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European Journal of Geriatrics and Gerontology is the official open access scientific publication organ of the Academic Association of Geriatrics. It is a double peer-reviewed journal published quarterly in April, August and December.

The target audience of the journal includes physicians working in the fields of geriatrics and gerontology and all other health professionals who are interested in these topics.

The editorial processes of the journal are shaped in accordance with the guidelines of the international organizations such as the International Council of Medical Journal Editors (ICMJE) (http://www.icmje.org) and the Committee on Publication Ethics (COPE) (http://publicationethics.org).

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Manuscripts should be prepared according to ICMJE guidelines (http://www.icmje.org).

Original manuscripts require a structured abstract. Label each section of the structured abstract with the appropriate subheading (Objective, Materials and Methods, Results, and Conclusion). Case reports require short unstructured abstracts. Letters to the editor do not require an abstract. Research or project support should be acknowledged as a footnote on the title page.

Technical and other assistance should be provided on the title page.

Title Page

Title: The title should provide important information regarding the manuscript's content.

The title page should include the authors' names, degrees, and institutional/professional affiliations, a short title, abbreviations, keywords, financial disclosure statement, and conflict of interest statement. If a manuscript includes authors from more than one institution, each author's name should be followed by a superscript number that corresponds to their institution, which is listed separately. Please provide contact information for the corresponding author, including name, e-mail address, and telephone and fax numbers.

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Abstract

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Materials and Methods: Important methods should be written respectively.

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Original Articles

Original articles should have the following sections;

Introduction: The introduction should include an overview of the relevant literature presented in summary form (one page), and whatever remains interesting, unique, problematic, relevant, or unknown about the topic must be specified. The introduction should conclude with the rationale for the study, its design, and its objective(s).

Materials and Methods: Clearly describe the selection of observational or experimental participants, such as patients, laboratory animals, and controls, including inclusion and exclusion criteria and a description of the source population. Identify the methods and procedures in sufficient detail to allow other researchers to reproduce your results. Provide references to established methods (including statistical methods), provide references to brief modified methods, and provide the rationale for using them and an evaluation of their limitations. Identify all drugs and chemicals used, including generic names, doses, and routes of administration. The section should include only information that was available at the time the plan or protocol for the study was devised on STROBE (http://www.strobe-statement.org).

Statistics: Describe the statistical methods used in enough detail to enable a knowledgeable reader with access to the original data to verify the reported results. Statistically important data should be given in the text, tables and figures. Provide details about randomization, describe treatment complications, provide the number of observations, and specify all computer programs used.

Results: Present your results in logical sequence in the text, tables, and figures. Do not present all the data provided in the tables and/or figures in the text; emphasize and/or summarize only important findings, results, and observations in the text. For clinical studies provide the number of samples, cases, and controls included in the study. Discrepancies between the planned number and obtained number of participants should be explained. Comparisons, and statistically important values (i.e. p value and confidence interval) should be provided.

Discussion: This section should include a discussion of the data. New and important findings/results, and the conclusions they lead to should be emphasized. Link the conclusions with the goals of the study, but avoid unqualified statements and conclusions not completely supported by the data. Do not repeat the findings/results in detail; important findings/results should be compared with those of similar studies in the literature, along with a summarization. In other words, similarities or differences in the obtained findings/results with those previously reported should be discussed.

Study Limitations: Limitations of the study should be detailed. In addition, an evaluation of the implications of the obtained findings/results for future research should be outlined.

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Bonanni E, Tognoni G, Maestri M, Salvati N, Fabbrini M, Borghetti D, DiCoscio E, Choub A, Sposito R, Pagni C, Iudice A, Murri L. Sleep disturbancesin elderly subjects: an epidemiological survey in an Italian district. ActaNeurol Scand 2010;122:389-397.

2. Organization as Author

American Geriatrics Society 2015 Updated Beers Criteria Expert panel. American geriatrics society 2015 updated Beer criteria for potentially inappropriate medication use in older adults. J Am Geriatr Soc 2015;63: 2227-2246.

3. Complete Book

Ham RJ, Sloane PD, Warshaw GA, Potter JF, Flaherty E. Ham's primary care geriatrics : a case-based approach, 6th ed. Philadelphia, Elsevier/Saunders, 2014.

4. Chapter in Book

BG Katzung. Special Aspects of Geriatric Pharmacology, In:Bertram G. Katzung,Susan B. Masters, Anthony J. Trevor (Eds). Basic and Clinical Pharmacology. 10th edition, Lange, Mc Graw Hill, USA 2007, pp 983-90.

5. Abstract

Reichenbach S, Dieppe P, Nuesch E, Williams S, Villiger PM, Juni P. Association of bone attrition with knee pain, stiffness and disability; a cross sectional study. Ann Rheum Dis 2011;70:293-8. (abstract).

6. Letter to the Editor

Rovner B. The Role of the Annals of Geriatric Medicine and Research as a Platform for Validating Smart Healthcare Devices for Older Adults. Ann Geriatr. 2017;21:215-216.

7. Supplement

Garfinkel D. The tsunami in 21st century healthcare: The age-related vicious circle of co-morbidity - multiple symptoms - over-diagnosis - over treatment - polypharmacy [abstract]. J Nutr Health Aging 2013;17(Suppl 1):224-227.

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Case Presentation: This section describes the case in detail, including the initial diagnosis and outcome.

Discussion: This section should include a brief review of the relevant literature and how the presented case furthers our understanding to the disease process.

Review Articles

Reviews should include a conclusion, in which a new hypothesis or study about the subject may be posited. Do not publish methods for literature search or level of evidence. Authors who will prepare review articles should already have published research articles on the relevant subject. There should be a maximum of two authors for review articles.

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Article Type	Abstract (words)	Document (words) (excluding references)	References	Total Tables and Figures
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Review Articles	300	3500	75	5
Invited Review Article	300	3500	75	5
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Images	None	500	10	2
Letters to the Editor	None	600	10	1
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Acknowledgments

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4. All authors are responsible for the manuscript's content
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CONTENTS

EDITORIAL

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Eur J Geriatr Gerontol 2021;3(3):131-133

A 15-day Working Shift Prevent the Cross-contamination of Coronavirus Disease-2019 in a Nursing Home in Turkey

Oktay Özten[1], Tülay Aytekin Aktaş[1], Hüseyin Süer[1], Hafize Doğan[1], Ayşe Üner[1], Salim Özpınar[1], Yunus Ayyıldız[1], Hilal Bektaş[1], Bülent Saka[2]

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[2]İstanbul University, İstanbul Faculty of Medicine, Department of Internal Medicine, İstanbul, Turkey

Introduction

The new type of Coronavirus disease-2019 (COVID-19) outbreak had gained speed especially after spreading to the continents of Europe and America and reached a large number of deaths. Many countries declared suppression measures including social isolation, closed schools and workplaces and cessation of social activities. It has been observed that many of those who lost their lives due to COVID-19 were old aged people from nursing homes and chronic care centers (1).

In Turkey, reported number of COVID-19 positive cases are more than 260 thousand and number of deaths are over 6.100 with 91% recovery rate and 73 death/1 M population (2). With strict preventive measures began before the pandemic resulted with low COVID-19 cases and mortality rate in nursing homes across the country (3). This report showed data from a nursing home in Turkey, İstanbul Municipality Kayışdağı Darülaceze Directorate, one of the biggest in the country with 679 residents, which did not have any COVID-19 case during the first year of the pandemic (both employees and residents) with a working plan that successfully prevent cross-contamination.

İstanbul Municipality Kayışdağı Darülaceze Directorate

A total of 679 residents (272 women and 407 men) are living in the nursing home. The mean age of the residents is 72.1±8.1 years (72.2±8.6 years for women and 71.8±6.2 years for men). 29% of the residents are independent, 39% are mild or moderately dependent and 32% are completely dependent. Figure 1 showed the prevalence of the chronic diseases. Staff included; 13 doctors, 104 nurses/other health personnel, 5 psychologists, 2 sociologists, 243 care-givers, 97 other service providers and 40 personnel working in the kitchen.

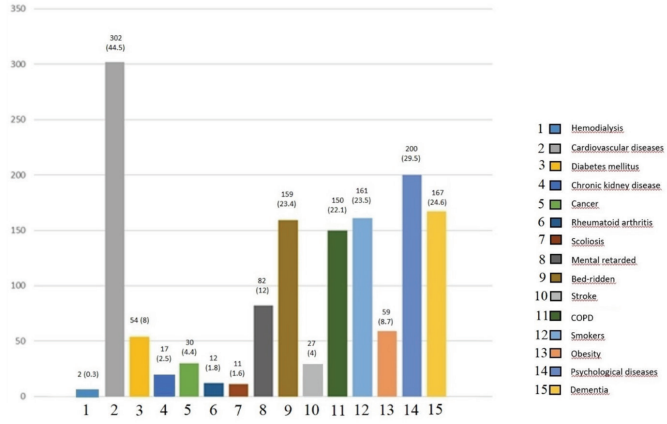

Figure 1. Chronic diseases of the residents; number (%)

COPD: Chronic obstructive pulmonary disease

Preventive Measures During COVID-19 Pandemic

Before and during the first month of the pandemic:

- Announcement of a COVID-19 protocol that included preventive measures and algoritm for COVID-19 positive cases.
- Health personnel started to use protective equipment (gloves, face-shields, masks and disposable clothings).
- Alcohol-based disinfectants were placed in all entrances and floors.

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- Residents were not allowed outside except for medical reasons.
- Regular measurement of body temperature were made to all residents and the staff.
- New admissions were suspended temporarily. Visitors were not allowed unless there was an urgent condition.
- Residents with any clinical sign and symptoms were isolated in the infirmary, evaluated clinically and followed up by the doctors and nurses. If indicated, they were transferred to the hospital.
- Two seperate infirmary wards were arranged for suspicious cases in order to perform polymerase chain reaction (PCR) tests, treatment and follow-up. Residents those came from hospitals were isolated in those wards for 2 weeks.
- İstanbul Municipality organised a special transportation for the staff in order to prevent contamination from public transport.

Next 11 months of the pandemic:

- District Health Directorate organised COVID-19 PCR testing to whole staff.
- A new organisation was initiated for the staff that included 15-days working periods. In every period, one group would be on duty and stayed in the institution while the other rested at home. All of the staff and the executive staff voluntarily accepted to stay in the institution throughout the pandemic in such an organisation.
- Before changing the working staff groups, COVID-19 PCR tests were repeated. Any personnel with a suspected clinical sign/symptom was not accepted to institution unless it was proven that he/she did not have COVID-19 infection.
- The institution made cooperations with the banks to maintain transport of salaries to the residents by the officials.
- The directorate made the daily shopping for the residents.
- In case of any medical emergency, patients were sent to pandemic-free hospitals.
- Inside the buildings, staff was not allowed to go beyond the areas reserved for them.
- In case of any contact with COVID-19 positive relatives, the employee would not be accepted to the institution before 14 days of isolation at home and approved negative PCR test result.
- In case of any suspcious symptom(s), the residents were transported to a specific ward that was formerly prepared for quarantine.
- Social distance (1.5 m) and face masks were mandatory in restaurants, parks and cafes. Social distance was 2 m for smokers.

