Turkish journal of GERIATRICS

Volume: 27 | Number: 4 | Year: 2024

The Official Scientific Journal of Turkish Geriatrics Society

e-ISSN: 1307-9948

www.turkgeriatri.org

www.turkgeriatri.org

e-ISSN: 1307-9948

The official scientific journal of Turkish Geriatrics Society

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Turkish Journal of Geriatrics is indexed in: Thomson Reuters Science Citation Index Expanded (SCI-Exp) and Social Sciences Citation Index (SSCI) since 2008. And also in Scientific and Technological Research Council of Turkey (TÜBİTAK), Turkish Academic Network and Information Center (ULAKBİM) regional TR index (TR dizin) since 1998.

Published four times (March, June, September, December) a year

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Date of Publication: 20 December 2024

Turkish Journal of
GERIATRICS
Volume: 27 • Issue: 4 • Year: 2024

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http://www.geriatri.dergisi.org/static.php?id=7

TURKISH JOURNAL OF GERIATRICS

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GERIATRICS
Volume: 27 • Issue: 4 • Year: 2024

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From The Editor In Chief

Turkish Journal of Geriatrics is a scientific journal dedicated to geriatrics and gerontology, which is essential in today's aging world. As the global population ages, there is a growing need to understand the unique health challenges and needs of older adults.

Geriatrics focuses on the medical care and management of elderly individuals, while gerontology studies the broader aspects of aging, including its social, psychological, and biological impacts.

Turkish Journal of Geriatrics is indexed in Science Citation Index Expanded-SCI-Exp & Social Sciences Citation Index-SSCI and plays a critical role in advancing research and disseminating knowledge about aging-related issues. It provides a platform for sharing innovative research findings, clinical practices, and public health strategies specifically tailored to the elderly population.

This is crucial for improving the quality of life, extending healthy lifespans, and reducing healthcare costs associated with aging.

Furthermore, this specialized journal fosters interdisciplinary collaboration, bringing together experts from medicine, psychology, sociology, and other fields to address complex aging issues. It helps set research priorities, guides policy-making, and educates healthcare professionals about the latest advancements in geriatric care and gerontology.

Turkish Journal of Geriatrics is vital for addressing the multifaceted challenges of aging, promoting evidence-based care, and ensuring that older adults can lead healthier, more fulfilling lives.

Yeşim GÖKÇE KUTSAL

ORIGINAL ARTICLE

DEATH DISTRESS AND END OF LIFE IN OLDER ADULTS LIVING ALONE

Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.406
2024; 27(4):331−338

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Received : Nov 12, 2024
Accepted : Nov 25, 2024

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Abstract

Introduction: Even if it is not perceived as such in real life, death is a natural part of life. Many factors, such as age, medical history, religious beliefs, and culture, affect the perception of death and cause distress. Investigating the factors that cause death distress in older adults is a prerequisite for developing support mechanisms. This study aimed to determine whether living alone is one of the conditions that causes death distress.

Materials and Method: This descriptive study was conducted. A sociodemographic information form created by the researchers and the Death Distress Scale were used. After obtaining the necessary institutional and ethical permission, face-to-face data were collected from 1189 older adults registered at a university's aging studies application and research center.

Results: The Death Distress Scale mean total scores of older adults was 28.18±4.14. The scale scores of the older adults living alone were found to be statistically significantly higher ($p \leq 0.01$). The scale scores of the women were significantly higher than those of the men ($p < 0.01$). Older adults living alone had higher rates of pet ownership. In both groups, those with pets had significantly lower Death Distress Scale scores than those without pets.

Conclusion: Social awareness is important in reducing the death stress experienced by older adults who live alone because of the loss of their relatives, living far away, and other reasons. Activities should be conducted to socialize and improve the quality of life of older adults.

Keywords: Aged; Ethics, Medical; Death; Advance Care Planning.

INTRODUCTION

Many definitions of death have been made in different cultures, societies, and disciplines, which also differ depending on the personality, age, religion, and cultural position of the individual. In individual and social terms, death has never been understood as a simple event; therefore, death creates anxiety for both the person himself/herself and his/her relatives (1). As older adults are closer to the end of their life expectancy, they are more associated with the concept of death, and it is a fact that young deaths are fewer than older adults, so older adults are more exposed to the theme of death and are more likely to experience anxiety and stress related to death than younger individuals (2-4). When we examine the factors affecting the views and approaches of older adults regarding the concept of death, we come across the concepts of understanding death and life after death. Every adult is curious about the uncertainty of life after death. This situation is listed among the causes of death anxiety among individuals and may shape their wishes about the last process of life. These wishes and demands may be shaped according to cultures and perhaps lifestyle (whether they live alone or not), and beliefs of older adults may affect their thoughts about the end of life and death. Death distress is a broad spectrum that encompasses anxiety, obsession and depression related to death, that is, negative attitudes and thoughts about death (5,6). Death distress can potentially contribute to suicidal acts (7), making it extremely dangerous for older adults. It is important to determine the factors that cause death distress and to investigate what to do to preventive measures. Some studies have shown that loneliness increases stress levels (8,9) by increasing cognitive, emotional, and behavioral problems (10,11) and depressive symptoms (12). It has been shown that the feeling of loneliness increases among older adults, especially due to age-related changes in social relationships (13), and the risk of suicide increases due to emotional loneliness in older adults who experience problems in their social relationships and their environment (14,15). Therefore, it is important to investigate the sociodemographic characteristics of the effects of death distress experienced by older adults; whether feelings of loneliness and death distress are related; and whether the feelings, thoughts, and wishes of older adults living alone at the end of life differ from those of those living with someone else, in terms of identifying and preventing risk factors.

METHOD

Sample

This is a descriptive study. Data were collected from older adults registered at a university's aging research center who agreed to participate in the study between January 10, 2024, and June 10, 2024, after obtaining the necessary ethical permissions. A total of 1189 older adults participated in this study. A questionnaire of approximately 30 min duration was administered in a location deemed appropriate by participants who provided informed consent. While collecting data, the researcher and participants were allowed to meet alone. They were assured that their identities would be kept confidential by explaining the importance of reflecting on their true and sincere thoughts and the purpose of the study.

Data Collection Tools

Sociodemographic data form: The researchers created sociodemographic data forms for older adults. The sociodemographic characteristics of the older adults included age, sex, income, whether they lived alone or with someone, marital status, educational status, number of social activities, having a chronic disease, having a pet, and end-of-life wishes.

Death Distress Scale: The Death Distress Scale (DDS) is a 9-item self-report measure designed to evaluate thoughts and feelings concerning death and dying (16). Each item was rated on a five-point rating scale (1=never to 5=always), and as the total

DDS score increased, death distress increased. A previous study indicated that this scale has strong internal reliability in a Turkish sample. Confirmatory factor analysis affirmed the factor structure of the scale with the sample of this study, suggesting good-data-model fit statistics (χ^2=78.64, df=22, p<0.001, CFI=0.96, TLI=0.95, SRMR=0.04, RMSEA [95% CI]=0.06 [0.05, 0.08]; λ range=0.27 [item 3]-to-0.90; α range=0.60-to-0.85).

Statistical Evaluation

Data obtained from the study were analyzed using SPSS software (version 20.0; IBM Corp., Armonk, NY, USA). The Kolmogorov–Smirnov test was used to determine the fit of the normally distributed data, and frequency, percentage, and averages were used to examine the demographic characteristics of older adults. Independent sample t-test for paired groups, ANOVA test for more than two groups, and correlation tests were used to compare demographic variables as independent variables and DDS scores as dependent variables. Cronbach's alpha and item-total correlation analyses were performed to test the reliability of the DDS. All statistical tests were evaluated at a 95% confidence interval (CI) with a significance level of p<0.05 significance level.

Ethical Dimension of Research

Before initiating the study, ethical approval was obtained from the Burdur Mehmet Akif Ersoy University Non-Interventional Research Ethics Committee (No: GO2024/01-89).

RESULTS

The mean age of the older adults was 77.4±9,7 years, 58,6% were female, 35.7% were primary school graduates, 64,8% were married, 63.2% had an income equal to their expenses, 55,8% participate in 1-2 social activities a week, 81.4% have a chronic disease, and %8,9 have a pet. The mean total scores of older adults was 28.18±4.14. The DDS scores of the older adults living alone were found to be statistically significantly higher (p≤0.01), so it can be said that older adults living alone experience more death distress. When the total scale scores for older adults were compared to live alone or with someone, a significant difference was found between the two groups for sociodemographic variables except educational status (p≤0.05) (Table 1). When the mean DDS scores were evaluated separately for the two groups, it was found that the mean DDS scores of older adults aged 85 years and older were significantly lower in both groups than in the other age groups (p<0.001), and participants in this age group experienced less death distress. Women's DDS scores were significantly higher than those of men (p<0. 01), that is, women experienced more death distress than men in both groups; respondents with income higher than their expenses experienced more death distress (p≤0.02); those who were married had significantly higher DDS scores than the other groups (p≤0.01); social activities (visiting relatives, shopping, meeting friends, going to courses, cinema, theatre, concert activities, etc.) are effective in terms of death distress, the DDS scores of those with 3 or more social activities per week are statistically significantly lower than the other groups (p≤0.01), the DDS scores of those with bachelor's degree and higher education in older adults living alone are significantly higher than the others (p≤0. 02), those with primary school education had significantly lower DDS scores than the other groups (p≤0.01); in both groups, those with chronic diseases experienced more death distress (p≤0.01); older adults living alone had higher rates of pet ownership and in both groups, those with pets had significantly lower DDS scores than those without pets (Table 1).

The participants were asked open-ended questions about their wishes and demands regarding the end of life, and the answers were grouped into seven categories, as shown in Table 2. When the answers given by the older adults were

Table 1. Examination of within-group and between-group mean scores of the Death Distress Scale in older adults living alone and living with others according to sociodemographic data

Socio-demographic data		n (%)	Death Distress Scale mean total scores		
			Live alone (n (%); Mean±SD)	Live with someone (n (%); Mean±SD)	P Value (within the group)
Age	65-74	696 (58.5)	124 (59.3; 36.64±8.12)	572 (58.4; 32.16±8.23)	≤0.04
	75-84	385 (32.4)	45 (21.5; 29.75±5.16)	340 (34.7; 26.52±4.14)	
	85 +	108 (9.1)	**40 (19.2; 21.26±4.22)***	**68 (6.9;18.35±6.32)***	
	(p)		**≤0.001****	**≤0.001****	
Sex	Women	697 (58.6)	141 (67.5; 32.45±4.62)	556 (56.7; 26.75±6.32)	≤0.02
	Men	492 (41.4)	68 (32.5; 35.26±6.36)	424 (43.3;29.68±7.34)	
	(p)		≤0.01**	≤0.01**	
Income	Income less than expenditure	299 (25.1)	42 (20.1; 27.63±7.54)	257 (26.3;24.12±7.14)	≤0.05
	Income equals expenditure	751 (63.2)	124 (59.3; 29.14±6.24)	627 (63.9; 26.06±4.32)	
	Income more than expenditure	139 (11.7)	**43 (20.6; 32.18±5.12)***	**96 (9.8; 30.36±5.62)***	
	(p)		**≤0.01****	**≤0.02****	
Marital Status	Married	771 (64.8)		771 (78.6; 33.56±6.84)	≤0.001
	Single	418 (35.2)	209 (100; 30.96±4.26)	209 (21.4; 27.16±3.38)	
	(p)			**≤0.01****	
Weekly Social Activities	0	86 (7.3)	24 (11.5; 33.16±7.08)	62 (6.3; 28.44±8.42)	≤0.01
	1-2	664 (55.8)	82 (39.2; 21.84±6.38)	582 (59.4; 23.26±6.32)	
	3 +	439 (36.9)	**103(49.3;17.02±4.56)***	**336(34.3; 19.16±6.32)***	
	(p)		**≤0.01****	**≤0.01****	
Education	Elementary school	424 (35.7)	**99 (47.4; 23.22±7.61)***	325(33.2; 21.82±4.24)	≥0.05
	Intermediate school	306 (25.7)	48 (22.9; 29.06±6.09)	258 (26.3; 25.52±5.82)	
	High school	254 (21.4)	46 (22.0; 30.08±7.28)	208 (21.2; 24.36±6.56)	
	Undergraduate and above	205 (17.2)	16 (7.7; 30.48±4.54)	**189(19.3; 28.58±5.16)***	
	(p)		**≤0.02****	**≤0.01****	
Chronic Ciseases	yes	968 (81.4)	180(86.1; 34.17±6.66)	788 (80.4; 28.68±9.16)	≤0.01
	no	221 (18.6)	29 (13.9; 23.16±7.22)	192 (19.6; 21.17±5.32)	
	(p)		**≤0.01**	**≤0.01**	
Pet Ownership	yes	106 (8.9)	34 (16.2; 22.85±4.16)	72 (7.3; 21.73±4.36)	≤0.001
	no	1083 (91.1)	175 (83.8; 32.05±2.22)	908 (92.7;27.16±3.42)	
	(p)		**≤0.001**	**≤0.001**	
Total		1189 (100.0)	209 (17.6; 30.96±4.26)	980 (82.4; 25.36±4.32)	**≤0.01**

n: number, SD: standard deviation

* According to the Post Hoc Tukey test results, the group is the source of the statistical difference within the group.

** Statistical significance of comparisons within the group

Table 2. Distribution of end-of-life requests according to groups

Wishes and requests *	Live alone (n=209)	Live with someone (n=980)
Painless death and end-of-life processes	%96.2	%98.3
Peaceful death in one's own environment	%83.4	%95.4
Having the opportunity to say goodbye to their loved ones	%68.8	%89.6
Fulfilment of wishes and desires after death	%76.9	%65.2
Wishes and requests related to religious beliefs	%86.3	%82.7
Request for medical support at a health facility	%72.6	%57.4
Requests related to pets	%16.2	%3.5

* All items expressed by the participants were evaluated and summarized under the headings.

evaluated, it was observed that the demand for the end-of-life process to be painless was ranked first in both groups, and the demands related to pets were ranked last place, and it was determined that all (16.2%) respondents living alone with a pet (n=34, 16.2%) and almost half (3.5%) the respondents living with someone and a pet (n=72, 7.3%) had demands for the care of their pets after their death.

DISCUSSION

As is the case worldwide, Turkiye's population is aging. Therefore, it is necessary to identify older adults' needs and develop solutions accordingly. In this context, revealing the situations that increase death distress in older adults is the first step towards a solution. This study found that living alone was an important factor that increased death distress. Similarly, in Japan and India, living alone is a source of chronic stress and is associated with depression (17,18).

In a study conducted in Turkiye on death anxiety among older adults, no relationship was found between death anxiety and age. The same study found that the presence of mood disorders increased death anxiety. In addition, a weak positive correlation was found between death anxiety and general loneliness, social loneliness and emotional loneliness (19). In our study, death distress was lower among older adults over 85 years of age. This may be due to the decrease in stress with acceptance when the end-of-life expectancy is approached.

In a study conducted on patients with cancer in Chile, the Death and Dying Distress Scale scores of women were found to be higher than those of men (20). In our study, the scale scores of women were also higher. Women may experience more distress owing to their gender roles. In a study conducted among hospitalized older adults, death anxiety was found to be high (21). In our study, the scale scores of participants with chronic diseases were high. It is believed that older adults experience distress owing to social isolation and physical limitations caused by their existing diseases.

In a study conducted during the Covid19 pandemic, positivity reduced death distress (16). In a study of 400 patients diagnosed with depression and anxiety living in the Canary Islands, death distress was found to be closely related to religious beliefs (22). Additionally, individuals with negative religious coping have higher scores for death distress than those with positive religious coping (23). In our study, although older adults were not asked about their religious beliefs, the scale scores changed as education and income levels changed. Socioeconomic status plays an

important role in making sense of life. It is believed that the differences between the groups were due to different ways of perceiving life.

Verbal cognition was found to be better in studies conducted on older adults living alone with pets (24). In our study, the scale scores of pet owners were lower. Emotional support from pets for older adults may have played a role in coping with death distress.

When older adults were asked about their wishes for an end of life with an open-ended question, painless death, whether they lived alone or with someone else, came first. Older adults living with someone else ranked peaceful death second in their own environment, whereas those living alone ranked death according to religious beliefs. At this point, it can be considered that quality of life is prioritized at the end of life. These findings reveal the necessity of conducting more in-depth qualitative studies on end-of-life care. Thus, it was possible to reveal the factors related to death distress more clearly.

CONCLUSION

Older adults who are left alone because of the shrinking of their social environment, the loss of family members, or distance from family members have difficulty coping with the thought of death in the last period of their lives. In an increasingly aging population, it is important to support older adults. Social support systems and services play crucial roles in providing the social connections that older people living alone need. Practices such as social inclusion, community events, volunteer visits, and support groups can help reduce feelings of loneliness and alleviate the fear of death. Increasing the societal awareness of this group and creating effective support mechanisms will improve individuals' quality of life and empower them to cope with these fears.

However, it is important to prepare public service announcements that emphasize the importance of children, grandchildren, and other young family members visiting their older relatives regularly and raise awareness of this issue. Although it is preferred that these visits be voluntary visits from the heart, legal regulations that make this a legal obligation are also being implemented worldwide. In fact, in 2013, the "Law on the Protection of the Rights and Interests of the Elderly" was enacted in China, which stipulated that the older adults should be visited regularly, and the "good child" law, which made it mandatory for children to visit their older parents, was enacted.

Pets can play an important role in reducing feelings of loneliness and improving the quality of life. Pets can be useful in coping with death distress by providing emotional support, encouraging social interaction, encouraging owners to be physically active, and providing older people with daily routines and responsibilities. Of course, older adults may find it difficult to care for animals or may find it difficult to meet the needs of animals due to physical health problems. Therefore, it is important to provide appropriate support and services. Therefore, it is important for society to recognize the needs of older adults and provide support and resources to keep them active throughout their social lives.

Limitations and Implications

Despite the important contributions of this study to the field of aging, some limitations must be addressed. First, it uses self-reported data and a cross-sectional approach. These are important limitations regarding the generalizability of this study. Second, the sample comprised older adults living in a small Turkish city. This limitation can also be considered in terms of the generalizability of findings. Therefore, further studies are required to investigate the effects of death distress in older adults. Although we found that social activities and pet ownership decrease death distress, and loneliness increases death distress, studies on factors that decrease death distress in older adults in different samples can be expanded.

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Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.407
2024; 27(4):339–348

ORIGINAL ARTICLE

DETECTION OF POTENTIALLY INAPPROPRIATE PRESCRIPTIONS USING TIME AND STOPP/START LISTS IN TURKISH GERIATRIC PATIENTS: A SINGLE CENTER EXPERIENCE

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Received : Oct 21, 2024
Accepted : Dec 04, 2024

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Abstract

Introduction: Screening Tool of Older Person's Prescriptions (STOPP) / Screening Tool to Alert Doctors to the Right Treatment (START) is among the most forthcoming lists developed to detect potentially inappropriate prescribing, which consists of potentially inappropriate medications and potential prescription omissions. Turkish Inappropriate Medication Use in the Elderly (TIME) was developed based on STOPP/START version 2 for the eastern European population. We aimed to compare the effectiveness of STOPP/START and TIME in detecting potentially inappropriate prescribing, potentially inappropriate medications, and potential prescribing omissions.

Materials and methods: Eighty-five patients who presented to Gazi University Hospital's Geriatrics Outpatient Clinic between November 2020 and March 2022 were included in this study. The patients' detailed clinical records were evaluated according to TIME and STOPP/START. The numbers of potentially inappropriate prescribing, potentially inappropriate medications, and potential prescribing omissions were determined.

Results: Median number of potentially inappropriate prescribing detected according to TIME was significantly higher than according to STOPP/START (6 [IQR 4-7] vs. 3 [IQR 2-5], $p<0.001$). However, no significant difference was observed in the number of potentially inappropriate medications detected. The number of patients meeting potentially inappropriate prescribing criteria according to the TIME was significantly higher than START, which was attributable primarily to the disparity in the vaccination category.

Conclusion: Our results suggest that TIME is more successful in detecting potentially inappropriate prescribing than STOPP/START in Turkish geriatric patients. This success was probably due to the better performance of TIME in detecting potential prescribing omissions. Further studies are needed to confirm these findings.

Keywords: Potentially Inappropriate Medication List; Polypharmacy; Drug Therapy; Geriatric Assessment; Drug Interactions.

INTRODUCTION

Comorbidities and polypharmacy in elderly patients are serious issues that health-care professionals must address. Increased interactions between diseases and medications escalate adverse drug reactions. Furthermore, medication effects differ in older patients, which creates the need for careful clinical practice evaluation. The adverse drug reactions that result from the interplay of these elements lead to an increase in hospital and emergency department admissions. Medication-related issues in the elderly continue to harm patients and strain health-care systems.

Given these negative circumstances, older people's drug use must be monitored. In response to this need, the concept of potentially inappropriate prescribing (PIP) has been introduced. This concept covers two issues: potentially inappropriate medications (PIMs) and potential prescription omissions (PPOs). PIMs are drugs that a patient is using that are potentially inappropriate. PPOs refer to medications that the patient should be using based on their clinical condition but that have not been prescribed. Various lists of criteria have been developed to anticipate potentially inappropriate prescriptions and prevent potential adverse effects (1).

Among these lists, one of the most important consists of the Screening Tool of Older Person's Prescriptions (STOPP) and the Screening Tool to Alert Doctors to the Right Treatment (START). Studies have demonstrated the association between the potentially inappropriate medications identified by this list and adverse drug reactions (2-4). This list was developed by 18 experts in geriatric pharmacology, who used the Delphi method for this task. In the first version of the list there are 65 criteria in the STOPP section (for PIMs) and 22 criteria in the START section (for PPOs). The list has been expanded to 114 criteria in the second version, including 80 STOPP criteria and 34 START criteria. (5). Researchers in different countries have adapted this list to their national contexts (6, 7). The third version of this list, with an expanded scope and number of criteria, was published in 2023 (8).

Prescription habits and drug-market products vary widely by country (9). As a result, new lists of criteria, or the adaptation of existing ones, are necessary. To meet this need, the Turkish Inappropriate Medication Use in the Elderly (TIME) list was developed for use in eastern Europe. This list contains two sections: TIME-to-STOP and TIME-to-START. The first version of the list was published in 2020. The next year, the list was validated and updated internationally with minor changes using the Delphi method (10, 11). The methodology and format of STOPP/START were used to prepare TIME. Therefore, TIME-to-STOP addresses PIMs, and TIME-to-START deals with PPOs. The first section comprises 101 criteria, while the second one contains 33, which amounts to a total of 134 criteria. As indicated by the number of criteria, STOPP/START and TIME differ significantly in content (10, 11). According to the relevant consensus study, the TIME list should be considered a separate list; also, as noted by Lee et al. in their systematic review, the literature features TIME as a separate entity (1, 11).

The TIME list addresses the needs of a population living in a more localized geographical area. It represents a pioneering effort in terms of the target population and country context. Accordingly, we aimed to compare the effectiveness of STOPP/START and TIME in patients attending a university hospital geriatric outpatient clinic through a descriptive study. To the best of our knowledge, the present study is the first of its kind.

MATERIALS AND METHOD

Approval was obtained from the Gazi University Clinical Research Ethics Committee (meeting date: October 2, 2020; decision no.: 684). The study was conducted cross-sectionally at the Gazi University Hospital Geriatric Outpatient Clinic and

the Department of Medical Pharmacology. Written informed consent was obtained for the detailed examination of all the clinical data of 85 patients who applied to the clinic between November 2020 and March 2022. The patients' demographic information, complaints, comorbidities, medical histories, medications being used, and relevant laboratory and imaging results were recorded in case report forms. Subsequently, these forms were examined to check the adherence of the patients' medications to the TIME and STOPP/START version 2 lists. When evaluating the clinical information of the patients, the most recent medications prescribed on the date of informed consent were taken as reference. PIMs and PPOs were identified, and the criterion class on the basis of which they were identified was recorded.

Since the TIME list is based on STOPP/START v2, we preferred to use the second version. On the other hand, it was considered appropriate to use the most recent and available lists at the time the patients were evaluated.

In our research, when TIME is specified as a list, it means that TIME to STOP and TIME to START are evaluated together. If there is a separate evaluation involving distinct subsections, they will be identified as TIME to STOP or TIME to START. Similarly, if the STOPP/START list was evaluated as a whole, it will be named as such, if distinct sub-sections were evaluated, it will be specified as STOPP or START.

An a priori power analysis was conducted using G*Power version 3.1.9.7 to determine the minimum sample size required to test the study's hypothesis (12). This analysis indicated that the required sample size to achieve 80% power to detect an effect size of 0.3, with a significance criterion of α=0.05, was N=176 for the Mann–Whitney U test. Thus, the obtained total sample size of N=170 (85 patients for each of the tests) was adequate to test the hypothesis.

All the statistical analyses were performed using IBM SPSS Statistics version 23. Descriptive statistics were expressed as percentages, means, standard deviations, interquartile ranges, and minimum and maximum values. The data were evaluated for normality using the Kolmogorov–Smirnov test. Parametrically distributed data were analyzed using independent t-tests, while non-parametrically distributed data were analyzed using the Mann–Whitney U test. A significance level of $p<0.05$ was considered statistically significant.

RESULTS

Demographic Data

In the sample, 37% of the participants were male, and 63% were female. The mean age was 74.5±6.0. The participants had an average of 4.5±2.1 comorbidities. The most commonly observed comorbidities were hypertension, diabetes mellitus, coronary artery disease, osteoporosis, and hyperlipidemia (the prevalence of comorbidities in the population was n=65, 76.5%; n=43, 50.6%; n=26, 30.6%; n=21, 24.8%; and n=16, 18.9%, respectively). There was no significant difference in the number of comorbidities between males and females. The participants used an average of 7.5±3.5 medications. There was no significant difference in the mean number of medications used between the two genders (Females: 7.9±3.6 vs. Males: 6.8±3.6; p=0.141).

Meeting at Least One Criterion

When evaluating which criteria the participants met, it was observed that all of them met at least one criterion of the TIME list, while 96.5% met at least one criterion of the START/STOPP list. Looking at the subgroups, 55.3% of the participants met at least one PIM criterion according to TIME to STOP, while 44.7% met at least one PIM criterion according to STOPP. All the participants met at least one PPO criterion of the TIME to START list, while the figure for the START list was 95.3%. In terms of gender, 64.2% of female participants met at least one PIM

criterion based on TIME to STOP, while 54.7% of them met at least one PIM criterion based on STOPP. Among the male participants, these rates were 40.6% (TIME to STOP) and 28.1% (STOPP). Furthermore, 96.2% of female participants met at least one PPO criterion according to the START list, while this rate was 93.9% in males.

Number of Criteria Met According to List

When evaluating the medications used by the participants, the number of criteria met was found to be significantly higher for the TIME list, as shown by the median (Mdn) values (TIME Mdn: 6[IQR 4–7]; STOPP/START Mdn: 3[IQR 2–5]). No significant difference existed between the number of PIM criteria met according to the TIME to STOP list and the number met according to the STOPP list (p=0.056). The number of PPO criteria met based on the TIME to START list was significantly higher than that met based on the START list (TIME to START Mdn: 4[IQR 4–5]; START Mdn: 2[IQR 2–3]) (Table 1, Figure 1).

Comparisons Between Females and Males

According to the TIME list, females met more PIP criteria than males (Female Mdn: 6[IQR 5–8]; Male Mdn: 5[IQR 4–6]; p=0.009). However, there was no significant difference between the total number of PIP criteria met in females and that met in males according to the STOPP/START list. Based on both TIME to STOP and STOPP, females met more PIM criteria than males (TIME to STOP Female Mdn: 1[IQR 0–2] vs. TIME to STOP Male Mdn: 0[IQR 0–1.75], p=0.02; STOPP Female Mdn: 1[IQR 0–2] vs.

