Predictors of cognitive status in community-dwelling older adults

Toplumda yaşayan yaşlı yetişkinlerde bilişsel durumun belirleyicileri

Abstract

Aim: Progression of cognitive problems can be prevented in the early stages. Scanning the cognition and detecting the predictors are critical, although the risk factors are not well-described in the community-dwelling older adults. This study aimed to evaluate cognitive status and related factors in community-dwelling older adults.

Methods: Eight hundred forty-one older adults participated in this cross-sectional study (female: 422, male: 419). We used the Standardized Mini-Mental Test, Center for Disease Control and Prevention Health-Related Quality of Life-4 Scale (CDC HRQOL-4), Geriatric Depression Scale (GDS), and a 6-point Likert-type musculoskeletal pain scale for cognitive status, quality of life, depression, and musculoskeletal pain, respectively. We used the classification and regression tree analysis to identify factors associated with cognitive status.

Results: Of the participants, 672 (79.9%) defined pain in the musculoskeletal system, 38.6% had definite depression, 41.0% had severe cognitive impairment, and the vast majority (41.0%) reported their health level as moderate. The first five predictors were age, depression, quality of life, neck, and headache severity related to cognitive status in older adults.

Conclusions: The determinants of cognitive status were age, depression, quality of life, neck pain, and headache in older adults. Our findings suggest that routinely assessing education level, depressive symptoms, and pain in community-dwelling older adults may facilitate the early identification of those at risk for cognitive decline and guide preventive interventions.

Keywords: Classification; cognitive dysfunction; depression; geriatrics; quality of life, risk factors

Öz

Amaç: Bilişsel sorunların ilerlemesi erken evrelerde önlenebilir. Toplumda yaşayan yaşlı yetişkinlerde risk faktörleri iyi tanımlanmamış olsa da bilişi taramak ve yordayıcıları tespit etmek kritik öneme sahiptir. Bu çalışma, toplumda yaşayan yaşlı yetişkinlerde bilişsel durumu ve ilgili faktörleri değerlendirmeyi amaçladı.

Yöntemler: Bu kesitsel çalışmaya 841 yaşlı yetişkin katılmıştır (kadın: 422, erkek: 419). Bilişsel durum, yaşam kalitesi, depresyon ve kas-iskelet sistemi ağrısı için sırasıyla Standartlaştırılmış Mini Mental Test, Hastalık Kontrol ve Önleme Merkezi Sağlıkla İlgili Yaşam Kalitesi-4 Ölçeği (CDC HRQOL-4), Geriatrik Depresyon Ölçeği (GDS) ve 6 noktalı Likert tipi kas-iskelet sistemi ağrısı ölçeğini kullandık. Bilişsel durumla ilişkili faktörleri belirlemek için sınıflandırma ve regresyon ağacı analizini kullandık.

Bulgular: Katılımcıların 672'si (%79,9) kas-iskelet sisteminde ağrı tanımladı, %38,6'sı belirgin depresyon, %41,0'ı ciddi bilişsel bozukluk yaşadı ve büyük çoğunluğu (%41,0) sağlık düzeyini orta olarak bildirdi. Yaşlı yetişkinlerde bilişsel durumla ilişkili ilk beş belirleyici değişken yaş, depresyon, yaşam kalitesi, boyun ve baş ağrısı şiddetiydi.

Sonuçlar: Yaşlı erişkinlerde bilişsel durumun belirleyicileri yaş, depresyon, yaşam kalitesi, boyun ağrısı ve baş ağrısıdır. Bulgularımız, toplumda yaşayan yaşlı bireylerde eğitim düzeyi, depresif belirtiler ve ağrının düzenli olarak değerlendirilmesinin, bilişsel gerileme riski taşıyan bireylerin erken dönemde belirlenmesine ve önleyici müdahalelerin planlanmasına katkı sağlayabileceğini göstermektedir.