Psychosocial Support

Fifteen days working shift plan was important in overcoming the fear of death and abandonment among the residents. The use of a communication language including, "We are with you, you are not alone and unattended", was very important. In order to control the attitudes and behaviors of the residents towards the pandemic, psychological support interviews were conducted. Exercise and sports activities were carried out periodically.

15-days shifts increased the stress of the staff both physically and psychologically. Beneath social activities, they had group communication therapies with sociologists and psychologists. During the stay, one of the most important stress factor was separation from families. Solutions, such as giving parents' gifts to their children, birthday cakes and video conferencing decreased the stress of parents and children.

Discussion

Since older adults living in chronic care facilities are mostly frail, they are vulnerable to infections such as COVID-19. Abrams et al. (1) reported COVID-19 positive cases in 2.949 (31.4%) nursing homes across US. Larger facility size, urban location, greater percentage of African American residents, non-chain status, and state were significantly ($p<0.05$) related to probability of having a COVID-19 case. According to data of the International Long Term Care Policy Network, COVID-related deaths among care home residents ranges from 24-82% in different countries (4).

During the COVID-19 outbreak, residents and the staff were isolated with many other preventive measures. Occupancy rates, increased number of testing, environmental and personal hygiene, social isolation, follow-up of signs and symptoms, ongoing education, supplies of personal protective equipment are important to decrease contamination risk. Centers for disease control recommends that nursing homes and assisted living facilities should follow strict isolation policies to protect the health of residents and staff (5).

On the other hand, outside contacts of the staff increased the risk in the nursing homes (6). Roxby et al. (7) highlighted the potential role of infected staff members in the cross-contamination. 28% of the staff reported symptoms potentially compatible with COVID-19 (7). Then periodical screening tests among healthcare personnel those are in close contact with the residents can decrease contamination.

In United States of America, Centers for Medicare and Medicaid Services announced recommendations for prevention of

COVID-19 in nursing homes (8). Tan and Seetharaman (9) reported successful management of COVID-19 prevention in a geriatric center by restriction of visitors, prescreening of visitors, and reduction in unnecessary transfer of patients.

During the pandemic other important problems were the treatment of acute medical conditions other than COVID infection and the complications of the chronic diseases. Our reports did not show any increase in the incidence of medical conditions other than COVID in that period. In case of hospitalization, COVID-free hospital wards were preferred. After hospitalization, residents were followed in the quarantine wards of the institution for 15 days.

Without any COVID-19 positive case in our nursing home, it seems that 15-days working shift plan with strict adherence to other preventive measures were successful. Although it is difficult to convince the staff to stay at institution for such a long period, collaboration of the executive staff and the psychosocial support improve their adherence and adaptation. They did not have extra payment for this plan.

Keywords: COVID-19, long-term care, prevention

Ethics

Peer-review: Internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: O.Ö., T.A.A., H.S., H.D., A.Ü., S.Ö., Y.A., H.B., B.S., Concept: O.Ö., T.A.A., H.S., H.D., A.Ü., S.Ö., Y.A., H.B., B.S., Design: O.Ö., T.A.A., H.S., H.D., A.Ü., S.Ö., Y.A., H.B., B.S., Data Collection or Processing: O.Ö., T.A.A., H.S., H.D., A.Ü., S.Ö., Y.A., H.B., Analysis or Interpretation: O.Ö., H.S., H.D., A.Ü., B.S., Literature Search: O.Ö., H.S., H.D., B.S., Writing: O.Ö., H.S., H.D., B.S.

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SYSTEMATIC REVIEW

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Effect of Dance Therapy on the Physical Abilities of Older Adults with Dementia: A Systematic Review

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Abstract

Music and dance are used as therapies in different diseases to improve physical function. However, no reviews have been published on the impact of dance therapy on the physical functions of older adults with dementia. We conducted a systematic review of studies that reported the quantitative results of gait quality, gait speed, endurance, balance, strength, and the ability to perform activities of daily living. Six articles that met the inclusion criteria were reviewed. The functional results of the included studies were very heterogeneous, which showed a possible positive effect on balance, walking speed, and the ability to perform activities of daily living. Future trials should explicitly and objectively set the criteria for the inclusion or exclusion of participants. In addition, randomized controlled trials with large samples are necessary to provide further evidence on the efficacy of different styles of dance compared with other types of physical activity.

Keywords: Dance therapy, older adults, dementia

Introduction

Dementia is a major public health challenge as it affects around 45 million people worldwide (1). It is one of the major causes of disability and dependency among older people (2). Impairments of memory and cognitive functions are the most characteristic signs of this pathology. However, balance and walking disorders are frequently observed (3), worsening the patient's global condition and indicating a poor prognosis. Thus, the quality of life of the patient and his/her family is severely affected (4).

Alzheimer's disease is the most common cause of dementia, causing between 50 and 75% of cases. The pharmacological treatments currently available aim at treating the symptoms, but current data show that they are only moderately effective in the best of cases (1). Faced with this observation and given the numerous mechanisms involved, many teams experiment with a reorientation of the interventions in favor of functional, psychological, and psychosocial approaches (5). These new approaches aim at optimizing the patient's well-being and quality of life as well as delay, prevent or reduce adverse outcomes of the disease.

Music and dancing are thought to induce numerous benefits on the motor function (6). Dancing involves rhythmic movements of the limbs and trunk and music provides external cues that facilitate movement (7). Music and dancing have been shown to encourage patients to develop attention, memory, rhythm, coordination, balance, and self-perception of the body in space (8). Therefore, music and dancing are commonly used as complementary therapies in various pathologies such as cardiovascular diseases (9), Parkinson's disease (10), or cancer (11).

Previous literature reviews have examined the health benefits of dance (12-18). However, there is to our knowledge no study that reviewed quantitative studies investigating the effects of dance on the functional abilities of older people with dementia. In 2017, Karkou and Meekums (14) published a systematic review about the effects of dance movement therapy (DMT) on people with dementia. The review was focused on psychosocial outcomes and age was not an exclusion/inclusion criterion.

Mabire et al. (17) included studies implementing a dance intervention for people with dementia. However, the authors did not integrate inclusion/exclusion criteria about age, types

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of outcomes, nor study designs. The systematic review of Ruiz-Muelle and López-Rodriguez (13) had no restrictions on the age or cognitive status of the participants.

Our systematic review focused on quantitative trials using therapy-based dance interventions in people with dementia over the age of 65. This review aimed to analyze the effects of dance therapy on physical skills in older adults with dementia.

Materials and Methods

This systematic review was based upon the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines (19).

Search Strategy

Up to March 2020, an electronic search was conducted to identify relevant studies published in the following databases: PubMed, Web of Science, Scopus, and ALOIS. The search terms were «dementia», «alzheimer», «dance», «dancing», «older adults» and «elderly». bibliographic references of the included articles were examined to search for articles that had escaped the initial search strategy.

Eligibility Criteria

Our review included experimental studies, available in full text, and published in English, French, Portuguese, or Spanish. Excerpts from congresses, case reports, protocols, books, essays, and thesis were excluded.

We considered studies including individuals who met the following criteria: Individuals aged 65 or above; diagnosed with dementia; trials that were limited to participants with mild cognitive impairment, or with a mini mental state examination (20) score over 24 were excluded; studies about Parkinson's disease were excluded.

Experimental interventions aiming at finding some benefit of scheduled dance sessions were included. The sessions included movements to the rhythm of music with the presence of an instructor, therapist, or guide. We included studies reporting quantitative results regarding gait quality, gait speed, endurance, balance, strength, and the ability to carry out the activities of daily living (ADL).

Study Selection

The references of articles resulting from the research were exported to Mendeley©. We then carried out an automatic reference check to target and eliminate duplicates. Two reviewers (LB and GP) carried out an examination of article titles and abstracts for eligibility. Subsequently, the full texts of potential studies were screened to determine final eligibility for inclusion. Disagreements about the eligibility were resolved by discussion and consensus between the reviewers.

Data Extraction

One reviewer (LB) extracted the following data from the studies: Design, objective, sample characteristics, description of the intervention of the experimental and control groups, and outcome measures. These data were compiled in Table 1.

Study Quality Assessment

Two reviewers (LB and GP) independently assessed the methodological quality of each included article, using a standardized checklist of 12 predefined criteria developed following de Vet et al. (21) recommendation for the quality assessment of trials in physical therapy. The 12 criteria are: (1) comparison with a control group; (2) randomization; (3) blinding participants; (4) homogeneity of groups at baseline; (5) alternative activity for the control group; (6) intentions (7); inclusion/exclusion criteria; (8) at least two socio-demographic variables (9); comorbidity (10); intervention description (11); dropouts; (12) valid outcomes measures. If the criteria were met, a point was assigned. If the criteria were not met or were not sufficiently described, no point was assigned (Table 2).

Studies that met more than 75% of the criteria were classified as high quality. Studies that met between 50 and 75% of the criteria were considered as moderate quality. Studies that met less than 50% of the criteria were classified as low quality.

Results

A flow diagram of the study selection process is shown in Figure 1. A total of six studies were included in this systematic review. The most important excluded studies with reasons for exclusion are shown in Table 3.

Characteristics of Included Studies

Included studies were published from 2008 to 2019 and conducted in France, Brazil, Spain, Finland, Singapore, and Australia. Two were randomized controlled trials (RCT), (22,23) one was a pilot RCT, (24) one was a controlled clinical trial (25) and two used a quasi-experimental design (26,27).

A total of 208 participants were involved in this review. Among them, 135 persons were assigned to intervention groups. The mean age of participants ranged between 76 and 82 years. Mean MMSE scores were between 12 and 23.5. Participants of most studies (22-25,27) came from nursing homes and care homes. Only Koh et al. (26) included community-dwelling participants, but the participants were recruited from a day-care center for persons with dementia.