Table 1. Number of criteria met in general patient population

	TIME median, [IQR]	STOPP/START median, [IQR]	P value
PIM	2, [0-2]	0, [0-1]	0.056
PPO	4, [4-5]	2, [2-3]	<0.001
PIP (TOTAL)	6, [4-7]	3, [2-5]	<0.001

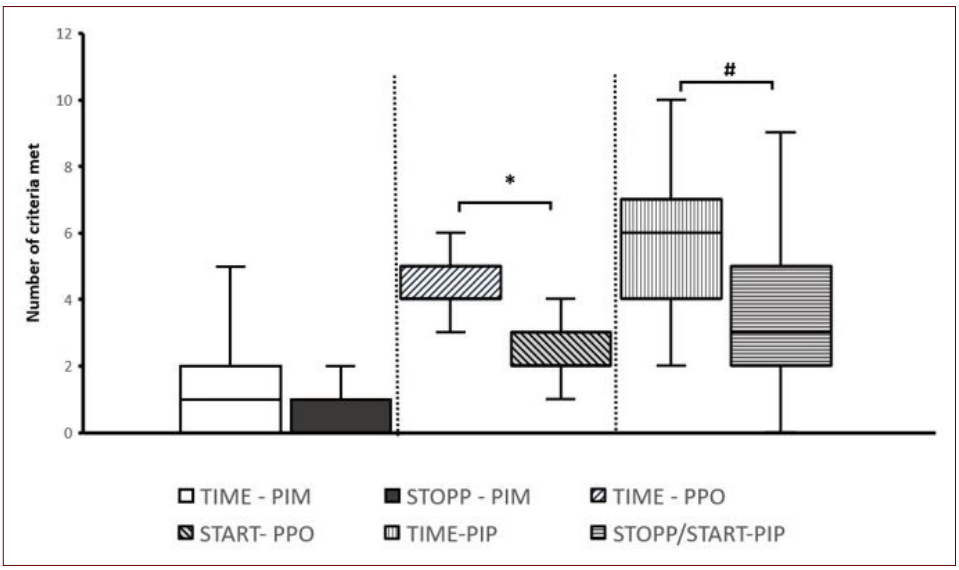

Figure 1. Number of PIMs, PPOs and PIPs covered by TIME and STOPP/START lists (*<0.001, #p<0.001, Mann Whitney-U Test).

STOPP Male Mdn: 0[IQR 0–1], p=0.02). There was no significant difference between the number of PPO criteria met in females and males according to both the TIME to START and START lists (Table 2).

The number of criteria met based on the TIME and STOPP/START lists was compared separately for females and males. In both genders, the total number of PIP criteria met according to TIME was significantly higher than that met according to STOPP/START (TIME Female Mdn: 6[IQR 5–8] vs. STOPP/START Female Mdn: 3[IQR 2–6], p<0.001; TIME Male Mdn: 5[IQR 4–6] vs. STOPP/START Male Mdn: 3[IQR 2–4], p<0.001). Both among males and females, the total number of PIM criteria met based on the TIME to STOP list did not significantly differ from that met according to the STOPP list. In both genders, the total number of PPO criteria met according to TIME to START was significantly higher than that met according to START (TIME to START Female Mdn: 5[IQR 4–5] vs. START Female Mdn: 2[IQR 2–3.5], p<0.001; TIME to START Male Mdn: 4[IQR 4–5] vs. START Male Mdn: 2.5[IQR 2–3], p<0.001).

Comparisons by Organ System Category

The TIME and STOPP/START lists were also compared based on the organ system categories they contain.

When examining the PIM criteria from this perspective, it was noted that STOPP listed two subsets of criteria under the categories Cardiovascular System and Coagulation System; in contrast, TIME to STOP list had only the category Cardiovascular System. Therefore, Cardiovascular System in the TIME to STOP list was compared to Cardiovascular System and Coagulation System in the STOPP list. The number of criteria met was significantly higher in the combined category Cardiovascular System and Coagulation System in the TIME to STOP list compared to the STOPP list (TIME to STOP Mdn: 0[IQR 0, 1] vs. STOPP Mdn: 0[IQR 0, 0]; p<0.001). No significant difference was observed between the two criteria lists in the categories Central Nervous System, Gastrointestinal System, Respiratory System, Musculoskeletal System, Urogenital System, Endocrine System, and Antimuscarinic Drugs.

When examining the PPO criteria in terms of organ system subcategories, it was noted that in Gastrointestinal System Drugs and Vaccines, the TIME to START list had a significantly higher number of met criteria compared to the STOPP list. Regarding Musculoskeletal System Drugs, however, the START list had a considerably higher number of met criteria compared to the TIME to START list (Table 3). No significant difference was observed between the two lists in the categories

Table 2. Number of criteria met in males and females.

	Male median, [IQR]	Female median, [IQR]	P value
TIME PIP	5, [4-6]	6, [5-8]	0.009
STOPP/START PIP	3, [2-4]	3, [2-6]	0.072
TIME PIM	0, [0-1.75]	1, [0-2]	0.02
STOPP PIM	1, [0-1]	1, [0-2]	0.02
TIME PPO	4, [4-5]	5, [4-5]	0.058
START PPO	2.5, [2-3]	2, [2-3.5]	0.524

Table 3. Number of PPO criteria for organ system subcategories

	TIME median, [IQR], (min, max)	STOPP median [IQR], (min, max)	P value
Cardiovascular System	0, [0-1], (0, 3)	0, [0-1], (0, 3)	0.626
Central Nervous System	0, [0-0], (0,1)	0, [0-0], (0, 1)	1.000
Gastrointestinal System	0, [0-0], (0-1)	0, [0-0], (0, 0)	<0.001
Respiratory System	0, [0-0], (0, 2)	0, [0-0], (0, 2)	0.655
Musculoskeletal System	0, [0-0], (0, 2)	0, [0-0], (0, 3)	0.007
Urogenital System	0, [0-0], (0, 1)	0, [0-0], (0, 2)	0.081
Endocrine System	0, [0-0], (0, 0)	0, [0-0], (0, 1)	0.173
Vaccines	4, [4-4], (2, 4)	2, [2-2], (0, 2)	<0.001
Vaccines Excluded From Total	1, [0-2], (0, 5)	1, [0-1.5], (0, 4)	0.705

Cardiovascular System, Central Nervous System, Respiratory System, Endocrine System, and Urogenital System. Furthermore, excluding the significant difference observed in the Vaccines category, all the other criteria were also evaluated within their own categories. No significant difference was observed in this comparison between the two lists (Table 3).

DISCUSSION

The potentially inappropriate medication use and PPOs of patients attending a university hospital geriatric outpatient clinic were evaluated using the TIME and STOPP/START lists.

The first notable result of the study is that according to the TIME list, all the participants met at least one criterion, while according to the STOPP/START list, almost all the participants met at least one criterion. Reviewing the literature, evaluations using the STOPP/START list typically show a criterion-met rate of 50%–70% (13-16). However, some studies report lower rates (17).

Moreover, in our study, the rates of patients with at least one PIM determined using the TIME to STOP and STOPP lists appear to be in line with the literature. However, the PPO rates are higher than previously documented (14-16).

The reason for this discrepancy could be the composition of the study population, which consisted of patients from a university hospital clinic. The complexity of comorbidities in patients visiting a university hospital may lead to more challenging polypharmacy scenarios. However, in their multicenter cross-sectional study published in 2022, Zeng et al. reported that PIMs were prescribed more frequently in primary care settings (18). Thus, further research is needed to evaluate the possible high rates of PPOs in the population of university hospitals in Türkiye.

When the medications used by the participants were evaluated, the average number of criteria met (the number of identified instances of PIP) according to the TIME list was found to be significantly higher than that based on the STOPP/START list. Hence, it could be suggested that TIME is more effective in detecting PIP in the Turkish population. Additionally, the mean number of instances of PIP identified by STOPP/START in our study is consistent with the literature (19, 20). However, to the best of our

knowledge, no data are available on the mean number of instances of PIP determined by TIME.

Although the TIME to STOP list identified more PIMs than STOPP, this difference was not statistically significant. Also, the rate of PPOs identified by TIME to START was significantly higher. However, this significance was lost when the Vaccines category was excluded.

In the TIME to START list, the Vaccines category has been expanded compared to the START, and the varicella-zoster virus (VZV) and tetanus–diphtheria vaccines have been added to the list. Therefore, it can be said that the difference in effectiveness between TIME to START and START largely stems from this expansion. Nowadays, vaccination against VZV, tetanus, and diphtheria is considered a necessity in routine geriatric health-care services (21-23). Thus, it can be concluded that the TIME list draws attention to an essential aspect of geriatric care in Türkiye and has the potential to raise considerable awareness about vaccination in geriatric health-care practice.

The TIME to STOP list detected significantly more PIMs in the categories regarding cardiovascular drugs and the coagulation system compared to the STOPP list. In the TIME to STOP list, the categories Cardiovascular System and Coagulation System from the STOPP list are grouped under a single heading. However, it should be noted that there are 30 criteria under a single heading for these two systems in the TIME to STOP list, while there are 23 under two headings in the STOPP list. Furthermore, 14 criteria present under the single heading in question in TIME to STOP are not found in STOPP, and eight criteria have been changed compared to STOPP. Both the expansion of the criteria and the changes made to them suggest that considerable differences have occurred in the detection of inappropriate drug use in the Turkish patient population (5).

When evaluating PPOs, it was observed that the TIME to START list discovered significantly more cases with reference to the Gastrointestinal System category. In the TIME-to-START section, which assesses PPOs, only one criterion recommends fiber use in everyone with symptomatic constipation who does not respond to dietary therapy. The START list has a criterion for proton pump inhibitor use and a second criterion recommending fiber support in individuals with diverticulosis and symptomatic constipation. Thus, the success of the TIME to START list in this regard may be attributed to its more liberal approach to recommending fiber use. Two significant articles published after STOPP/START version 2 have been cited in the TIME list regarding this issue. These publications recommend fiber use in symptomatic constipation (5, 10, 24, 25). This issue has been expanded in the third version of the STOPP/START list, with a recommendation added for the use of osmotic laxatives in elderly individuals with idiopathic or secondary benign constipation. However, in the newer version, the presence of diverticulosis is still deemed necessary for the use of fiber supplementation (8). This can be interpreted as an indication that STOPP/START version 3 has incorporated the current approach of TIME.

Upon reevaluation of the PPO results, it was found that more cases were identified concerning the Musculoskeletal System category in START. In this list, there are seven criteria under this category, while in the TIME to START list, there are eight criteria. In TIME to START, three criteria from START were preserved; two were preserved but modified, and one criterion from START's Analgesics category was transferred to the Musculoskeletal System category. Two criteria included in the START list but not in the TIME to START list are related to prescribing vitamin D in elderly individuals receiving long-term corticosteroid therapy, those at risk of falls, or those with osteopenia (20). The detection of more PPOs related to Musculoskeletal System Drugs in START could indicate a deficiency in prescribing vitamin D to elderly individuals in Türkiye.

In our study, more instances of PIP were detected in females according to the TIME list, while no gender difference was observed in the STOPP/START list. However, more PIMs were identified in females based on both the TIME to STOP and STOPP lists. Regarding PPO rates, no gender difference was observed between TIME to START and START. These findings suggest a tendency for more PIM prescriptions in females. A similar trend has been reported in the literature (15, 16). Furthermore, in our study, a higher rate of PIM detection was observed for females according to both lists, but no significant difference was found between males and females in terms of PPO rates. Thus, the higher prevalence of PIP detection for females may be due to more PIM prescriptions. More studies are needed to investigate why higher PIM rates are observed in females.

The present study also examined the differences in terms of PIP identified by TIME and START/STOPP in the male and female populations. A similar pattern emerged in both genders, with the TIME list detecting considerably more instances of PIP and PPOs among all participants. This suggests that the effectiveness of the TIME and START/STOPP lists in identifying instances of PIP does not vary between the genders.

The fact that all the participants visited the geriatric outpatient clinic during the COVID-19 pandemic is another important aspect of this study. The data are crucial for determining the frequency of PIP in the patient population during the pandemic.

The most significant aspect of this study is the comprehensive evaluation of detailed clinical data for all the participants. Given their content, the TIME and STOPP/START lists require full access to patient data.

The main limitation of the study is its small sample size. More comprehensive results could be obtained in a more extensive study where patients are selected from a clinic's patient pool through full randomization rather than voluntary participation. Furthermore, studies conducted in multiple institutions could advance our understanding of the phenomenon. Another limitation of the study is its observational design. More complete data can be obtained from prospective studies that correlate PIP data with adverse event and morbidity occurence.

Acknowledgments: The authors wish to thank the "Gazi University Academic Writing Application and Research Center" and "Scribendi.com" for its assistance in proofreading the article.

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ORIGINAL ARTICLE

VALIDITY AND RELIABILITY OF THE TURKISH VERSION OF 'AACHEN FALLS PREVENTION SCALE' IN OLDER INDIVIDUALS

Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.408
2024; 27(4):349−362

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Abstract

Introduction: This study aimed to develop a Turkish version of the Aachen Falls Prevention Scale and determine its psychometric properties (reliability and validity).

Materials and Method: This methodological study involved 200 individuals aged ≥ 65 years from selected Family Health Centers in Manisa, Turkey, who were categorised as fallers and non-fallers. The study proceeded with distribution and item analyses of the scale, followed by reliability and validity assessments, including criterion validity, confirmatory factor analysis, known groups, and parallel form validity for construct validity.

Results: The Turkish version of Aachen Falls Prevention Scale demonstrated a sensitivity of 71.0% and specificity of 75.0% for the first part of the index score and a sensitivity of 75.0% and specificity of 55.0% for the third part. Confirmatory factor analysis for the single-factor structure of the first section yielded a chi-square/degrees of freedom ratio of 1.13, a comparative fit index of 0.939, and a root mean square error of approximation of 0.025. According to the results of known-groups analysis, the 1st and the 3rd parts of the scale were discriminative for all known groups whereas the 2nd part was not sensitive to some variables.

Conclusion: The study findings indicate highly satisfactory psychometric results for the Aachen Falls Prevention Scale. Specifically, the tool showed superior predictive capability for fall risk in older individuals compared to balance tests, such as the Tinetti test. Consequently, the Aachen Falls Prevention Scale can effectively assess fall risk among Turkish-speaking older adults in hospitals and primary healthcare settings.

Keywords: Accidental Falls; Aged; Geriatric Assessment; Sensitivity and Specificity.

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Received : Oct 06 , 2024
Accepted : Dec 07, 2024

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INTRODUCTION

The world is undergoing continuous demographic transition characterised by increasing life expectancies and declining fertility rates, resulting in a significant shift in the age structure of the population. Consequently, both the proportion and absolute number of older individuals are steadily rising (1). In Turkey, the proportion of population aged ≥65 years increased from 8.5% in 2017 to 10.2% by 2023(2).

Geriatric syndromes are prevalent among older individuals owing to the cumulative effects of disorders across multiple systems and their decreased ability to compensate for these conditions. Common geriatric syndromes include falls, cognitive impairment, delirium, depression, polypharmacy, and urinary incontinence. Falls are a significant cause of mortality and morbidity in older adults and pose a substantial public health challenge due to their frequency, associated morbidity, and healthcare costs (3). Risk factors for falls in olderindividuals have been published in several recent reviews (4,5).

The tools utilised for assessing fall risk in older adults should effectively identify those at a high risk of falling and accurately distinguish between fallers and non-fallers to mitigate the incidence of falls (6,7). In a recent systematic review, Park stated that the predictive validity of tools currently used for fall risk assessment in older adults is inadequate (7), and the timed up and go (TUG) test, which is most commonly used to evaluate fall risk in daily clinical practice in Turkey, is not recommended tobe used alone to assess fall risk. Among the instruments used to assess fall risk in Turkey, only the performance-oriented mobility assessment (POMA) (Tinetti Balance) test has demonstrated psychometric validity in community-dwelling older individuals. Therefore, there is a need for new fall risk assessment instruments with proven validity in older adults.This study aimed to adapt the "Aachen Falls Prevention Scale"(AFPS) into Turkish and to determine the psychometric properties (validity and reliability) of the developed Turkish version.

MATERIALS AND METHOD

This is a cross-cultural adaptation study of the AFPS for Turkish speaking older adults.

Subjects

The research population comprised older adults aged ≥ 65 years who visited the five selected urban Family Health Centers(FHCs) at Manisa city centre, Turkey. The sample size was calculated as 99 participants for each group, considering a Type 1 error rate of 0.05 and an effect size of 0.40 for two-tailed hypothesis. The study included a sample of 200 older adults, categorized as 100 individuals who had experienced a fall within the past year and 100 who had not. Given the increasing frequency of falls with advancing age, 25% of the included individuals were selected from the age group 65–69 years, whereas 75% were selected from the age group of ≥ 70 years. Sample selection was performed using convenience sampling from the applicants of the five selected FHSs; 20 individuals with a fall history within the past year and 20 individuals without such a history were selected for each of the five FHCs during the intended period of 8 consecutive days of data collection. An older adult who experienced a fall was matched with a non-faller within a ±3 years age range to mitigate the potential confounding effect of age.

Participation rate

Of the adults invited to participate in the study, 43 refused to participate and 27 were unable to complete the interviews. Consequently, the participation rate in the first phase of the research was 75.0%. The overall sample size (n=200) was determined using new volunteers from the same FHCs during the same data collection period.

Inclusion and exclusion criteria

Inclusion criteria for this study were older adults ≥ 65 years of age, being cognitively competent,

and registered with the FHC from which the sample was selected. The participants' cognitive competence was assessed using the Mini-Mental State Examination. Older adults who did not meet the cognitive competence criteria were excluded.

Definition of fall

A fall, as defined by the World Health Organization, is "an event which results in a person coming to rest inadvertently on the ground, floor, or other lower level"(8). First, the participants were explained the definition of falling and were then encouraged to respond to the questions based on their experiences. If an individual had experienced two or more falls within the past year, it was considered a recurrent fall.

Instruments

The questionnaire battery included a sociodemographic and health survey, the AFPS, the Tinetti Balance and Gait Assessment, and the Frailty Scale.

Aachen Falls Prevention Scale

The AFPS was developed by Dr. Pape and colleagues in 2015 (9).The key distinguishing feature of the Aachen Falls Prevention Scale is encompassing both balance and risk assessment. A significant advantage of this scale in practical application is its ability to be utilized as a self-rated measure when necessary. The scale comprises three parts:

Part 1: The first part is referred to as the AFPS "Fall Index Score". It consists of 10 yes/no questions. Participants receive 1 point for each "yes" response and 0 points for each "no" response, resulting in a possible score range of 0 to 10. The cutoff score for this part was set at 4. Individuals scoring ≤ 4 are considered to have a low risk of falling, whereas those scoring ≥ 5 are categorised as having a high risk of falling (9).

Part 2: The second part is termed the AFPS "20-Second Standing Test". In this part, individuals are asked to stand still without holding onto anything, and the duration is measured. If a person can stand for ≥ 20 s, they are considered to be at low risk of falling.

Part 3: The third part is named the AFPS "Perceived Fall Risk Assessment". In this part, individuals rate themselves on a scale from 1 to 10 regarding their perceived risk of falling. Knobe et al. (10) determined a cutoff point of 4, while Rasche et al. (11) set a cutoff of 5 for this section.

Tinetti Balance and Gait Assessment Test

The Tinetti Balance and Gait Assessment Test, originally developed by Mary Tinetti in 1986 called Performance-Oriented Assessment of Mobility Problems in Elderly Patients, was later renamed the Tinetti Balance and Gait Assessment (12). The validity and reliability of the Turkish version were demonstrated by Onal et al. (13). This test comprises two parts with a total of 16 items: the first part includes 9 items assessing balance and the second part includes 7 items assessing walking ability. The scores range from a minimum of 0 points to a maximum of 28 points. The cutoff score for the total Tinetti score is set at 18. Individuals scoring ≤ 18 points are considered to have poor balance and gait.

The FRAIL Scale

The FRAIL Scale was developed by Moray in 2012 (14) and its validity and reliability in Turkish populations were evaluated by Hymabaccus in 2023 (15). This scale consists of 5 items and yields a total score ranging from 0 to 5. A score of 0 indicates non-frail, 1–2 points is considered pre-frail, and a score>2 indicates frail (14, 15).

Procedure

1. Translation and adaptation of the Aachen Falls Prevention Scale into Turkish

After obtaining official permission to adapt the AFPS into Turkish from the developers of the

instrument, a "consensus" version was created based on two independent forward translations from English to Turkish by a field expert. In cultural adaptation studies, it is commonly recommended that consensus versions, developed after forward translation from English to Turkish, undergo backward translation. This process allows for comparison and ensures conceptual equivalence by discussing the backward translation with the original developers of the scale. However, in this study, the developer of the scale did not request a backward translation, as indicated in the correspondence. Therefore, in accordance with the developer's preference, backward translation was not deemed necessary.

Following the development of the consensus version, five older individuals were individually recruited for "cognitive debriefing interviews" to evaluate their comprehension of the latest Turkish version and identify any perception problems. Based on the wording revisions agreed upon by the participants, the necessary changes were made to create the final Turkish field version of the AFPS. TheTurkish version of the scale is provided in Appendix 1.

2. Application of the study questionnaires battery to the study population

The sociodemographic and health survey was initially administered face-to-face to the participants at a convenient location in the Family Health Center. Following the application of the Tinetti test, the AFPS was administered in three parts: First, participants answered the 10 questions in the "Fall Index" section (part 1) of the AFPS. Second, participants were instructed to stand motionless without holding onto anything, and their standing time was measured in the "20-Second Standing Test" (part 2). A standing time of < 20 s indicates a higher fall risk. In the third and final part of the AFPS, known as the "Perceived Fall Risk", participants rated their own perceived risk of falling on a scale from 1 to 10.

3. Psychometric analyses

A summary of the reliability and validity analyses conducted on the AFPS is presented in Table 1 (n=200). Distributional characteristics of the scale were assessed for floor and ceiling effects, skewness, and kurtosis. A maximum value of 15% was used to determine acceptable floor and ceiling effects (16), while skewness and kurtosis values of 1.0 were established as the acceptable thresholds (17).

Validity and reliability analyses

A confirmatory approach was employed for the reliability and validity analyses conducted in this study. A summary of the methods used for reliability and validity analyses of the AFPS is presented in Table 1.

a-Reliability analyses

Internal consistency analysis was performed to assess the reliability of the first section of the scale (AFPS Index Score). The internal consistency of the scale was evaluated using two complementary methods: (1) calculating the Kuder-Richardson 20 (KR-20) values considering the dichotomous response options of the items and (2) item-total correlation coefficients.

b-Validity analyses

The validity of the Turkish version of AFPS was assessed using criterion validity and construct validity.

b1-Criterion validity

Criterion validity was examined separately for each of the three parts of the AFPS. Criterion validity is conventionally tested with a gold standard; in this study, a fall in the previous year was used as the gold standard (experiencing a falling incident within the past year). Sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio (+LR), negative likelihood ratio (−LR), and Youden's Index were calculated for the criterion validity analyses.

Table 1. Summary table of the methods used in the reliability and validity analyses for the Aachen Falls Prevention Scale

AFPS	Variable type	Characteristics of a distribution	Reliability	Validity
Part 1: Fall Index Score	Numeric (10 items) or Dichotomous (cut off value:4/5) (9)	-Mean ± SD -IQR -Skewness -Kurtosis -Floor and ceiling effect	-Internal consistency (KR-20). - Item Analysis (If item deleted KR-20 and Corrected item-total correlation)	- Criterion validity *(sensitivity/ specificity)* - Construct validity *(Exploratory Factor Analysis, Confirmatory Factor Analysis and Known-groups validity).*
Part 2: 20 second Standing Test	Dichotomous (yes/ no)	n / %	na*	- Criterion validity *(sensitivity/ specificity)* - Construct validity *(exploratory factor analysis, confirmatory factor analysis, known-groups validity, and concurrent -parallel forms- validity.*
Part 3: Perceived Fall Risk Assessment	Numeric (1 item) or Dichotomous (cut off value:4/5)[10]	-Skewness -Kurtosis -Floor and ceiling effect	na*	- Criterion validity *(sensitivity/ specificity)* - Construct validity *(known-groups validity).*

na: not applicable

When analysing the criterion validity of the first part, which was a numerical index, the index score was dichotomised from the 4/5 cutoff value, as suggested by the scale developers (18). A dichotomous outcome, such as "*can stand up/ cannot stand up*" was used for testing the criterion validity of part 2 (20 s standing test) of AFPS.

Concurrent validity, a subtype of criterion validity, was also tested using the Tinetti Balance for part 1 and part 2 scores of the AFPS.

b2-Construct validity

The construct validity of the scale was assessed using known-groups validity and confirmatory factor analysis (CFA).

In the known-groups validity analysis, variables for which significant differences in mean scale scores were expected among the subcategories were used (19). The scores from the first and third sections of the AFPS were used in the known-groups validity analyses.

CFA was applied only to the first part of the AFPS. The acceptable values for the goodness of fit parameters used in the CFA were considered as follows: Comparative fit index (CFI) and Tucker-Lewis Index (TLI) >0.95; root mean square error of approximation (RMSEA) ≤0.06, and chi-square/ degrees of freedom <2.0 (20).

Statistics

SPSS version 26.0 (IBM Corp.) was used for conventional statistical analyses, while Jamovi version 2.3 was employed for CFA analysis using the diagonally weighted least squares (DWLS) method. A Type I error threshold of <0.05 was applied to all statistical analyses.

4. Ethical issues and permissions

All participants provided informed consent to participate in the study. Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine(approval number: 20.478.486/1570, dated November 2, 2022).

RESULTS

Among the study participants, the proportion of women was 82.0% among those with a history of falling and 41.0% among those without. The mean age was 74.18± 6.37 for those with a history of fall and 72.67 ± 5.09 for those without. The other features of this study are presented in Table 2. Among older adults with a history of falling, 26% had a history of recurrent falls.

The distribution characteristics of the AFPS are presented in Table 3. Skewness and kurtosis values indicate a robust distribution, and floor and ceiling effects show acceptable measurement ability of parts 1 and 3 of the scale.

The overall KR-20 value was 0.58, which is a measure of the internal consistency of the Fall Index of the AFPS. The range of the item-scale correlations for the 10 items of the Fall Index was between 0.17

Table 2. Study sample characteristics

Variable	Category	Faller% (n=100)	Non-faller% (n=100)	p value
Gender	Women	82.0	41.0	<0.001*
	Men	18.0	59.0	
Age group	65–69	24.0	28.0	0.490*
	70-74	37.0	41.0	
	75 +	39.0	31.0	
Level of education	Elementary school and below	69.0	53.0	0.053*
	Middle school	4.0	9.0	
	High school and above	27.0	38.0	
Social class (based on current or previous employment status of the head of the household)	Upper Social Class	26.0	39.0	0.05*
	Lower/Middle Social Class	74.0	61.0	
Current employment status	Retired	53.0	72.0	0.001*
	Neither currently employed nor retired	46.0	23.0	
	Employed	1.0	5.0	
Marital status	Married	45.0	72.0	<0.001*
	Not married	55.0	28.0	
Social assurance	Yes, covered through spouse	47.0	24.0	0.003*
	Yes, covered through self	52.0	73.0	
	No social assurance	1.0	3.0	
Income perception	income < expenses	50.0	50.0	0.594*
	income = expenses	47.0	49.0	
	income > expenses	3.0	1.0	
Smoking	Yes	11.0	16.0	<0.001*
	Quit	16.0	44.0	
	No	73.0	40.0	

Table 2. Continued...