Anahtar Sözcükler: Bilişsel disfonksiyon; depresyon; geriatri; risk faktörleri; sınıflandırma, yaşam kalitesi

Guzin Kara[1], Umut Eraslan[2], Elif Nur Tascıoglu[3], Emine Aslan Telci[3], Hande Senol[4], Nesrin Yagci[3]

[1] Department of Neurological Rehabilitation, Faculty of Physiotherapy and Rehabilitation, Pamukkale University

[2] Department of Orthopedic Rehabilitation, Faculty of Physiotherapy and Rehabilitation, Pamukkale University

[3] Department of Physiotherapy and Rehabilitation, Faculty of Physiotherapy and Rehabilitation, Pamukkale University

[4] Department of Biostatistics, Faculty of Medicine, Pamukkale University

Received/*Geliş* : 05.08.2025
Accepted/*Kabul*: 16.10.2025

DOI: 10.21673/anadoluklin.1756316

Corresponding author/*Yazışma yazarı*

Elif Nur Taşcıoğlu

Pamukkale Üniversitesi, Fizyoterapi ve Rehabilitasyon Fakültesi, Fizyoterapi ve Rehabilitasyon Anabilim Dalı, Denizli, Türkiye
E-mail: elifnurtascioglu@gmail.com

ORCID

Güzin Kara: 0000-0002-8893-5235
Umut Eraslan: 0000-0002-2428-8411
Elif Nur Taşcıoğlu: 0000-0002-8995-3734
Emine Aslan Telci: 0000-0003-2749-295X
Hande Şenol: 0000-0001-6395-7924
Nesrin Yağcı: 0000-0002-5669-4932

INTRODUCTION

The geriatric population has increased alarmingly in recent years. With ageing, many changes occur in brain structure and functions, including cognitive decline (1,2). It is unclear whether cognitive decline is associated with a disease or the normal ageing process. Cognitive impairment refers to deficits in memory, attention, or executive functions that go beyond normal ageing but do not necessarily interfere with daily living activities. However, patients with cognitive impairment have a higher risk of developing dementia (3). Dementia is a more severe condition characterized not only by cognitive decline but also by significant impairment in daily functioning and independence. Although dementia is an important health indicator in the geriatric population, its incidence among the older adults living in the community has been reported as 13.8/1000 per year (4). Age is the major risk factor for dementia. Patients can be diagnosed at any point in the cognitive impairment-dementia process. Although neurodegeneration occurs long before, the disease is usually diagnosed at an advanced stage (5).

Several factors have been identified as influencing cognitive status in community-dwelling older adults. Faramarzi et al. showed that in the Iranian elderly population, female sex, age 70 and above, low education level, depression, and low social support were associated with cognitive decline with depression and low social support having particularly significant impacts on cognitive deterioration (6). Another study conducted in China found that increasing age and low education level were associated with a higher risk of cognitive deterioration and, highlighting these factors as important indicators for early screening and intervention (7). Community-based studies in Turkey highlighted several factors affecting cognitive function among older adults. For instance, a cross-sectional study in Kayseri reported a 26.1% prevalence of cognitive impairment in individuals aged 60 and above, with illiteracy, depression, and a higher number of children identified as major risk factors (8). Additionally, cognitive function was found to be influenced by age, residency, mental burnout, and smoking status, emphasizing the importance of careful assessment and monitoring of these risk factors (9)

Beyond these sociodemographic and psychosocial factors, physical health conditions (e.g., hypertension, diabetes, cardiovascular diseases), lifestyle factors such as physical activity and diet, social and cognitive engagement, and psychiatric conditions (e.g., anxiety, chronic stress) have also been associated with cognitive decline in older adults, as reported in studies conducted in the populations of the United States, China, and the United Kingdom (10-12).

Collectively, these findings underscore the multifactorial nature of cognitive function in aging populations and highlight the need for comprehensive assessment and targeted preventive strategies. However, the number of existing studies is limited, and they have been conducted across different countries and populations, which complicates comparison and generalization of findings. In Turkey, community-based data remain scarce, with most studies examining risk factors in isolation and employing cross-sectional designs that restrict causal inference.

It is important to investigate cognitive impairment in the geriatric population both because of its social impact and in terms of its relationship with the risk of conversion to dementia and other pathologies (3). Progression of cognitive impairment can only be prevented when it is mild (13). However, cognitive assessment is not performed adequately in the geriatric population. In addition, studies describing older adults with cognitive impairment are insufficient in the literature (4,14). Detection of cognitive impairment in older adults enables the diagnosis of more serious problems and allows the initiation of treatment and follow-up plans, which helps to maximize recovery, function, and quality of life. The National Audit of Dementia Care noted that cognitive function is not adequately evaluated in the community-dwelling older adults (14).