The dance style was found to vary between studies. Brami et al. (25) used a virtual dance intervention. During the program, choreographies followed an increasing level of difficulty concerning the rhythm, intensity, and complexity

Table 1. Summary of included studies

Author (country)	Study design	Inclusion criteria/exclusion criteria	Sample/mean age/mean score MMSE/place of recruitment	Intervention/control group	Main results
Brami et al. (25) (France)	Controlled clinical trial	MMSE ≤21/ Inability to walk without technical aids. Uncorrected visual or hearing disorders. Contraindication to physical activity.	N=22 84.55±6.7 IG: 14.17±5; CG: 13±4.7 Long term care units	Virtual dance (Dance central on Xbox One) 2 days/week; 45 minutes; 12 weeks CG: Keeping daily habits	Intragroup: Not significant changes. Intergroup: Significant difference in favor of the IG in TUG (p=0.02) and gait speed test (4 meters) (p=0.02).
Borges et al. (23) (Brazil)	Randomized controlled trial	Autonomy for carrying out ADL; No regular physical activity in the past 3 months/ Heart disease, high blood pressure, and uncontrolled asthmatic bronchitis, osteoarthritis, recent fracture, tendinopathy and prostheses, neurological disorders, severe obesity, and the use of drugs that may affect attention.	N=60 IG: 66±6.8; CG: 67±7.2 IG: 22.7; CG: 24.2 Long-stay institution	Ballroom dancing (foxtrot, waltz, rumba, swing, samba, and bolero) 3 days/weeks; 50 minutes; 12 weeks CG: Keeping daily habits. Committed to not perform any systematic physical activity during the 12-week experiment	Intragroup: Significant improvement in the autonomy to performance of the ADL (p<0.0001) and in body balance (p=0.002) Intergroup: Significant difference in favor of the IG in the autonomy to performance of the ADL (p=0.011) and in body balance (p=0.04).
Gomez Gallego & Gomez Garcia (27) (Spain)	Quasi-experimental	Medically diagnosed with mild to moderate dementia / Aphasia or deafness that makes intervention difficult	N=42 77.5±8.3 15.02±5.40 Retreatment home	Music therapy and dance therapy 2 days/week; 45 minutes; 6 weeks	Barthel index: Not significant changes (p=0.338).
Hokkanen et al. (22) (Finland)	Randomized controlled trial	? /?	N=29 IG: 79.9±7.7; CG: 84.5±3.4 IG: 12.08±5.53 Dementia nursing home	Dance and movement therapy (DMT) 1 day/week; 30-45 minutes; 9 weeks CG: Keeping daily habits	Intragroup: Not significant changes in NOSGER. Intergroup: CG shows a significant deterioration in the self-Care subscale (p=0.001).
Koh et al. (26) (Singapore)	Quasi-experimental	Age ≥65; Medically diagnosed with mild to moderate dementia; Able to walk independently or with aids/ Severe hearing or visual impairment; Cancer, end-stage renal failure; Overtly violent or suicidal; Other progressive neurological conditions.	N=37 80.1±6.9 (N=21) 17±4.7 Daycare center for persons with dementia	Creative dance intervention 1 day/week; 60 minutes; 8 weeks	Not significant improvement in 6-meter gait speed (p=114), in the FMI (p=0.075) and in CONFbal scale (p=0.234).
Low et al. (24) (Australia)	Pilot Randomized controlled trial	Age ≥65; Dementia diagnosis; MMSE: 10-23; Able to walk independently or with aids/ Fully blind or deaf; Limited life expectancy; Floridly psychotic; Medically advised not to exercise; Very high falls risk; Non-English speaking	N=18 ? ? Nursing home	Dance program. Popular music from the 40s, 50s, and 60s. 3 days/week; 45 minutes; 16 weeks GC: Music and socialization control	At 16 weeks decrease in the mean SPPB score.

NOSGER: Nurses' observation scale for geriatric patients, ADL: Activities of daily living, TUG: Timed up and go test, GDLAM: The autonomy protocol of the Latin American Group for Maturity, composed of five tests: Gait speed (10 meters), chair stand test, time to rising from a ventral decubitus position, time to putting on and taking off a t-shirt, SPPB: Short physical performance battery, FMI: Functional independence measure

Table 2. Methodological quality of the studies according to de Vet et al. (21)

Author	1	2	3	4	5	6	7	8	9	10	11	12	Total
Brami et al. (25)	1	0	0	0	0	1	1	1	0	1	1	1	7
Borges et al. (23)	1	1	0	0	0	1	0	1	0	1	1	1	7
Gomez Gallego and Gomez Garcia (27)	0	0	0	0	0	1	1	1	1	1	0	1	6
Hokkanen et al. (22)	1	1	0	1	0	1	0	0	0	1	0	1	6
Koh et al. (26)	0	0	0	0	0	1	1	1	0	1	1	1	6
Low et al. (24)	1	1	0	0	1	1	1	0	0	1	1	1	8

1: Met criteria, 0: Did not meet criteria

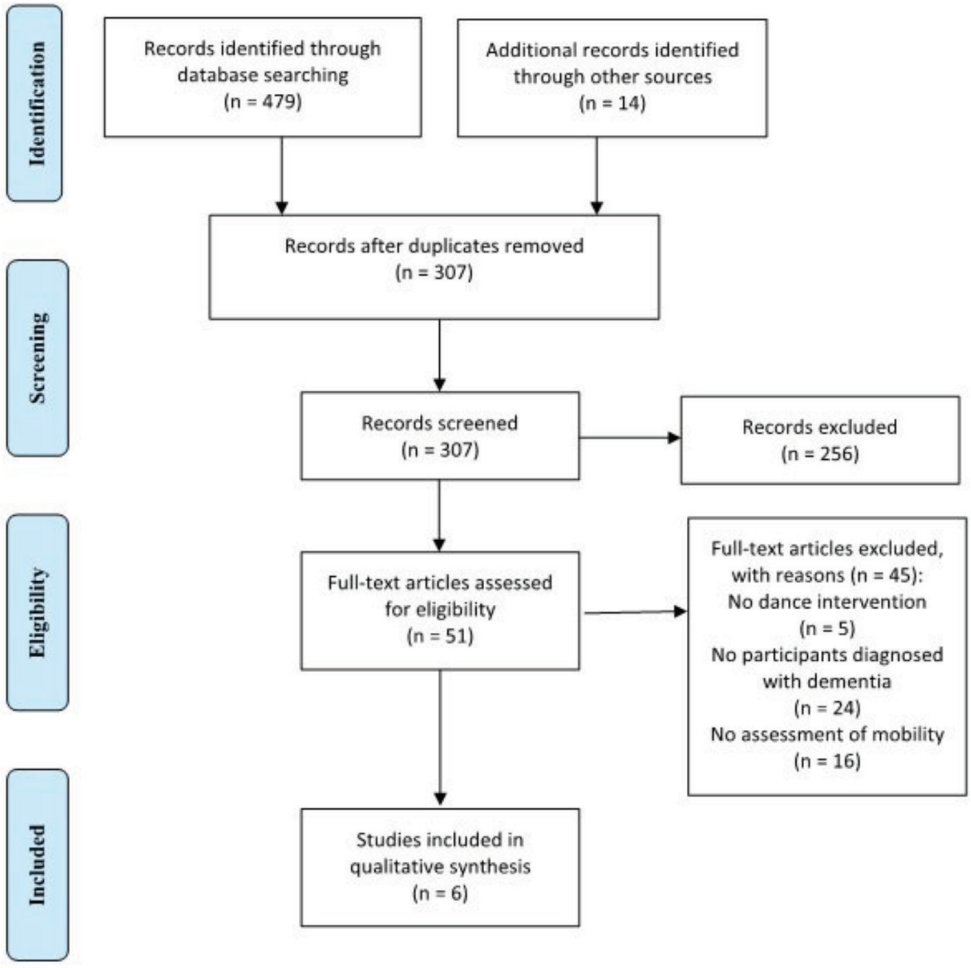

Figure 1. Study selection. Flow diagram based on the PRISMA statement (19)

PRISMA: Preferred reporting items for systematic reviews and meta-analyses

of the movements. Borges et al. (23) proposed a ballroom dance program with various musical rhythms (foxtrot, waltz, rumba, swing, samba, and bolero). Gomez Gallego and Gomez Garcia (27) used musical therapy sessions with songs that were appreciated by the participants. Sessions included: A welcome song, rhythmic accompaniment activities with clapping and musical instruments, movements with background music, dance therapy with rings and balls, and a farewell song. The interventions of Hokkanen et al. (22) consisted of DMT sessions.

Koh et al. (26) used a person-centered creative dance intervention, which comprised simple warm-up physical exercises, improvised movement based on culturally appropriate music familiar to the generation of the participants, collaborative exercises that required arm movement coordination, and social occasions for greeting

and sharing with the therapist and other participants. Low et al. (24) used a program led by a professional dancer. Popular music from the 40s, 50s, and 60s, and a mixture of dance types (ballroom, tango, folk dance) were incorporated.

Main Functional Outcomes

Three studies assessed balance (23-25) and one assessed balance confidence. Borges et al. (23) found significant improvements using stabilometric and postural platform assessments. Brami et al. (25) and Low et al. (24) assessed the balance component in the short physical performance battery (SPPB). Low et al. (24) did not report the results for each subtest. However, the mean SPPB score was reported to decrease from 6.8±1.6 to 5.9±1.8 after 16 weeks of intervention. Brami et al. (25) found no significant differences in balance after the intervention. Otherwise Koh et al. (26) found a non-significant improvement in balance confidence, evaluated using the CONFbal scale.

Gait speed was measured in four studies (23-26). Borges et al. (23) found a significant intragroup improvement in the 10-metre gait speed (pre-test: 21.67±6.22 s, post-test 16.05±4.06 s, $p<0.05$) and a significant intergroup difference in the post-test (CG: 22.06±5.16 s, $p<0.05$). Brami et al. (25) found significant intergroup differences in the 4-metre gait speed post-test (CG: 8.27±1.24 s, IG: 5.96±1.46 s, $p=0.02$) but non-significant intragroup improvement (pre-test: 6.69±1.68 s, $p=0.25$; post-test: 5.96±1.46 s). Koh et al. (26) used a 6-metre gait speed and found a non-significant improvement (pre-test: 0.72±0.20 m/s, post-test: 0.76±0.22 m/s, $p=0.114$).

Gomez Gallego and Gomez Garcia (27) and Koh et al. (26) assessed performances in ADL with respectively the Barthel index and the functional independence measure. Both studies reported no significant improvement. Hokkanen et al. (22) used the nurses' observation scale for geriatric patients (NOSGER) to assess behavioral aspects of mental functioning in daily life. Control and intervention groups did not differ according to the total NOSGER score. However, the control group deteriorated on the self-care subscale compared to baseline. Borges et al. (23) also measured performance in two daily life activities: The time to stand up from a ventral decubitus position and the time to put on and take off a t-shirt. The authors found a significant improvement after the intervention for both performances.

Quality Assessment

The overall quality of included studies was moderate. The mean quality score was 6.5, with a range of 6 to 8. No trial blinded neither participants nor professionals. Only one study [Low et al. (24)] had a control group engaged in another activity (music appreciation and socialization groups also led by the dance teacher). Only one trial (27) reported comorbid conditions in participants.

Discussion

This systematic review aimed to analyze the effects of dance therapy on functional outcomes in older adults with dementia. According to the trials examined, dance-based interventions may lead to improved physical abilities in older people with dementia. Only Borges et al. (23) found a significant improvement in balance and lower limb strength. Walking speed and timed up and go performance significantly improved in two studies (23,25). ADL performance significantly improved in Borges et al. (23). Additionally, Hokkanen et al. (22) reported a significant intergroup difference after the intervention.