Variable	Category	Faller% (n=100)	Non-faller% (n=100)	p value
Alcohol consumption	Yes	5.0	6.0	0.756*
	No	95.0	94.0	
Frequency of meeting with relatives	Most of the time	84.0	87.0	0.486*
	Sometimes	8.0	9.0	
	Very rarely	8.0	4.0	
Frequency of meeting with neighbors	Most of the time	66.0	72.0	0.593*
	Sometimes	8.0	8.0	
	Very rarely	26.0	20.0	
Body mass index	Underweight/Normal (BMI<25.0)	29.0	37.0	0.023*
	Overweight (BMI=25.0-29.99)	31.0	41.0	
	Obese (BMI>29.99)	40.0	22.0	
Self-rated health	Good	70.0	77.0	0.533*
	Moderate	17.0	13.0	
	Poor	13.0	10.0	
Perceived health transition (compared to previous year)	Better	23.0	19.0	0.753*
	No Change	24.0	27.0	
	Worse	53.0	54.0	
Chronic diseases	No chronic diseases	12.0	18.0	0.344*
	One chronic disease	33.0	36.0	
	Two or more chronic diseases	55.0	46.0	
Polypharmacy (Five or more medication)	Yes	56.0	71.0	0.028*
	No	44.0	29.0	
Frequency of having adequate / balanced nutrition	Most of the time	78.0	84.0	0.279*
	Rarely/Occasionally	22.0	16.0	
Frequency of forgetting to drink water	Rarely forgets	61.0	69.0	0.027*
	Occasionally	24.0	10.0	
	Most of the time	15.0	21.0	
Difficulty falling asleep	Rarely has difficulty	46.0	60.0	0.140*
	Occasionally	23.0	17.0	
	Most of the time	31.0	23.0	
Trouble waking up early	Rarely wakes up	37.0	53.0	0.053*
	Occasionally	25.0	15.0	
	Most of the time	38.0	32.0	

*Chi Square

Table 3. The distribution characteristics of the Aachen Falls Prevention Scale

	n (%)	Mean	STD	IQR*	Skewness	Kurtosis	Floor effect (%)	Ceiling effect (%)
Part 1 (Fall Index Score)								
	na	4.53	2.02	3/6	0.16±0.17	-0.45±0.34	1.5	0.0
Part 2 (20 Second Standing Test)								
Successful	188 (94.0)	na	na	na	na	na	na	na
Failed	12(6.0)	na	na	na	na	na	na	na
Part 3 (Self Assessment of Fall Risk)								
	na	4.71	2.28	3/6	0.03±0.17	-0.78±0.34	10.5	1.5

na: not applicable

*Interquartile range

Table 4. The criterion validity of the Aachen Falls Prevention Scale

Reference: Faller/Non-faller in the past one year.	Sensitivity† %	Specificity‡ %	PPV †† %	NPV ‡‡ %	+LR†††	-LR‡‡‡
Part 1 (Fall index score) *(Cut offvalue:4/5)*[9]	71.0 (71/100)	75.0 (75/100)	73.95 (71/96)	72.11 (75/104)	2.84	0.39
Part 2 (20 sec. Standing test) *(can/can not stand up)*	10.0	98.0	83.3	52.12	5.0	0.91
Part 3 (Self assessment of fall risk) *(Cut off value: 4/5)*[10]	75.0	55.0	62.5	68.7	1.67	0.45

†: True positive / (True positive +False negative)
‡: True negative / (True negative + False positive)
††: Positive predictive value= True positive/ (True positive+ False positive)
‡‡: Negative predictive value= True negative/ (True negative+ False negative)
†††: Sensitivity / (1-Specificity)
‡‡‡:(1-Sensitivity) /Specificity

to 0.33 and none of the "if item deleted" KR-20 values of the items exceed overall KR-20 value of the Fall Index,indicating significant contribution of all the items to the fall index.

The criterion validity analyses of the three parts of the AFPS are presented in Table 4 with "presence or absence of previous fall experience" as the reference (criterion) test. The sensitivity and specificity for the first part of the AFPS were within moderately acceptable limits, while the specificity for the second part was nearly perfect, and the sensitivity for the third part was moderate. Part 2 had the highest +LR. However, part 1 emerged as the most effective test, considering both the positive and negative LRs. Sensitivity increased to 0.94 for part 1 and 0.88 for part 3 when recurrent falls were used as the reference test (not shown in the table).

The ROC curves for the AFPS index score (first part) yielded an area under the curve (AUC) of 0.809 (95% CI: 0.748–0.861), while for the AFPS perceived fall risk score (third part), the AUC was 0.712 (95%

Table 5. Known-Groups Validity of the Aachen Falls Prevention Scale

Independent variable	Variable categories	Part 1 Fall index score (ES) †	Part 2 20 sec. Standing test (Successful %)	Part 3 Self-assessment of Fall risk (ES) †
Age group	65-69/70-74/75+	0.02	98.1/96.2/88.6	0.008
Gender	Women / Men	0.88***	94.3/93.5	1.26***
Marital status	Married/Not married	0.74***	95.7/91.6	0.54***
Level of education	Elementary and below/ Middle/ High and above	0.04*	91.0/92.3/100.0*	0.02
Social class	Upper /Lower -Middle	0.69***	100.0/91.1*	0.50**
Body mass index	Normal / Overweight /Obese	0.03*	90.6 / 97.2 / 93.5	0.01
Perceived health compared to peers	Good/Moderate/Poor	0.09***	97.3 / 90.0 / 78.3*** (post hoc: a>b>c)	0.04**
Difficulty falling asleep	Rarely / Occasionally/ Most of the time	0.07***	96.2/90.0/92.6	0.04**
Frequent awakenings from sleep	Rarely/Occasionally/ Most of the time	0.07***	97.8/87.5/92.9	0.07***
Number of people living in the household	Alone/ Two or more	0.64*	90.4/95.3	0.50**
Feelings of loneliness	Rarely/Occasionally/ Most of the time	0.23***	98.0/97.4/87.7*	0.12***
Polypharmacy	Yes/No	0.55***	87.7/97.6**	0.16
Number of chronic diseases	1 or less/ 2 or more	0.36**	97.0/91.1	0.29*
Previous employment status	Upper Social Class / Lower Social Class	0.69***	100.0/91.1*	0.50**
EQ5-D	Healthy/Non healthy	0.98***	100.0/86.8***	0.84***
Frailty	Yes/No	0.97***	73.5/98.2***	0.87***

†Cohen'sEffect sizes (d) for comparing two group means based on group mean comparisons and eta-squared (η^2) for comparing three group means.
Significant at level: *p<0.05 **: p<0.01 ***: p<0.001

CI: 0.644–0.774). Both curves were statistically significant (p<0.01). The difference between the AUCs of the two ROC curves was 0.097 (95% CI: 0.020–0.174), which was statistically significant (p=0.01).

The AUCs of the "Fall Index" of the AFPS and Tinetti Balance scale differed significantly (p<0.001), with the Fall Index being superior (0.194, 95% CI 0.118–0.271). This indicates that the AFPS more effectively predicts decline than the Tinetti scale.

Construct validity of the AFPS was assessed using CFA analysis and known-groups validity. The RMSEA was 0.025 (90% CI: 0.00–0.059), chi-square/ degree of freedom was 1.13 (39.8/35.0), and the CFI was 0.94 for the one-dimensional model.

According to the known-groups analysis, the first and third parts of the AFPS showed discriminative ability across all known groups, whereas the 20-seconds standing test (second part) did not exhibit sensitivity to certain variables (Table 5).

DISCUSSION

The AFPS is one of the most recent self-assessment tools for assessing fall risk in older adults, which is adapted and validated. This study demonstrates that the Turkish version of the scale not only maintains acceptable conceptual equivalence with the original AFPS but also exhibits comparable reliability and initial validity findings. Both criterion validity and known-groups approaches provide robust evidence to support the clinical utility of the scale. This meticulous and comprehensive adaptation process ensured that most translation-related issues were resolved satisfactorily. Cognitive debriefing interviews with older adults facilitated the identification and rectification of elements that were culturally inappropriate for Turkey, ensuring the scale's cultural relevance and applicability.

Although the first and third parts of the AFPS are numerical variables, both their numerical and dichotomous properties were used in the validity analyses by applying cutoff points suggested in previous studies (10, 11,21).

The distribution characteristics of the first and third parts of the scale, including skewness, kurtosis values, and the presence of ceiling and floor effects, are within acceptable limits. These results confirm the measurement precision and reliability of these components.

Internal consistency could only be assessed for the first part, which consisted of ten items; the overall KR-20 value was close to the acceptable limit of 0.58. More importantly, no problematic items were identified in the first part, as indicated by the item-total correlation results and KR-20 values when any item was removed. The corrected item-total correlations for the individual items in the first part were >0.20 (except for one item). Additionally, the internal consistency coefficient (KR-20) remained stable or decreased when an item was removed (22).

Criterion validity of the "parts" of the AFPS were assessed using the "previous fall history" of an older adult as a reference test. When fall history was used as the reference test, the validity of the three parts of the AFPS was evaluated separately by calculating the LRs. The diagnostic power of part 1 was at an acceptable level (though not excellent); only the +LR value of part 2 was good, and part 3 was not considered an effective test. Ideally, a test with high diagnostic power is expected to have a +LR value >10.0 or a -LR value <0.1. At the very least, the +LR value should be >2.0 and the -LR value should be <0.5 (23).

The sensitivity and specificity values reported in studies by Knobe (10) and Rasche (11) examining the psychometric properties of the Aachen scale were similar to our results. In our study, the sensitivity and specificity results for perceived fall risk (part 3) were 0.75 and 0.55, respectively, compared to 0.56 and 0.64 in Knobe's study, and 0.67 and 0.88 in Rasche's study. In terms of +LR ratios, our results (+LR=1.66, -LR=0.45) were superior to those of Knobe (+LR=1,5 -LR=0,68) and similar to those of Rasche et al. (+LR=5.58, -LR=0.38).

We also compared the predictive ability of the first part (index score) and third part (perceived fall risk) of the AFPS using an ROC curve. The AUC value for the first section was significantly larger than that of the third section, indicating that the index score (part 1) is more predictive of fall risk than perceived fall risk (part 3). The AUC for the AFPS index score was 0.809 (95% CI: 0.748–0.861), while the AUC for the AFPS perceived fall risk score (part 3) was 0.712 (95% CI: 0.644–0.774). Both curves were statistically significant ($p<0.01$). The AUC for primary outcome of the AFPS were 0.692 and 0.873 as reported by Knobe (10) and Rasche (11), respectively, which are similar to our findings.

We tested the concurrent validity of the first part of the Aachen scale using the Tinetti Balance Test and found that part 1 of the AFPS was superior to

the Tinetti test when comparing the AUC of the ROC analyses. This indicates that balance tests such as Tinetti's may not be as predictive as the first part (index score) of the Aachen scale.

In CFA, a one-factor solution showed satisfactory goodness-of-fit indices for part 1 of the AFPS. The chi-square/degrees of freedom were found to be 1.13 (less than 3.0), the CFI was 0.97 (greater than 0.90), and the RMSEA was 0.025 (less than 0.08) (20).

To demonstrate the known-groups validity of the first and third parts of the AFPS, variables indicating factors related to the risk of falling, such as sex, age, employment status, number of people living in the household, individuals' perception of loneliness, number of medications being used (polypharmacy), number of chronic diseases, and frailty status, were tested. According to Cohen's guidelines, effect sizes of approximately 0.2, 0.5, and 0.8 were considered small, medium, and large, respectively (24). For eta-squared (η^2), values of approximately 0.01, 0.06, and 0.14 were considered small, medium, and large, respectively (25).

Known-groups validity analyses showed statistically significant relationships between the first and third dimensions of the Aachen Scale for all the independent variables. However, while female sex, marital status (not-married/widowed), high frailty, anxiety, depressive mood, and polypharmacy exhibited high effect sizes, medium effect sizes were observed for the variables of social class, number of people living at home, and body mass index (BMI). Advanced age and number of chronic diseases in older individuals and those living alone were statistically significant; however, both presented weak effect sizes.

The results of the known group comparisons for advanced age, female sex, lower social class, living alone, being unmarried/widowed, frailty, polypharmacy, number of chronic diseases, being overweight and obese, and anxiety/depression are consistent with the findings of previous studies (4,5,8).

LIMITATIONS

This study has some methodological limitations, including;

(1) Sample selection and environment in which procedures were applied. The older adults accepted for the study were selected from those who applied to Family Health Centers for any health problem, which may not represent the broader community of older adults.

(2) Additionally, administering the questionnaires and conducting risk assessments in a Family Health Center setting might have affected the level of cooperation of older adults.

(3)Data were collected at Family Health Centers because the Provincial Health Directorate's research committee denied our request to interview the older individuals at their homes, citing patient privacy concerns. Consequently, home safety (home ergonomics) measures in the participants' homes could not be evaluated.

CONCLUSION

The findings of this study showed that the psychometric results of the Turkish version of the AFPS, particularly part 1, were highly satisfactory. Notably, we demonstrated that the tool can predict the risk of falling in older individuals more successfully than commonly used balance tests, such as the Tinetti test. Therefore, the AFPS can be effectively used to assess fall risk among Turkish-speaking older adults in both hospital and primary healthcare settings.This attribute is particularly beneficial in primary healthcare settings, where ease of use and patient autonomy are essential. Effective fall risk assessments are crucial in countries such as Turkey, where physical dependency is high among the older people.

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Appendix 1. Turkish Version of 'Aachen Falls Prevention Scale'

Bölüm 1

1) İşitme veya görme ile ilgili sorununuz var mı?

1. Evet

2. Hayır

2) Son zamanlarda kendinizi güvende hissetmediğiniz veya düştüğünüz oldu mu?

1. Evet

2. Hayır

3)Düşmekten korkuyor musunuz?

1. Evet

2. Hayır

4) Uyku, kalp sorunları, idrar söktürücü veya yatıştırıcı ilaçlar alıyor musunuz?

1. Evet

2. Hayır

5) İstemsiz olarak idrar veya dışkı kaçırıyor musunuz?

1. Evet

2. Hayır

6) Unutkanlığınız var mı?

1. Evet

2. Hayır

7) Zaman zaman kendinizi yalnız hissediyor ve hayatınızın değersiz olduğunu düşünüyor musunuz?

1. Evet

2. Hayır

8) Düzenli olarak (baston, yürüteç gibi) yürümenize yardımcı araçlar kullanıyor musunuz?

1. Evet

2. Hayır

9) Parkinson, Artrit veya Romatizma gibi hastalığınız var mı?

1. Evet

2. Hayır

10) Evinizde düşmeye neden olabilecek engeller, faktörler (parçalı halı-kilim, kaygan zemin, karanlık ortam, kapı eşikleri, yerlerde alçak cisimler vb) var mı?

1. Evet

2. Hayır

Bölüm 2

Serbestçe durun, kimseye yaslanmayınveya tutunmayın, kolunuz, üst bedeniniz veya bacaklarınız ile dengenizi düzeltici bir hareket yapmanız gerekene kadar geçen süreyi ölçün.

1. 20 saniye veya daha fazla

2. 20 saniyeden az

Bölüm 3

Sonuç ve öz değerlendirme

Düşme ihtimalinizi 1 ila 10 (10 …maks. Risk) arasında nasıl derecelendirirsiniz?.....

Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.409
2024; 27(4):363-370

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Received : Sep 30, 2024
Accepted : Dec 04, 2024

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ORIGINAL ARTICLE

THE EXPERIENCE OF A TERTIARY CENTER: DISTRIBUTION AND CONSISTENCY OF THE ELECTRONEUROMYOGRAPHY REQUESTS AND THE FINAL NEUROPHYSIOLOGICAL DIAGNOSIS IN OLDER AGE

Abstract

Introduction: Electroneuromyography is a test to evaluate peripheral nervous system disorders in a laboratory setting. Considering accompanying comorbidities, the geriatric age group constitutes a naive and unique segment of society. This study aimed to determine the ratio of electroneuromyography requests in individuals over 70 to all electroneuromyography requests and the compatibility of the requests and preliminary diagnoses with the results, applied procedures, and the departments making the requests.

Materials and Method: We retrospectively reviewed the electroneuromyography reports of individuals over 70 who applied to our electroneuromyography laboratory between 2018 and 2023.

Results: After a five-year query, 1,056 records, 11.4% of all electroneuromyography requests, were detected. A combination of nerve conduction studies and needle electromyography was performed in 68.2% of the patients. Polyneuropathy was the most requested electroneuromyography test protocol (n = 490, 42.7%). The most frequent electrophysiological diagnosis was polyneuropathy (n = 336), followed by lumbosacral radiculopathy (n = 297) and median nerve entrapment neuropathy in the wrist segment (n = 258). The primary diagnosis and electrophysiological findings were consistent in 55.2% of the cases. Most physicians referring patients to our electroneuromyography unit were neurologists. There were no significant differences among the departments in terms of the compatibility between the clinical preliminary and electrophysiological diagnoses (p = 0.15).

Conclusion: Polyneuropathy was the most common peripheral nervous system disorder in our study's geriatric population. The combination of nerve conduction studies and needle electromyography was determined to be the most applied procedure. When we compared the departments' requests, there was no significant difference in compatibility.

Keywords: Aged; Electromyography; Geriatrics; Neuromuscular Diseases.

INTRODUCTION

Electroneuromyography (EMG) is one of the most important diagnostic tools in diagnosing neuromuscular diseases (1). It is considered a crucial part of the neurological examination and is directly linked to the appropriate referral preliminary diagnosis (2). It can be applied to any age group but is of particular significance in the geriatric population due to comorbidities that can obscure the clinical presentation; thus, making an accurate diagnosis is challenging. EMG not only distinguishes objectively complex diagnoses and helps to confirm the diagnosis but also prevents unnecessary additional and costly examinations and treatments.

The number of elderly individuals is increasing daily, and this demographic shift is significantly impacting the distribution of neuromuscular diseases. According to Turkish Statistical Institute data, the population aged 65 and over increased from 8.8% in 2018 to 10.2% in 2023. With the increase in the number of elderly individuals, the World Health Organization redefined the 0–17 age group as adolescents, the 18–65 age group as young people, the 66–79 age group as middle age, and age 80 and over as elderly individuals in 2017 (3). The rise in comorbidities among older individuals is leading to a shift in the distribution of neuromuscular diseases, making the study of EMG evaluation in the elderly a matter of increasing importance (4). Our aim in this study is to identify the common peripheral nerve diseases in elderly patients referred to our EMG laboratory, assess the compatibility between clinical preliminary diagnosis and final electrodiagnosis, and contribute to the electrophysiological knowledge belonging to this population.

MATERIALS AND METHOD

The individuals over 70 referred to our EMG unit from various departments between November 2018 and November 2023 were retrospectively screened. The physicians referring patients to our EMG unit were often neurologists, physical therapy and rehabilitation specialists, orthopedists, and internal medicine specialists. The departments from which the patients were sent were noted. Electrodiagnostic (EDX) tests were performed utilizing Keypoint.Net (Medtronic A/S, Copenhagen, Denmark) EMG machines. As per the requested protocol, motor and sensory nerve conduction studies (NCSs), F wave recordings, needle electromyography (nEMG), evoked potentials, single fiber EMG, repetitive nerve stimulation, tremor recording, autonomic nerve tests, and reflex studies were performed separately or in combination. Requested protocols, performed procedures, and final electrophysiological diagnoses were documented.

The examinations were conducted by the same three technicians, each with at least 10 years of experience, and were reviewed by the same two physicians, each with at least 20 years of EMG experience.

The EDX protocols were as follows: entrapment neuropathy (median, ulnar, peroneal), radiculopathy (cervical and lumbosacral), plexopathy (brachial and lumbosacral), cranial neuropathy, sciatic nerve injury, myasthenia gravis, myopathy, motor neuron disease, evoked potentials (such as visual evoked potential, somatosensory evoked potential [SEP], motor evoked potential, and brainstem auditory evoked potential [BAEP]), reflex studies, movement disorders, autonomic tests (heart rate variability analysis and sympathetic skin responses), and anal EMG.

The level of compatibility between the clinical preliminary diagnosis and the electrophysiological diagnosis was categorized as "yes," "no," "requiring further evaluation," or "no comment." The protocols in which compatibility could not be determined were evoked potentials, autonomic tests, anal EMG, and reflex studies. These tests are usually requested for a specific initial diagnosis and used for monitoring the disease prognosis. Our institution's local ethics committee approved this study with approval number SBA 23/396.

The data were analyzed using the IBM Statistical Package for Social Sciences (SPSS) program version 27.0 (Armonk, NY: IBM Corp.). A significance level of $p < 0.05$ was used/established for all analyses. Data were presented as numbers with percentages or mean with standard deviation or range. The chi-square test was employed for intergroup comparisons. However, Fisher's exact test was used if more than 25% of cells had a count lower than expected.

Since we used data from performed examinations, informed consent was not required.

RESULTS

A retrospective scan using the data collection system for the past five years revealed that 1,056 (11.4%) of 9,184 records were of individuals over 70 years. Approximately 211 electrophysiological examinations were performed on individuals over 70 annually. However, during 2020–2021, this number decreased to 116 due to the COVID-19 pandemic (Figure 1).

Of the 1,014 patients from the screened records, 556 (54.8%) were female, 458 (45.2%) were male, and the mean age was 76.6 ± 5.4.

Figure 1. Distribution of electrodiagnostic studies by years (≥70 and other age groups)

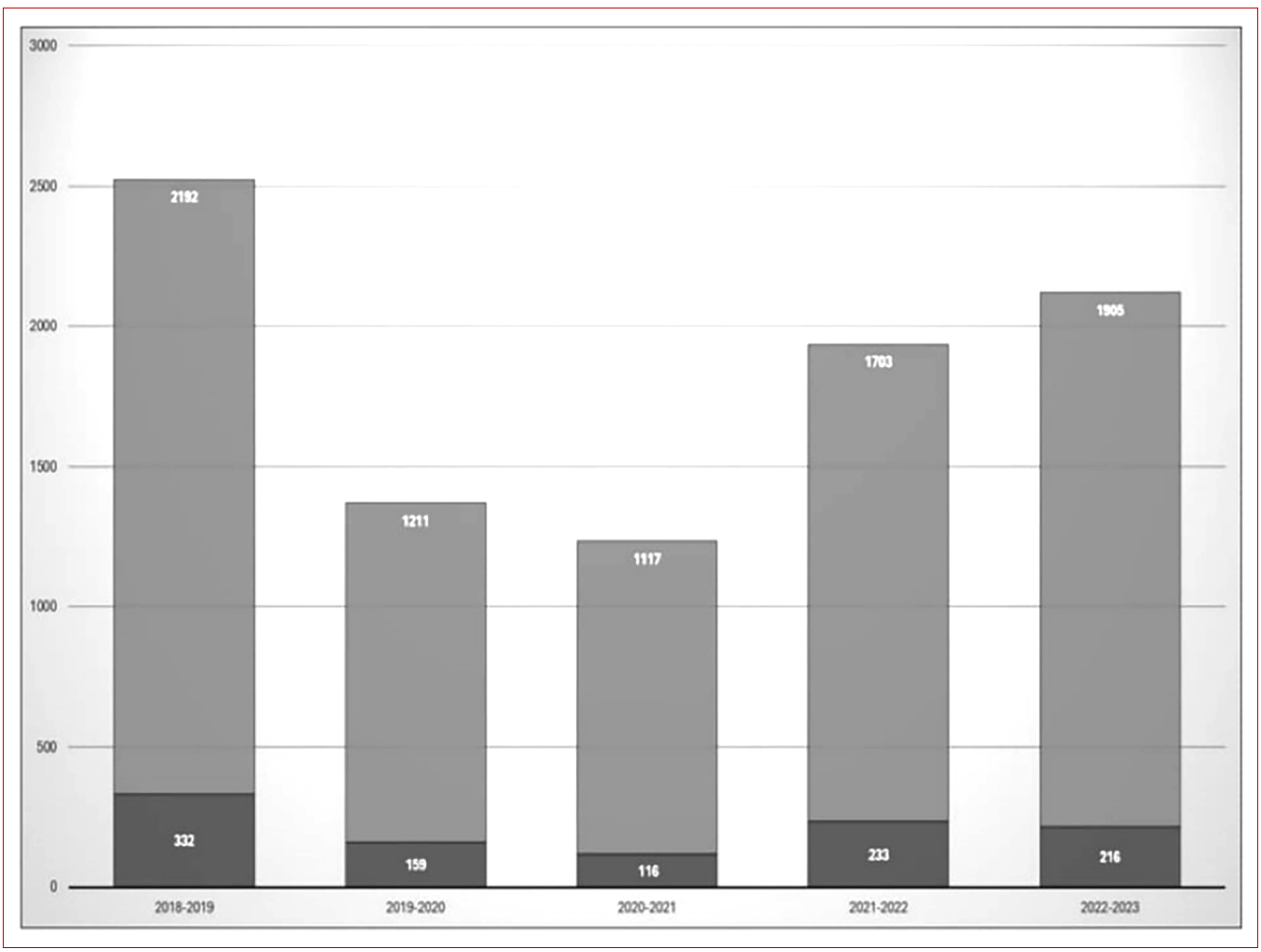
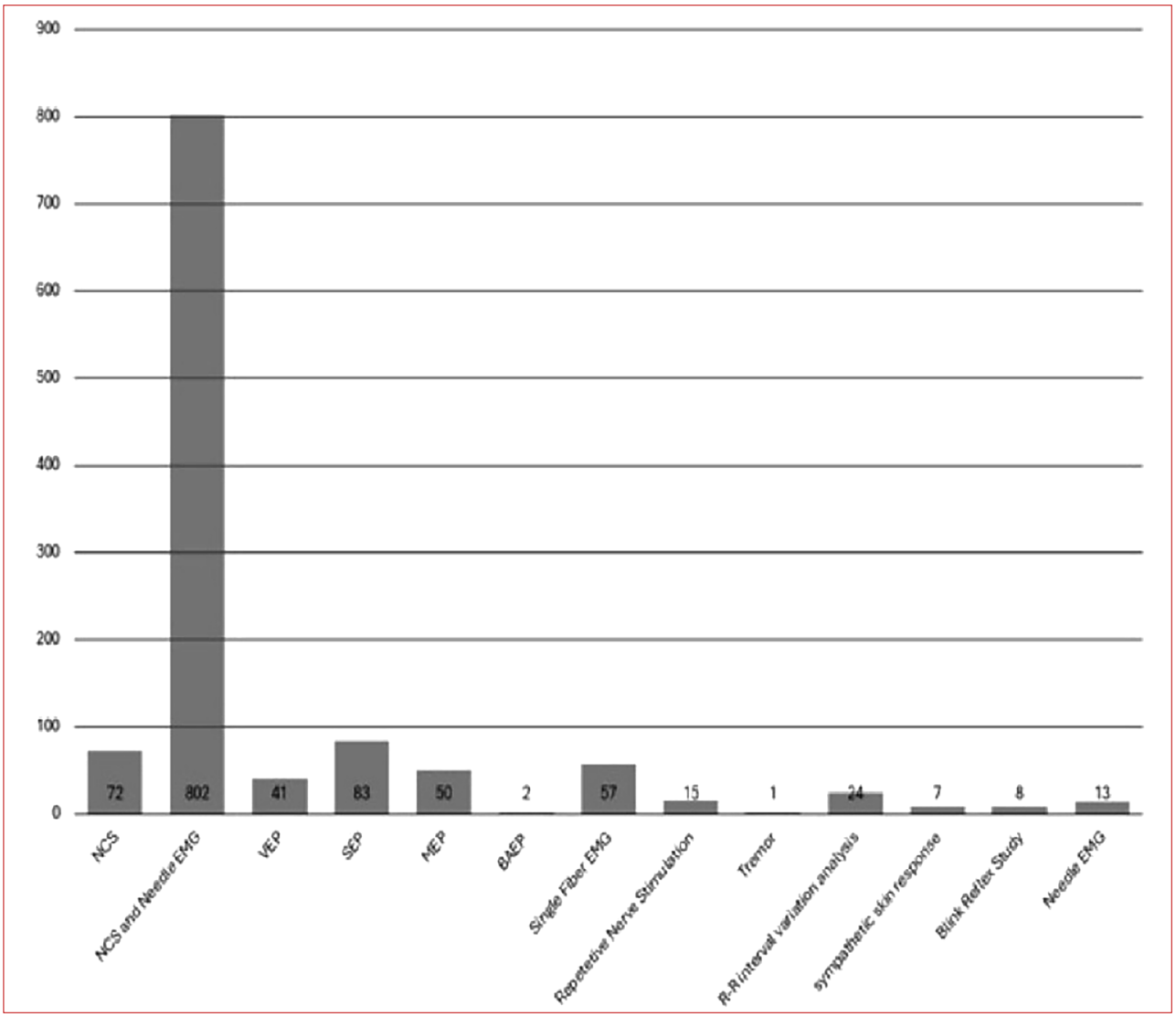


Table 1. Number of EMG requests of departments and rates of compatibility

Department	Number of Requests (n)	Compatibility with electrophysiological diagnosis (%)
Neurology	667	58.1
Internal Medicine	122	65.0
Physical Therapy and Rehabilitation	64	60.9

Figure 2. Distribution of the procedures performed



(NCS=Nerve conduction study, EMG=Electromyography, VEP=Visual evoked potential, SEP=Somatosensory evoked potential, BAEP=Brainstem evoked potential, MEP=Motor evoked potential)

When we screened the 1,056 procedures for age groups, 785, 243, and 28 belonged to the age groups 70–79, 80–89, and 90–99, respectively. We observed that compatibility was 54%, 56%, and 75%, respectively, for these age groups. It was noted that the percentage of compatibility increased with aging. However, no statistically significant difference was observed in compatibility between age groups (p=0.37).