In light of this information, this study aimed to determine the predictors of the cognitive status in community-dwelling older adults.

MATERIAL AND METHODS

Participants

This cross-sectional study was conducted between April 2017 and February 2019, with a total of 841 older adults (female: 422, male: 419) aged 65 and over. The commu-

nity-dwelling older adults from one city participated in this study. The inclusion criteria were being over 65 years old, having communication skills for answering the questions, and living at home. Exclusion criteria was having central nervous system impairments.

As can be seen in Figure 1, the participants were included by a simple sampling method. The evaluations were conducted by 20 trained final-year students studying at the Faculty of Physical Therapy and Rehabilitation, using face-to-face interviews, under the supervision of two experienced researchers. All participants provided informed consent, and the study protocol was reviewed and approved by the ethics committee, following the guidelines of the Declaration of Helsinki. Pamukkale University Non-Interventional Clinical Research Ethics Committee approved the study (date: 07.03.2017, decision no: 2017/04). This study protocol was registered in Clinical Trials.gov PRS. (Figure 1)

Outcome measures

The sociodemographic and medical information were recorded at baseline. In addition, information about the medical condition of geriatric individuals, such as body mass index and the number of drugs used, was also recorded in the form.

The Standardized Mini-Mental Test (SMMT), the Center for Disease Control Health-Related Quality of Life-4 Scale (CDC HRQoL-4), the Geriatric Depression Scale (GDS), and a 6-point Likert-type scale were used to evaluate the cognitive status, quality of life, emotional status, and the severity of pain levels, respectively.

The SMMT assesses orientation (10 points), recording memory (3 points), attention and calculation (5 points), recall (3 points), and language (9 points). This scale includes 11 items with scores between 0-30 points. A score of 27-30 is considered normal cognitive status, 24-27 is considered a mild cognitive impairment, and below 24 is considered a severe cognitive impairment (15). The validity and reliability of the scale in the Turkish population were examined by Güngen et al. (16). The scale has sensitivity of 0.91, specificity of 0.95, and interrater reliability of r = 0.99 with a kappa value of 0.92. The scale has high validity and reliability in the Turkish population (16).

The CDC HRQOL-4 scale has four questions regarding general health, physical and mental health, and how activities have been affected by physical or mental problems in the last 30 days. We used the first item of the CDC HRQOL-4 scale which defines general health as excellent, very good, good, fair, and poor (17). The HRQOL-4 has been previously used in Turkish older adult populations (18).

The GDS consists of 30 items with "yes" or "no" answers. The total score of the scale is 0-30 points with 0-10 points "no depression", 11-13 points "possible depression", and 14 and above points "definite depression" (19). The GDS was proved to be valid and reliable in Turkish older adults and showed a high internal consistency with a Cronbach's alpha of 0.92 (20).

The chronic pain severity of ten body regions scored as 0 "no pain", 1 "mild", 2 "moderate", 3 "severe", 4 "very severe", and 5 "unbearable". The 6-point Likert-type scale is easy to understand for older adults (21).

Statistical analyses

We used the SPSS Statistics for Windows (Statistical Package for the Social Sciences package program version 25.0, IBM Corp., Armonk, N.Y., USA). To assess the generalizability of the model, the dataset was randomly divided into 70% training and 30% validation groups using the SPSS "Validation" option. The maximum tree depth was 5. Minimum and maximum cases in parent and child nodes were 100 and 50, respectively. The number of nodes was 11, the number of terminal nodes was 6, and the depth of the tree was 3. Variable importance values were calculated using rankings for each independent (predictor) variable based on its importance to the model. One of the authors, the biostatistician, proposed the Regression Tree Method (RTM) for examining the association between risk factors and the outcome variable (the SMMT in the present study) with a scheme. In RTM, homogeneous groups are formed by considering the cut-off values of the risk factors. The "root node" was created by collecting all participants in a group at baseline. Homogeneous groups that come into being based on recursive binary splitting are termed "terminal node" (22). The most accurate predictor variable is determined by splitting the sample into two subgroups (splitting that maximizes the between groups sum-of-squares) in the first step. This process is iteratively applied to each subgroup individually when the subgroups reach

the minimum size or when no further improvement in model fit is possible (23). The descriptive statistics were shown as the mean ± standard deviation, median (minimum–maximum values), and categorical variables by number and percent.