Nonetheless, the evidence of a positive impact of dance on the physical abilities of older adults with dementia seems insubstantial. The literature we reviewed failed to provide convincing evidence for several reasons. First, the small number of studies and participants included. In this sense, it is worth recognizing the difficulty of conducting studies of this type. Most of these people are under legal protection measures and it is not easy to obtain agreement from persons in charge for their participation in investigations. Furthermore, older adults with dementia often experience complex psycho-emotional states, (e.g., apathy or mood swing), which may result in low participation in the proposed activities. One can note that heterogeneity is a characteristic of this population. It is therefore difficult to develop a specific activity for a group of people with different abilities. These constraints possibly result in small samples in all the studies we reviewed. Only Borges et al. (23) recruited more than 50 participants.

Otherwise, the quality of the included studies was moderate. Only four trials had a control group, of which only three were randomized; no study blinded the participants and/or the therapist; only two trials provide data about the homogeneity of the groups at baseline and Brami et al. (25) showed an important baseline imbalance in the physical abilities. Only Low et al. (24) proposed an alternative activity to the control group, resulting in an improvement in the internal validity of the trial (28). In contrast, Hokkanen et al. (22) make no mention of the inclusion/exclusion criteria, although it was the only study to report the type of dementia of the participants. Borges et al. (23) make no mention of dementia in the inclusion/exclusion criteria.

The studies analyzed presented the results of small, heterogeneous samples, with different inclusion/exclusion criteria, different intervention kinds, and diverse tools of measurement. This diversity made it difficult to draw conclusions regarding the effect of dance therapy on these people.

Many unanswered questions remain, including the ideal intensity and frequency, appropriate dance styles, and

comparisons with an alternative activity. Future studies should have clearer inclusion and exclusion criteria, be based on large samples, propose an alternative activity to the control group, and use validated instruments to produce reliable, comparable results. Furthermore, these studies should present information such as participants' comorbidities to measure their impact on the results.

In our review, four fundamental factors led us to exclude articles. First, many papers referred to interventions about people with cognitive impairment (29-34) but few articles included people diagnosed with dementia. Many articles were unclear regarding participant inclusion and exclusion criteria, which made the eligibility stage difficult. The review by Ruiz-Muelle and López-Rodríguez (13) about dance for people with Alzheimer's disease included articles that we excluded because we found no reference to Alzheimer's disease or other dementias. For example, one of the inclusion criteria for Marquez et al. (35) was an adequate cognitive status, while Lazarou et al. (32) included people with mild cognitive impairment but not dementia. Although they were unclear in their inclusion criteria, the mean MMSE score of the intervention group was 27.6±2.19, showing that they were not people with dementia.

Moreover, we were tempted to include certain articles that did not speak of dementia, but which reported neuropsychological tests that revealed significant cognitive problems among participants. This was the case of the study by Hackney et al. (36) which excluded people with a history of neurodegenerative disease. However, the mean montreal cognitive assessment score was 22.5±4 in the intervention group, showing a certain degree of cognitive problems, and even dementia, among the participants (37).

We included all the studies that used dance as the main intervention instrument. We did not consider some studies, because they used dancing in a small part of the intervention and not as the main tool (38-40).

Many of the analyzed studies were conducted using a qualitative design (41-44). We decided to restrict ourselves to trials using a quantitative design because we considered it difficult to objectify and analyze changes in physical function in a qualitative way. Furthermore, in general, qualitative studies aim to observe psychosocial and behavioral aspects and exclude the results of physical function.

Interventions performed on people with dementia primarily seek psychosocial, behavioral, emotional, and neurocognitive benefits (45-50). The motor component, fundamental for independence in ADL, is less frequently considered. However, there is evidence of the relationship between the ability to carry out ADL and depression (51), agitation (52), etc.

Table 3. Excluded studies and reasons

First author (year of publication)	Reason for exclusion
Abreu and Hartley (53)	Study design: Case description/intervention.
Barnes et al. (38)	Intervention: The intervention is named "integrative exercise program" and this included the dance sequences in the séance. However, and most of the session is made up of other kinds of exercise.
Bisbe et al. (54)	Inclusion criteria: Normal general cognition, defined by a mini-mental state examination (MMSE) (48,49) score ≥24.
Dominguez et al. (29)	Participants: There are no references to dementia, only to mild cognitive impairment (MCI).
Douka et al. (30)	Participants: There are no references to dementia, only to MCI.
Esmail et al. (31)	Exclusion criteria: MMSE ≤24.
Hackney et al. (36)	Participants: There are no references to dementia.
Hamill et al. (48)	Outcomes: No assessment of mobility function.
Hernández et al. (55)	Intervention: The intervention is called "physical activity" and it incorporates the dance sequences in the séance. However, there is no reference to "dance therapy" and most of the session is made up of conventional exercises of rehabilitation.
Ho et al. (49)	Outcomes: Results not yet available.
Ho et al. (56)	Outcomes: Results not yet available.
Ho et al. (57)	Outcomes: No assessment of mobility function.
Hokkanen et al. (50)	Outcomes: No assessment of mobility function.
Krug et al. (39)	Intervention: Dance was a little part of a program including multiple activities (functional and psychosocial therapeutic activities).
Lazarou et al. (32)	Participants: Here are not references to dementia, only to MCI.
Marquez et al. (35)	Participants: There are no references to dementia. Inclusion criteria: Adequate cognitive status as assessed by a version of the MMSE. Not provide the mean of MMSE. Outcomes: No assessment of mobility function.

Table 3. Continued

First author (year of publication)	Reason for exclusion
Meng et al. (33)	Participants: Here are not references to dementia.
Merom et al. (58)	Exclusion criteria: Had significant cognitive impairment determined by <21 points on the telephone interview of cognitive status, which is the telephone modification of the MMSE, equivalent to 24.
Merom et al. (59)	Exclusion criteria: MMSE ≤24.
Qi et al. (60)	Inclusion criteria: MMSE score between 25 and 30.
Wang et al. (34)	Participants: There are no references to dementia, only to MCI.

Agreements and Disagreements with Other Studies or Reviews

The conclusions drawn from this review partially agree with the conclusions of the included studies. Dance seems to be an intervention appreciated by older people (41) and could bring great benefits. According to Hwang and Braun (12), strong evidence suggests that dance, regardless of style and intensity, significantly improves older adults' functional fitness. However, we cannot be sure that this statement also applies to older persons with dementia. Gomez Gallego and Gomez Garcia (27) and Koh et al. (26) pointed out the need to expand the sample and add a control group to measure the placebo effect.

No trial met the inclusion criteria of the review by Karkou and Meekums (14). The lack of clarity in the selection of participants was one of the reasons. In our review, two of the six articles included did not detail the inclusion and exclusion criteria. This lack of information was recurrent and made it difficult to analyze the results. We agree with Mabire et al. (17) in that detailed information about the dance intervention was incomplete and unclear in some studies. Future research should focus on examining the effectiveness and efficiency of these interventions, by comparing the cost-benefit with that of other interventions.

Conclusion

Even though dance interventions targeting older people with dementia are appreciated and enjoyed, the scientific evidence regarding their benefits on physical abilities is moderate to poor. Although some studies showed an improvement in balance, walking speed, and the ability to carry out ADL, the results of the different studies are heterogeneous and did not allow us to establish an intervention model, with a determined intensity, frequency, and duration, that could be more effective than others. Most existing trials have not compared dance interventions with alternative activities. Therefore, it is unknown whether dance therapy interventions are more effective than other types of non-drug interventions.

Future trials should explicitly set out the criteria for inclusion/exclusion of participants, setting limits through validated measurements. To evaluate the efficacy of dance therapy, RCT with large samples are required, with alternative activities proposed to the control group. It is also essential to implement validated instruments in the search for relevant results. Besides, it is important to detail the methodology of the interventions, stating the resources necessary for their implementation.

Ethics

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: L.B., A.P.C., F.M., Design: L.B., G.P., A.P.C., F.M., Data Collection or Processing: L.B., G.P., Analysis or Interpretation: L.B., G.P., A.P.C., F.M., Literature Search: L.B., G.P., Writing: L.B., G.P., A.P.C., F.M.

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ORIGINAL RESEARCH

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Relationship Between Neutrophil-lymphocyte Ratio and Malnutrition in Older Adults

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Abstract

Objective: Blood neutrophil-lymphocyte ratio (NLR) indicated an increased inflammation in cardiac, rheumatologic, cancer, and some geriatric syndromes. This study aimed to determine the diagnostic value of NLR in the diagnosis of malnutrition or severity.

Materials and Methods: A total of 303 elderly patients were included in this study. A comprehensive geriatric assessment was performed on each patient, and the mini nutritional assessment tool was used to assess the nutritional status. The hemogram values of all patients were investigated to determine an NLR inflammatory marker.

Results: Logistic regression analysis showed that the presence and risk of malnutrition were independently associated with NLR, hemoglobin, hematocrit, albumin, age, and smoking in univariate analysis. Of the above independent variables, body mass index, hematocrit, and vitamin B12 were found to be significantly associated with malnutrition and risk of malnutrition in multivariate analysis. This study revealed that patients with malnutrition and those at risk of malnutrition have elevated NLR than those with normal nutritional status. However, it was not significantly associated with multivariate analysis.

Conclusion: A variety of etiological factors and mild or severe inflammation in the course of concomitant diseases cannot be overlooked in the current state of patients. Therefore, laboratory or clinical criteria other than the NLR would be useful for early detection of the relationship between malnutrition and inflammation.

Keywords: Blood neutrophil-lymphocyte ratio, malnutrition, older adult, inflammation

Introduction

Malnutrition (MN) is defined as a change in body composition (decrease in lean body mass) and a decrease in body mass due to a decrease in the intake of nutrients and deterioration in physical and mental functions and clinical results. MN may be the result of hunger and/or disease and/or aging. These factors that adversely affect the nutritional status in the elderly include physiological changes associated with aging, acute and chronic diseases, dental and oral health problems, polypharmacy, economic problems, inability to shop alone, inability to prepare food, and problems with eating. Unfortunately, this geriatric syndrome, which is not recognized or cared enough for by many clinicians and is not uncommon, has many negative consequences such as impaired functionality, increased morbidity and mortality risk (1,2).

Many malnourished patients have disease-related inflammation, and the presence of inflammation affects both requirements and food intake. As a result, with the development of inflammation, anorexia is induced and muscle catabolism and resting energy consumption increase (3). The global leadership initiative on MN recommends that the presence of severe disease/inflammation has a vital role to play in both etiological criteria and screening tests (4). Primary infections, burns, and closed head trauma are often associated with severe acute inflammation. It is often

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observed with fever, negative nitrogen balance, and increased resting energy consumption. There is also a mild to moderate chronic or recurrent inflammation in chronic organ failures, such as heart failure, chronic liver, kidney failure, or chronic obstructive pulmonary disease, and rheumatoid arthritis. In severe inflammation, the diagnosis and decision-making process is easily passed, whereas in less severe cases, laboratory-based biomarkers are needed. C-reactive protein (CRP), erythrocyte sedimentation rate, albumin or pre-albumin are commonly used today.