EMG requests were for both outpatients and inpatients from many departments. The departments with the highest number of requests were neurology (n=667), internal medicine (n=122), and physical therapy and rehabilitation (n=64; Table 1). Requests were also received from many departments, such as orthopedy, neurosurgery, and intensive care. No significant difference was observed in the compatibility between the electrophysiological diagnoses and the clinical preliminary diagnoses among the departments (p=0.15).

More than one protocol could be requested in the same session (n=1,146). It was detected that the most requested procedure was the polyneuropathy protocol, with 490 requests (42.7%). It was followed by radiculopathy and entrapment neuropathy protocols.

More than one procedure could be performed in the same session (for example, polyneuropathy and SEP). The total number of examinations was 1,175. The most performed procedure was combined NCS and nEMG, constituting 68.2% (n=802) of all procedures (Figure 2). This was followed by SEP, 83

Table 2. Compatibility of electrophysiological diagnoses with requested protocols

Requested Protocol	Number of Requests (n)	Compatibility with electrophysiological diagnosis (%)
Entrapment Neuropathy	107	
Median nerve	103	82.6
Ulnar nerve	3	66.6
Peroneal nerve	1	100
Polyneuropathy	490	
GBS	16	56.2
Other axonal and demyelinating PNP	474	58.8
Radiculopathy	137	
Cervical	35	65.7
Lumbosacral	102	89.2
Brachial Plexopathy	8	75
Motor Neuron Disease	48	33.3
Cranial Neuropathy	9	
Facial nerve	5	83.3
Other cranial nerves	4	100
Myopathy	67	50.7
Myasthenia Gravis	65	33.8
Sciatic Nerve Injury	4	100
Radial Nerve Injury	3	66.6

*GBS=Guillain-Barre Syndrome; PNP=Polyneuropathy

(7%), and NCS, 72 (6%). Only one tremor record and two BAEP studies were noted as the least frequently performed examinations.

It was determined that polyneuropathy (*n*=336) was the most common electrophysiological diagnosis, followed by lumbosacral radiculopathy (*n*=297) and median nerve entrapment neuropathy in the wrist segment (*n*=258). Overall, 15.7% (*n*=166) of the examinations were reported electrophysiologically normal.

The preliminary and electrophysiological diagnoses were compatible in 55.2% (*n*=582) of the reports. However, this compatibility was not found in 32.4% (*n*=343) of the reports, and 1.8% (*n*=19) were in the follow-up decisions group. In 10.6% (*n*=112), no comment was made.

The requested protocols and electrophysiological diagnoses were evaluated separately, and the least compatibility was observed in the motor neuron disease (33%) and myasthenia gravis protocols (33%; Table 2).

DISCUSSION

EDX procedures are an extension of the neurological examination used to diagnose neuromuscular diseases (1). EMG in older individuals has distinct characteristics, including differences in the obtained data compared to adults and potential technical challenges due to the comorbidities. Given the growing older population in society, this issue is significant. Thus, it has become increasingly important to identify neuromuscular diseases in this age group.

The requests for EMG can vary depending on the healthcare institution, the referring department, and the physician. Mondelli and coworkers claimed that the most common request is the entrapment neuropathy protocol, especially for carpal tunnel syndrome (5). However, in our study, we observed that the most requested protocol was for polyneuropathy. In a study conducted at a tertiary reference center, as in our research, it was reported that the most common request was the polyneuropathy protocol, followed by radiculopathy (6).

The relatively low number of carpal tunnel syndrome, ulnar nerve lesions, and other focal neuropathies observed in our study, despite their high prevalence in the general population, was thought to be influenced by the limited number of patients referred from the orthopedics and neurosurgery departments. Additionally, it was considered that the plastic surgery and hand surgery departments, in addition to these specialties, may have directed such patients presenting with neuropathic complaints to conservative interventions based on their history and physical examination findings without the need for EMG studies, which could also contribute to the low patient numbers.

The incidence of polyneuropathy increases with aging (7). It was reported that the rates of neuropathic complaints were 26% in people aged 65–74 and 54% in people aged 85 and over (8). In our study, consistent with previous data, it was determined that the requests for polyneuropathy protocol and EDX diagnosis took precedence. The diagnoses of lumbosacral radiculopathy and median nerve entrapment neuropathy in the wrist segment followed the diagnoses of polyneuropathy. The median age at diagnosis of lumbosacral radiculopathy was reported to be 70 years (9). It is known that median nerve entrapment neuropathy in the wrist segment has a bimodal age distribution. Its first peak is reported to occur between ages 50 and 54, and its second peak occurs between ages 75 and 84 (10). A multicenter study examining EDX studies showed that abnormal findings were identified at a rate of 65% (11). However, our study found this rate to be higher, at approximately 85%.

Numerous studies have examined the difference between clinical preliminary diagnosis and EDX diagnosis. Studies investigating the correlation

between preliminary diagnosis of upper extremity requests and EDX studies have reported that this rate varies between 37% and 49% (12,13). Our study found the percentage compatibility between the clinical preliminary and electrophysiological diagnoses to be 55.2% (*n*=582).

The higher compatibility rates between abnormal EDX studies and clinical preliminary diagnoses/electrophysiological diagnoses in our study compared to other studies can be attributed to several factors. First, our center is a referral center, which can be explained by the fact that our referrals are also experienced. Additionally, the EDX pathology detection rate increases due to the higher rate of comorbidities in elderly individuals.

When evaluating the requested protocols and electrophysiological diagnoses separately, compatibility was lowest for the motor neuron disease (33%) and myasthenia gravis protocols (33%). This was likely due to the lower incidence of motor neuron disease and myasthenia gravis in this age group. Motor neuron disease typically occurs between ages 51 and 66, while myasthenia gravis has a bimodal onset age of 30–50 (14). However, it was believed that medical professionals requested these protocols to rule out these severe diseases in patients experiencing symptoms such as widespread weakness and swallowing and breathing difficulties.

In agreement with other studies, our study found that the compatibility between the clinical preliminary diagnosis and the electrophysiological diagnosis increased as age increased (15).

The neurology department made the highest number of requests, and there was no significant difference between the clinical preliminary diagnosis and the electrophysiological diagnosis compatibility with other departments. We believe that the lack of compatibility differences between departments might be because the neurology department verified the EMG protocols requested by inpatient services. Furthermore, in our study, more EMG examinations were performed in females (54.8%) than in males (45.2%), which is consistent with previous studies (16,17).

In conclusion, considering the increasing elderly population in the country, the importance of evaluating this group separately comes to the fore. Our study is critical because it is the most comprehensive examination of the characteristics of EDX studies in the geriatric age group.

Limitations

Polyneuropathies were not classified based on etiology (e.g., diabetic, chemotherapy-induced, vitamin deficiency-related). This limits the specificity of our findings regarding the underlying causes of polyneuropathies in the geriatric population.

The study reflects data from a single tertiary center, and the patient population is limited to those referred for electrophysiological studies. This may result in referral bias, affecting the generalizability of the findings.

Acknowledgments: None

Sources of Funding: No funding has been received for this study.

Conflicts of Interests: The authors have no competing interests.

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ORIGINAL ARTICLE

RISK FACTORS FOR 90-DAY MORTALITY IN CRITICALLY ILL ELDERLY PATIENTS UNDERGOING TRACHEOSTOMY

Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.410
2024; 27(4):371−382

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Received : Sep 19, 2024
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Abstract

Introduction: The ongoing debate surrounding the early and long-term mortality of critically ill elderly patients who undergo tracheostomy remains unresolved.

Materials and Method: The primary aim of this retrospective study is to define independent factors for 90-day mortality in critically ill elderly patients who underwent tracheostomy during their intensive care unit stays between November 1, 2010, and October 31, 2020, in an academic tertiary hospital. The data were analyzed using the Mann-Whitney U, chi-square, and Fisher's exact tests. Logistic regression analysis was performed to identify independent factors associated with 90-day mortality.

Results: A total of 585 elderly patients were included in the study. The 90-day mortality rate was 77.6%, which increased to 89.2% in one year. Vasopressor requirement (odds ratio [OR], 2.61; 95% confidence interval [CI], 1.46–4.57; p=0.001), hospital stay prior to intensive care unit admission >14 days (OR, 2.09; 95% CI, 1.18–3.68; p=0.011), occurrence of one or more periprocedural complications of tracheostomy procedure (OR, 2.27; 95% CI, 1.07–4.82; p=0.033), and patients with a Charlson comorbidity index ≥6 (OR, 1.57; 95% CI, 1.03–2.40; p=0.037) were identified as independent factors for 90-day mortality in critically ill elderly patients.

Conclusions: Elderly patients with respiratory failure who undergo tracheostomy procedures frequently require prolonged, complex care during hospitalization and after discharge. Further research is essential to develop predictive models for early and long-term mortality risk and to establish benchmarks for the quality of post-discharge care.

Keywords: Critical Care; Aged; Morbidity: Mortality; Tracheostomy.

INTRODUCTION

The proportion of the population comprising individuals aged 60 and above has been increasing for several decades. According to the World Health Organization, the number of people in this age group is projected to grow by 10% compared to 2015, reaching 22% in 2050 (1). This is also associated with increases in the number of people with severe diseases in the last years of life (2). Consequently, it can be reasonably assumed that the intensive care needs of elderly patients will increase over time.

The treatment and management of elderly patients in critical care settings present a distinctive set of challenges, largely due to functional limitations. Moreover, elderly patients are more susceptible to developing acute respiratory failure (3). Additionally, the rate of emergency department admission for respiratory failure in elderly patients was 48.6% (4). Age has also been identified as an independent factor for prolonged mechanical ventilation (5). Furthermore, elderly patients with chronic respiratory or cardiac disease are likelier to experience weaning failure (6). These factors render elderly patients more susceptible to undergoing a tracheostomy procedure, which also carries risks during and after the procedure, in addition to the risks associated with intensive care unit (ICU) follow-up. Several risk factors were identified with respect to mortality in elderly patients who underwent tracheostomy in the ICU. A previous study demonstrated that mortality in patients who underwent tracheostomy is more closely associated with underlying medical conditions than with complications related to the procedure itself (7). However, mortality due to tracheostomy complications is more prevalent in older age groups than in younger age groups (8,9). Conversely, another study demonstrated that mortality did not differ between age groups in surgical tracheostomy (10). The presence of comorbidities, including cardiac and hepatic disease, was identified as an independent risk factor for mortality in patients admitted to the emergency department due to tracheostomy complications. Furthermore, prolonged hospital stay was associated with an increased risk of mortality in patients with tracheostomy complications (8).

Consequently, we designed the present study to elucidate the undefined factors related to mortality among critically ill elderly individuals who underwent tracheostomy. These factors encompass patient and hospitalization characteristics, laboratory data, ICU follow-up-related major events and therapies, and the periprocedural and long-term complications of tracheostomy procedures.

MATERIALS AND METHODS

Study design, setting, and selection of participants

This retrospective study was conducted in the tertiary-level ICUs of Dokuz Eylül University after ethics committee approval (date: 22.12.2021 and IRB number:2021/38-13). The study included elderly patients (≥65 years) who underwent tracheostomy during their ICU stay between November 1, 2010, and October 31, 2020. Patients with COVID-2019 or related conditions were excluded from the screening process to avoid the potential confounders that could influence the results. This was due to the potential negative impact of the COVID-19 on mortality in the early stages of outbreak, which exceeded the capacity of health resources. Furthermore, the uncertainty of treatment practices for the disease during this period, and the lack of use of a vaccine, contributed to this decision. Patients with data loss and tracheostomy procedures performed as a component of difficult airway management were excluded. The study was conducted in accordance with the ethical standards set forth in the Declaration of Helsinki (11). The requirement for written informed consent was waived since the study was designed retrospectively.

Variables

All data were collected from electronic medical records. Demographic data, comorbidities, and

prognostic scores, including the Glasgow coma scale, Charlson comorbidity index (CCI), and acute physiology and chronic health evaluation II (APACHE II) scores, were recorded. The primary reasons for ICU admission and major events during the ICU stay were identified. These included ventilator-associated pneumonia (VAP), acute kidney injury (AKI), new-onset arrhythmia, cardiac injury, delirium, the occurrence of cardiopulmonary resuscitation (CPR), resulting in the return of spontaneous circulation (ROSC), sepsis, deep venous thrombosis and pulmonary embolism. Additionally, the administration of major therapies during the ICU stay, including vasopressor requirements and renal replacement therapy was documented. The duration of hospitalization, in total and prior to ICU admission; the length of intubation duration; and the ICU stay were recorded. Laboratory data, as well as periprocedural and long-term complications associated with the tracheostomy procedure, were also screened.

Definitions

The diagnosis of major events in the ICU was determined following a data evaluation in accordance with the current guidelines. The diagnosis of VAP was based on the definitions outlined in a previous study (12). Kidney disease-improving global outcome guidelines were employed to identify AKI (13). The diagnosis of new-onset arrhythmia was based on a comprehensive evaluation of electrocardiogram and cardiologic examination notes. Cardiac injury was defined as an increase in both HS-sensitive troponin I and troponin T levels above the 99th percentile upper reference limit (14). The presence of delirium was determined by a review of the daily medical records, including data from the confusion assessment method for the intensive care unit and information on the need for medical intervention to control the delirium symptoms. The presence of spontaneous circulation at least 24 hours after CPR was the criterion for ROSC. Sepsis was defined according to the Surviving Sepsis Campaign Guidelines (15). The diagnosis of DVT and PE was based on radiological evidence. The occurrence of bleeding due to tracheostomy procedure was documented in paper charts or operative notes. Desaturation was identified as oxygen saturation ≤93% for longer than one minute.

Outcomes

The primary outcome of this study was to identify independent factors for 90-day mortality among critically ill elderly individuals who underwent tracheostomy during their ICU stay. Secondary outcomes include the determination of patient characteristics, the incidence of periprocedural and long-term complications of tracheostomy, and early and long-term mortality.

Statistical analysis

Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) Version 24 (Armonk, NY, IBM Corp., US) statistical software package. Categorical variables were presented as numbers and percentages. Continuous variables were presented as the median and interquartile range. Continuous and categorical variables were compared in the univariate analysis using the Mann–Whitney U test and chi-square or Fisher's exact tests, respectively. A logistic regression analysis was employed to identify independent factors for 90-day mortality among critically ill elderly individuals who underwent a tracheostomy procedure during ICU follow-up. A model was constructed to incorporate the essential clinical variables and significant parameters identified in the univariate analysis. These included patient and hospitalization characteristics, prognostic scores, major events and therapies during the ICU stay, tracheostomy complications, and laboratory data, which were potential confounders. For each independent factor, an adjusted odds ratio (OR) and a confidence interval (CI) with a rate of 95% were stated. Statistical significance was determined by a two-tailed *p*-value of less than 0.05.

RESULTS

General Characteristics

A total of 9,573 patients admitted to the ICU between November 1, 2010, and October 31, 2020, were screened. Of these patients, 774 underwent tracheostomy procedure. A total of 632 elderly patients were included in the analysis. Subsequently, 47 patients were excluded from the study due to data loss (30 patients), lack of arterial blood gas analysis (15 patients), and tracheostomy procedures for the management of a difficult airway (2 patients). Finally, 585 elderly patients were included in the study.

The median age of the patients was 77 (70–86) years, and 59.0% were older elderly (Table 1). A total

Table 1. Patient Characteristics

Characteristics	90-day mortality			*P* value
	All (n = 585)	Deceased (n = 454)	Survived (n = 131)	
Age, years	77 (70–86)	77 (70–87)	77 (69–86)	0.49
Younger elderly (65–74 years)	240 (41.0)	187 (41.2)	53 (40.5)	0.92
Older elderly (≥75 years)	345 (59.0)	267 (58.8)	78 (59.5)	
Sex, male	333 (56.9)	257 (56.6)	76 (58.0)	0.84
APACHE II score[a]	18 (14–23)	19 (15–23)	17 (14–22)	0.08
CCI[a]	6 (4–7)	6 (5–7)	5 (4–7)	**0.016**
CCI ≥ 6	306 (52.3)	253 (55.7)	53 (40.5)	**0.003**
GCS[a]	9 (6–12)	9 (6–12)	9 (7–12)	0.20
Comorbidities	557 (95.2)	436 (96.0)	121 (92.4)	0.10
Hypertension	356 (60.9)	277 (61.0)	79 (60.3)	0.92
Diabetes mellitus	209 (35.7)	162 (35.7)	47 (35.9)	1.00
Coronary artery disease	165 (28.2)	136 (30.0)	29 (22.1)	0.10
Congestive heart failure	138 (23.6)	109 (24.0)	29 (22.1)	0.73
Malignancy	137 (23.4)	112 (24.7)	25 (19.1)	0.20
Solid organ malignancy	124 (21.2)	102 (22.5)	22 (16.8)	0.18
Hematological malignancy	13 (2.2)	10 (2.2)	3 (2.3)	1.00
COPD	136 (23.2)	114 (25.1)	22 (16.8)	**0.047**
CKD	130 (22.2)	102 (22.5)	28 (21.4)	0.91
Alzheimer's disease	104 (17.8)	75 (16.5)	29 (22.1)	0.15
Cerebrovascular disease	102 (17.4)	74 (16.3)	28 (21.4)	0.19
History of thromboembolism	28 (4.8)	23 (5.1)	5 (3.8)	0.65
Immunosuppression	24 (4.1)	23 (5.1)	1 (0.8)	**0.024**
Chronic liver disease	11 (1.9)	10 (2.2)	1 (0.8)	0.47
Obesity	7 (1.2)	6 (1.3)	1 (0.8)	N/A
Multimorbidity[b]	447 (76.4)	348 (76.6)	99 (75.6)	0.82

All values are expressed as numbers (percentages) or median (interquartile range).
Abbreviations: APACHE II score, Acute Physiology and Chronic Health Evaluation II score; CCI, Charlson comorbidity index; GCS, Glasgow coma scale; COPD, chronic obstructive pulmonary disease; CKD, chronic kidney disease; N/A, not applicable.
[a]Calculated on the day of ICU admission.
[b]Total number of comorbidities ≥2.

of 56.9% of the patients were male. In the univariate analysis, the median value of the CCI score and the number of patients with a CCI score of six or more were significantly higher in deceased patients than in survivors. Furthermore, deceased patients exhibited significantly higher rates of comorbidities, including chronic obstructive pulmonary disease (COPD) and immunosuppression, than survivors. The total number of comorbidities and multimorbidity were not found to differ significantly among elderly patients in relation to 90-day mortality.

Table 2. Major Events and Therapies During ICU Stay and Hospitalization Characteristics

Characteristics	90-day mortality			*P* value
	All (n = 585)	Deceased (n = 454)	Survived (n = 131)	
Reason for ICU admission				
Respiratory failure	333 (56.9)	262 (57.7)	71 (54.2)	0.49
Postoperative	143 (24.4)	111 (24.4)	32 (24.4)	1.00
Neurological disease	100 (17.1)	79 (17.4)	21 (16.0)	0.79
Septicemia	69 (11.8)	53 (11.7)	16 (12.2)	0.88
Congestive heart failure	39 (6.7)	30 (6.6)	9 (6.9)	0.85
Multi-trauma	22 (3.8)	17 (3.7)	5 (3.8)	1.00
Other	53 (9.1)	40 (8.8)	13 (9.9)	0.73
Major events during ICU stay				
Vasopressor requirement	523 (89.4)	417 (91.9)	106 (80.9)	**0.001**
Septicemia	523 (89.4)	402 (88.5)	121 (92.4)	0.26
VAP	447 (76.4)	333 (73.3)	114 (87.0)	0.001
AKI	421 (72.0)	333 (73.3)	88 (67.2)	0.19
Cardiac injury	418 (71.5)	317 (69.8)	101 (77.1)	0.12
Renal replacement therapy	267 (45.6)	216 (47.6)	51 (38.9)	0.09
New onset arrhythmia	154 (26.3)	125 (27.5)	29 (22.1)	0.26
Delirium	130 (22.2)	96 (21.1)	34 (26.0)	0.28
CPR resulted in ROSC	88 (15.0)	76 (16.7)	12 (9.2)	**0.037**
DVT	19 (3.2)	15 (3.3)	4 (3.1)	1.00
PTE	6 (1.0)	6 (1.3)	0 (0.0)	0.35
Length of				
Hospital stay, days	48 (31–79)	40 (28–59)	103 (64–145)	< 0.001
ICU stay, days	35 (22–56)	30 (20–44)	79 (37–119)	< 0.001
Hospital stay before ICU admission, days	4 (1–13)	6 (1–14)	2 (1–7)	**< 0.001**
Hospital stay before ICU admission >14 days	128 (21.9)	111 (24.4)	17 (13.0)	**0.006**
Intubation duration, days	15 (10–21)	15 (10–21)	14 (10–21)	0.95

All values are expressed as numbers (percentages) or median (interquartile range).

Abbreviations: ICU, intensive care unit; VAP, ventilator-associated pneumonia; AKI, acute kidney injury; CPR, cardiopulmonary resuscitation; ROSC, return of spontaneous circulation; DVT, deep venous thrombosis; PTE, pulmonary thromboembolism.

Table 3. Laboratory Data of the Patients

Laboratory test[a]	90-day mortality			*P* value
	All (n = 585)	Deceased (n = 454)	Survived (n = 131)	
WBC, x 10^3/µL	12.5 (9.4–16.7)	12.5 (9.4–16.7)	12.5 (9.4–17.0)	0.77
Neutrophil, x 10^3/µL	10.7 (7.9–14.7)	10.6 (7.8–14.7)	10.8 (8.1–14.6)	0.89
Hemoglobin, g/dL	10.0 (8.8–11.4)	9.9 (8.7–11.4)	10.4 (8.9–11.5)	0.10
Lymphocyte, x 10^3/µL	0.8 (0.5–1.2)	0.7 (0.5–1.2)	0.8 (0.6–1.3)	**0.048**
Platelet, x 10^3/µL	212.0 (142.0–286.5)	212.0 (140–285.0)	207.0 (148.0–309.0)	0.42
HS Troponin I, ng/L	0.06 (0.05–0.19)	0.06 (0.05–0.17)	0.07 (0.05–0.23)	0.49
Troponin T	27.0 (12.0–131.7)	30.0 (11.2–129.7)	23.3 (13.2–229.5)	0.54
D-dimer, ug/mL	4.0 (1.9–7.6)	4.0 (2.0–7.8)	3.8 (1.5–6.9)	0.18
BNP, pg/mL	423 (213–957)	466 (217–975)	363 (195–835)	0.19
BUN, mg/dL	36.0 (23.6–53.4)	36.1 (23.7–53.3)	34.0 (23.0–53.8)	0.81
Creatinine, mg/dL	1.20 (0.76–2.08)	1.20 (0.76–2.11)	1.26 (0.76–2.03)	0.95
Total Bilirubin, mg/dL	0.78 (0.56–1.11)	0.78 (0.56–1.10)	0.74 (0.56–1.18)	0.57
AST, U/L	32 (20–62)	31 (21–60)	33 (18–71)	0.91
ALT, U/L	21 (12–44)	20 (11–44)	21 (12–54)	0.56
LDH, U/L	301 (234–414)	304 (236–414)	295 (223–422)	0.45
ALP, U/L	89 (65–133)	91 (66–137)	83 (61–117)	**0.035**
CRP, mg/L	122 (57–197)	123 (58–192)	117 (48–217)	0.87
Procalcitonin, ng/mL	0.86 (0.27–4.66)	0.89 (0.29–4.59)	0.81 (0.20–5.40)	0.40
Arterial gas analysis				
pH	7.39 (7.31–7.45)	7.39 (7.31–7.45)	7.38 (7.31–7.45)	0.88
PCO_2, mmHg	37.0 (31.0–46.4)	37.2 (31.5–46.4)	37.0 (30.6–46.4)	0.44
PaO_2, mmHg	84.0 (66.2–122.5)	84.0 (65.8–124.4)	83.2 (69.0–121.0)	0.68
HCO_3, mEq/L	23.0 (20.0–26.6)	23.1 (20.0–26.4)	23.0 (19.1–27.0)	0.77
Lactate, mmol/L	1.5 (1.0–2.25)	1.4 (1.0–2.3)	1.6 (1.0–2.2)	0.54
SO_2, %	96.5 (92.0–98.8)	96.1 (92.0–98.9)	97.0 (93.0–98.5)	0.89
PaO_2 / FiO_2	208 (155–270)	206 (151–267)	218 (168–300)	0.15

All values are expressed as median (interquartile range).
Abbreviations: WBC, white blood cell; HS Troponin I, high sensitive troponin I; BNP, brain natriuretic peptide; BUN, blood urea nitrogen; AST, aspartate aminotransferase; ALT alanine aminotransferase; LDH, lactate dehydrogenase; ALP, alkaline phosphatase; CRP, C-reactive protein; PCO_2, partial pressure of carbon dioxide; PaO_2, partial pressure of oxygen; SO_2, oxygen saturation; FiO_2, fraction of inspired oxygen
[a]Performed on day of ICU admission.

Hospitalization characteristics, data related to ICU follow-up and laboratory

The most frequent significant reasons for ICU admission were respiratory failure, the need for postoperative follow-up, and neurological diseases (Table 2). The most common major events during ICU stays were vasopressor requirement, septicemia, and VAP. AKI development was observed in 72.0% of the patients, with 45.6% of them requiring RRT. A notable discrepancy was observed between deceased and surviving patients in vasopressor requirements and the need for CPR, resulting in

ROSC during the ICU stay. As anticipated, the length of hospital and ICU stays was notably longer in survivors than in deceased patients. The median length of hospital stays prior to ICU admission was significantly longer among the deceased patients than among the survivors. Moreover, the proportion of patients with a hospital stay prior to ICU admission exceeding 14 days was significantly higher in the group of patients who subsequently died than in those who survived.