RESULTS

Table 1 includes the sociodemographic and medical data of the participants. Of the participants, 672 (79.9%) defined pain in the musculoskeletal system, and the regional distribution of pain is shown in Table 2 (Table 1 and Table 2). The majority reported pain, most commonly in the neck, lower back, and knees.

The results of the participants regarding depression, cognitive status, and quality of life are shown in Table 3. Considering the GDS results, 38.6% of the participants had definite depression, while 41.0% of the participants had severe cognitive impairment according to the SMMT results. The vast majority (41.0%) of the participants reported their health level as moderate (Table 3).

In Table 4, the most influential variables on cognitive status are given, respectively, according to the regression tree analysis. Age, depression, quality of life, neck and headache severity were found to be the first five predictors with the most significant impact on cognitive status (Table 4).

According to the regression tree analysis, depression, years of education, age, neck pain, and hip pain were identified as the main predictors of cognitive status (Figure 2). In participants with higher depression scores, age was negatively associated with SMMT performance. Among participants with depression scores below 16.5, longer education was associated with higher SMMT scores. Neck pain was associated with cognitive status in participants with depression scores below 16.5 and less than 6.5 years of education, while hip pain was associated with cognitive status in participants with depression scores above 16.5 and age below 79.5 years.

Table 1. Sociodemographics of the older adults

Variables		Mean±SD	Median (min-max)
Age (years)		72.24 ± 6.31	71 (65-97)
BMI (kg/m²)		27.29 ± 4.49	26.67 (15.63-55.56)
Duration of education (years)		3.69 ± 3.91	5 (0-15)
		n	**%**
Sex	Female	422	50.2
	Male	419	49.8
Residence	Village	233	27.7
	Town	141	16.8
	City	467	55.5
People living with	alone at home	122	14.5
	with children	141	16.8
	with a partner	392	46.6
	with a partner and children	159	18.9
	with relatives	27	3.2
Exercise habit	Yes	255	30.3
	No	586	69.7
Marital status	Married	573	68.1
	Single	268	31.9
Work status	Yes	56	6.7
	No	560	66.6
	Never worked	225	26.8

SD: Standard deviation; Min-max: minimum-maximum, BMI: Body mass index, n: number.

Table 2. Regional distribution of musculoskeletal pain

		n	%
Head	No	579	68.8
	Mild	105	12.5
	Moderate	94	11.2
	Severe	44	5.2
	Very Severe	16	1.9
	Unbearable	3	0.4
Neck	No	566	67.3
	Mild	103	12.2
	Moderate	113	13.4
	Severe	47	5.6
	Very Severe	12	1.4
Upper Back	No	583	69.3
	Mild	101	12.0
	Moderate	110	13.1
	Severe	39	4.6
	Very Severe	8	1.0
Low Back	No	422	50.2
	Mild	97	11.5
	Moderate	161	19.1
	Severe	126	15.0
	Very Severe	34	4.0
	Unbearable	1	0.1
Shoulder	No	601	71.5
	Mild	108	12.8
	Moderate	79	9.4
	Severe	43	5.1
	Very Severe	10	1.2
Elbow	No	743	88.3
	Mild	48	5.7
	Moderate	31	3.7
	Severe	15	1.8
	Very Severe	3	0.4
	Unbearable	1	0.1
Wrist-Hand	No	723	86.0
	Mild	53	6.3
	Moderate	36	4.3
	Severe	21	2.5
	Very Severe	7	0.8
	Unbearable	1	0.1
Hip	No	602	71.6
	Mild	75	8.9
	Moderate	93	11.1
	Severe	58	6.9
	Very Severe	12	1.4
	Unbearable	1	0.1
Knee	No	391	46.5
	Mild	79	9.4
	Moderate	163	19.4
	Severe	132	15.7
	Very Severe	70	8.3
	Unbearable	6	0.7
Ankle-Foot	No	668	79.4
	Mild	59	7.0
	Moderate	59	7.0
	Severe	36	4.3
	Very Severe	18	2.1
	Unbearable	1	0.1

n: number, %: Percent

DISCUSSION AND CONCLUSION

In the 2019 World Alzheimer Report, it was reported that approximately 50 million people worldwide had dementia, and by 2050, this number is expected to triple and reach 152 million. Recognition of risk factors that affect cognition is especially important to diagnose dementia and improve patient care (24). In this study, which we planned from this point of view, the predictors of cognitive status in community-dwelling older adults were investigated using the regression tree method, and age, depression, quality of life, neck pain, and headache were found to be the five most influential predictors of cognitive status in the older adults.