Blood neutrophil-lymphocyte ratio (NLR) is a new, cheap, and easily measurable marker of inflammation. In cardiac diseases, rheumatologic diseases, and cancers and some geriatric syndromes such as frailty, sarcopenia, and Alzheimer's disease (AD), NLR has been shown to indicate an increase in inflammation, or it is associated with severity or mortality in the related disease. In this case, the use of practical, inexpensive, laboratory-based biomarkers that will draw the clinician's attention will become increasingly important.

The present study aims to determine whether the NLR has a diagnostic value in the diagnosis or severity of MN.

Materials and Methods

Three hundred and three patients aged sixty years and over who were admitted to the geriatric medicine outpatient clinic of our hospital for medical care for any reason were enrolled in this cross-sectional study. Participants aged 60 and over who had a detailed geriatric evaluation and did not meet the following exclusion criteria were included in the study. Exclusion criteria were: Those with known immune origin or rheumatologic disease; those with high clinical suspicion and research in terms of rheumatologic disease; those who received immunosuppressive treatment; those who received systemic medication with steroid for any reason, and those who had active or not cured cancer history and acute infection. Patient information including age, sex, smoking, height, weight, number of chronic diseases including dementia and depression, and prescribed drugs, whether they were using enteral nutrition products in the last six months, was collected. Body mass index (BMI) was calculated using weight (kg)/height squared (m^2). Nutritional status was assessed by the mini nutritional assessment (MNA). MNA is suitable for both elderly outpatients and inpatients and also for nursing homes. According to this scale; if the individual's score is ≥24 it is considered as well-nourished (WN), <17 is considered as MN, between 17 and 23.5 is considered as malnutrition risk (MNR) (5). Frailty was assessed by the FRAIL scale (fatigue, resistance, ambulation, illnesses and loss of weight). According to the FRAIL scale, ≥3 points frail, 1-2 points pre-frail, 0 points are considered to be robust (6). The screening tool used for the evaluation of dysphagia risk was the 10-item eating assessment tool (7). A score of ≥3 in the EAT-10 dysphagia screening test is interpreted as abnormal in terms of dysphagia. The SARC-F questionnaire was developed as a rapid diagnostic tool for sarcopenia. SARC-F survey is an inexpensive, easy and short screening test developed for sarcopenia screening. A score of ≥4 as a result of this test is considered abnormal and clinically associated with poor outcomes associated with sarcopenia (8). Geriatric depression was assessed by the geriatric depression scale-30 questionnaire; 14 points are accepted in favor of depression with high sensitivity and high specificity (9). The mini-mental state assessment test was applied to the patients; ≤23 score is most often described as abnormal and is considered an indicator of cognitive impairment (10,11). The hemogram (CBC) values of all patients were investigated to determine NLR. Blood count analysis was performed with the Sysmex XN-9000 automated hematology system (Kobe, Japan). The neutrophil and lymphocyte counts were recorded in units of $10^3/\mu L$ and were proportioned. Patients with elevated isolated CRP as a result of further investigations were not excluded. Informed consent was obtained from all the participants. The study was approved by the Local Ethics Committee (2019/136, 20.02.2019).

Statistics

Histogram, q-q plots, and Shapiro-Wilk's test were applied to assess data normality. Descriptive statistics of categorical data are given as n and percentage, while descriptive of countinous variables are given as mean, median, standard deviation and 25-75. percentile values. The relationship between the categorical variables with each other was tested by Exact method of Pearson chi-square test statistics, and Bonferroni test statistics corrected Dunn test were used to multiple comparison test in categorical variables. The mean comparison between more than two independent groups was evaluated in One-Way ANOVA and Kruscal-Wallis test statistics. Levene test was used to assess variance homogeneity, while multiple group comparison analyzes were performed with Bonferonni test statistic. The risk factors were investigated between the individuals with and without MN according to the blood parameters examined and the demographic characteristics of the patient. Binary logistic regressions, with results reported as odds ratios (OR) and 95% confidence intervals (CI). Furthermore, univariate and multivariate logistic regression analysis were used to determine the most significant risk factors. Significant variables at $p<0.25$ on univariate analysis were taken into multiple model and forward stepwise selection was performed using likelihood ratio statistic at $p<0.10$ stringency level. OR were also given with 95% CI. Hosmer Lemeshow test statistics used to goodness of fit test for testing model instability. Analyses were conducted using TURCOSA TURCOSA (Turcosa Analytics Ltd. Co., Turkey, https://turcosa.com.tr/) software. A p-value less than 5% was considered statistically significant.

Results

We included 303 older adults whose mean age was 71.00 (66.00-78.00), of which 63.8% were females, and 36.3% were males. According to MNA, it was found that 40 participants (13.2%) were malnourished (MN), and 125 participants (41.2%) were at risk of MNR while 138 participants (45.5%) were WN. Analyzes were made separately for each of the groups (MN, MNR, WN) in order to better determine the relationship between demographic data, laboratory values and clinical characteristics with nutritional status. It was found that MN rates were found to increase in advanced age in both genders (p<0.001). Table 1 shows that there were significant differences in age (p<0.001), female gender (p=0.047), BMI (p<0.001), hemoglobin (p<0.001), hydrochlorothiazide (p<0.001), total protein (p<0.001), albumin (p<0.001), B12 (p<0.001), and folic acid (p<0.001) findings between WN and MNR and MN participiants. The characteristics of the participants and laboratory are given in Table 1. The clinic and comorbid features of WN, MNR, and MN participants are given in Table 2. This shows the significant differences in chronic diseases and geriatric syndromes; polypharmacy (≥4 drugs) (p=0.046), urinary incontinence (p<0.001), dementia (p<0.001), depression (p<0.001), dysphagia (p<0.001), SARC-F (≥4) (p<0.001), and frail older adults (p<0.001). Logistic regression analyses were performed to identify independent risk factors over nutritional status. At this stage of the statistical analysis; In order to capture the possible significance or relationship between NLR and MN level, MN and MNR were accepted as a group, while WN was accepted as a separate group. The poor nutritional status was defined as a combination of MN and MNR. Patients were divided into two groups, with an MNA score of ≤23.5 and those with >24. Logistic regression analysis showed that the presence of poor nutritional status was independently associated with NLR, Hb, HCT, albumin, age, smoking in

Table 1. Demographic and laboratory features of MNR, MN and WN

Variable	Total (n=303)	MNR (17-23.5) (n=125)	MN (<17) (n=40)	WN (≥24) (n=138)	p
Age (years)	71.00 (66.0-78.0)	71.0 (66.0-77.5)[b]	79.0 (69.0-84.0)[a]	70.0 (66.0-74.0)[b]	<0.001
Gender, female	193 (63.7)	80 (64.0)[a]	32 (80.0)[b]	81 (58.7)[a]	0.047
Smoking status Ex smoker Current smoker Non-smoker	 38 (14.1) 24 (8.9) 208 (77.0)	 11 (10.2) 12 (11.1) 85 (78.7)	 3 (9.4) 4 (12.5) 25 (78.1)	 24 (18.5) 8 (6.2) 98 (75.4)	0.223
BMI (kg/cm²)	28.7 (24.4-33.6)	28.9 (24.3-34.4)[a]	24.2 (22.0-28.1)[b]	30.1 (26.2-33.8)[a]	<0.001
NLR	2.0 (1.6-2.8)	2.1 (1.5-3.0)	2.3 (1.8-3.2)	2.0 (1.5-2.7)	0.092
CRP (mg/dL)	2.7 (1.4-4.8)	2.4 (1.3-4.9)	2.9 (1.2-6.1)	2.9 (1.5-4.5)	0.780
Hb (g/dL)	13.9±1.7	13.8±1.7[a]	12.8±1.80[b]	14.4±2.8[c]	<0.001
HTC	42.3±4.6	41.8±5.0[a]	39.5±5.1[b]	43.5±3.7[c]	<0.001
WBC (µL)	7.2 (6.1-8.6)	7.2 (6.2-8.9)	7.0 (6.2-7.6)	7.4 (5.8-8.7)	0.307
PLT (µL)	257.0 (211.8-301.5)	268.0 (211.0-308.0)	269.0 (237.0-311.0)	249.0 (210.5-299.0)	0.349
Glu (mg/dL)	103.0 (90.0-128.0)	108.0 (90.0-128.0)	97.0 (86.0-120.0)	103.0 (92.0-134.8)	0.101
GFR (mL/min)	74.2 (61.1-87.5)	73.6 (59.7-87.2)	70.4 (53.1-88.4)	76.2 (65.0-87.8)	0.316
Uric acid (mg/dL)	5.2 (4.3-6.2)	5.1 (4.3-6.0)	5.0 (3.7-6.3)	5.4 (4.8-6.4)	0.341
TG (mg/dL)	159.2±83.3	157.2±81.0	140.3±66.0	165.9±88.9	0.278
LDL (mg/dL)	118.7±36.1	115.6±37.1	115.3±37.5	122.2±34.8	0.319
HDL (mg/dL)	49.5 (41.0-58.0)	49.0 (40.0-57.0)	52.0 (40.6-61.0)	49.9 (41.0-59.0)	0.845
Total protein (g/dL)	7.3 (7.0-7.6)	7.3 (7.0-7.6)[a]	7.0 (6.7-7.6)[ab]	7.3 (7.0-7.7)[b]	0.032
Albumin (g/dL)	4.6±0.4	4.5±0.4[a]	4.3±0.4[b]	4.7±0.3[b]	<0.001
ALT (U/L)	15.5 (12.0-20.0)	15.0 (11.5-18.5)[a]	12.0 (9.00-16.6)[a]	17.0 (12.8-24.0)[b]	<0.001
B12 (pg/mL)	382.0 (269.1-547.8)	388.5 (282.4-574.9)[b]	481.5 (334.0-865.5)[a]	348.0 (258.0-494.8)[b]	0.003
Folik acid (mg/dL)	7.2 (5.4-9.7)	7.1 (5.4-9.6)[ab]	5.6 (4.0-8.6)[a]	8.1 (6.2-11.0)[b]	0.013
Vitamin D	20.4±10.6	20.4±9.5	20.5±10.5	20.4±11.6	0.998
PTH (pg/mL)	53.7 (39.0-74.5)	52.1 (34.8-71.1)	49.0 (36.2-74.1)	55.6 (41.0-76.6)	0.242

Mean ± SD, median (25 p-75 p), n (%), p-value for comparison between MN, MNR, WN groups. Chi-square test for categorical variable and Kruskal-Wallis test and One-Way ANOVA test for continuous variable. The same letters show similarity, but different letters differ. Different superscripts in the same row indicate a statistical significant difference among groups. SD: Standard deviation, MN: Malnutrition, WN: Well-nourished, MNR: Malnutrition risk, BMI: Body mass index, NLR: Neutrophil-lymphocyte ratio, CRP: C-reactive protein, HGB: Hemoglobin, HTC: Hematocrit, WBC: White blood cell, PLT: Platelets, Glu: Glucose, GFR: Glomerular filtration rate, TG: Triglyceride, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, ALT: Alanine aminotransferase, PTH: Parathormone

univariate analysis. Of the above independent variables, BMI, HCT, B12 were found to be significantly associated with poor nutritional status in multivariate analysis (Table 3). The present study found that patients with MN and those at risk of MN have elevated NLR in comparison with normal nutritional status but was not found to be significantly associated in multivariate analysis.