Univariate analysis revealed no significant differences between the surviving or deceased participants with respect to most of the laboratory tests (Table 3). However, the median values

Table 4. Periprocedural and Long-Term Complications Related to Tracheostomy

Characteristics	90-day mortality			
	All (n = 585)	Deceased (n = 454)	Survived (n = 131)	*P* value
Tracheostomy method				
Percutaneous	497 (85.0)	382 (81.4)	115 (87.8)	0.33
Surgical	88 (15.0)	72 (15.9)	16 (12.2)	
Periprocedural complications	70 (12.0)	61 (13.4)	9 (6.9)	**0.046**
Atelectasis	27 (4.6)	26 (5.7)	1 (0.8)	**0.016**
Bleeding	21 (3.6)	18 (4.0)	3 (2.3)	0.59
Subcutaneous emphysema	8 (1.4)	8 (1.8)	0 (0.0)	0.21
Desaturation	8 (1.4)	8 (1.8)	0 (0.0)	0.21
Pneumothorax	6 (1.0)	5 (1.1)	1 (0.8)	1.00
Posterior esophageal wall injury	5 (0.9)	5 (1.1)	0 (0.0)	0.59
Tracheal ring injury	5 (0.9)	5 (1.1)	0 (0.0)	0.59
Pneumomediastinum	5 (0.9)	5 (1.1)	0 (0.0)	0.59
Cannula obstruction	4 (0.7)	2 (0.4)	2 (1.5)	0.22
Pulmonary aspiration	4 (0.7)	3 (0.7)	1 (0.8)	1.00
Esophageal damage	3 (0.5)	2 (0.4)	1 (0.8)	0.53
Unintended decannulation	3 (0.5)	3 (0.7)	0 (0.0)	1.00
Bronchospasm	2 (0.3)	1 (0.2)	1 (0.8)	0.40
Cardiac arrest	2 (0.3)	2 (0.4)	0 (0.0)	1.00
Hypercapnia	1 (0.2)	1 (0.2)	0 (0.0)	1.00
Long-term complications	35 (6.0)	19 (4.2)	16 (12.2)	**0.001**
Bleeding	14 (2.4)	11 (2.4)	3 (2.3)	1.00
Dysphagia	8 (1.4)	0 (0.0)	8 (6.1)	**< 0.001**
Stoma infection	6 (1.0)	4 (0.9)	2 (1.5)	0.62
Granulation	4 (0.7)	3 (0.7)	1 (0.8)	1.00
Tracheomalacia	3 (0.5)	0 (0.0)	3 (2.3)	**0.011**
Tracheoesophageal fistula	2 (0.3)	1 (0.2)	1 (0.8)	0.40
Stenosis	1 (0.2)	1 (0.2)	0 (0.0)	1.00

All values are expressed as number (percentages).
Abbreviations: N/A, not applicable.

of absolute lymphocyte count and alkaline phosphatase were slightly higher in the survivors than in the deceased patients.

Complications of tracheostomy

Most participants underwent percutaneous dilatational tracheostomy, which is an invasive procedure whereby a tracheal stoma is created by means of dilation to insert the tracheostomy cannula. (Table 4). There was no significant effect of the type of tracheostomy on 90-day mortality. The most common periprocedural complications were atelectasis, bleeding, subcutaneous emphysema, and desaturation. The results of the univariate analysis indicated that atelectasis following tracheostomy and the presence of at least one or more periprocedural complications were significantly more prevalent in deceased patients than in surviving patients. As anticipated, the overall rates of long-term tracheostomy complications, dysphagia, and tracheomalacia were significantly higher in surviving than in deceased patients.

Independent factors related to 90-day mortality

The in-hospital mortality rate was 83.9%. The 28-day mortality rate was 33.0%, which increased to 67.4% in 60 days, 77.6% in 90 days, 86.8% in six months, and 89.2% in one year.

The results of the logistic regression analysis are presented in Table 5. The analysis indicated that vasopressor requirement (OR, 2.61; 95% CI, 1.46–4.57; p = 0.001), hospital stay prior to ICU admission >14 days (OR, 2.09; 95% CI, 1.18–3.68; p = 0.011), occurrence of one or more periprocedural complications of tracheostomy (OR, 2.27; 95% CI, 1.07–4.82; p = 0.033), and patients with a CCI score ≥6 (OR, 1.57; 95% CI, 1.03–2.40; p = 0.037) were independently associated with 90-day mortality in critically ill elderly patients treated in the ICU.

Table 5. Independent Factors for 90-Day Mortality

Factors related to 90-mortality	OR (95% CI)	*P* value
Major events and therapies during ICU stay		
Vasopressor requirement	2.61 (1.46–4.57)	**0.001**
CPR resulting in ROSC	1.85 (0.96–3.58)	0.07
Hospitalization characteristics		
Hospital stay prior to ICU admission >14 days	2.09 (1.18–3.68)	**0.011**
Complications related to tracheostomy procedure		
Occurrence of one or more periprocedural complications	2.27 (1.07–4.82)	**0.033**
Prognostic scores		
Patients with a CCI ≥6	1.57 (1.03–2.40)	**0.037**
Laboratory data		
Lymphocyte count	0.87 (0.74–1.02)	0.09
Comorbidities		
COPD	1.54 (0.90–2.62)	0.11
Age		
Older elderly (≥75 years)	0.97 (0.64–1.48)	0.90

Abbreviations: OR, odds ratio; ICU, intensive care unit; CPR, cardiopulmonary resuscitation; ROSC, return of spontaneous circulation; COPD, chronic obstructive pulmonary disease; CCI, Charlson comorbidity index.

DISCUSSION

The present study, which examined the risk factors for mortality among critically ill elderly individuals who underwent tracheostomy in the ICU, revealed a 28-day mortality rate of 33% and a relatively high mortality rate of 77.6% at 90 days, which increased to 89.2% at one year. The study demonstrated that vasopressor requirements, the length of hospital stay before ICU admission exceeding 14 days, the occurrence of one or more periprocedural tracheostomy complications, and a score of CCI ≥6 were independently associated with 90-day mortality.

Mortality in critically ill elderly patients is associated with multiple factors. The ongoing debates regarding the direct relationship between age and mortality have been almost finalized following the definition of the concept of frailty, which offers insights based on declines in physiologic function and reserve across organ systems. Frail patients have a reduced ability to regain physiological homeostasis after a destabilizing and stressful event. Increased proinflammatory cytokines and chronic inflammation have been shown in this population. In addition, sarcopenia, lower levels of sex steroids, IGF-1, vitamin D and other hormones such as cortisol cause weakness in the musculoskeletal system and impaired mobility. For these reasons, frailty is associated with pathophysiological, social and health care problems that increase the risk of morbidity and mortality (16). Furthermore, frailty is the most common condition leading to death in the last five years of life in patients aged ≥70 years (2). Although age is an unreliable predictor of prognosis, mortality tends to increase with age among the elderly (3,17). In contrast, a study analyzing tracheostomy-related complications reported as a cause of death demonstrated that the base rate of mortality was tenfold higher in children than in adults (18). However, a study comparing elderly and non-elderly patients admitted to the emergency department due to tracheostomy complications revealed that old age is a predictor of death (8). Tamir et al. (9) revealed that the 30-day mortality rate was higher in older patients than in younger patients following surgical tracheostomy procedure. A further study comparing younger (65–74 years-old) and older elderly (≥75 years) patients who underwent tracheostomy indicated that mortality did not differ by age (10). The present study did not determine any increases in mortality with age or significant differences between younger and older elderly individuals. Regrettably, this study did not document whether the patients were frail.

Severity scores have been identified as mortality predictors among elderly individuals (3). In the present study, the CCI score, which predicts long-term mortality by considering the combinations of comorbidities and age, demonstrated a significant difference between deceased and surviving patients. However, the presence of at least one comorbidity or multimorbidity was not associated with 90-day mortality in the univariate analysis. In contrast, a previous meta-analysis comparing elderly patients with and without multimorbidity revealed that the number of comorbidities was related to an increased risk of death (19). In the univariate analysis, comorbidities, immunosuppression, and COPD were associated with 90-day mortality. The mortality risk among elderly patients with COPD who require positive pressure ventilation via tracheostomy in the wards or at home may be attributed to the challenges encountered in managing these patients. As anticipated, individuals of advanced age and immunosuppression are at an elevated risk of developing infectious complications, which may result in mortality. Moreover, Fimognari et al. (4) demonstrated that elderly patients with respiratory failure due to congestive heart failure or COPD have a lower risk of death than those with other causes of respiratory failure. However, in a previous study, comorbidities heart and liver disease were identified as independent factors leading to mortality in patients admitted to the emergency department due to tracheostomy complications (8).

The risk of death for critically ill elderly individuals is directly related to the necessity of major supportive therapies and the occurrence of serious adverse events in the ICU, as well as the primary reason for ICU admission. Notably, the present study identified vasopressor requirements and occurrences of CPR resulting in ROSC as risk factors for 90-day mortality. Previous studies have demonstrated that AKI, metabolic acidosis, sepsis, hypotension (17), vasopressor requirement (3), alteration in mental status (17), the need for mechanical ventilation (3), and respiratory failure (17) are risk factors for mortality in elderly patients. In contrast with the present study, Vallet et al. (3) identified diagnosis at ICU admission as a risk factor for mortality. Moreover, a low functional status and a body mass index comparable to that of frailty have been identified as risk factors for mortality among elderly patients (3,20). A previous study demonstrated that the rate of 30-day mortality in elderly patients after in-hospital cardiac arrest increases incrementally with age (21). The conditions observed in patients who experienced in-hospital cardiac arrest in a location with cardiac monitoring, which is typically provided in an ICU, resulted in improved survival (21). Nevertheless, long-term mortality following in-hospital cardiac arrest appears to be particularly related to the level of neurological disability at the time of discharge (22).

One of the factors that influences mortality in critically ill individuals is the timing of ICU admission. In-hospital mortality in patients hospitalized in the wards for more than 15 days is significantly higher than that of other patients (23). Furthermore, age was identified as a mortality predictor in relation to the length of stay on the wards before ICU admission (23). A further study comparing elderly and non-elderly patients with tracheostomy complications identified that longer hospital stays were associated with in-hospital mortality (8). Similarly, the present study identified that hospital stays before ICU admission exceeding 14 days were predictors of 90-day mortality. Evidently, patients with complex issues requiring therapeutic processes or who are unresponsive to treatment require longer hospital stays. Nevertheless, prolonged hospitalization may contribute to the development of complications, thereby increasing the risk of death.

Previous studies have investigated the relationship between laboratory data and mortality in elderly patients. A few studies have presented novel frailty indexes that include laboratory tests as markers of cellular aging. These indexes have been identified as reliable assessment tools for predicting long-term mortality in elderly individuals (24,25). However, the present study did not identify a specific set of laboratory tests for the prediction of mortality, except for a lower count of lymphocytes in deceased patients than in survivors.

The impact of tracheostomy complications may also be associated with mortality. In a study of adult patients, the overall complication rate was 3.2%, and the in-hospital mortality rate was 19.2% (7). Another study analyzing over 25.5 million reported deaths over a 10-year period stated that the rate of tracheostomy-related deaths was 2.43% (18). In the aforementioned study, tracheostomy-related deaths were likeliest to occur in a hospital setting and in African American children, adults, and Hispanic adults. Another study found no discernible difference in the incidence of intraoperative complications associated with surgical tracheostomy procedure between deceased and surviving patients. Furthermore, the timing of tracheostomy did not appear to influence the incidence of tracheostomy-related complications (9). A large cohort study examining adult patients found that in-hospital mortality is more commonly related to underlying diseases than tracheostomy complications (7). In the present study, the presence of at least one periprocedural complication was a predictor of 90-day mortality. As anticipated, long-term complications, such as tracheomalacia and dysphagia, were more prevalent in survivors than in

deceased patients. Additionally, lower educational levels and procedures performed on weekends and at non-teaching hospitals were identified as additional factors associated with complications of tracheostomy-related deaths (7,18).

LIMITATIONS

The present study is subject to limitations. The results are based on retrospective data from a single center, which requires the support of further studies to generalize the findings. Moreover, the necessity of mechanical ventilation and decannulation at discharge may be associated with mortality. However, due to the unavailability of data, we could not consider these conditions. We also did not consider the patients' frailty status.

Nevertheless, this study has several notable strengths. It included a relatively large sample size, allowing for a robust analysis. The determination of long-term mortality in this population constitutes a notable contribution to a specific research field. Furthermore, the study analyzes numerous subsets of mortality-related factors.

CONCLUSION

The management of elderly patients in critical care settings presents a set of challenges, particularly for those with respiratory failure who undergo tracheostomy. Multiple factors influence in-hospital and long-term mortality, and the prediction of mortality remains an unresolved issue. The decision-making process for tracheostomy is especially complex in this context. Moreover, the quality of patient care following discharge significantly determines long-term outcomes. Further studies should be conducted to address the prediction of early and long-term mortality as well as the establishment of benchmarks for the quality of post-discharge care in critically ill elderly patients who undergo tracheostomy.

Funding: The authors declared that this study had received no financial support.

Competing interest: There is no conflict of interest among the authors.

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ORIGINAL ARTICLE

EVALUATION OF DRY EYE AND MEIBOMIAN GLAND DYSFUNCTION IN CASES OF UNILATERAL BLEPHAROPTOSIS

Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.411
2024; 27(4):383-389

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Abstract

Introduction: Dry eye is a prevalent public health issue among the geriatric population. When accompanied by blepharoptosis, it carries the potential for complications.

Materials and Method: The study involved the evaluation of dry eye survey scores, dry eye tests, and the structure of meibomian glands by meibography in 25 cases of unilateral blepharoptosis. Comparisons were made between ptotic and non-ptotic eyes. In addition, measurements of levator function, palpebral fissure distance, and margin reflex distance were recorded for both ptotic and non-ptotic eyes, and the relationships between these parameters were analyzed.

Results: No significant differences were found between the ptotic and non-ptotic eyes in terms of tear break-up time, Schirmer 1 test results, or meiboscores in cases of unilateral blepharoptosis. However, the non-ptotic upper eyelids showed a greater area of loss in the meibomian glands compared to the ptotic eyelids.

Conclusion: In cases of unilateral blepharoptosis, while a reduction in dry eye parameters was observed bilaterally, an increase in the degree of ptosis was associated with a bilateral decrease in tear production. No significant difference was found between the ptotic and non-ptotic upper eyelids in terms of meiboscores. Blepharoptosis does not appear to cause significant alterations in the meibomian glands.

Keywords: Blepharoptosis; Dry Eye; Meibomian Gland Dysfunction.

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Received : Oct 06, 2024
Accepted : Nov 27, 2024

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INTRODUCTION

Dry eye is a multifactorial disease that arises from the disruption of tear film stability on the ocular surface, leading to symptoms such as burning, stinging, and redness. It develops as a result of decreased tear production or conditions that cause increased evaporation on the ocular surface. The condition becomes symptomatic with an increase in tear osmolarity and ocular surface inflammation. In advanced and prolonged cases of dry eye, destructive complications such as corneal vascularization, ulceration, perforation, and even vision loss may occur.

Age-related eyelid laxity and metaplasia at the meibomian gland orifices contribute to the increased incidence of blepharoptosis and dry eye in elderly patients (1). Therefore, dry eye is widely recognized as a significant public health issue in the geriatric population (2).

Studies have shown that in blepharoptosis, the atony and atrophy of the tarsal muscles surrounding the meibomian glands can cause a decrease in glandular secretion, potentially resulting in evaporative dry eye (3). Moesen et al., on the other hand, demonstrated that dry eye could be a contributing factor in the development of blepharoptosis (4). The increased orbital muscle tone caused by dry eye may lead to dehiscence and weakening of the levator aponeurosis at its attachment site, thereby contributing to the development of ptosis. Following ptosis surgery, dry eye symptoms may intensify as a result of the increased distance between the lower and upper eyelids (known as palpebral fissure distance [PFD]) and increased exposure of the ocular surface to ultraviolet effects due to inadequate eyelid closure (5).

The meibomian glands are responsible for the secretion of the lipid layer of the tear film, while the production of the aqueous layer is carried out by the lacrimal gland and accessory lacrimal glands. In eyelid operations performed with the conjunctival approach, if an incision is made on the tarsus, the meibomian glands located within the tarsus may be affected. Conjunctival operations that avoid the tarsus may have an effect on the accessory lacrimal glands of Wolfring and Krause, situated at the upper boundary of the tarsus and within the conjunctival fornix. This can lead to both aqueous-type and evaporative-type dry eye, associated with the increase in PFD. Therefore, in cases of ptosis, assessing dry eye and the status of the meibomian glands is crucial for planning the surgical approach and avoiding severe postoperative dry eye.

This study aimed to assess the meibomian glands in the ptotic and non-ptotic upper eyelids along with dry eye tests in unilateral blepharoptosis cases and explore the relationships between them.

METHODS

Patients presenting to the ophthalmology clinic of the tertiary hospital with unilateral blepharoptosis between June 2024 and August 2024 were included in the study after undergoing comprehensive ophthalmologic examinations. The data obtained from the ptotic and non-ptotic eyes of the cases were compared. Only patients without any other ocular pathology, who did not have a history of contact lens use, ocular trauma, or surgery were considered eligible. Informed written consent was obtained from all participants prior to their inclusion in the study.

The degree of ptosis in each case was evaluated using margin reflex distance (MRD), PFD, and levator function (LF) measurements. MRD was defined as the distance between the upper eyelid margin and the corneal light reflex. PFD was measured as the distance between the upper and lower eyelid margins. To measure LF, the patient was instructed to gaze downward as much as possible, and the position of the upper eyelid's lash edge was recorded on a ruler. Then, the patient was directed

to gaze upward as much as possible. The distance covered by the lash edge on the ruler was measured and recorded as the LF measurement.

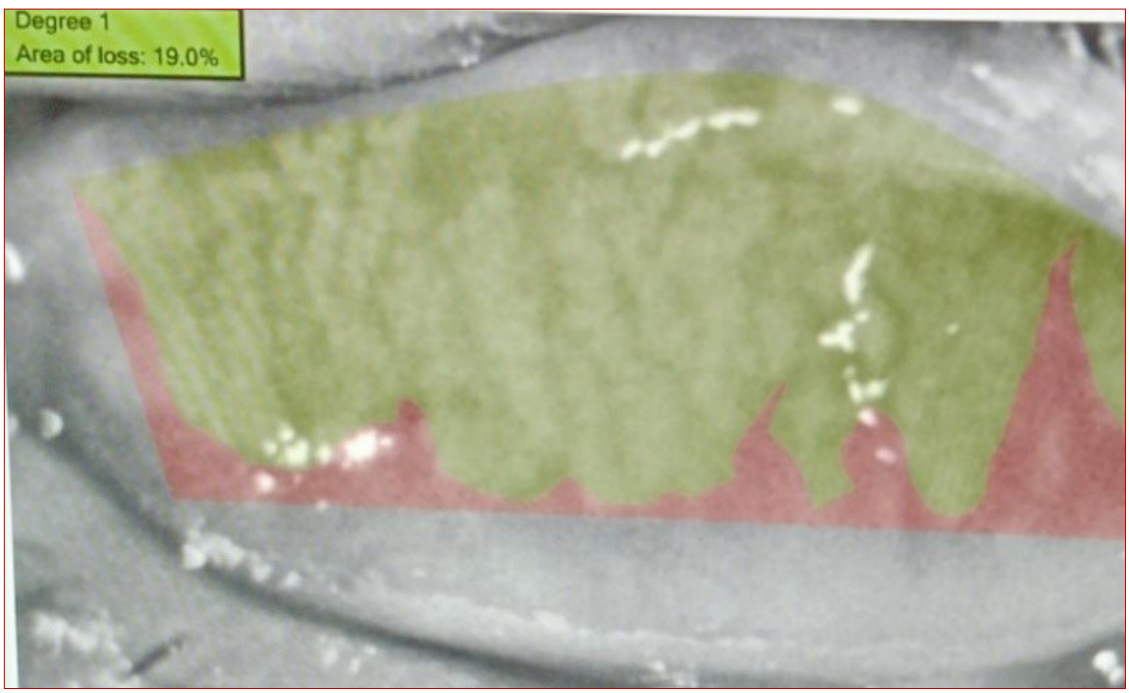
Dry eye symptoms were assessed using the Ocular Surface Disease Index (OSDI) questionnaire, a 12-question survey (6). The OSDI scores were categorized as follows: "normal" for scores between 0 and 12, "mild" for 13–22, "moderate" for 23–32, and "severe" for 33–100.

The evaluation of dry eye included the Schirmer 1 test and tear break-up time (TBUT) measurements. For the Schirmer 1 test, a specialized filter paper was placed in the lower eyelid's temporal conjunctiva, and the amount of tear production at 5 minutes was recorded as the Schirmer 1 value (7). For TBUT measurement, fluorescein paper was applied to the tarsal conjunctiva, and the corneal surface was examined under the blue light filter of a slit lamp. The time taken for the first corneal dry spot to appear after the patient blinked was recorded as the TBUT value (8). A Schirmer score below 5 mm and a TBUT below 10 seconds were considered indicative of dry eye.

To assess the meibomian glands, the upper eyelid was everted, and meibography was performed using the Sirius topography (CSO, Italy) to capture infrared images of the tarsal structure of the upper eyelid. Meibomian glands were marked manually on the images taken by the device. The ratio of the area of meibomian gland loss automatically detected by the device to the entire tarsal area (area of gland loss [AOL]), along with the meiboscore, were recorded (Figure 1). Meiboscores were categorized as follows: Grade 0 (no loss), Grade 1 (<25% loss), Grade 2 (25–50% loss), Grade 3 (50–75% loss), and Grade 4 (>75% loss) (9). Measurements were performed by the same specialist (Ş.S.) three times, and their averages were taken.

The study was conducted in accordance with the criteria of the Declaration of Helsinki after receiving approval from the Institutional Ethics Committee (date: June 6, 2024; decision number: 8/5).

Figure 1. Measurement of meibomian gland loss using the Sirius topography.



Statistical Analysis

The statistical analyses of the study findings were performed using SPSS 2027 software. Quantitative variables were presented as mean, standard deviation, median, minimum, and maximum values. The Shapiro-Wilk test and box plot graphs were used to assess the normality of the data distribution. For intra-group comparisons, the Wilcoxon signed-rank test was used for non-normally distributed variables, while the paired-samples t-test was employed for normally distributed variables. The relationships between variables were evaluated using Pearson's or Spearman's correlation analysis, depending on the distribution. Results were considered statistically significant at a 95% confidence interval, with a significance level of $p < 0.05$.

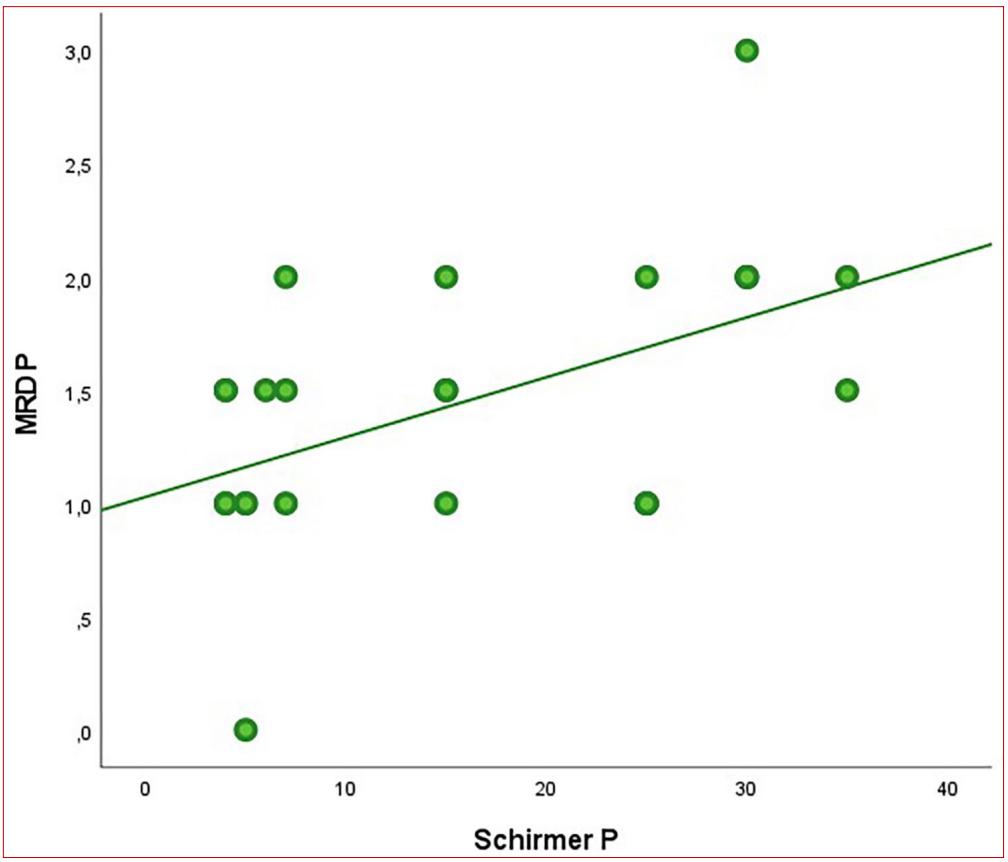
RESULTS

The study included 25 patients with unilateral blepharoptosis, consisting of 12 females and 13 males, with a mean age of 69 ± 10.6 years (range: 59–80 years).

The mean OSDI scores of the ptotic and non-ptotic eyes were 9.8 ± 3.2 and 9.8 ± 3.1, respectively. According to the OSDI scoring, 84% of the patients were classified as normal, while 16% were classified as having mild dry eye symptoms.

In 84% of both ptotic and non-ptotic eyes, the TBUT was less than 10 seconds. Schirmer test measurements were below 5 mm in 16% of the ptotic eyes and 8% of the non-ptotic eyes. There were no statistically significant differences between

Figure 2. Correlation between Schirmer test values and margin reflex distance in ptotic eyes



the ptotic and non-ptotic eyes in terms of TBUT or Schirmer 1 measurements (p>0.05).

Correlation analysis conducted between the degree of ptosis and parameters affecting the choice of surgical method, including MRD, PFD, and LF values, and dry eye parameters revealed a statistically significant positive correlation between BUT and LF in ptotic eyes (r=0.655, p=0.001; p<0.01). In contrast, no statistically significant relationship was found between BUT and PFD or MRD values in ptotic eyes (p>0.05). Similarly, no statistically significant correlations were observed between BUT and LF, PFD or MRD values in non-ptotic eyes (p>0.05).

No statistically significant correlation was found between Schirmer values and LF in ptotic eyes (p>0.05). However, there was a statistically significant positive correlation between Schirmer values and both PFD (r=0.667, p=0.001; p<0.01) and MRD (r=0.529; p=0.007; p<0.01) in ptotic eyes (Figure 2). No statistically significant correlations were detected between Schirmer values and PFD, MRD, or LF in non-ptotic eyes (p>0.05) (Table 1).

AOL measurements were significantly higher in non-ptotic eyes compared to ptotic eyes (p=0.001; p>0.01) (Table 2).

Table 1. Correlations of TBUT and Schirmer 1 Test Values with PFD, MRD, and LF

		TBUT, ptotic	TBUT, non-ptotic	Schirmer, ptotic	Schirmer, non-ptotic
PFD, ptotic	r	0.373	0.276	0.667	0.533
	p	0.066	0.182	0.001**	0.006**
PFD, non-ptotic	r	0.291	0.144	0.225	0.067
	p	0.157	0.492	0.281	0.750
MRD, ptotic	r	0.190	0.003	0.529	0.361
	p	0.363	0.988	0.007**	0.077
MRD, non-ptotic	r	0.494	0.032	0.481	0.305
	p	0.012*	0.878	0.015*	0.138
LF, ptotic	r	0.655	0.486	0.324	0.190
	p	0.001**	0.014*	0.114	0.363
LF, non-ptotic	r	0.316	0.321	0.118	0.058
	p	0.124	0.118	0.575	0.784

r: Spearman's correlation test, *p<0.05, **p<0.01
LF: levator function; MRD, margin reflex distance; PFD, palpebral fissure distance; TBUT, tear break-up time

Table 2. Comparison of AOL Values

			Change Δ	p
AOL, ptotic	Mean ± SD	11.80 ± 7.97	5.22 ± 4.62	0.001**
	Median (min–max)	9.7 (1.6–37.6)		
AOL, non-ptotic	Mean ± SD	17.02 ± 10.49		
	Median (min–max)	14.8 (3.7–57.3)		

Wilcoxon signed-rank test, **p < 0.01
AOL: area of gland loss; SD: standard deviation

Table 3. Meiboscores of the ptotic and non-ptotic eyes

Group	Grade 0 (No loss)	Grade 1 (<25% loss)	Grade 2 (25–50% loss)	Grade 3 (50–75% loss)	Grade 4 (>75% loss)
Ptotic eyes (n)	11	12	2	0	0
Non-ptotic eyes (n)	9	13	2	1	0

No statistically significant difference was found between the meiboscores of the ptotic and non-ptotic eyes (p=0.87; p>0.01) (Table 3).