It is stated in the literature that many people affected by dementia are not properly diagnosed. The prevalence of cognitive impairment was 22.2% among older adults in a study, and the prevalence of undiagnosed dementia was 61.7% in another study (24,25). The most important risk factors reported for cognitive impairment in older adults are poor education, age, a higher body mass index, being single, insufficient social support, low socioeconomic status, living alone, anxiety disorders, history of stroke, physical inactivity, less fresh fruit, and vegetable consumption, not drinking coffee, and poor physical function (24-28).

It is known that education level is inversely proportional to cognitive decline (27). In addition, the year of formal education is a potentially modifiable risk factor for cognitive impairment in older adults (29). It is thought that education can help protect individuals against cognitive impairment by creating a cognitive reserve that accumulates throughout their lives. In a meta-analysis on the subject, it was revealed that the risk of dementia decreased by 7% per year with increasing education (27). While some of the studies on education level have shown that the correlation between education and cognition may be linked to healthier habits, in others, it has been shown that education remains significantly related to cognitive function even after lifestyle factors are controlled. Education level and memory capacity are related factors. Therefore, a higher education level can enable individuals to have higher self-awareness and self-control about their own life and health conditions (25). The results of our study also showed that a higher education level has a positive effect on cognitive status.

Table 3. Outcome measurements of the older adults

	Mean±SD	Median (min-max)
GDS Total score	12.2 ± 7.51	12 (0 - 30)
	n (%)	
No depression	389 (45.1)	
Possible depression	140 (16.3)	
Definite depression	333 (38.6)	
SMMT Total score	23.57 ± 5.49	25 (0 - 30)
	n (%)	
Normal	307 (36.4)	
Mild Cognitive Impairment	190 (22.6)	
Severe Cognitive Impairment	344 (41)	
	n	**%**
CDC HRQoL-4 (Q1)		
Excellent	19	2.3
Very Good	62	7.4
Good	276	32.8
Fair	345	41.0
Poor	139	16.5

SD: Standard deviation, Min-max: minimum-maximum, GDS: Geriatric Depression Scale, SMMT: Standardized Mini-mental Test, CDC HRQoL: Center for Diasease Control and Prevention Health Related Quality of Life; Q1: First Question; n: Number, %: Percent

Table 4. Significance levels of independent variables affecting cognitive status according to regression tree diagram

Independent variable	Importance	Relative importance (%)
Age	3.970	100.0
Depression	3.673	92.5
Quality of life	2.290	57.7
Neck pain	2.014	50.7
Headache	1.788	45.0
Duration of education	1.400	35.3
Upper back pain	1.346	33.9
Monthly income	1.014	25.6
Wrist and hand pain	0.989	24.9
Low back pain	0.783	19.7
Hip pain	0.714	18.0
Elbow pain	0.655	16.5
Shoulder pain	0.472	11.9
Ankle and foot pain	0.390	9.8
Knee pain	0.080	2.0
BMI	0.040	1.0

BMI: Body mass index, %: Percent

Age and gender are prominent predictors for dementia and cognitive impairments (25,26). The age-standardized prevalence of cognitive disorders for individuals aged 65 and over has been reported as 8.2%-10.4%. The prevalence of age-related dementia was found to be 18-20% in the older adults 75 years of age and older, and 35%-40% in those over 85 years of age. The prevalence increased sharply with age, especially for those aged over 75 years (27). Also, in our study, it was observed that the mean SMMT score decreased with increasing age.

The cognitive disorder prevalence was higher in women than in men, and in rural than urban areas among community-dwelling older adults (26,28).

A study conducted among older adults showed an independent and dose-related association with cognitive decline and depression (29,30). However, it is unclear whether depression increases the dementia risk or is a premise risk factor of dementia-related neurodegenerative disorders (29). The results of our study also support the literature. The participants with low depression total scores had higher cognitive scores in the study.

