older adults

		n/%	p
Sex	Female	57/46.3	.001[a]
	Male	66/53.7	.033[b]
Marital status	Married	97/78.9	.014[c]
	Single	26/21.1	.000[d]
Education	Primary school	71/57.7	.000[a] .012[b]
	High school	25/20.3	
	University	27/22	
Working status	Other	6/4.87	
	Retired	117/95.1	
Having chronic diseases	Yes	62/50.4	
	No	61/50.4	

p[a]: Montreal cognitive assessment score, p[b]: 10-meter walk test score, p[c]: Timed up and go score, p[d]: Keele assessment of participation score

In cognitive functions, walking speeds, and mobility levels, males exhibited higher scores compared to females ($p<0.01$ and $p<0.05$, respectively). Conversely, females demonstrated higher levels of social participation compared to males ($p<0.01$). Among university graduates, cognitive levels ($p<0.01$) and walking speeds ($p<0.05$) were higher compared to those with primary school education.

Older adults with higher cognitive function showed better functional status (walking speed and mobility) and social participation compared to those with lower cognitive function. Participants who engaged in moderate and high levels of physical activity demonstrated superior cognitive function, functional status, and social participation compared to those with low physical activity levels. According to the timed up and go (TUG) test, older adults without fall risks exhibited better cognitive function, social participation, and physical activity levels, and walked faster than those at risk of falls. Older adults without limitations in participation showed higher levels of cognitive function, functional status, and physical activity compared to those with participation restrictions ($p<0.01$). The clinical characteristics of older adults have been presented in Table 2.

The correlations between parameters evaluated of older adults have been presented in Table 3.

Table 3. Correlations between parameters evaluated in older adults in the study

	MoCA	IPAQ	TUG	10 mWT	KAP
Age	-.234*	-.167*	.364*	.387*	.128
Sex	.300*	.150	-.240*	-.226*	-.331*
Education	.603*	.301*	-.342*	-.329*	-.329*
IPAQ	.260*	-	-.385*	-.475*	-.279*
TUG	-.470*	-.385*	-	.850*	.496*
10 mWT	-.430*	-.475*	.850*	-	.428*
KAP	-.513*	-.279*	.496*	.428*	-

MoCA: Montreal cognitive assessment, IPAQ: International physical activity questionnaire, TUG: timed up and go test, 10 mWT: ten-meter walk test, KAP: Keele assessment of participation, *Correlation is significant at the 0.01 level (2-tailed). Pearson correlation

In this study, a model was developed to examine the impact of age, education, physical activity level, functional status, and social participation on the cognitive function of older adults. The model revealed a strong relationship between the dependent variable and independent variables ($p<0.01$, $r=0.722$). The independent variables (age, education, physical activity level, functional status, and social participation) collectively explained 50.1% of the variance in the dependent variable (cognitive function) (r square=0.522) (Table 4).

Table 2. Clinical characteristics of older adults

		n (%)	X±SD (min-max)	p
MoCA[10]	MoCA score ≥21	83/67.5	25.2±2.6 (21-30)	$p^{b,c,d,e}<0.01^{2}$
	MoCA score ≤20 (mild cognitive impairment)	40/32.5	16±2.5 (12-20)	
	Total	123/100	22.2±5.1 (12-30)	
IPAQ	Low physical activity	41/33.3	284.6±232.8 (0-960)	$p^{a,b,c,d}<0.01^{1}$ $p^{a,b,c,d}<0.01^{2,3,4}$
	Moderate physical activity	62/50.4	1565.3±681.3 (579-2994)	
	High physical activity	20/16.3	5279.7±2213.8 (3150-11466)	
	Total	123/100	1742.4±1947.9 (0-11466)	
TUG	TUG score ≥12	47/38.2	13.4±1.5(11.5-20)	$p^{a,b,d,e}<0.01^{2}$
	TUG score <12	76/61.8	9.8±1.1 (7.5-11.5)	
	Total	123/100	11.1±2.1 (7.5-20)	
10 mWT	Total	123/100	10.3±2.2 (7-19)	
KAP[16]	No restriction	20/16.3	.0±.0 (0-0)	$p^{a,b,c,e}<0.01^{2}$
	Exist restriction	103/83.7	3.6±1.9 (1-8)	
	Total	123/100	3.1±2.2 (0-8)	