DISCUSSION

Dry eye and blepharoptosis are prevalent, especially in the elderly population, and can lead to severe complications, including vision loss, if left untreated (10). When blepharoptosis is accompanied by dry eye, the potential for increased dry eye symptoms is increased, particularly due to the possibility of inadequate eyelid closure and increased PFD following ptosis surgery.

In our study, we did not detect significant dry eye symptoms in the ptotic eyes based on the OSDI questionnaire, and the Schirmer test results were consistent with this finding, showing normal values. However, TBUT values were below normal in 84% of the cases.

One of the main findings of our study is that while there was a decrease in TBUT in blepharoptosis cases, no significant reduction was observed in Schirmer 1 test results. In the current study, a decrease in Schirmer 1 values was only observed in cases where MRD and PFD values were significantly reduced. This suggests that in cases of ptosis, there is primarily an evaporative type of dry eye, and when MRD and PFD are severely reduced, aqueous tear production also decreases (4). Similarly, Moosen et al. reported a decrease in both TBUT and Schirmer tests in blepharoptosis cases, suggesting that dry eye can lead to weakening and separation of the levator aponeurosis. However, Dailey and Uğurbaş et al. found no effect of conjunctival Müller muscle resection surgery on tear parameters or meibomian gland dysfunction values in blepharoptosis cases (11,12).

In our study, the lack of significant differences in meiboscores between ptotic and non-ptotic eyes suggests that ptosis does not directly affect the meibomian glands, and that evaporation may be associated with a reduction in the blink reflex. The lack of significant differences in dry eye test scores between ptotic and non-ptotic eyes indicates that dry eye tests are symmetrically affected in unilateral blepharoptosis. This may also be related to the bilateral nature of the blink reflex.

In our cases, there was a positive correlation between TBUT and LF in ptotic eyes, whereas no significant correlation was found between Schirmer 1 and LF. The positive correlation between Schirmer 1 and PFD and MRD indicates that as ptosis severity increases and PFD and MRD decrease, aqueous tear production also decreases. The extensive coverage of the ocular surface by the eyelid may reflexively reduce tear production. We found no correlation between TBUT values and LF among non-ptotic eyes.

According to our study, the higher AOL values observed in non-ptotic eyes compared to ptotic eyes do not directly support the idea that blepharoptosis causes atrophy in the meibomian glands. However, the presence of ptosis, even if unilateral, may lead to a decrease in neurosecretory reflex stimulation, subsequently reducing the need for tear production. This reduction could indirectly result in atrophy of the meibomian glands in both ptotic and non-ptotic eyelids. The higher meiboscore results in our study, compared to other studies, may be related to

the fact that the mean age of our patients fell within the middle and older age groups (13).

Further studies involving a larger number of cases are needed to evaluate ocular surface and dry eye parameters related to the degree and frequency of eyelid opening and closure associated with blepharoptosis. In cases of bilateral ptosis, incorporating assessments of dry eye tests and meibography parameters could provide more informative results. Another limitation of our study is the lack of a healthy control group of similar age. Comparing the meibomian gland status of non-ptotic individuals in the same age group could provide more objective results.

CONCLUSION

Dry eye and blepharoptosis are particularly prevalent in the geriatric population. While aqueous-deficient dry eye may occur at an advanced age, the presence of blepharoptosis may also lead to the development of evaporative dry eye. According to our results, the meiboscores of eyelids with blepharoptosis did not significantly differ from those of non-ptotic eyelids. However, consistent with the degree of ptosis, there was a decrease in the TBUT and Schirmer test parameters. Following ptosis surgery, an increase in eyelid aperture may lead to an exacerbation of dry eye symptoms, a factor that should be considered during surgical planning. Furthermore, the preoperative evaluation of the meibomian glands through meibography is crucial for detecting potential meibomian gland dysfunction.

Conflict of Interest: The authors state that the study was conducted without any commercial or financial relationships that could be seen as a potential conflict of interest.

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ORIGINAL ARTICLE

A LEFT VENTRICULAR ASSIST DEVICE IS THE BEST TREATMENT METHOD FOR ELDERLY PATIENTS WITH ADVANCED HEART FAILURE

Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.412
2024; 27(4):390−397

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Received : Sep 13, 2024
Accepted : Oct 25, 2024

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Abstract

Introduction: In end stage heart failure, cardiac transplantation is the gold standart treatment. But advance age (>65 years old) is one of the relative contrindication for cardiac trasnplantation. So these patients were left to their faith out of medical treatment.

Material and Methods: Between april 2012 to december 2023, 98 left ventricular assit device implantation patients were retrospectively analysed. Patients divided into two group according to their ages (>65; <65 years old). Group were compared according to preoperative, perioperative and postoperative parameters.

Results: The demographic datas, preoperative cardiac parameters, perioperative datas, postoperative datas and complication were similar according to statistically analyses. Statistically, the only difference between the groups is the day on which device thrombosis developed.

Conclusion: Although the number of patients on the heart transplant list increases day by day, the number of donors does not increase. For this reason, advanced age is considered a relative contraindication for heart transplantation in many clinics. For this reason, the elderly patient group is left helpless apart from medical treatment. This study showed that left ventricular assist device therapy is a good alternative to transplantation in the group of patients sentenced to medical treatment.

Keywords: Heart-Assist Devices; Heart Transplantation; Heart Failure.

INTRODUCTION

The prevalence of advanced heart failure has increased due to greater life expectancy, and the mortality rate among elderly patients (over 65 years) with advanced heart failure who are followed-up with only maximal medical treatment is 20%-30% annually (1). In addition to the high mortality rate, a greater number of hospitalization episodes and prolonged hospital stays are causing a significant rise in healthcare costs (1).

Although cardiac transplantation is accepted as the gold standard treatment for advanced heart failure, the number of patients waiting for cardiac transplantation increases daily due to a lack of donors (2). Because of this scarcity, younger patients with fewer comorbidities are prioritized over older patients. Although age is not an absolute contraindication for cardiac transplantation, many centers establish an age greater than 60 to 70 years as a relative contraindication for cardiac transplantation. Consequently, this age group is left with no hope except medical treatment.

With the increased use of left ventricular assist devices (LVADs) as a bridging therapy for cardiac transplantation in the early stages of heart failure, destination therapy has been added as an indication for ventricular assist devices (VADs). In the US in the early 2000s, patients of 70 years or older constituted only 3.5% of patients implanted with a VAD, but this proportion had increased to 10.4% by 2014 (3). Interagency Registry for Mecanically Assisted Circulatory Support (INTERMACS) reports also show that 30% of patients who have undergone a LVAD implantation were 65 years or older (4).

The Randomized Evaluation of Mechanical Assistance for the Treatment of Congestive Heart Failure (REMATCH) trial and other trials by Rose, Dembitsky, and Sarling have all shown that patients who undergo a VAD implantation have significantly better survival rates and quality of life improvement than patients receiving only medical treatment (5-8). It has also been shown, however, that the risk of developing a major complication (device thrombosis or malfunction, stroke, hemorrhage, infection, etc.) increases with every day spent with a VAD (4).

The current study compared patients 65 years of age and older using VADs as destination therapy with patients 50 to 64 years of age in terms of mortality and morbidity to determine whether this treatment choice represents a good alternative in the elderly patient population.

MATERIAL AND METHODS

After receiving Baskent University Institutional Review Board (No. KA23/280) approval according to ethical quidelines of the 1975 Declaration of Helsinki. We retrospectively analyzed 98 patients who underwent LVAD implantation as a destination therapy in our clinic between April 2012 and December 2023. Eighty-four patients received the HeartWare LVAD (Medtronic, St. Paul, MN, USA), seven received the HeartMate II (St. Jude Medical, Minneapolis, MN, USA), and seven received the HeartMate III (St. Jude Medical).The exclusion criteria embraced postoperative early mortality, cardiac transplantation in the first postoperative year, presence of a congenital heart disease, right VAD implantation, presence of preoperative acute kidney injury (AKI), chronic kidney disease, patients who were not New York Heart Assosiation (NYHA) class 3 or 4, and patients 50 years of age or younger. After the exclusion criteria were applied, 64 patients were included in the study. The patients were divided into two groups according to their age. Patients who were at least 65 years old were labeled as Group 1 (n=12; 18.75%; 10 HeartWare, 2 HeartMate III), and patients from 50 to 64 years of age were identified as Group 2 (control group) (n=42; 62.625%; 38 HeartWare, 2 HeartMate II, 2 HeartMate III). The two groups were compared by their demographic, perioperative, and postoperative data. Additionally, the groups were compared

regarding the medical treatments they received during follow-up, stroke incidence, development of right heart failure, device/driveline infection, AKI development, gastrointestinal complications, gastrointestinal and/or nose bleedings that could not be stopped via simple medical treatment, and mortality. All patients who were included in the trial were started on warfarin sodium (dosage titrated to maintain an International Normalised Ratio of blood clots time (INR) of 3.0–3.5) and acetylsalicylic acid 100 mg per oral daily for anticoagulation after VAD implantation; in cases of nontherapeutic levels of INR during routine follow-up, temporary subcutaneous injections of enoxaparin sodium were added to the anticoagulation therapy. All follow-up was done monthly, including management of LVAD device parameters and transthoracic echocardiography (TTE) to evaluate cardiac functions. Right ventricle functions were evaluated by transannular systolic plane excursion (TAPSE) and right ventricle fractional area change (FAC). All patient data included in the trial were obtained from the database of the Başkent University School of Medicine Ankara Hospital.

Statistical Anaylsis

Kolmogorov Smirnov test was used for analyzing the normal distribution of the data. Continuous variables were expressed as mean ± SD, or median values if abnormally distributed. Categorical variables were expressed as numbers and percentages. Demographic characteristics and perioperative variables were compared using "independent samples t-test" or "Mann-Whitney-U test" for continuous variables and "chi-square test" or "Fisher's exact test" for categorical variables between patients aged 65 and under 65 after surgery. Patients were compared between groups in terms of cerebro vascular events, asist device driveline infection, assist device thrombosis, and bleeding during follow-up using Kaplan-Meier survival test. Differences between Kaplan-Meier curves were tested for significance using log-rank test. In all statistical tests, p value <0.05 was accepted as significant. All statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (Armonk, NY: IBM Corp.).

RESULTS

Table 1 presents the demographic data and preoperative cardiac parameters of both groups. No statistically significant difference between the two groups was found with the exception of age.

When compared by reoperation, there were 3 (25%) patients in the older age group and 6 (14.3%) patients in the younger age group, which was not statistically significant (*p=.99)*

Table 2 lists the perioperative data of both groups. There was no statistically significant difference between them.

In the postoperative period, 2 patients (16.6%) in the older age group and 2 patients (2.4%) in the younger group were taken into revision because of bleeding in the first 24 hours postoperatively. One patient (8.3%) in the older group and 2 (2.4%) in the younger group were taken into revision because of bleeding after the first 24 hours. There was no statistically significant difference between the groups in terms of revision due to surgical bleeding (*p*=.324).

Table 3 shows the days of hospitalization and length of intensive care unit (ICU) stay. Both of those factors were longer in the older age group, but there was no statistically significant difference.

Table 4 gives the data on postoperative AKI development, renal replacement therapy, and postoperative complications after VAD implantation. In the postoperative parameters, there was no statistically significant difference between the two groups except in day of LVAD thrombosis.

Of the 42 patients in the younger age group, 19 patients (19 HeartWare) had a stroke, whereas 9

patients (8 HeartWare, 1 HeartMate II) in the older age group had a stroke. Twelve patients (29%; 10 HeartWare, 2 HeartMate II) in the younger age group had a device thrombosis, whereas 1 patient (8.3%; HeartWare) had a device thrombosis in the older age group. Twenty patients (48%; 19 HeartWare, 1 HeartMate II) in the younger age group had a driveline infection, whereas 4 patients (25%; 4 HeartWare) in the older age group had a driveline infection.

Table 1. Preoperative demographic data and cardiac parameters

	Group 1	Group 2	p-value
Age	68.41±2.77	54.21±3.01	.001
Male gender	9 (75%)	40 (95%)	.06
BSA (m²)	1.58±0.67	1.85±0.34	.97
DM	4 (33.3%)	19 (45.2%)	.525
AF	3 (25%)	7 (16.6%)	.674
COPD	2 (16.6%)	1 (2.4%)	.121
PVD	2 (16.6%)	1 (2.4%)	.121
Preoperative EF	21.00±3.01	18.80±4.12	.09
Preoperative TAPSE	14.08±1.83	15.71±3.66	.144
Preoperative FAC	27.83±6.32	27.33±5.71	.795
Mean PAP (mmHg)	37.83±10.22	36.66±9.56	.715
PCWP (mmHg)	24.08±6.20	27.02±7.62	.227
PVR (wood unite)	5.92±18.4	4.31±10.6	.794

AF: atrial fibrillation; BSA: body surface area; COPD: chronic obstructive pulmonary disease; DM: diabetes mellitus; EF: ejection fraction; FAC: fractional area change of right vetricle;PAP: pulmonary artery pressure; PCWP: pulmonary capillary wedge pressure; PVD: peripheral vascular disease; PVR: pulmonary vascular resistance; TAPSE: transannular systolic plane excursion

Table 2. Perioperative data

	Group 1	Group 2	*p*-value
CPB (min)	137.41±35.29	133.21±46.32	.773
Concomitant procedure	6 (50.0%)	18 (42.85%)	.748
Tricuspid valve annuloplasty	4 (33.3%)	10 (23.8%)	.485
Urinary output in CPB	327.5±170.93	405.83±321.22	.422

CPB: cardiopulmonary bypass

Table 3. Days of hospitalization and length of ICU stay

	Group 1	Group 2	*p*-value
Stay in hospital (days)	46.41±32.10	32.90±35.22	.238
Stay in ICU (days)	30.83±35.34	20.95±34.70	.390

ICU: intensive care unit

Table 4. Postoperative AKI development, renal replacement therapy and postoperative complications after VAD implantation

	Group 1	Group 2	p-value
Number of patients who developed AKI	7 (58.3%)	18 (42.87%)	.322
Stage of AKI			.552
0	5 (41.7%)	24 (57.13%)	
1	3 (25.0%)	7 (16.6%)	
2	3 (25.0%)	5 (11.9%)	
3	1 (16.6%)	6 (14.3%)	
Renal replacement therapy	3 (25.0%)	7 (16.6%)	.674
CVE	9 (75.0%)	19 (45.23%)	.103
Day of CVE	269.58±265.07	176.07±295.01	.327
Bleeding	4 (33.3%)	10 (23.8%)	.485
Day of bleeding	77.58±166.47	64.54±194.26	.834
LVAD thrombosis	1 (8.3%)	12 (28.6%)	.254
Day of LVAD thrombosis	14.6±50.80	165.66±328.75	.006
Driveline infection	4 (33.3%)	20 (47.6%)	.515
Day of driveline infection	149.41±255.54	178.02±315.03	.774

CVE: cerebrovascular event; LVAD: left ventricular assist device

Days spent with the device were 788.75±255.54 for the older age group and 952.95±798.17 for the younger age group. There was no statistically significant difference between the groups in this comparison (p=.367). There were 8 (66.6%) mortalities in the older age group and 17 (40.5%) in the younger group. There was no statistically significant difference (p=.188). Six patients (14.3%) were bridged to cardiac transplantation in the younger age group during the first year after LVAD implantation, whereas no patients were bridged to cardiac transplantation in the older group.

DISCUSSION

Since LVAD began being used as a destination therapy, the number of patients over 65 years of age undergoing LVAD implantation has continually increased. According to the annual INTERMACS reports, approximately 40% of patients undergoing a LVAD implantation are 65 or older, and the average age of a patient undergoing a LVAD implantation has increased to 57±1.0 year (9).

The main finding of our trial is that LVAD systems can be used in the treatment of advanced stage heart failure in older patients equally and as effectively as in younger patients. The data that inspired this conclusion include the absence of difference in the preoperative comorbidities of the groups, both groups having very similar preoperative TTE and catheterization findings, and there being no statistically significant difference regarding mortality. Despite the older group having a longer hospitalization time and longer ICU stay, there was no statistically significant difference between the groups.

LVAD systems are lifesaving technologies for treating advanced stage heart failure as a bridge to transplantation or as destination therapy, but device-related complications, complications

secondary to medical treatment started after device implantation, and complications secondary to the patient's comorbidities are possible. Stroke is the complication that most reduces quality of life in patients who have undergone LVAD implantation. Coffin and Yoshioka show that there is a correlation between age and stroke, with the risk of stroke being double in patients older than 70 years (10,11), but our study found no statistically significant difference between the groups in terms of stroke incidence or day of cerebrovascular event. Studies by Harvey and Frontera have similarly shown that age is not a risk factor for stroke (12,13).

Lushaj et al. report similar results to those of our study, finding no statistically significant difference between age groups regarding revision due to surgical bleeding (14). In our study, there was no statistically significant difference between the groups in terms of major bleeding or the postoperative day on which the bleeding occurred. By contrast, a study by Caraballo found that the risk of bleeding was greater in the older age group (15). Increased tissue fragility and acquired-type von Willebrand syndrome were shown as the causes of this result. That study also states that the older patients had more comorbidities and worse preoperative right ventricle functions (15). Yoshioka et al. (10) describe similar findings to those of Caraballo. The major difference between our study and those two is that, in our study, the patient groups had no differences in preoperative comorbidities, right ventricle functions, or perioperative parameters, so the groups were more homogeneous.

One of the more feared complications after LVAD implantation is device thrombosis. In addition to causing device malfunction, device thrombosis is an important cause of mortality, morbidity, and stroke.

In our study, there was no statistically significant difference between the two groups in terms of device thrombosis incidence. Yoshioka et al. found that LVAD thrombosis is seen more often in the older age group, whereas Carabello et al. found the opposite (10-15). When we compared groups according to day of thrombosis, there was a statistically significant difference in terms of the day of thrombosis development,we showed that device thrombosis developed earlier in the older patient group if it did occur. No other study was found in the literature that examined the day of implantation thrombosis development. One of the more significant causes of LVAD thrombosis development is the inflow cannula drawing in adjacent tissues. We believe that the reason for earlier thrombosis development in older patients may be the elongation of tissues caused by the degradation of the tissue collagen, especially in the chordae. Additionally, adaptation to medications can be lower in elderly patients than in younger patients.

Another possible major complication after LVAD implantation is AKI. Our study found no statistically significant difference between the two groups in terms of AKI development, which is similar to the result of Lushaj's study (14). The risk of AKI development is greater in older patients after LVAD implantation (16).

There was no statistically significant difference between the two groups in terms of infection. Critsinelis et al. found a correlation between age and infection, which they hypothesize is caused by older patients having lower serum albumin levels because of malnutrition (17). In that study, patients older than 75 years were compared with all age groups. In our study, the two compared groups had closer ages. Consequently, there was a conflicting result.

Postoperative right ventricular failure is one of the more significant causes of morbidity and mortality after LVAD implantation (4). In our study, there was no statistically significant difference between the two groups in terms of postoperative right ventricular failure. We believe that this is explained by correct patient selection in the preoperative period.

Age is a risk factor for prolonged hospital stay after LVAD implantation (18-20). In our study, there was no statistically significant difference between the two groups in terms of length of stay in the hospital or length of stay in the ICU, but there was a numerical difference, albeit not statistically significant. This is an expected result considering that older patients are more fragile and their healing process is slower and longer. Additionally, Kirklin et al. found no difference in terms of hospital and ICU stay between different age groups, but they indicate that some of the older patients went to rehabilitation centers instead of their homes after being discharged (18).

In our study, there was no statistically significant difference between the groups in terms of mortality. This result contributes to our main hypothesis that LVAD implantation is an efficacious method of treatment in the older patient group with advanced heart failure. By contrast, age was identified as a risk factor for prolonged hospital stay and mortality after LVAD implantation in studies conducted by Kirklin and Colts (18,19).

Every day spent with a device after LVAD implantation increases the risk for any complication. In our study, there was no statistically significant difference between the groups in terms of days spent with a device. Similarly, statistical analysis showed no statistically significant difference between the groups regarding complications. Morgan et al. report similar results (20). In that study, there was no statistically significant difference between patients older than 70 years and young patients in terms of mortality, morbidity, and complications. There was also no difference in hospital or ICU stay, but the sample group was small. Advanced age is not a negative predictor for survival and is not a contraindication for LVAD implantation. There was no statistically significant difference between the groups in terms of survival. Studies by Frazier and Rao have shown no correlation between age and survival (21,22), but age was a risk factor for high mortality and worse survival in studies by Kirklin and Sandler (4,18).

Our results show that LVAD implantation has similar risks in the older age group compared to younger patients except in the occurrence of day of assist device thrombosis. We believe that the use of LVAD is a very good alternative choice of treatment for older patients with a relative contraindication for cardiac transplantation.

Consequently, we consider that LVAD implantation is an important modality in the treatment of advanced heart failure and can be implemented with acceptable mortality and morbidity rates in patients older than 65 years with advanced heart failure and relative contraindications for cardiac transplantation in the presence of correct echocardiographic assessment, appropriate management of the patients' preoperative comorbidities, and close monitoring and follow-up during the perioperative and postoperative periods.

The most important limitation in our study is that it was a single-center study with a relatively small patient sample group. Multicenter studies with much larger sample sizes will deepen the understanding of the best medical and surgical treatment in the elderly patient population.

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ORIGINAL ARTICLE

OPTIMIZATION OF MORRIS WATER MAZE PROTOCOLS: EFFECTS OF WATER TEMPERATURE AND HYPOTHERMIA ON SPATIAL LEARNING AND MEMORY IN AGED FEMALE RATS

Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.413
2024; 27(4):398-408

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Received : Aug 26, 2024
Accepted : Oct 25, 2024

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Abstract

Introduction: Aging is a highly complex process driven by a multitude of factors. The use of humans in aging research is complicated by many factors (ethical issues; environmental and social factors; long natural life span). Therefore, rats are common models for the study of aging and age-related diseases. The Morris water maze test is one of the most common cognitive tests in studies investigating age-related learning and memory. However, standardized protocols are lacking, which could influence results. This study investigated the effects of water temperature and inter-trial interval on physiological parameters, hippocampus-dependent learning, and memory in aged female rats performing the Morris Water Maze.

Materials and Methods: Thirty-two female Wistar Hannover rats, aged over 18 months, were divided into four groups based on water temperature (20 °C or 24 °C) and inter-trial interval (30 seconds or 13 minutes).

Results: Rats exposed to 24 °C demonstrated better spatial learning and memory retention than those at 20 °C. The interaction between inter-trial interval and water temperature significantly affected memory, with higher temperatures improving memory, especially with shorter intervals. Inter-trial interval alone did not significantly affect learning, but longer durations were associated with more stable body temperatures. Neither water temperature nor inter-trial interval significantly influenced body weight.

Conclusion: These findings emphasize the need to standardize environmental conditions in Morris water maze protocols to enhance research validity and reliability. Optimizing these protocols is crucial to upholding ethical standards and ensuring animal welfare, advancing more effective and scientifically sound practices in gerontological research, and fostering a better understanding of aging processes.

Keywords: Aging; Animal Welfare; Body Temperature; Memory and Learning Test; Spatial Memory; Morris Water Maze Test.

INTRODUCTION

Understanding the pathophysiology of diseases such as dementia, Alzheimer's, and sarcopenia that accompany aging, and developing treatment strategies for these conditions, is critically dependent on experimental models. Although a large number of experimental studies have been carried out in this area, their aetiology needs to be further clarified. However, in studies within the field of gerontology, the fragility of the aged animals used must be considered, and protocol details specific to geriatric animals should be standardized. Otherwise, inconsistencies in the clinical application of findings may arise due to the lack of standardization between experiments.

The Morris water maze (MWM) test is one of the most commonly used cognitive tests in research in the fields of age-related learning and memory loss (1,2). However, factors such as the level of care during test administration and the experience of the practitioner can influence the model animals' associated stress levels, potentially impacting test performance. Indeed, studies in both mice and rats have shown that heightened sensitivity to stress can negatively influence performance in the MWM test (3). Additionally, MWM protocols commonly result in varying levels of hypothermia due to prolonged exposure to cold water, which can further elevate stress levels. Uncontrolled hypothermia observed during MWM test performance may exacerbate stress effects, resulting in impaired cognitive performance (4,5). These discrepancies necessitate the development of standardized protocols to minimize confounding variables and improve the consistency and reliability of MWM test outcomes.

Increasing the standardization and reliability of animal experiments can also improve animal welfare. In the context of the MWM, minimizing the side effects of the tests requires a detailed examination of the associated hypothermia-related processes and subsequent protocol optimization according to specific criteria (e.g. gender, age, animal model, body weight, etc.). Gender differences in spatial cognition remain a controversial issue, as many studies have shown no differences (6), while some studies have reported that males generally outperform females in terms of some spatial abilities (7). Furthermore, the historical predominance of male animals in scientific research has resulted in the inadequate representation of female biological and behavioral responses, thereby hindering our comprehensive understanding of interspecies biological differences. Thus, the use of female rats in the present study aims to deepen the investigation into gender-specific responses, thereby expanding the scope of research findings.

Age is one of the critical factors that should be taken into account when designing behavioral tests or interpreting behavioral differences that can occur due to the effect of experimental applications (8). Several experimental studies have shown that aging increases anxiety levels in rats, and further negatively impacting cognitive abilities such as learning and memory functions (8,9). Indeed, studies have shown that older rats of both sexes must perform significantly more trials to learn the maze task than younger rats (6). Further, several studies have shown that older animals take longer to find the hidden platform, travel longer distances to find the platform, and may require more trials for learning (10,11). As a result of these longer learning times, older animals spend more time in the water before completion of the experimental period.

Studies have shown that extending the time between flotation tests prevents hypothermia by eliminating the net cooling effect of water, and further exerts positive effects on learning. Studies have further reported that this may change depending on age (4,5). As such, the level of hypothermia may influence age-related learning processes as a major factor, potentially introducing comorbidities with neurodegenerative effects. In particular, adding test-induced hypothermia to the already present

comorbidities, such as progressive neuronal damage, neurodegeneration, and inflammation seen in conditions like traumatic brain injury, further complicates the outcomes of MWM tests (12).

Given the above context, the present study aimed to examine the effects of different water temperatures (WT) and varying exposure intervals to these temperatures on hippocampus-dependent learning and memory processes in aged rats (over 18 months old). Unlike previous studies, the present study followed a protocol that involved placing the animals in heated drying cages between flotation sessions to minimize body temperature (BT) loss, thereby enhancing animal welfare throughout the procedure. This study also sought to explore the relationship between age—a key variable in assessing cognitive impairment—and learning, as prior research has identified a significant difference in learning associated with waiting times in adult rats (5). By examining this relationship, we aimed to standardize MWM waiting times for aged rats and to reassess these parameters from the perspective of animal welfare. This approach was designed to provide a more effective framework for MWM protocols, particularly those conducted in series. Moreover, this study emphasized the need for precise control over influencing variables such as waiting times and WT, which are often inconsistently reported or overlooked in prior research (13). Given that WT can vary considerably across studies (14), even minor differences in these parameters within what is considered a standard range, can significantly impact scientific outcomes, particularly in geriatric populations. This research underscores the necessity of carefully considering these variables to enhance the accuracy and reliability of results in aging studies.