Studies have shown that pain has a complex effect on the cognitive performance of older adults. Some areas of the brain may interact as they are associated with both chronic pain and selective cognitive functions (31). Neurobiological mechanisms, including neuroinflammation, microglial activation, and structural changes in the hippocampus and prefrontal

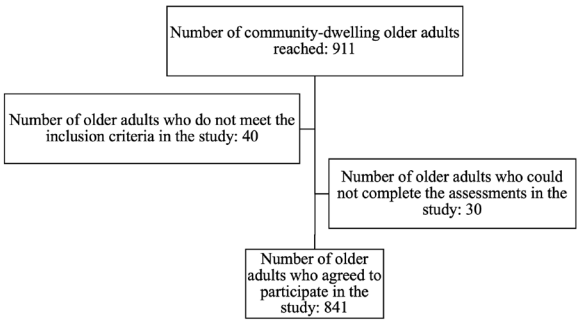

Figure 1. Flow chart of the older adults participating in the study

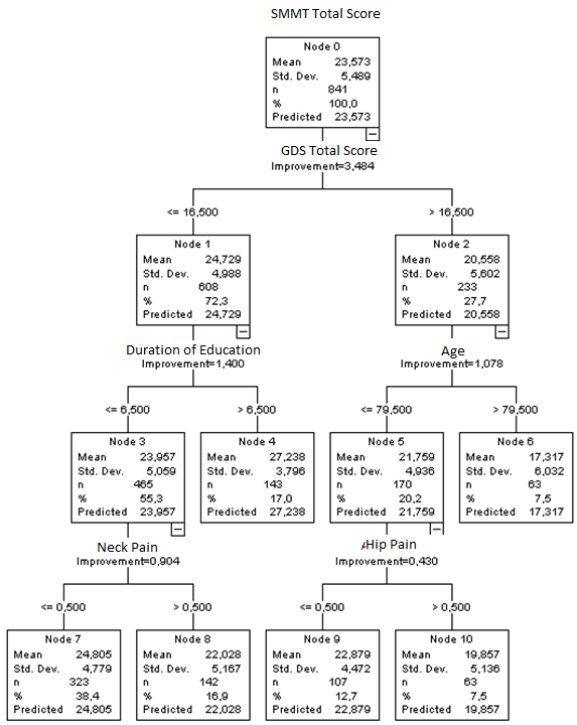

Figure 2. Analysis of factors affecting cognitive status - Regression tree

cortex—particularly gray matter atrophy—have been proposed as key contributors to cognitive decline associated with chronic pain. These changes can affect memory, attention, and executive functions, and overlapping pathways with depression and neurodegenerative diseases may further exacerbate cognitive impairments (32,33). Additionally, a review implicated the evidence about the interference of pain with attention, executive, and general cognitive functions (31,34). Older adults with more severe pain performed poorer on memory tests and executive functions than older adults with no or less pain. It has been stated that the presence of pain is also associated with impaired attention capacity (31). It has been reported that some of the association between musculoskeletal pain and the onset of disability in older adults is likely to involve this pathway (34). However, the authors suggest comprehensive future studies to understand the pain and cognition interactions. In the future, short- and long-term pain control methods can be vital for cognitive functions of older adults in the management of healthcare services (31). In order to develop policies for the prevention of dementia and cognitive impairment, it is thought that the characteristics of the age group in which these conditions are common should be understood (27). According to the results of our study, 672 (79.9%) of the older adults described pain in the musculoskeletal system. Accordingly, we think that the presence of neck pain can be said to reduce the SMMT total score. In addition, hip pain was effective on the cognitive status of the participants whose age was under 79.5 years. The presence of hip pain in these participants had a lowering effect on the SMMT total score.

Eliminating the modifiable risk factors of cognitive disorders in community-dwelling older adults is crucial for healthy aging. This study uniquely examines the combined effects of musculoskeletal pain, depression, and demographic factors on cognitive status among community-dwelling older adults in Turkey using regression tree analysis. By addressing a gap in the literature, considering multiple interacting risk factors simultaneously, and focusing on an understudied population, the study provides novel insights for early screening, preventive strategies, and targeted interventions. The results obtained in our study were compatible with the literature, and it was possible to determine the most important predictors of cognitive status with the applied regression tree method. Age, depression, quality of life, neck pain, and headache are the indicators for the cognitive status of older adults, suggesting that it may be useful to examine each factor in detail. For this reason, we think that preventive rehabilitation programs to be planned by focusing on the predictors of cognitive status in the community-dwelling older adults in future studies may be beneficial for the preservation of cognitive skills and ensuring a healthy ageing process.