Discussion

The present study found that older adults that are MN and at MN risk have elevated NLR in comparison with normal nutritional status but were not found to be significantly associated with multivariate analysis. Inflammaging is a chronic low-grade inflammation -increased pro-inflammatory cytokines that are commonly observed during aging (12). Additionality, chronic inflammation is associated- with many age-related chronic disorders such as atherosclerosis, diabetes, obesity, sarcopenia, and AD (13). Inflammation contributes to MN through altered metabolism with increased anorexia and reduced food intake, as well as increased resting energy expenditure and increased muscle catabolism. Notably, the appetite may be reduced due to acute and chronic diseases associated with inflammation (cancer, chronic obstructive pulmonary disease, heart failure) or during the treatment process of diseases such as drug treatment, surgery.

On the other hand, psychosocial problems such as depression, loneliness, and loss of spouses are the factors that cause decreased appetite. Cachexia can be a severe cause of MN. It may develop as a result of MN, is mediated by pro-inflammatory cytokines, and has long been associated with several chronic conditions (14). Derman et al. (15) showed that baseline weight and NLR were inversely related, and weight change (loss or gaining) and NLR were inversely related at 12 weeks. In this study, longitudinal measurements of weight and NLR were also negatively associated (15). Another study demonstrated that the NLR is a useful marker of MN and it was significantly inversely correlated with serum levels of prealbumin and retinol-binding protein in stage IV gastric cancer (16). These studies were carried out with cancer patients. However, we evaluated the relationship between NLR and MN in older adults without inflammation. To our knowledge, the present study is the first study to demonstrate the NLR an association between with MN. The role of inflammation and oxidative stress in the pathogenesis of cardiovascular disease is well known. Therefore, the importance of relevant biomarkers has been emphasized frequently (17). In another study by Gibson et al. (18), it was found that NLR increase in pre-operative and post-operative period was closely related to the development of atrial fibrillation. Increased NLR was found to be associated with long-term mortality in patients with unstable angina and non-ST elevation myocardial infarction (19). The NLR is in the literature in determining the severity of cardiovascular disease and is accepted as a cheap, easy and clinically relevant marker in this regard (20). In another study with 255 ulcerative colitis and control group, attention was drawn to the close association of NLR with disease activity

Table 2. Clinical and Laboratory characteristics of population according to MNR, MN and WN

Variable	Total (n=303)	MNR (17-23.5) (n=125)	MN (<17) (n=40)	WN (≥24) (n=138)	p
Drug					
<4	123 (42.0)	49 (40.8)	10 (25.6)	64 (47.8)	0.046
≥4	170 (58.0)	71 (59.2)	29 (74.4)	70 (52.2)	
UI	132 (46.2)	56 (47.5)	26 (72.2)	50 (37.9)	0.001
HT	217 (72.1)	88 (70.4)	29 (74.4)	100 (73.0)	0.847
DM	122 (40.5)	53 (42.4)	10 (25.6)	59 (43.1)	0.127
CAD	68 (22.7)	36 (29.0)	10 (25.6)	22 (16.1)	0.039
Dementia	42 (14.0)	19 (15.4)	16 (40.0)	7 (5.1)	<0.001
Depression	158 (53.2)	77 (62.1)	33 (84.6)	48 (35.8)	<0.001
Dysphagia	62 (21.2)	38 (31.4)	16 (45.7)	8 (5.9)	<0.001
ONS	14 (4.7)	6 (4.8)	4 (10.3)	4 (2.9)	0.158
Sarc-F					
<4	171 (57.8)	56 (46.3)	7 (18.4)	108 (78.8)	<0.001
≥4	125 (42.2)	65 (53.7)	31 (81.6)	29 (21.2)	
FRAIL scale					
Robust	47 (15.9)	12 (9.8)	0 (0)	35 (25.5)	<0.001
Prefrail	165 (55.7)	70 (57.4)	12 (32.4)	83 (60.6)	
Frail	84 (28.4)	40 (32.8)	25 (67.9)	19 (13.9)	

N (%), p-value for comparison between MN, MNR, WN. Chi-square test for categorical variable.
MN: Malnutrition, WN: Well-nourished, MNR: Malnutrition risk, HT: Hypertension, DM: Diabetes mellitus, CAD: Coronary arter disease, UI: Urinary incontinence, ONS: Previous oral nutrition use

Table 3. Univariate and multivariate binary logistic regression results in predicting MNA in geriatric patients

	Univariate		Multivariate	
Variable	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**
Age (years)	1.05 (1.02-1.08)	0.002	-	-
Gender, female	1.49 (0.93-2.38)	0.099	-	-
Smoking status Current smoker Ex smoker Non-smoker	 1.00 0.29 (0.10-0.85) 0.56 (0.23-1.37)	 - 0.025 0.561	-	-
BMI	0.95 (0.91-0.99)	0.010	0.88 (0.80-0.97)	0.007
NLR	1.22 (1.01-1.47)	0.038	-	-
CRP (mg/dL)	1.04 (0.96-1.12)	0.324	-	-
Hb (g/dL)	1.01 (0.99-1.02)	0.559	-	-
HTC	0.89 (0.84-0.94)	<0.001	0.90 (0.80-1.01)	0.082
WBC (µL)	1.05 (0.93-1.19)	0.413	-	-
PLT (µL)	1.00 (1.00-1.0)	0.089	-	-
Glu (mg/dL)	0.99 (0.99-1.00)	0.239	-	-
GFR (mL/dk)	0.99 (0.98-1.00)	0.061	-	-
Uric acid (mg/dL)	0.88 (0.72-1.07)	0.187	-	-
TG (mg/dL)	0.99 (0.99-1.00)	0.219	-	-
LDL (mg/dL)	0.99 (0.99-1.00)	0.131	-	-
HDL (mg/dL)	1.00 (0.99-1.02)	0.813	-	-
Total protein (g/dL)	0.68 (0.43-1.08)	0.678	-	-
Albumin (g/dL)	0.27 (0.13-0.54)	<0.001	-	-
ALT (U/L)	0.99 (0.97-1.00)	0.194	-	-
B12 (pg/mL)	1.00 (1.00-1.00)	0.011	1.00 (1.00-1.01)	0.071
Folic acid (mg/dL)	0.94 (0.87-1.01)	0.088	-	-
Vitamin D	1.00 (0.98-1.02)	0.973	-	-
PTH (pg/mL)	0.99 (0.99-1.00)	0.476	-	-

OR: Odds ratio, CI: confidence interval, MNA: Malnutrition assesment test (poor nutrition: 0-23.5, normal: ≥24), BMI: Body mass index, NLR: Neutrophil-lymphocyte ratio, CRP: C-reactive protein, HGB: Hemoglobin, HTC: Hematocrit, WBC: White blood cell, PLT: Platelets, Glu: Glucose, GFR: Glomerular filtration rate, TG: Triglyceride, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, ALT: Alanine aminotransferase, PTH: Parathormone

(21). In a study of 399 diabetic and control subjects, the NLR was found to be higher in patients with diabetes but was also correlated with the presence of simultaneous microvascular complications (22).

A study including 817 older adults in Turkey showed a significant relationship between inflammation and frailty (23). In a study of 416 older adults, including AD and control group, higher NLR rates were found in the AD group compared to healthy controls. The role of the inflammatory process in the pathogenesis of AD has been emphasized (24). In light of this information in the literature, the NLR rate has been accepted as an indicator of inflammation for many diseases and geriatric syndromes. One reason for the lack of a significant relationship between MN and NLR in this study is that MN may develop due to multiple etiologic factors or as a result of one or more geriatric syndromes such as frailty, sarcopenia, and AD. The association of these syndromes with the inflammatory process is well known. Also, it is difficult to say that the current outcome, whether there is any possible relationship between MN/MNR and NLR is not entirely independent of the effects of frailty, sarcopenia, and AD. Significant increases in NLR may already be expected in diseases such as diabetes mellitus, coronary artery disease or activation of any chronic immune disease with moderate to severe inflammatory processes. The exclusion criteria in this study excluded the evident inflammatory processes or processes that may contribute to the increase in CRP. Therefore, exclusion criteria were applied very strictly to minimize the margin of error. One of the limited aspects of the study is the exclusion of as many as obvious inflammatory causes, which may constitute a significant portion of the etiologic causes. In this case, the relationship between MN/MNR and NLR may not be well reflected since it is difficult to know to what extent the MN/MNR contains inflammation on a case-by-case basis.

Conclusion

As mentioned above, the etiology of MN includes reduced food intake or decreased food absorption, or an acute event/injury-related or chronic disease-related inflammatory condition. A variety of etiological factors and mild or severe inflammation in the course of concomitant diseases cannot be overlooked in the current state of patients. Accordingly, it would be useful to find other laboratory or clinical criteria other than NLR in order to detect early the relationship between MN and inflammation.

Ethics

Ethics Committee Approval: The study was approved by the Local Ethics Committee (2019/136, 20.02.2019).

Informed Consent: Informed consent was obtained from all the participants.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: B.M.G., S.A., F.F.Ö., T.S., N.Ş.D., Concept: B.M.G., S.A., F.F.Ö., T.S., N.Ş.D., G.E.Z., Design: B.M.G., S.A., F.F.Ö., T.S., N.Ş.D., G.E.Z., Data Collection or Processing: B.M.G., S.A., F.F.Ö., T.S., N.Ş.D., Analysis or Interpretation: S.A., G.E.Z., Literature Search: B.M.G., S.A., G.E.Z., Writing: B.M.G., S.A., G.E.Z.

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ORIGINAL RESEARCH

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Prevalence of Care Problems in Older Adults in Turkish Hospitals

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Abstract

Objective: Malnutrition, pressure ulcers, falls, pain, and restraints are important quality of care indicators in healthcare settings. The Landelijke Prevalentiemeting Zorgkwaliteit-National Care Indicators Prevalence Study is an annual international multicenter cross-sectional prevalence measurement of care problems in the institution, department, and patient-level across Europe. This study aimed to measure the prevalence of care problems among older adults in Turkish hospitals.

Materials and Methods: A multicenter, cross-sectional study was performed using a standardized and tested questionnaire. Data were collected from older adult patients (65 years and over) in the hospitals. The study was conducted in 12 centers from 6 big cities of the country in November 2017 and 2018.