Min: Minimum, Max: Maximum, X: Mean, SD: Standard deviation, MoCA: Montreal cognitive assessment, IPAQ: International physical activity questionnaire, TUG: Timed up and go test, 10 mWT: Ten meter walk test, KAP: Keele assessment of participation, p[a]: Montreal cognitive assessment score, p[b]: Ten meter walk score, p[c]: Timed up and go score, p[d]: Keele assessment of participation score, p[e]: International physical activity questionnaire score, [1]Kruskal Wallis, [2]Mann Whitney U test, [3]Low-moderate physical activity level comparison, [4]Low-high physical activity level comparison

Table 4. Linear regression model (dependent variable: MoCA)								
Cognitive function risk model	**b**	**SD error**	**Beta**	**t**	**p**	**Partial r**	**Part r**	**OR (CI 95%) (lower/upper)**
Constant	36.665	5.032	-	7.287	.000	-	-	(26.701/46.630)
Independent Variables								
Age	-.183	.077	-.167	-2.392	.018	-.216	-.153	(-.335/-.032)
Education	1.790	.265	.482	6.755	<0.01	.530	.432	(1.266/2.315)
IPAQ	-.000	.000	-.039	-.542	.589	-.050	-.035	(.000/.000)
TUG	-.275	.195	-.118	-1.413	.160	-.129	-.090	(-.661/.111)
KAP	-.643	.170	-.286	-3.790	<0.01	-.331	-.242	(-.978/-.307)

MoCA: Montreal cognitive assessment, SD: Standard deviation, IPAQ: International physical activity questionnaire, TUG: Timed up and go test, KAP: Keele assessment of participation, r: correlation, CI: Confidence interval for b, r=.722, r^2=.522, Adjusted r^2=.501, f= 25.509, p=0.00, Durbin-Watson=1.763

DISCUSSION

This study aimed to investigate the relationship between cognitive function and physical activity, functional status, and social participation in older adults. The findings revealed a positive correlation between cognitive function and levels of physical activity, functional status, and social participation among older adults. Furthermore, significant associations were observed among physical activity levels, functional status, and social participation, as assessed in the study. Additionally, a cognitive function risk model indicated that age, educational attainment, and social participation significantly impact cognitive function in older adults.

Gender differences in cognitive function remain a complex issue, with some studies suggesting that men generally exhibit better cognitive skills than women.[18,19] Our findings support this trend, as men in the study tended to have higher cognitive levels than women, potentially influenced by factors such as income and educational status. However, these gender disparities likely reflect a broader societal context, where men may have historically had greater access to education and economic opportunities.[20] Future research should explore these differences more critically, considering the interplay of social, economic, and biological factors in cognitive aging.

The study further demonstrated that higher educational levels in older adults correspond to enhanced cognitive function, consistent with previous research.[21,22] Zhang et al.'s[23] study with older adults supported these findings, indicating that education positively influences cognitive skills, including episodic memory and overall cognitive function. These findings highlight the long-term benefits of educational attainment in promoting cognitive health in older adults, reinforcing the need for policies that support lifelong learning.