When standardization between experiments is not achieved, and the characteristics of the population being modeled are neglected, inconsistencies in clinical applications of the findings may arise. The authors were particularly attentive to the fact that the same protocols used for both aged and young animals in MWM studies may not adequately reflect the unique needs of geriatric subjects (5,14). As a result, this study aimed to contribute to the field of gerontology by developing a detailed protocol specifically for aged animals, thereby improving the accuracy and reliability of aging research.

MATERIALS AND METHODS

Animals

This experimental study was approved by the Local Ethics Committee for Animal Experiments of Bağcılar Training and Research Hospital (Protocol no: 2023/13). After receiving ethical approval, the study was performed at the Experimental Research and Skill Development Center (BADABEM) of Bağcılar Training and Research Hospital.

Thirty-two female Wistar Hannover rats aged over 18 months, with an average weight of 400-450 g were used as the experimental animals. Rats were provided with water and feed ad libitum, under the following controlled conditions: humidity of 50-60% humidity, room temperature 18-22 °C, 15-17 cycles of ventilation per hour, and a 12 hour light/dark cycle. All animals were born and taken care of in the same laboratory and kept in the same housing conditions during the experiment. Animals were fed ad libitum and placed on a stainless-steel wire grid (PLEXX, Netherlands) with 750 ml drinker cups. Groups were housed in 425 x 265 x 180 mm polycarbonate conventional Type 3H cages (PLEXX, The Netherlands) in pairs.

In accordance with legislation and guidelines on the ethical use of animals, all subjects in this study were aged specimens housed in the laboratory that had previously been used for educational purposes. This approach was taken to minimize animal use, while ensuring compliance with animal welfare standards.

The 32 experimental rats were divided into four groups of 8 rats each, according to inter-trial interval (ITI) and water temperature (WT). The groups were

as follows: ITI of 30 seconds at WT 20°C, ITI of 30 seconds at WT 24°C, ITI of 13 minutes at WT 20°C, and ITI of 13 minutes at WT 24°C.

Experimental Design

The MWM test was applied to all animals to evaluate hippocampus-dependent learning and memory (1). To reduce stress and acclimate the animals, three days before the start of the tests, rats were kept in the experimental room for 15 minutes a day and moved to the room 1 hour before the tests. Each animal was weighed once a day before starting the protocol. In addition, BT was measured rectally twice a day, both before and after MWM (i.e., as soon as the 4 trials were completed for each animal). During rectal measurement, the experimentor ensured that there was no feces in the anus, and that the thermometer was placed 1 cm inside the anus.

Morris Water Maze (MWM)

The MWM protocol was performed in a 150 cm diameter, 60 cm deep standard water-filled pool. The 15 cm wide platform placed in the pool was filled with water so that the platform was submerged by 1.5 cm. All objects in the room were maintained in the same place from the beginning to the end of the experiment. The WT of the pool was fixed at either 24 °C or 20 °C, in accordance with the experimental groups. The water was opacified with black food coloring, and remained turbid during all exercises and tests. The MWM test comprised both learning and memory assessments. In the learning phase, rats were allowed to learn the location of the platform by swimming in a pool with a diameter of 150 cm for 60 seconds, 4 times a day over 4 consecutive days. The rats were released into the water from 3 of the quadrants, excluding the quadrant where the platform was located, according to the randomly determined release order. During each trial, the rat was placed in the pool, close to and facing the wall, and was never released from the same quadrant in the same day. The time it took the rats to find the platform was recorded, and these data were used to assess the learning function. To evaluate memory retention, the probe trial was conducted on the fifth day: in this trial, the platform was removed, and the time spent swimming in the target quadrant (where the platform was previously located) was recorded. After the protocol was completed, all animals were returned to BADABEM.

Statistical Analysis

The descriptive statistics were computed to summarize the central tendencies and dispersion. Normality was subsequently assessed using skewness, kurtosis, and histogram inspection to confirm compliance with parametric assumptions. Learning performance (LP) was evaluated over four consecutive days, with four trials performed each day. The mean scores for each day were calculated, resulting in phase scores labeled as Trials 1 through 4. A 4x2x2 Multivariate Analysis of Variance (MANOVA) for Mixed Measures was conducted, with LP as the dependent variable and WT (20 °C, 24 °C) and ITI (30 seconds, 13 minutes) as the independent variables. Memory performance (MP) was analyzed using a Two-Way Analysis of Variance (2x2 ANOVA), with memory scores as the dependent variable and ITI and WT as independent variables. Changes in basal BT (ΔT) were measured as the difference between the daily pre-trial and post-trial temperatures, while body weight (BW) was tracked to monitor physiological changes. These variables were finally analyzed with a MANOVA using a 5-level structure for daily measurements, with WT and ITI as independent variables. Post hoc analyses were performed using Bonferroni corrections. All analyses were conducted in SPSS (v26.0, IBM Corp.), with significance set at $p<.05$.

RESULTS

MANOVA for Mixed Measures was conducted to examine whether LP differed based on the ITI and WT levels. A statistically significant difference was observed between the means of LP at the different

WT levels (F[3, 84] = 3.102, p<.05, η^2 = .100). However, no statistically significant effect was found for ITI (F[3, 84] = 0.894, p>.05, η^2 = .031), or for the interaction between ITI and WT on LP (F[3, 84] = 2.333, p>.05, η^2 = .077) (Table 1 and Table 2).

ANOVA (2x2) was conducted to examine whether MP differed according to ITI and WT levels. The interaction effect of ITI and WT variables was found to significantly affect MP (F[1, 28] = 4.240, p<.05, η^2 = .132). Further, MP varied significantly across WT categories when not considering ITI (F(1, 28) = 5.956, p<.05, η^2 = .175); however, no significant variation in MP was observed when considering ITI alone without accounting for WT (F[1, 28] = 0.093, p>.05, η^2 = .003) (Table 3).

MANOVA for Mixed Measures was conducted to examine whether the changes in basal BT (ΔT) varied according to ITI and WT levels, yielding a statistically significant difference in the ΔT means across ITI levels (F[4, 112] = 6.909, p<.01, η^2 = .198). However, no significant differences were found across WT levels (F[4, 112] = 2.039, p>.05, η^2 = .068), nor was there a significant interaction effect on ΔT scores between ITI and WT levels (F[4, 112] = 2.068, p>.05, η^2 = .069) (Table 4 and Table 5).

MANOVA for Mixed Measures was conducted to examine whether BW varied according to the ITI and WT levels, with results indicating that neither the ITI levels (F(4, 112) = 1.501, p>.05, η^2 = .051) nor the WT levels (F[4, 112] = 1.834, p>.05, η^2 = .061) significantly affected BW. Furthermore, no significant interaction effect of BW was observed between ITI and WT levels (F[4, 112] = 0.224, p>.05, η^2 = .008).

Table 1. Descriptive statistics of MWM learning performance

	ITI Group	WT Group	n	M	SD
Trial 1	30 s	20 °C	8	53.41	6.79
		24°C	8	45.59	8.82
	13 min	20 °C	8	57.06	4.62
		24°C	8	42.91	13.79
Trial 2	30 s	20 °C	8	49.22	14.46
		24°C	8	43.66	11.39
	13 min	20 °C	8	48.94	18.19
		24°C	8	41.13	11.73
Trial 3	30 s	20 °C	8	34.34	17.28
		24°C	8	37.91	13.88
	13 min	20 °C	8	30.50	13.55
		24°C	8	38.94	15.81
Trial 4	30 s	20 °C	8	39.38	20.53
		24°C	8	30.06	8.96
	13 min	20 °C	8	17.62	7.78
		24°C	8	33.38	13.77

Note. ITI = Inter-trial Interval; M = Mean; SD = Standard Deviation; WT = Water Temperature.

Table 2. Effect of water temperature groups on MWM learning performance

		Learning Performance		
WT Group	**Time Point**	**n**	**M**	**SD**
20 °C	Trial 1	16	55.23a	5.92
	Trial 2	16	49.08	16.88
	Trial 3	16	34.42	15.13
	Trial 4	16	28.50	18.74
24°C	Trial 1	16	44.25a	11.27
	Trial 2	16	42.39	11.25
	Trial 3	16	38.41	15.81
	Trial 4	16	31.72	11.36
		df	**F**	**Partial η^2**
Main effect of WT		3, 84	3.102*	.100

Note. *p<.05; a = Values within the same column marked with the same superscript differ significantly; df = Degrees of Freedom; M = Mean; SD=Standard Deviation; WT=Water Temperature.

Table 3. Effects of water temperature and ITI on MWM memory performance

	Memory Performance		
	n	**M**	**SD**
WT Group			
20 °C	16	13.19	1.16
24 °C	16	17.19	1.16
ITI Group			
30 s	16	15.44	1.16
13 min	16	14.94	1.16
WT x ITI			
20 °C - 30 s	8	11.75a	3.50
20 °C - 13 min	8	14.63	3.66
24 °C - 30 s	8	19.13a	5.74
24 °C - 13 min	8	15.25	5.23
	df	**F**	**Partial η^2**
Main effect of WT	1, 28	5.956*	.175
Main effect of ITI	1, 28	.093	.003
WT X ITI	1, 28	4.240*	.132

Note. *p<.05; a = Values within the same column marked with the same superscript differ significantly; df = Degrees of Freedom; M = Mean; SD = Standard Deviation; WT = Water Temperature.

Table 4. Descriptive Statistics for Changes in Basal Temperature (ΔT) Between Trials

	WT Group	ITI Group	n	M	SD
Trial 1 ΔT	20 °C	30 s	8	2.55	1.17
		13 min	8	2.46	.98
	24°C	30 s	8	2.99	1.34
		13 min	8	1.48	.81
Trial 2 ΔT	20 °C	30 s	8	3.19	1.45
		13 min	8	1.25	1.01
	24°C	30 s	8	1.51	.98
		13 min	8	0.89	.98
Trial 3 ΔT	20 °C	30 s	8	2.28	1.30
		13 min	8	-.66	1.08
	24°C	30 s	8	1.44	.79
		13 min	8	.44	.68
Trial 4 ΔT	20 °C	30 s	8	1.48	1.73
		13 min	8	0.25	.38
	24°C	30 s	8	.98	.85
		13 min	8	-.01	.87
Trial 5 ΔT	20 °C	30 s	8	.21	.36
		13 min	8	1.19	.93
	24°C	30 s	8	-1.41	3.90
		13 min	8	-.11	.41

Note. ITI = Inter-trial Interval; M = Mean; SD = Standard Deviation; WT = Water Temperature; ΔT = Difference in body temperatures (initial body temperature measurement - final body temperature measurement).

Table 5. Effect of ITI on Changes in Basal Temperature (ΔT) Between Trials

			ΔT	
ITI Group	**Time Point**	**n**	**M**	**SD**
30 s	Trial 1 ΔT	16	2.77	1.23
	Trial 2 ΔT	16	2.35a	1.50
	Trial 3 ΔT	16	1.86b	1.12
	Trial 4 ΔT	16	1.23c	1.34
	Trial 5 ΔT	16	-.60	2.80
13 min	Trial 1 ΔT	16	1.97	1.01
	Trial 2 ΔT	16	1.07a	11.25
	Trial 3 ΔT	16	-.11b	1.04
	Trial 4 ΔT	16	.12c	.66
	Trial 5 ΔT	16	.54	.96
		df	**F**	**η^2**
Main effect of ITI		2.401, 67.234	6.909**	.198

Note. *p<.05, **p<.01, ***p<.001; a, b, c = Values with the same superscript within a column indicate statistically significant differences; ITI = Inter-trial Interval; M = Mean; SD = Standard Deviation; WT = Water Temperature, ΔT = Change in body temperature (initial body temperature measurement - final body temperature measurement).

DISCUSSION

The present study was conducted to examine the effect of changes in WT and ITI on hippocampus-related learning, memory processes, and physiological parameters such as basal BT and BW in aged female rats. Overall, our findings revealed that WT exerted a significant effect on LP; in particular, rats swimming at 24°C learned the location of the target quadrant more efficiently than those swimming at 20°C, particularly on the first trials. This result demonstrates the potential effects of conditions on neural plasticity and memory formation, and agree with the modulatory effects of stress on learning reported in previous studies (15,16). However, the ITI and the interaction between ITI and WT exerted no significant effect on LP. These results highlight the importance of considering environmental factors such as WT when optimizing MWM protocols. As these findings indicate that ITI duration alone is not a determinant of LP in aged rats, researchers should investigate alternative factors when manipulation of this variable does not have the expected effect. Further, it should be considered that this phenomenon may also be attributed to aging and cognitive impairments. Indeed, research on LP spans a broad age range, typically between 18 and 28 months. Additionally, it has been reported that the outcomes are closely associated with strain differences (17).

Rats swimming at 24°C showed superior MP to those swimming at 20°C, demonstrating the importance of the effect of the thermal environment on cognitive functions. This result is in line with the capacity of temperature to modulate neurobiological processes reported in previous studies (18). In particular, the positive effects of optimal temperatures on neuronal activity and synaptic plasticity have been frequently reported in previous studies (19,20). In contrast, we found that ITI alone did not significantly affect MP in aged rats. This is in contrast with a previous report in young rats, where MP improved as the ITI was extended (5). These findings indicate that the ITI alone may have a limited capacity to influence learning and memory in aged rats, possibly due to age-related frailty. Importantly, the interaction between ITI and WT significantly impacted MP. Specifically, higher WT improved MP, particularly when the ITI was short. This result highlights the complex interactions of environmental conditions and trial configuration on cognitive processes.

Another important finding was that ITI had a significant effect (η^2 = .198) on the basal BT of aged female rats. In particular, longer ITI durations decreased the changes in BT, indicating that ITI plays a prominent role in temperature regulation and physiological adaptation processes, which is similar to the findings in studies with mice (4). However, WT and the interaction of WT and ITI had no significant effect on BT changes, suggesting the possibility that WT did not have the expected effect on the animals' capacity to regulate BT, that the temperature ranges used were not sufficiently different, or that both groups were old and had similarly low thermoregulatory capacity (21). For this reason, it is important for further studies to replicate this study, but including different age groups.

ITI did not show a significant effect on LP and MP, suggesting that the effects of this variable on cognitive performance may be limited. Conversely, the fact that ITI had a significant effect on changes in basal BT indicates that this variable may affect the thermal comfort of animals, and thus could have important effects on animal welfare.

Finally, we found that ITI and WT are not significant influencing variables of BW in aged rats. BW is considered an important indicator of general health and well-being. In animal experiments, while changes in BW can be triggered by factors such as stress, disease, or nutritional deficiency (22). In the present study, modulation of the ITI and WT did not significantly impact BW, indicating that these factors do not have the potential to induce stress or other negative physiological effects in aged female rats.

However, this outcome may also reflect the positive effects of our ensurance of animal welfare, such as providing warmth and facilitating adaptation throughout the experiment.

The results of this study have significant implications for the optimization of the protocols used in the MWM test. As the present study shows, the standardization of environmental variables such as WT can have a significant impact on the consistency and reliability of experimental results. The different WTs used in the MWM test could introduce variations in research results; as such, the development of standardized protocols is important to ensure the comparability and reproducibility of scientific findings.

The aged female rats used in this study are important as a model sensitive to cognitive changes associated with aging. Indeed, older rats may show more sensitive responses than younger individuals, which requires the application of specialized protocols, particularly when investigating this population (23).

Scientific research has historically focused on male animals, a trend which has resulted in a poor understanding of the biological differences between the sexes (24). Therefore, the present study aimed to improve the biological validity of the MWM test using female rats, which are generally considered to be at a disadvantage in terms of factors such as thermoregulation. Furthermore, by using older female rats, this research supports the effort to provide a more inclusive and balanced body of knowledge in the scientific community. Tailoring MWM protocols specifically for this population could maximize the scientific accuracy of such studies by increasing the reliability and reproducibility of experimental results. Further, this study emphasizes the importance of rigorously managing environmental factors in cognitive and physiological experiments on aged rats to improve scientific accuracy and animal welfare. This research highlights that experimental designs should be optimized to take into account the effects of variables such as ITI and WT on animals, thereby providing researchers with ways to improve the thermal comfort and overall health of animals. This approach could contribute to the adoption of more ethical and humane scientific methodologies, particularly when applied to animals impacted by sensitive processes such as aging.

Moreover, the results of this study underscore the critical need to refine experimental protocols for aged animals in gerontological research, given their increased vulnerability compared to younger subjects. Rather than applying standard protocols designed for younger animals, researchers should tailor methodologies to the specific needs of aged models. This approach aligns with recent human studies, which point to molecular damage as a key factor in age-related phenotypes (25). Furthermore, the shorter lifespan of laboratory animals allows for accelerated investigation into aging, offering valuable insights into mitigating molecular damage and developing interventions that can slow aging processes (26). Ensuring the standardization of aging, as a physiological process, in experimental studies will significantly contribute to research in the field of gerontology.

While this study offers a comprehensive methodological approach, it is not without limitations. Most importantly, the difficulty in sourcing aged animals constrained the sample size, thus limiting the generalizability of the findings. Additionally, due to limited laboratory facilities, we were unable to perform detailed measurements of swimming strategies and speeds using automated systems. Instead, manual measurements were conducted using a camera, which may have introduced some variability in the data collection process. Previous studies have further demonstrated that animals may adopt a variety of swimming strategies during tests, including search strategies such as thigmotaxis, random search, scanning, chaining, focal search, focal wrong, perseverance, and direct search, as

well as non-search strategies such as circling and floating (27). The inability of the present study to capture these nuanced behaviors may have affected the depth of our behavioral analysis as well as the interpretation of MP. Future research could expand on our results by incorporating different gender and age groups, thereby contributing to the development of standardized protocols. Nevertheless, despite these challenges, the findings of the present study underscore the critical importance of rigorously managing environmental factors and optimizing experimental designs when performing experiments with aged populations. This approach not only enhances the reliability and reproducibility of scientific outcomes, but also aligns with the ethical imperative to ensure the well-being of animal subjects. By advancing standardization of the experimental investigation of aging, this research contributes to the broader field of gerontology, offering insights that may facilitate the development of more effective and humane methodologies to study the physiological processes of aging.

Acknowledgements: We extend our sincere gratitude to Editage (www.editage.com) for their meticulous language editing, which significantly enhanced the clarity of our manuscript. We also deeply thank the BADABEM technicians for their dedicated care of the experimental animals, ensuring their welfare throughout the study. Most importantly, we wish to acknowledge and honor all the experimental animals that have selflessly contributed to scientific advancement up to this point. Their sacrifice is invaluable.

Conflict of Interest: The authors declare no conflict of interest regarding the publication of this manuscript.

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ORIGINAL ARTICLE

UNIVERSITY STUDENTS' ATTITUDES TOWARDS OLDER WOMEN: A SCALE DEVELOPMENT STUDY

Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.414
2024; 27(4):409-415

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Received : Sep 10, 2024
Accepted : Nov 28, 2024

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Abstract

Introduction: The world population is rapidly aging due to decreased fertility rates, increased longevity, and the development of preventive and curative health services. In general, women live longer than men and, therefore, are exposed to negative attitudes more frequently. No measurement tool currently exists that can reliably and validly assess people's attitudes towards older women in Türkiye. Therefore, the Attitude Towards Older Women Scale is expected to significantly meet this need.

Materials and Method: The study participants consisted of 512 students from a university in the Central Anatolia Region who were continuing their education and agreed to participate in the study voluntarily. Validity and reliability analyses were conducted, and the 'Attitude Towards Older Women Scale,' designed as a five-point Likert-type scale, was subjected to both exploratory and confirmatory factor analyses.

Results: The 23-item "Attitude Towards Older Women Scale" consists of 9 items for positive attitudes and 14 items for negative attitudes. The total score that can be obtained from the scale varies between 23 and 115. The total score is obtained by summing the scores from the two factors in the scale. A high score indicates high positive attitudes towards older women, while a low score indicates low positive attitudes towards older women.

Conclusion: According to the analysis results, the reliability and validity of the "Attitude Towards Older Women Scale" are at an acceptable level, indicating that the scale can be used to determine the attitudes of university students towards older women in Türkiye.

Key Words: Aged; Attitude; Women; Students.

INTRODUCTION

Human life is divided into certain periods, such as childhood, youth, adulthood, and old age. Although it is impossible to separate the stages of life, old age, following adulthood, is, like otherperiods of life, considered a natural and universal reality, but is also a process in which physical and psychological loss of abilities occurs (1).The World Health Organization defines old age as beginning at 65 years and above, whereas United Nations reports consider it to start at 60 years (2). With decreased fertility and mortality rates, alongside the development of preventive and curative health services, the world population is rapidly aging (3). According to 2023 data, in Türkiye women live longer than men, with a difference of 5.5 years in life expectancy (4). Therefore, women may be more frequently exposed to negative attitudes towards old age. In general, age discrimination and stereotypes towards older adults can significantly impact their physical and mental health and well-being (5).

Since the number of older adults will increase in the near future, it is essential to develop positive attitudes and behaviors towards people in this age group (6). Older women are at considerably higher risk than men for various reasons, including lower education levels, widowhood, living in nursing homes or alone, low socio-economic status, illness, and the use of multiple medications. It has been noted that they are more exposed to negative attitudes, age discrimination, and social exclusion since they are more dependent on others (7).

The concept of attitude refers to a mental state that influences individuals' thoughts, feelings, and behaviors towards objects, ideas, events, and other people. Attitudes are the most important factors ensuring that individuals have positive behaviors towards older adults is feelings and attitudes (8). However, no existing measurement tool can reliably and validly assess people's attitudes towards older women in Türkiye. Therefore, the Attitude Towards Older Women Scale is expected to significantly meet this need.

MATERIALS AND METHOD

Attitude Towards Older Women Scale

At the first stage of the scale development process, a literature review was performed, and scales related to attitudes towards older women were scanned (9,10,11). The literature review revealed no existing measurement tool related to attitudes towards older women. Therefore, items that best evaluated attitudes towards older adults were identified, and a 34-item pool was created. To evaluate university students' positive and negative attitudes towards older women, one item that reflected positive attitudes on the 5-point Likert scale (1=Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly Agree) was "Being with older women is peaceful." An example of an item reflecting negative attitudes was "Older women are stubborn." Items reflecting negative attitudes were reverse-scored.. An increase in the positive attitude score indicates a stronger positive attitude towards older women, while a decrease in the negative attitude score indicates a more negative attitude.

At the second stage, expert opinions were sought regarding the scope of the items, item consistency, and the identification of irrelevant items on the draft scale (12). To this end, five faculty members specializing in social work and sociology were consulted. After the reviewby these experts, the number of items was reduced to 32.

At the third stage, a Turkish language and literature expert reviewed the scale to ensure it was linguistically comprehensible, after which the scale was finalized. The necessary permission was obtained from the Non-Interventional Ethics Committee of a university in the Central Anatolia Region for the prepared scale form. The draft scale, which was ready for implementation, was named the "Attitude Towards Older Women Scale (ATOWS)."

Participants

The study participants consisted of 512 students from a university in the Central Anatolia Region who

volunteered for the study while continuing their education. Of the participants, 87.3% (n=447) were female, with a mean age of 20.87 years (SD = 2.17), ranging from 18 to 35 years.

Data analysis

Exploratory factor analysis (EFA) was first conducted to determine the construct validity of the Attitude Towards Older Women Scale. Before the analysis, the normality distribution of the data was tested with the skewness-kurtosis test. The skewness and kurtosis values of the items ranged between -1.50 and +1.50, indicating that the items were normally distributed (12). The research data were examined by exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) for construct validity using SPSS and AMOS software. After CFA, Cronbach's alpha values were checked for reliability.

RESULTS

EFA and CFA analyses were conducted to test the scale's construct validity.

Exploratory Factor Analysis

To ensure the data is suitable for factor analysis, the KMO coefficient should be higher than .60, and the result of Bartlett's test should be significant. In this study, the KMO sample concordance coefficient was found to be .848, and Bartlett's test of sphericity yielded an χ^2 value of 2373.838 ($p<.001$). These results indicated that the responses to the scale items could be factored. A minimum sample size of 300 is recommended for factor analysis (12), and this analysis was conducted with 303 students. As the aim of this study was to develop a two-dimensional scale, the varimax rotation factor analysis using the principal components technique in EFA was limited to two factors. The literature states that when deciding whether an item should be included in the scale during scale development, a factor loading value of .45 or higher would be a good criterion for selection. Additionally, when deciding whether to include an item in the scale, the difference between the two highest loading values should be at least .10 (13). As a result of the exploratory factor analysis performed with the varimax rotation method, nine items (I7, I16, I18, I20, I21, I22, I26, I27, and I29) with discrimination indices below .45 were deleted from the scale.

Table 1 lists the item factor loading values of the scale's final version.

Table 1. Item factor loading values of the Attitude Towards Older Women Scale

Item No	Positive attitude	Negative attitude
I25	.727	
I24	.704	
I33	.660	
I6	.558	
I10	.631	
I28	.582	
I17	.572	
I3	.557	
I11	.522	
I13		.713
I14		.709
I19		.670
I34		.659
I2		.665
I32		.647
I12		.621
I1		.607
I31		.592
I15		.567
I23		.543
I9		.540
I8		.460
I30		.501
Eigenvalue	3.402	5.818
Explained Variance	14.792	25.297
Total Variance Explained	40.089	

As shown in Table 1, the eigenvalues in the two subscales are 3.402 in the first and 5.818 in the other. The percentage of total variance explained is 14.792% in the first subscale, 25.297% in the second subscale, and 40.089% in total. The factor loading values of the items vary between .460 and .727. In social sciences, an accepted variance ratio is considered adequate between 40% and 60%. However, since a variance ratio of 30% or more (14) is acceptable in single-factor structures, the explained variance ratio of 40.089% is considered acceptable.

Table 2. Reliability analysis of the Attitude Towards Older Women Scale

Subscales	Number of Questions	Cronbach's Alpha Reliability Coefficient
Positive Attitude	9	.840
Negative Attitude	14	.892
Total	23	.889

The Cronbach's alpha reliability coefficient calculated for the overall Attitude Towards Older Women Scale was .889, and it was calculated as .840 for the positive attitude subscale and .892 for the negative attitude subscale. Given that these values exceed .70, the scale's reliability is considered acceptable (12).

Item Analysis

The comparison of the subgroup and the supergroup is one of the methods used to determine whether the items retained in the scale have internal validity. The test scores obtained from the scale were ranked from smallest to largest, and it was determined that 27% of the sample equated to 81 participants. According to the scale score, the 81 people with the lowest score were recoded as the 'subgroup.' The difference between these groups was examined using the 'independent samples t-test.' When the findings regarding internal validity in Table 3 were examined, the difference between the arithmetic means of the attitude scores of the subgroup and the supergroup was found to be statistically significant ($p<0.001$).

Table 3. T-test results of the scale scores for the 27% subgroup and supergroup

	N	Mean ± SD	t	P
Subgroup	81	55.12 ± 9.41	17.329	.000
Supergroup	81	78.17 ± 7.39		

Confirmatory Factor Analysis

As a result of the exploratory factor analysis, a structure consisting of 23 items and two subscales was obtained. To test whether this structure obtained with EFA was confirmed or not, data were collected again using the scale's final version, and CFA was applied. It was suggested that the sample size for CFA should be between 100 and 200 observations (15). Consequently, a sample size of 209 students was deemed appropriate for the analysis. The items reflecting negative attitudes in the scale were reverse coded. Figure 1 shows the factor loadings related to the model obtained as a result of CFA.