Results: Data from 12 Turkish hospitals were collected in 2017 and 2018. In 2017, pressure ulcer prevalence was 6.4%, malnutrition risk was 30.2%, falls was 9.1%, pain was 53%, and restraint was 22.1%. The prevalence of malnutrition risk, falls, and restraints increased to 32.1%, 10.8%, and 31.1% in 2018, respectively. Completely care-dependent patients' rate in 2017 and 2018 was 17.4% and 12.8%, respectively. Protocol/guideline usage for pressure ulcers, malnutrition, and falls were 100%, which were 68.6% and 16.9% for pain and restraints, respectively. The main interventions for pressure ulcer prevention or treatment are pressure-relieving support surfaces and hydration or nutrition; for malnutrition are referral to a dietician and oral nutritional supplements; and for falls are patients or relative education, drug lists evaluation, bedside mattress utilization, and pharmacological pain treatments.

Conclusion: Annual measurement of risk or prevalence, preventive measures, and treatment interventions of geriatric syndromes will provide better care plans for older adults.

Keywords: Older people, quality of care, screening

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Introduction

The increase in longevity is associated with a higher burden of quality of life issues and health care expenses at the global level (1). However, increase in healthcare burden is not merely related to aging, but the chronic diseases that lead to impairment constitute the most significant part of the expenditures, particularly in vulnerable older individuals (2). Although most figures vary across countries, the sum of inpatient and outpatient care costs accounts for half or more of total health expenditures in European countries (3), including Turkey (4). In this context, to establish more effective care models and interventions, it is fundamental to determine the extent of major care issues and comorbidities encountered in the hospitals and long-term care settings.

The National Prevalence Measurement of Quality of Care (LPZ) (In Dutch: Landelijke Prevalentiemeting Zorgproblemen) is an annual, cross-sectional, independent assessment of the quality of care in health care institutions. It was initiated in 1998 with a pressure ulcer survey in the Netherlands (5,6). In the following years, five more countries participated in the LPZ surveys, and its content was expanded to additional care indicators, including incontinence, malnutrition, falls, restraints, and pain (5,6). In addition to the provision of multicomponent information about these care indicators, the LPZ tool allows identification of the types of interventional measures taken for each of them on an institution base. The ultimate goal of the LPZ surveys has been to provide the participating institutions and countries with insight into the quality of care they provide, prompting them as well as policymakers to take necessary measures.

Nevertheless, nationwide prevalence data of above mentioned care issues is scarce in Turkey. This study aimed to examine the results of two consecutive years using the LPZ tool in Turkish older inpatients.

Materials and Methods

Under the coordination of the Maastricht University, Netherlands, the Turkish Academic Geriatrics Society, Turkey, was the national collaborator for the two surveys in November 2017 and 2018. One country coordinator and additional coordinators in each participating site underwent training sessions each year. At least two health-care professionals enrolled the participants at each site, and site coordinator was responsible for the training of these interviewers. Data collection was carried out in a single day using a standardized questionnaire. Upon completion of the measurement, collected data was entered online using the LPZ web tool.

The participating institutions were encouraged to perform measurements in all departments on the day of the measurement. To be eligible, patients had to be hospitalized before the day of enrollment. The main exclusion criterion was rejecting participation in the study of the participant, or their legal representatives. Additional exclusion criteria were not specified. The present two surveys were performed in twelve institutions (university hospitals and general hospitals from six large cities across the country.

In the present study, we used the latest version "LPZ 2.0" (2016), which was developed for adults aged 18 years or older. LPZ 2.0 included three questionnaires; Questionnaire 1 and 2 for institutional and departmental information, respectively, and questionnaires 3 for patient information that included age, gender, comorbidities, surgical history, degree of care dependency and outcome indicators.

İstanbul University, İstanbul Faculty of Medicine Ethical Committee approved the protocol, and all patients or their relatives gave written, informed consent to participate in the surveys.

Statistics

Frequencies of care indicators were expressed as percentages of occurrence in the analyzed sample for categorical variables. Data regarding pressure ulcer, malnutrition, pain, restraints, comorbidities and interventions were described as categorical variables. The results of the Shapiro-Wilks test, histogram, and q-q plots were examined to assess data normality. Continuous variables with normal distribution were expressed as mean ± standard deviation, abnormally distributed data were expressed as median and interquartile ranges. Age and length of hospital stay were described as continuous variables. Statistical analysis was done by using SPSS 21.0 (IBM SPSS statistics. version 21).

Outcome indicators

For this study, we evaluated five care problems in LPZ 2.0: Pressure ulcers, malnutrition, falls, restraints, and pain. Care dependency of the participants was assessed by the care dependency scale (7).

Pressure ulcers

We identified nosocomial pressure ulcers by direct skin inspection. In the LPZ 2.0 version, pressure ulcers are subdivided into categories, described by the international guidelines of the NPUAP/EPUAP/PPPIA-2014 (8,9) as follows: Category I: Non-blanchable erythema; category II: Partial thickness; category III: Full thickness skin loss; category IV: Full thickness tissue loss; unstageable: Depth unknown; and suspected deep tissue injury: Depth unknown. In addition, the LPZ 2.0 assesses the risk of developing a pressure ulcer using the Braden scale for predicting pressure ulcer risk (10).

The rates of following six interventional measures taken to prevent and/or treat pressure ulcers were determined: Reactive support surface (mattress/bed), active support surface

(mattress/bed), seating support surface, scheduled repositioning in bed, prevention or treatment of hydration and/or nutrition deficits, and education on the prevention and/or management of pressure ulcers.

Malnutrition risk

We determined current body weight in kilograms, which was preferably measured without shoes and in light clothing, at a fixed time, and after having gone to the bathroom. If the participant could not be weighed on a standing scale, a chair scale or bed scale was used. Height was recorded in centimeters. In case direct measurement was not possible, knee height was measured to estimate the height using the following formulas: men: height (cm) =64.19 - [(0.04 x age (yrs.)] + [(2.02 x knee height (cm)]; women: height (cm)=84.88 - [(0.24 x age (yrs.)] + [(1.83 x knee height (cm)]. Body mass index was calculated by dividing body weight by height squared (kg/m^2).

Unintentional weight loss in the last 1, 3, and 6 months in kilograms, decreased appetite over the last month and poor oral intake in the last five days were recorded. Finally, malnutrition universal screening test (11) was used to assess the presence of malnutrition risk. All nutritional interventions were recorded. These included referral to a dietitian, an energy (protein)-enriched diet plan, oral nutrition supplements, and monitoring of fluid intake.

Falls

Falls in the last 30 days inside the institution, or in the last 12-months in or outside the institution were recorded. The level of injury were also noted for most severe falls. The use of following interventional measures to prevent falling and/or related injury was examined: Evaluation of current medications, one-to-one supervision, mattress on the floor and/or beside, and education of the participant.

Restraints

Restraint measures applied to the participant in the last 30 days in the institution were recorded. These were mechanical restraints as a safety belt, physical restraints to keep the participant restrained with physical force, medical/chemical restraints, psychological restraints (coercive talking), electronic restraints (alarm or video), and seclusion in a room or locked ward. Reasons for restraints were noted.

Pain

We recorded any history of pain episodes over the last seven days. Any intervention to reduce pain have been recorded for the participants: Non-pharmacological interventions (e.g., physiotherapy, spinal manipulation, manual therapy, transcutaneous electric neurostimulation, pharmacological interventions including the non-opioid and opioid classes.

Results

Basic Characteristics

The surveys in 2017 and 2018 included 298 and 296 hospitalized older adults, respectively. Table 1 shows the clinical characteristics of participants on admission. The mean age of the participants were 76.81 in 2017 and 75.32 in 2018, and there was a slight male predominance [2017: 151 (50.7%) in 2017; 2018: 149 (50.3%)] in both surveys. Cardiovascular disease, diabetes mellitus, respiratory disease, and cancer were among the most frequent diagnoses on admission. Infectious etiology was recorded by 27.5% in 2017 and 17.2% in 2018. The percentages of mainly or completely dependent patients were 52% and 38%, whereas 32.6% and 44.9% were found independent in the two consecutive surveys, respectively. Overall, more than half of hospitalized older adults in the two samples were somehow care dependent (Table 1).

Outcome Indicators

Table 2 shows the five outcome indicators. Pressure ulcer risk according to Braden scale was 73.5% in 2017 and 58.8% in 2018. Nosocomial pressure ulcer prevalences were 6.4 % and 4.4 % in 2017 and 2018, respectively. Malnutrition risk rates were 30.2% and 32.1% in 2017 and 2018, and besides, 25.5% and 24.3% of the participants had swallowing problems in these consecutive surveys. Prevalences of falls in the hospitals were 9.1% in 2017, 10.8% in 2018. Restraints were used in 22.1% and 31.1% of the patients in the two consecutive surveys. These restraints included mechanical (bed rails, belt fixation, special blankets/sheets, bed/chair table and others) (17.8-28.7%), physical (keeping someone restrained with physical force) (4.7-3%), pharmacological (5.4-4.1%), psychological (1.7%-0), electronic (alarm or video) (1%-0) restraints, one-to-one supervision (0.7-0.3%), seclusion in a room (2%-0), locked ward or building (0.7%), and other measures (0.7-1%). Pain was the most frequent outcome among the care indicators by 53% in 2017 and 50% in 2018.

Table 1. Main diagnoses for hospital admissions

	2017	2018
Infectious diseases	27.5	17.2
Cancer	17.8	20.6
Diabetes mellitus	28.9	29.1
Dementia	16.4	8.4
Central nervous system diseases	11.4	3.7
Cardiovascular diseases	30.2	39.5
Stroke	8.4	5.4
Respiratory diseases	30.5	20.9
Gastrointestinal diseases	18.5	16.9

Availability of Specific Protocols/Guidelines and Multidisciplinary Teams (MDTs)

The use of institutional protocol/guidelines on care problems was presented in Table 3. Regarding pressure ulcers, malnutrition, falls, and pain, protocols were available in 69% to 100% of hospitals. However, local protocols/guidelines for restrains were not available in most hospitals. Among the participating hospitals, MDTs were available for pressure ulcers by 25% and for malnutrition in 65%. Only one center had MDTs for falls, restraints, and pain. All hospitals had regular risk assessment schedules for pressure ulcers, malnutrition, and falls. They had staff training programs for pressure ulcer, malnutrition, and falls. 50% had staff training programs for restraints and 80% for pain.