This study has several limitations. First, its cross-sectional design prevents causal inferences. Second,

the sample was drawn from a single city, which may limit the generalizability of the findings to other populations. Third, data on pain and health-related variables were based on self-reports, which may introduce reporting bias. Future research using longitudinal designs, multi-center samples, and objective measures is recommended to address these limitations.

The findings of this study have shown that, age, depression, quality of life, and musculoskeletal pain—including neck and headache pain—as key predictors of cognitive status, emphasizes the need for comprehensive assessments in older adults. Early recognition of these risk factors can guide preventive strategies to maintain cognitive function and delay dementia onset. Clinically, integrating cognitive screening with evaluations of mental health and musculoskeletal conditions may help identify high-risk individuals and allow timely interventions. Targeted strategies such as physical therapy, psychological support, and lifestyle modifications could be prioritized, and community-based programs combining cognitive, physical, and mental health interventions may promote healthier aging and reduce the societal burden of cognitive decline.

Conflict-of-interest and financial disclosure

The authors declare that they have no conflict of interest to disclose. The authors also declare that they did not receive any financial support for the study.

REFERENCES

1. Agarwal A, Chauhan K, Shinglot K. Anthropometric indices and dietary intake: prospective determinants of geriatric cognitive impairment?. Nutr Health. 2013;22(2):157-67.
2. Diker J, Etiler N, Yıldız M, et al. Altmış beş yaş üzerindeki kişilerde bilişsel durumun günlük yaşam aktiviteleri, yaşam kalitesi ve demografik değişkenlerle ilişkisi: Bir alan çalışması. Anadolu Psikiyatri Derg. 2001;2:79–86
3. Millán-Calenti JC, Tubío J, Pita-Fernández S, et al. Prevalence of cognitive impairment: effects of level of education, age, sex and associated factors. Dement Geriatr Cogn Disord. 2009;28:440–5.
4. Holz AW, Nunes BP, Thume E, et al. Prevalence of cognitive impairment and associated factors among the elderly in Bagé, Rio Grande do Sul, Brazil. Rev Bras Epidemiol. 2013;16:880–8.
5. Von Arnim CaF, Bartsch T, Jacobs AH, et al. Diagnosis and treatment of cognitive impairment. Z Gerontol Geriatr. 2019;52:309–15.
6. Faramarzi M, Kamar MZ, Kheirkhah F, Karkhah A, Bijani A, Hosseini SR. Psychosocial predictors of cognitive impairment in the elderly: a cross-sectional study. Iran J Psychiatry. 2018;13(3):207-14.
7. Han F, Luo C, Lv D, Tian L, Qu C. Risk factors affecting cognitive impairment of the elderly aged 65 and over: a cross-sectional study. Front Aging Neurosci. 2022;14:903794.
8. Akdag B, Telci EA, Cavlak U. Factors affecting cognitive function in older adults: a Turkish sample. Int J Gerontol. 2013;7(3):137-41.
9. Arguvanli S, Akin S, Şafak ED, Mucuk S, Öztürk A, Mazicioğlu MM, et al. Prevalence of cognitive impairment and related risk factors in community-dwelling elderly in Kayseri, Turkey. Turk J Med Sci. 2015;45(5):1167-72.
10. Xie Q, Nie M, Zhang F, et al. An unexpected interaction between diabetes and cardiovascular diseases on cognitive function: A cross-sectional study. J Affect Disord. 2024;354:688-93.
11. Davis SF, Benkowitz C, Holland C, Gow AJ, Clarke C. A scoping review on the opportunities for social engagement and cognitive frailty in older adults. Public Health Rev. 2024;45:1606494.
12. Krueger KR, Wilson RS, Kamenetsky JM, Barnes LL, Bienias JL, Bennett DA. Social engagement and cognitive function in old age. Exp Aging Res. 2009;35(1):45-60.
13. Li CL, Hsu HC. Cognitive function and associated factors among older people in Taiwan: age and sex differences. Arch Gerontol Geriatr. 2015;60:196–200.
14. Shermon E, Vernon LO, Mcgrath AJ. Cognitive assessment of elderly inpatients: a clinical audit. Dement Geriatr Cogn Disord Extra. 2015;5:25–31.
15. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975;12:189–98.
16. Güngen C, Ertan T, Eker E, et al. Standardize Mini Mental Test'in Türk toplumunda hafif demans tanısında geçerlik ve güvenilirliği. Turk Psikiyatri Derg. 2002;13:273–81.
17. Centers for Disease Control and Prevention. Measuring healthy days. [Internet]. [cited 2025 Jul 29]. Available from: http://www.cdc.gov/hrqol
18. Cavlak U, Yagci N, Aslan UB, et al. A new tool measuring health-related quality of life (HRQOL): the effects of musculoskeletal pain in a group of older Turkish people.