In confirmatory factor analysis and structural equation modeling, the fit indices most commonly used to assess the fit of the model to the data are χ^2 (chi-square), RMSEA (Root Mean Square Error of Approximation), GFI (Goodness of Fit Index), AGFI (Adjusted Goodness of Fit Index), and CFI (Comparative Fit Index) (16). After the scale displayed a two-component structure, confirmatory factor analysis (CFA) was conducted to determine the fit of the structure. The CFA results indicated the following values: χ^2/sd=2.125, RMSEA=0.074, GFI=0.838, CFI=0.871, AGFI=0.800, NFI=0.884, IFI=0.873, and TLI=0.854. Table 2 below contains data on the fit indices obtained after the analyses.

When the goodness-of-fit indices for the Attitude Towards Older Women Scale were examined, it was found that the chi-square degree was χ^2=476.030 and the degree of freedom was

Figure 1. Path diagram for CFA results

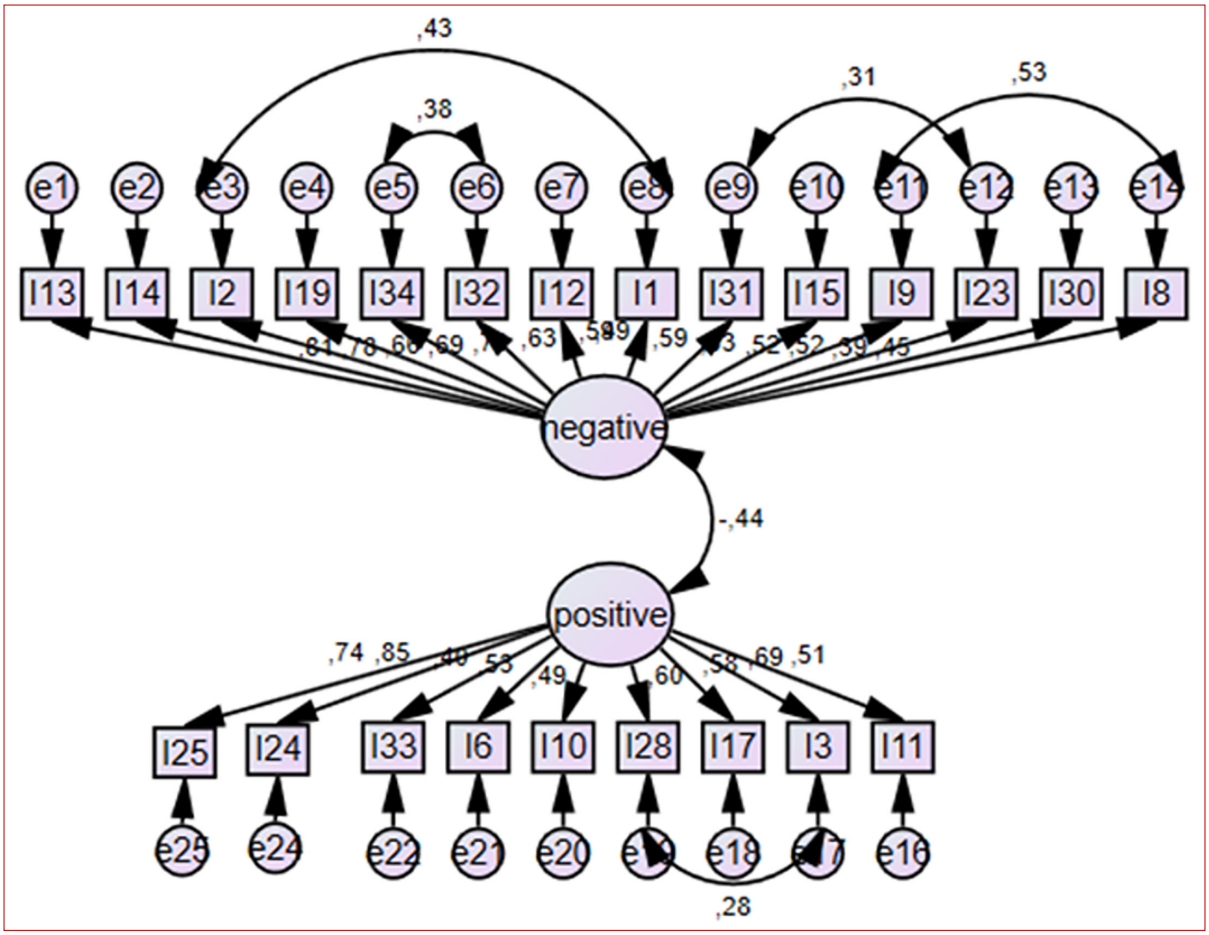

Table 4. Values related to goodness-of-fit indices for the Attitude Towards Older Women Scale

Chi-square	Sd	$\chi^{2/sd}$	RMSA	GFI	CFI	AGFI	IFI	TLI
476.030	270	2.125	.074	.838	.871	.800	.873	.854

sd=224. Accordingly, it was determined that the χ^2/sd ratio was 2.125 ($p<.05$). To understand if the model data fit is suitable, the χ^2/sd ratio should be less than 5 (17), and if it is less than 3, it is accepted that the model has a very good fit (18). The RMSEA value of the model was found to be .072. An RMSEA value of .08 and below indicates that the model has a good fit (19). An AGFI value exceeding .90 indicates a perfect fit, while .85 indicates an acceptable fit (20). However, some studies in the literature stress that an AGFI value above .80 is acceptable (21). The comparative fit index (CFI) value of the scale is 0.871. The Tucker-Lewis index (TLI) value is 0.854, and the incremental fit index (IFI) value is 0.853. These indices are considered acceptable when they are equal to or greater than 0.80 (12,22). When these criteria are considered, it can be stated that the two-factor structure obtained with confirmatory factor analysis is an acceptable model.

DISCUSSION

Negative and discriminatory attitudes towards older adults are more prevalent in modern societies than in traditional ones. Previous evaluations of attitudes towards older adults were typically based on various translations of Kogan's Attitude Toward Old People Scale (10). However, both foreign and domestic studies have examined university students' attitudes towards older adults. The majority of these studies have been conducted with students studying in the field of health. Students' attitudes towards older adults vary according to variables such as age, gender, department, income, and the presence of older adults in the family (7). The study adapting the Attitude Toward Older People Scale into Turkish indicated that due to prejudices about aging and the lack of economic security, many older adults experience health problems and increased dependence (9). A similar recent cross-sectional study in Austria with university students from various departments found that participants held negative attitudes towards older adults, describing them as dependent, insecure, and in poor health (23).

To combat the negative attitudes that older adults are exposed to, the attitudes and knowledge of young people should be structured in a more positive way. As such, they will not have stereotypical views about aging. In this regard, it is believed that the development of up-to-date, valid, and reliable measurement tools that will facilitate the acquisition of information that will guide policies and research on aging and older women will contribute to the literature.

Validity and reliability analyses were conducted on the "Attitude Towards Older Women Scale," which was developed as a five-point Likert-type scale and subjected to exploratory and confirmatory factor analyses. The exploratory factor analysis revealed that the 23-item "Attitude Towards Older Women Scale" consists of nine items for positive attitudes and 14 items for negative attitudes. The total score that can be obtained from the scale varies between 23 and 115. The total score is obtained by summing the scores obtained from the two factors in the scale.

A high score indicates high positive attitudes towards older women, whereas a low score indicates low positive attitudes towards older women. The variance explained by the two-factor structure is 40.089%. As a result of the analysis conducted regarding the measurement tool's reliability, Cronbach's alpha coefficients were found to be .840 for the first factor, .892 for the second factor, and .889 for the overall scale. According to the t-test results of the scale scores regarding the 27% subgroup and supergroup, the difference between the arithmetic means of the attitude scores of the subgroup and the supergroup was found to be statistically significant, possibly indicating that all items in the ATOWS are discriminatory. To test the structure's accuracy, confirmatory factor analysis was conducted, resulting in the following values: χ^2/sd=2.125, RMSEA=0.074, GFI=0.838, CFI=0.871, AGFI=0.800, NFI=0.884, IFI=0.873, and TLI=0.854. The confirmatory factor analysis confirmed that the two-factor structure is an acceptable model. The Attitude Towards Older Women Scale (ATOWS) is a two-dimensional measurement tool with 23 items, where high scores in the positive attitude subscale and low scores in the negative attitude subscale indicate positive attitudes towards older women.

CONCLUSION

In line with the analysis results, the acceptable reliability and validity of the "Attitude Towards Older Women Scale" show that the scale can be used to determine the attitudes of university students towards older women in Türkiye. It is also thought that it will fill the gap in the literature, especially in studies to be conducted in the field of women's studies.

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ORIGINAL ARTICLE

IMPACT OF RECREATIONAL ACTIVITIES ON DEPRESSION AND EMERGENCY ROOM VISITS IN OLDER ADULTS LIVING ALONE

Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.415
2024; 27(4):416-424

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Abstract

Introduction: This study aimed to determine the impact of recreational activities on the frequency of emergency room visits and depression levels of individuals aged ≥65 years living alone.

Materials and Method: This cross-sectional study included 192 older adults living alone who were admitted to a state hospital emergency room between June and September 2022. The mean age was 76.23 ± 7.24 years. The Older Adults Promotion and Recreational Activities Determination Form and Geriatric Depression Scale Short Form were used. The chi-square test, nonparametric comparison tests, sequential logistic regression, and correlation analysis were used to analyse the data.

Results: The mean Geriatric Depression Scale Short-Form score was 7.51 ± 4.47. The factors affecting depression were the duration of loneliness, interaction with family members and friends, physical activity, smartphone use, gardening, attending courses, trips, knitting, going on a picnic, walking, cycling, and making a cake. Wanting to engage in sports but not being able to was a significant factor for depression in the regression analysis. The number of medications used, number of children, smartphone use, and cancer status affected the frequency of emergency room visits. As the level of depression increased, the frequency of emergency room visits also increased.

Conclusion: Therefore, social policies that reduce depression and emergency department visits were recommended.

Keywords: Aged; Loneliness; Depression; Emergencies; Recreation.

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Received : Oct 26, 2024
Accepted : Dec 03, 2024

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INTRODUCTION

As individuals age, their risk of dependence and psychological challenges increases. Retirement, children leaving home, loss of spouses and friends, and the isolating effects of urban life contribute to loneliness (1). Psychosocial distress, social isolation, and loneliness along with the effects of ageing, can induce physiological changes that heighten the risk of depression and exacerbate it in vulnerable older adults (2).

Older adults often experience an increase in leisure time. Recreation is an enjoyable social activity practised during free time to renew oneself. Recreational activities, which create a feeling of satisfaction in people when realised, include hobbies and pursuits that support individuals psychologically (3). Regular recreational activities contribute to recovery from chronic diseases, coping with stress, and depression prevention in older adults, and include exercise, trips, cycling, music, cinema, meeting with friends, attending social events, walking, gardening, photography, swimming, and handicrafts (4, 5). People who participate in sports clubs and organise recreational activities have better mental health and are more resistant to the stress of modern life (6).

With advances in age, the physical activity performed by the older adults decreases, which triggers many diseases, such as diabetes, osteoporosis, cardiovascular diseases, and depression (7). The symptoms of these disorders increase the number of visits to health institutions. One reason for the increase in emergency room visits is individuals' fear and uncertainty regarding their condition. Parallel to the increase in the elderly population, the number of older adults applying for emergency services has also increased (8).

The term recreation is a concept that covers many activities. Studies conducted on some of these activities have been previously reported. The effects of social relationships, leisure activities, and health status on depression in lonely older adults have also been examined (2). The relationships between loneliness, depression, and social networks in older individuals (9); between loneliness, depression, and quality of life (10); and between physical activity and depression (11) were examined. Within the scope of the term 'recreation', there are studies on visiting the national forest recreation area in Taiwan (12) and recreational experience preferences in Sweden (13). However, none of these studies covered all recreational activities in the lives of lonely older adults or the effects of these activities on depression and emergency room visits. To the best of our knowledge, this study is the first to focus on such topics in the literature and is based on the following questions.

What is the level of depression among older adults living alone? Which recreational activities affect depression levels?

What recreational activities affect the frequency of emergency room visits among older adults living alone?

What are the recommendations for older adults to reduce their depression level and frequency of emergency room visits?

The current study aimed to investigate the effect of recreational activities on the lives of older adults living alone who visited the emergency room of a state hospital, their level of depression, and frequency of emergency room visits.

MATERIALS AND METHOD

Setting and Sampling

This cross-sectional study was conducted in the Çankırı province of Türkiye. The study sample comprised 192 patients who visited the Emergency Room of the Çankırı State Hospital and satisfied the inclusion criteria. The study utilised both convenience (since older adults who visited the emergency department were included) and

purposive (because older individuals who lived alone were included) sampling methods. Before starting the study, G-Power 3.1.9.4 software was used for power analysis. Within the scope of the Mann–Whitney U test, which was applied in a previous study using the Geriatric Depression Scale Short Form (GDS-15), the effect value was approximately d = 0.783 (14). Using this effect value and a 5% margin of error (p <0.05), the power value was calculated as 0.951 (95.1%) when working with 76 observations.

A repeat power analysis was applied to determine the statistical power of the study after study. Within the scope of the Kruskal–Wallis test applied to the GDS-15 score variable in the current study, the effect value was approximately d = 0.280, with a 5% margin of error, and the power value was calculated as 0.942 (94.2%) when working with 192 observations (Figure 1).

The inclusion criteria were as follows: age ≥65 years, living alone, history of admission to the emergency room, voluntarily accepting participation in the study, having a stable health status, and having no problems in mental functions.

The exclusion criteria were age <65 years and a psychiatric or neurological medical diagnosis preventing communication, dementia, and cerebrovascular disease.

Data collection tools

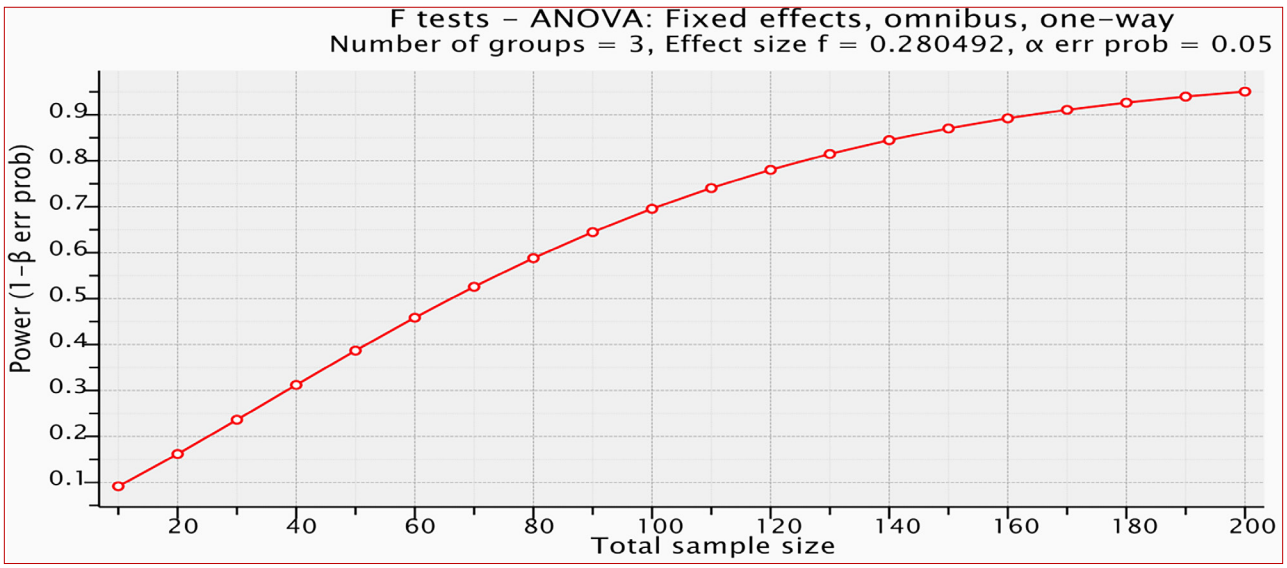
Older Adults Promotion and Recreational Activities Determination Form: This form utilised the literature to determine the participants sociodemographic data and recreational activities (5).

GDS-15: This form identified depression in the older population. The cut-off score is 5, and a score of >5 indicates a risk of depression, with 0–4 indicating no risk of depression, 5–8 indicating mild depression, 9–11 indicating moderate depression, and ≥12 indicating severe risk of depression. The 15-question scale was tested for validity and reliability regarding suitability for Turkish older people in Türkiye (15).

Data collection process

This study was explained to the individuals who visited the Emergency Room whose condition was stable, and questionnaires were administered

Figure 1. Post-study power analysis



personally and face-to-face after obtaining their signed consent forms between June and September 2022. The first author was a nurse working in the emergency department of a hospital. The data collection process was conducted in the green area, which includes individuals who do not require urgent intervention and can wait; in the yellow area, which includes patients who are not in a life-threatening position and whose treatment can be delayed; and in the Emergency Room observation rooms. Data were collected when the participant was alone to avoid restricting their free will.

Ethics

Approval was obtained from the University Ethics Committee (meeting no. 25, Decision Date: 21.04.2022) and Government Provincial Health Directorate (Number: E-64943697-799, Date: 03.06.2022) before starting the study. This study was conducted in accordance with the Declaration of Helsinki and other international ethical guidelines. Informed consent was obtained from all the participants.

Statistics

The data in this study were evaluated using the International Business Machines Statistical Package for the Social Sciences 24 (IBM SPSS). Frequency analysis and chi-square tests were performed. The data distribution normality was verified using the Shapiro–Wilk and Kolmogorov–Smirnov tests to select the appropriate statistical tests. Accordingly, either the Mann–Whitney U (between two groups) and Kruskal–Wallis (more than two groups) tests were used for group comparisons depending on the number of groups. Sequential logistic regression, binary logistic regression, and correlation analyses were performed.

RESULTS

The mean age of the participants was 76.23 ± 7.24 years (range: 65–91); 59.38% were female, and 22.92% were illiterate.

Depression levels

The mean GDS-15 participant scale score was 7.51 ± 4.47, and the median was 7 (range: 0–15).

The mild-to-moderate-to-severe depression risk ratios of the participants are shown in Table 1.

Recreation and depression

A chi-square association test was performed on recreational activities that may have affected participants' depression levels. Statistically significant independent variables were analysed using the GDS-15 score as the dependent variable and analysing their median values. Owing to the high number of variables in this study, significant variables affecting the level of depression are shown in Table 2. For instance, participants aged 65–74 years had a significantly lower risk of depression than those aged ≥85 years ($p<0.001$; Table 2). No significant differences were found according to sex or educational status (not shown in Table 2).

Table 1. Depression risk levels of the participants according to their GDS-15 scores

n (%)				
No Depression (<5 points)	**Mild Depression (5–8 points)**	**Moderate Depression (9–11 points)**	**Severe Depression (>11 points)**	**Total**
58 (30.2 %)	55 (28.6 %)	35 (18.2 %)	44 (22.9 %)	192 (100 %)
	134 (69.8 %)			

Table 2. Comparison of participants' GDS-15 score medians according to recreational activity variables

Variable	Group	n	Median	p	D.C. (English)
Age groups	65–74 (1)	78	6	**<0.001****	**3>1**
	75–84 (2)	82	8		
	85+ (3)	32	11		
Duration of living alone	Less than 1 year (1)	26	4.00	**0.039****	**3>1 4>1 5>1**
	1–5 years (2)	70	8.00		
	5–10 years (3)	38	7.00		
	10–15 years (4)	38	9.00		
	15 years and over (5)	20	8.00		
Using a smartphone	Yes	111	6.00	**<0.001***	
	No	81	10.00		
Interested in music, singing	Yes	53	4.00	**<0.001***	
	No	139	9.00		
Going for regular walks	No	131	9.00	**<0.001***	
	Yes	61	4.00		
Exercising	Yes	126	5.50	**<0.001***	
	No	66	11.00		
Cycling	No	175	8.00	**<0.001***	
	Yes	17	3.00		
Gardening	Yes	69	5.00	**<0.001***	
	No	123	8.00		
Volunteer work	Yes	25	3.00	**<0.001***	
	No	167	8.00		
Doing activities with family members	Yes	99	5.00	**<0.001***	
	No	91	10.00		
Activity with family members (don't go on a picnic)	No	108	9.00	**<0.001***	
	Yes	84	6.00		
Frequency of contact with friends	Once a week (1)	67	6.00	**<0.001****	**3>1**
	Once a month (2)	28	6.50		**5>1**
	Several times a year (3)	17	9.00		**3>4**
	Every day (4)	43	5.00		**5>4**
	Never to meet (5)	37	12.00		**5>2**
Participation in outing events (concert, exhibition, theatre)	No	161	8.00	**<0.001***	
	Yes	31	3.00		
Participation in outing events (wedding, entertainment)	No	119	9.00	**<0.001***	
	Yes	73	5.00		
Participation in outing events (sightseeing tours)	No	148	8.00	**<0.001***	
	Yes	44	3.00		
Participation in outing events (hobby courses)	No	158	8.00	**<0.001***	
	Yes	34	4.00		
Home activities (making cakes, pies)	No	136	8.00	**0.017***	
	Yes	56	6.00		
Home activities (knitting)	No	123	8.00	**0.032***	
	Yes	69	7.00		
Home activities (playing chess, checkers)	No	182	8.00	**<0.001***	
	Yes	10	1.00		
Is there an activity that you want to do but can't?	Yes	56	6.00	**0.012***	
	No	136	8.00		

* Mann Whitney U Test; ** Kruskal Wallis Test; D.C., Dual Comparison; p<0.05, Statistically significant; Only significant variables were included in the table and insignificant variables were not included

In addition, logistic regression analysis was applied to variables with significant relationships. Accordingly, participants who answered 'yes' for the variable 'sports activities', from the activities that the participants wished but could not do, were utilised as the reference group. However, the depression level of the participants who answered 'no' was significantly higher (Odds Rate = 353.817; p = 0.004). That is, the depression levels of the participants who wished but could not participate in sports were higher than that of those who wished to participate and could.

Recreation and frequency of emergency room visits

A chi-square test was conducted on the recreational activity variables that may be related to the frequency of emergency room visits in the last 6 months, and the statistically significant variables are summarised in Table 3.

Logistic regression analysis was also applied to the eight significant variables (Table 3). The frequency of emergency department visits in the last 6 months was a 5-level dependent, including

Table 3. Recreational activity variables associated with frequency of emergency room visits

Variable	Chi-Square Value	p-value
Amount of drugs used daily	39.963	<0.001[a]
Existence of children	35.844	0.01[a]
Using a phone	25.069	0.01[a]
Presence of chronic disease	15.086	0.01[b]
Hypertension	9.691	0.04[a]
Cancer	9.686	0.04[a]
Exercising on an apparatus	9.621	0.02[a]
Surfing on the Internet	18.686	<0.001[a]

a: Pearson Chi-Square test, b: Fisher exact test

Table 4. Results of the sequential logistic regression analysis

Variables		β	Standard error	Wald	p	OR
Number of drug uses	No medication	-1.417	1.417	1.000	0.317	0.242
	1–3	-0.772	0.465	2.762	0.097	0.462
	3–5	-0.947	0.442	4.585	**0.032**	0.388
	>5		Reference			
Number of children	None	-1.038	0.839	1.532	0.216	0.354
	1	-1.612	0.608	7.037	**0.008**	0.199
	2	-1.364	0.543	6.312	**0.012**	0.256
	3	-0.254	0.557	0.209	0.648	0.775
	4	-0.322	0.568	0.321	0.571	0.725
	≥5		Reference			
Smartphone usage	Yes	-1.672	0.441	14.372	**0.000**	0.188
	No		Reference			
Cancer	No	-2.278	0.944	5.828	**0.016**	0.102
	Yes		Reference			

OR: Odds ratio, β: regression coefficient, p: probability value

1, 2, 3, 4, and ≥5 visits in the last 6 months. In the analyses, a sequential logistic regression model was employed because of the structure of the dependent variable.

A sequential logistic regression model was constructed using a logit link function. The assumption of parallel curves, which is a sequential logistic model assumption, was satisfied, and the model's compliance tests yielded statistically significant results. The factors affecting the frequency of emergency room visits are presented in Table 4.

Relationship between depression and frequency of emergency room visits

When the relationship between the frequency of emergency department visits in the last 6 months and GDS-15 scores was analysed using Spearman's rho correlation coefficient, a low positive correlation was observed between the variables ($n = 192$; $r = 0.180$; $p = 0.013$).

DISCUSSION

In a study conducted in Nigeria, the likelihood of depression was higher in lonely retirees than in non-lonely retirees, and the prevalence of depression in lonely retirees was 52% (16). In a study conducted among older individuals in India, depression rates in lonely older individuals were higher than those in non-lonely older individuals (17). Herein, the prevalence of overall depression risk was 69.8%, whereas that of moderate-to-severe depression risk was 41%. To prevent the risk of depression, determining which recreational activities are meaningful in the lives of lonely older adults at high risk of depression is crucial.

In a study conducted in Tokyo, loneliness and weak social networks triggered depression; however, the effect of weak social networks was more dominant. Weak social networks are a social risk factor for mental health, even among non-lonely older adults (18). Another study comprising 3535 older adults in Spain, the significant risk factor for risk of depression for lonely older individuals was weak social networks (9). Therefore, more social support from family and friends is necessary, especially in old age (19). This study revealed that engaging in various recreational activities that provide social interaction has a positive effect on depression levels among older adults living alone. Activities such as meeting friends, using smartphones, engaging in family activities, volunteering, going on picnics, and participating in outdoor activities were identified as important factors that supported the mental health of older adults.

In Greece, depression levels increased in lonely older adults as their physical activity declined (11). Thus, a significant relationship has been observed between physical activity and depression variables (20). In another study, a significant decrease was found in depression levels in older individuals who underwent exercise (21). Likewise, another study found that older adults who played music had lower levels of depression (22). Herein, recreational activities such as walking, exercising, cycling, gardening, and playing music were factors that influenced depression levels.

One study found a significant relationship between depression and emergency room use (23). Similarly, in the current study, a weak positive correlation was found between the frequency of emergency room visits in the last 6 months and GDS-15 score. This relationship suggests that emergency health needs may indirectly affect mental health in older adults. Individuals who frequently visit the emergency department are likely to experience increased stress and anxiety owing to health problems, which may affect their depression scores.

Our study findings emphasise the importance of social support, interaction opportunities, and potential therapeutic effects of recreational activities for older individuals living alone. These results also provide a foundation for the identification of

meaningful recreational activities and development of intervention strategies along with evidence-based data for health policies and social service programs.

LIMITATIONS

The results of this study cannot be generalised for a larger population, as this study was conducted on older individuals admitted to the emergency department of a state hospital in a province and due to the presence of cultural differences. Thus, further multicentre studies that include different societies are warranted.

CONCLUSION

Advanced age, duration of loneliness, interaction with family members, meeting friends, physical exercise, walking, cycling, smartphone use, going on picnics with family members, making cakes and pastries at home, knitting, going to concerts and movies, going on excursions, attending courses, and gardening are all depression associated factors. Additionally, the desire of an older adult wanted to engage in sports is a significant predictor of depression in regression analysis. The number of medications received, number of children, smartphone use, and cancer status were factors that affected the frequency of emergency room visits. The frequency of emergency room visits proportionally increased with the level of depression.

Policy recommendations

The recreational activities identified in this study should be increased to protect the health of older adults. Local governments should open active living centres for older individuals to engage in social and artistic activities to allow them to access and form extensive social networks. Additionally, 'Will you be my grandson' or 'Will you be my grandfather or grandmother' projects that bring young and old individuals together can be planned. '3rd age universities', which have recently become prevalent worldwide, should be expanded, as this project, which is conducted within universities and accepts only older adults, allows older adults to participate in healthy living classes, knitting, and exercise. Finally, cafeterias could be established in neighbourhoods and branded as 'coffee houses for older adults.' Thus, older adults are encouraged to interact socially with others.

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