Our study demonstrated a moderate positive relationship between physical activity and cognitive function, aligning with previous research that supports the protective effects of moderate to vigorous physical activity on cognitive health. Physically active older adults have been shown to have larger hippocampal, prefrontal cortex, and basal ganglia volumes, enhanced brain connectivity, better white matter integrity, and improved executive and memory function.[24] The preservation of white matter integrity, linked to functional connectivity, suggests that physical activity may play a crucial role in maintaining cognitive function in aging populations.[25]

This study reinforces the idea that physical activity is an essential factor in cognitive aging, possibly exerting a more significant impact than age or education.[26]

Cognitive function and functional capacity are both key indicators of aging, crucial for independent living. Higher levels of functionality, such as walking speed and mobility, were associated with better cognitive function in our study, consistent with the literature.[27] Interventions targeting both motor and cognitive skills, such as those that incorporate sit-to-stand exercises, have been shown to benefit older adults with mild cognitive impairment.[28] Consistent with existing literature, our study showed that increased functionality (e.g., walking speed, mobility) corresponds to higher cognitive function levels. Additionally, contrary to Liao et al.'s findings suggesting older women are more physically active than older men [29], our study found higher walking speed and mobility levels among men compared to women.

Our study also revealed that increased social activity among older adults leads to higher cognitive function levels. Fu et al.[30] demonstrated in China that engaging in activities improves cognitive function in older adults of both genders, suggesting a protective effect of social engagement on cognitive function. Social engagement, such as participating in community groups, clubs, and social events, is proposed to delay or prevent cognitive decline in middle-aged and older individuals. Proposed mechanisms include mental stimulation, a sense of purpose, and stress reduction, all potentially protecting against neuropathology and cognitive impairment.[31,32] Although our findings suggested that older women engaged more in social activities than men, cultural norms may account for this difference, emphasizing the importance of fostering social networks to promote healthy cognitive aging.

The literature strongly advocates for encouraging and facilitating social participation in later life as a strategy to support healthy cognitive aging and prevent dementia. Therefore, promoting social engagement should be a key component of programs and policies aimed at optimizing cognitive function in older adults. While this study found relationships between physical activity, functional status, and social participation with cognitive function in older adults, the cognitive function risk model created in our study highlighted that social participation significantly influences cognitive function.

Limitations

A significant limitation of our study was the small sample size, which affects the generalizability and statistical power of our findings. Despite broad inclusion criteria, difficulties in recruiting participants from the target demographic of older adults contributed to a lower-than-expected response rate. Factors such as limited accessibility and mobility challenges likely played a role in this, highlighting the need for improved recruitment strategies in future research. With a sample of 123 older adults, the study provides a modest representation of the target population, but the small sample size may reduce the power to detect smaller effects or interactions, increasing the risk of Type II errors. The power of this study is also influenced by the observed effect sizes and the statistical methods employed. While Pearson correlation, Mann-Whitney U, and Kruskal-Wallis tests were appropriate for identifying relationships between variables, their efficacy is contingent upon the sample size and effect magnitude. The regression model demonstrated a relationship between cognitive function and independent variables such as age, education, physical activity, functional status, and social participation, with an R-squared value of 0.522, indicating that these variables collectively explain over half of the variance in cognitive function. However, the small sample size may limit the precision of these estimates, particularly in subgroup analyses (e.g., by gender or education level) or when detecting subtle effects. To enhance the power and generalizability of future research, conducting longitudinal studies with larger samples would be beneficial. This would allow for more precise estimates of effect sizes and stronger conclusions about the relationships between cognitive function and the lifestyle factors studied. Another limitation was the use of the IPAQ to measure physical activity, as its reliability is weaker, especially among the oldest age groups.

CONCLUSION

This study identified significant relationships between cognitive function, physical activity, functional status, and social participation in older adults. The cognitive function risk model findings highlight the critical role of social participation, along with age and education, in cognitive health. Prioritizing interventions that enhance physical activity, functionality, and social participation could help improve cognitive health and prevent dementia in aging populations.

This study aimed to fill a gap in the literature by exploring how physical activity, functional status, and social participation together impact cognitive function in older adults. Much of the existing research focuses on either physical activity or social participation in isolation, without considering how these factors interact to support cognitive resilience. This study underscores the importance of considering multiple lifestyle factors and the need for integrated interventions that address physical activity, functionality, and social participation in supporting cognitive health in older adults.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Akdeniz University Clinical Researches Ethics Committee (Date: 08.06.2022, Decision No: KAEK-403).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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