Arch Gerontol Geriatr. 2009;49:298–303.
19. Sağduyu A. Yaşlılar için depresyon ölçeği: Hamilton depresyon ölçeği ile karşılaştırmalı güvenilirlik ve geçerlilik çalışması. Turk Psikiyatri Derg. 1997;8:3–8.
20. Ertan T, Eker E, Şar V. Geriatrik depresyon ölçeğinin Türk yaşlı nüfusunda geçerlilik ve güvenilirliği. Nöropsikiyatri Arşivi. 1997;34:62–71.
21. Uluğ N, Yılmaz Ö. Servikal ve lumbar ağrı problemi olan hastaların ağrı, emosyonel durum ve yaşam kalitelerinin karşılaştırılması. Fizyoter Rehabil. 2012;23:90–9.
22. Bevilacqua M, Braglia M, Montanari R. The classification and regression tree approach to pump failure rate analysis. Reliab Eng Syst Saf. 2003;79:59–67.
23. Chester R, Khondoker M, Shepstone L, et al. Self-efficacy and risk of persistent shoulder pain: results of a classification and regression tree (CART) analysis. Br J Sports Med. 2019;53:825–34.
24. Kłoszewska M, Łyszczarz B, Kędziora-Kornatowska K. Sociodemographic and health-related factors associated with severity of cognitive impairment in elderly patients hospitalized in a geriatric clinic. Brain Sci. 2021;11:170.
25. Wu MS, Lan TH, Chen CM, et al. Socio-demographic and health-related factors associated with cognitive impairment in the elderly in Taiwan. BMC Public Health. 2011;11:1–8.
26. Han R, Tang Z, Ma L. Related factors of cognitive impairment in community-dwelling older adults in Beijing Longitudinal Study of Aging. Aging Clin Exp Res. 2019;31:95–100.
27. Kim H, Lee S, Ku BD, et al. Associated factors for cognitive impairment in the rural highly elderly. Brain Behav. 2019;9:e01203.
28. Zhang Q, Wu Y, Han T, et al. Changes in cognitive function and risk factors for cognitive impairment of the elderly in China: 2005–2014. Int J Environ Res Public Health. 2019;16:2847.
29. Baumgart M, Snyder HM, Carrillo MC, et al. Summary of the evidence on modifiable risk factors for cognitive decline and dementia: a population-based perspective. Alzheimers Dement. 2015;11:718–26.
30. Gallagher D, Kiss A, Lanctot K, et al. Depressive symptoms and cognitive decline: a longitudinal analysis of potentially modifiable risk factors in community dwelling older adults. J Affect Disord. 2016;190:235–40.
31. Van Der Leeuw G, Eggermont LHP, Shi L, et al. Pain and cognitive function among older adults living in the community. J Gerontol A Biol Sci Med Sci. 2016;71:398–405.
32. Patel M, Hasoon J, Diez Tafur R, Lo Bianco G, Abd-Elsayed A. The impact of chronic pain on cognitive function. Brain Sci. 2025;15(6):559.
33. Liu XG. Normalization of neuroinflammation: a new strategy for treatment of persistent pain and memory/emotional deficits in chronic pain. J Inflamm Res. 2022;15:5201-5233.
34. Blyth FM, Noguchi N. Chronic musculoskeletal pain and its impact on older people. Best Pract Res Clin Rheumatol. 2017;31:160–8.