Table 2. Participant characteristics and prevalence of care problems

	2017	2018
Gender		
Female	151 (50.7)	149 (50.3)
Male	147 (49.3)	147 (49.7)
Age groups		
65-74	129 (43.3)	145 (49.0)
75-84	112(37.6)	120 (40.5)
>85	57 (19.1)	31 (10.5)
Hospital stay	7.0 (1.0-20)	7.0 (4.0-18.0)
Dependency		
Completely dependent	52 (17.4)	38 (12.8)
To a great extent dependent	48 (16.1)	42 (14.2)
Partially dependent	58 (19.5)	41 (13.9)
To a limited extent dependent	43 (14.4)	42 (14.2)
Almost independent	97 (32.6)	133 (44.9)
Chronic diseases		
Respiratory	91 (30.5)	62 (20.9)
Diabetes	86 (28.9)	86 (29.1)
Cardiovascular	90 (30.2)	117 (39.5)
Infection	82 (27.5)	51 (17.2)
Cancer	53 (17.8)	61 (20.6)
Other	7 (2.3)	8 (2.7)
Pressure ulcer	38 (12.8)	35 (11.8)
Nosocomial pressure ulcer	19 (6.4)	13 (4.4)
Braden	219 (73.5)	174 (58.8)
Malnutrition	62 (20.8)	76 (25.7)
Malnutrition risk (MUST)	90 (30.2)	95 (32.1)
Dysphagia	76 (25.5)	72 (24.3)
Falls	78 (26.2)	97 (32.8)
Nosocomial falls	27 (9.1)	32 (10.8)
Restraints	66 (22.1)	92 (31.1)
Pain	158 (53)	148 (50)

MUST: Malnutrition universal screening test

Table 3. Protocol usage for pain, pressure ulcers, malnutrition, falls and restraints

	2017	2018
Pressure ulcers	100	100
Malnutrition	100	100
Falls	93.3	100
Restraints	33.9	16.9
Pain	75.5	68.6

Table 4. Main interventions to treat pain, pressure ulcers, malnutrition, falls and restraints

	2017	2018
Pain		
Non-pharmacologic	14.4	7.1
Pharmacologic	47.3	44.9
Non-opioid	43.3	40.2
Opioid	11.4	11.8
Weak opioids	9.1	10.8
Strong opioids	2.7	2.0
Acetaminophen	32.6	30.7
NSAID	10.1	13.5
Antidepressants	2.0	1.7
Antiepileptic drugs	5.7	2.4
Pressure ulcers		
Reactive surface	21.8	13.9
Active surface	24.8	19.3
Seating support	6.7	5.7
Repositioning	27.2	17.6
Prevention of dehydration and/or malnutrition	34.9	11.5
Education	29.5	13.5
Malnutrition		
Dietician referral	59	51
Energy (protein)-enriched diet	37.2	21.6
Supplementary oral nutrition	26.8	20.3
Fluid monitoring	30.9	9.8
Falls		
Evaluate/adapt medication	35.6	21.3
Observation	15.8	12.2
Supervision	17.8	12.2
Bedside matresses	27.2	14.5
Education	46	17.2
Restraints		
Mechanical	17.8	28.7
Physical	4.7	3
Pharmacologic	5.4	4.1
Psychological	1.7	0
Locking the room	2.0	0
Electronical monitoring	1	0

NSAID: Non-steroidal anti-inflammatory drug

Interventional/Preventive Measures Taken for Patients

Nutrition treatment and education were the two most frequent interventions to prevent/treat pressure ulcers in 2017, but active support surface and Scheduled repositioning in bed were more frequently recorded in 2018 (Table 4). Referral to a dietician and planning an energy (protein)-enriched diet were the most frequent interventions to correct malnutrition in the two surveys. To prevent falls, education of the patients/relatives, and evaluation of current medications were the main measures in both surveys. Concerning restrains, mechanical interventions were frequently used than any other. Non-opioid analgesics were preferred to treat pain.

Discussion

The results of the two annual multicenter surveys suggested a high burden of care problems in older inpatients in Turkish hospitals. Except for the use of restraints and pain, institutional protocols or guidelines were available for the care indicators we evaluated. Also, regular risk assessment was provided for most indicators we evaluated. However, MDTs were not available in most of the hospitals. Multicomponent intervention measures for each care problem were accessible, although the figures were somewhat different in 2017 and 2018 surveys. To the best of our knowledge, we provide the first, multicomponent data set that reveals the magnitude of foremost care problems of older inpatients at the national level.

The growing number of older patients with pressure ulcers, particularly those suffering from chronic diseases, resulted with a significant burden on the health care system (12). In this study, we detected nosocomial pressure ulcers in more than 4% of the participants in both surveys. Similar to our findings, pressure ulcers were found in 8 to 14% of hospitalized older adults in the International pressure ulcer prevalence survey (13). A European international registry revealed that 18.1% of 5.947 inpatients were suffering from pressure ulcers (14). Nevertheless, there is limited data on the prevalence of pressure ulcers in hospitalized Turkish older adults. A retrospective analysis of patient records between 2010 and 2014 in a university hospital identified pressure ulcer diagnosis in 3.3% of 20,175 patients (mean age 66.7 years) in the internal medicine wards (15). Concerning the measures taken to prevent/treat pressure ulcers, we observed heterogeneity in the selection of interventional options between the 2017 and 2018 surveys. Overall, none of the interventional measures were consistently taken in the majority of the participants. Indeed, the level of evidence is low to favor any of existing interventions over other in the prevention and/or treatment of pressure ulcers (16). Thus, our study suggests that participating hospitals' preferences on interventions were dependent more on local conditions and resources of the facility.

Previous studies have reported mixed results about the prevalence of malnutrition among hospitalized older adults in European countries, ranging between 3.4% and 44% (17). Divergent figures are likely resultant from the type of screening tool as well as from the definition of malnutrition (18). Given the similarities in sample characteristics, our results are consistent with the findings of Meijers et al. (19), who observed 19.2% to 23.8% malnutrition among older inpatients in various health care settings. Besides, a later meta-analysis has shown 22% of malnutrition prevalence among inpatient older adults (20). At the national level, the results of the screening of inpatients between 2005 and 2006 were consistent with a frequency of 25% malnutrition risk in individuals aged 60 years or older (21). Thus, our study suggests that local figures have not significantly changed over ten years. Among the potential interventions to correct malnutrition, referral to the dietitian was found 50% or more in both surveys, which is in accordance with the latest recommendations (22,23).

Inpatient falls, a significant concern in the care of hospitalized older adults, were related with increased length of hospital stay, institutionalizations, and costs. While falls have previously been recorded in 13% to 16% of inpatients in different settings (24), more than a quarter of our participants had fallen in the previous 30 days in both surveys. Of note, previous data at the national level is scant. A retrospective analysis of hospital registries has shown that falls were coded in less than 1% of older inpatients (25). On the contrary, our findings indicate a serious burden of falls among hospitalized Turkish older adults. Regarding fall prevention interventions, despite some discrepant findings from well-conducted studies, available guidelines typically stress the adoption of multicomponent interventions to prevent falls (26). In both surveys we evaluated, prioritization of interventions to prevent falls (e.g., review of medications, mobility supervision, walkway arrangements, education) was in line with earlier investigations in different populations (27). Nevertheless, heterogeneity across preferred interventional measures by the participating hospitals and the overall low rates of any intervention suggest the need for further improvements to prevent inpatient falls.

The use of restraints is sometimes unavoidable for geriatric inpatients. In the present study, we recorded at least one type of restraint in more than 20% of our participants. While this is the first report from the Turkish health system in the available literature, the use of restraints among older inpatients has been recorded up to 51.4% in different countries (28,29). Similar to other populations, the use of mechanical restraints was more common in our hospitals (28). These figures indicate a significant care issue for older people in everyday practice. While physical restraints are not recommended to manage behavioral symptoms in hospitalized older adults (30), yet there is no convincing evidence of a successful alternative.

Nearly 50% of the participants in our study mentioned any type of pain in the past seven days, which was the most frequent care problem and consistent with the previous reports (24,31-33). The primary interventions to treat pain were pharmacological treatments, predominantly paracetamol. Despite some concerns related to the widespread use of acetaminophen in older people, it is currently the most commonly prescribed drug alongside NSAIDs in the treatment of mild and moderate pain (34). On the other hand, treatment with opioid analgesics were lower than non-opioid drugs in both surveys. The use of opioid analgesics was previously reported as high as 80% in hospitalized older adults in well-conducted studies (32). Although not harmless; however, given intractable pain is also associated with worse outcomes in older people; physicians often need to prescribe opioid analgesics in moderate to severe pain (34). Non-opioid options partially worked in pain relief; 23.2% of patients indicated that the medication given for pain was effective and that our participants did not need opioid analgesics at all.

Study Limitations

This study has several limitations. First, both surveys were conducted to measure point prevalence, which did not allow discrimination of new cases during hospitalization or identification of diagnoses at discharge. Our focus was the burden of common care problems in a multicenter design at the national level. Second, we displayed crude prevalence results in the entire study samples; thus, no inferences could be made about confounding of the results by unmeasured variables. Finally, as the LPZ 2.0 was developed for use internationally, system differences across countries might have caused missing some data. To overcome this residual issue, we have performed targeted workshops and training sessions each year before the survey was conducted and maintained active communication at all stages of protocol implementation. Despite these limitations, this study provides original data on major care indicators in older inpatients. To our knowledge, this is the single largest, multicenter, national study of multiple care problems of older inpatients in Turkey.

Conclusion

This study showed that pressure ulcers, malnutrition, falls, restraints, and pain are substantial problems in hospitals in Turkey. Key areas of improvement identified were, though not limited to five indicators here, establishment of local protocols/guidelines for all care indicators, MDTs, and internal training programs. Our results have the potential to encourage institutions and policymakers to take the necessary measures, including enhanced screening methods and interventions to improve outcomes. Nonetheless, as the population of older adults with multimorbidity grows, it is fundamental to follow these figures dynamically in future surveys.

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Institutions are required to pay a participating fee per institution and per patient within the LPZ program. Both surveys in 2017 and 2018 years were supported by grant from Nutricia Turkey. The funding organization did not have any role in data collection, analysis or reporting, the latter two were performed centrally in the Maastricht University.

Ethics

Ethics Committee Approval: İstanbul University, İstanbul Faculty of Medicine Ethical Committee approved the protocol (decision no: 02, date: 22.01.2016/no: 153).

Informed Consent: Informed consent was obtained.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Concept: B.S., S.A., Design: B.S., S.A., İ.T., Data Collection or Processing: B.S., T.S., S.A., P.T.T., S.S., A.T.Ç., H.Y., D.S.E., C.B., M.E., Z.A.Ö., G.S., S.N., M.V., M.A.K., Analysis or Interpretation: B.S., T.S., S.A., Literature Search: T.S., B.S., İ.T., S.A., Writing: T.S., İ.T., B.S., S.A.

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ORIGINAL RESEARCH

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Psychometric Properties of a Modified Balance Evaluation Systems Test

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Abstract

Objective: This study aimed to assist the realization of the postural control systems framework by presenting a short balance evaluation systems test (BESTest) that has a clear classification of items among postural control components to determine the cause of balance problems in older adults.

Materials and Methods: A total of 86 older adults with varying degrees of balance disorders performed all the BESTest items. An 11-member expert team participated in the content validity ratio study and item selection, and two evaluators determined the reliability of the scale made. Values of the area under the curve, sensitivity, and specificity were calculated.

Results: The short-BESTest consists of 12 selected items with a cut-off point of 20 out of 36 and a sensitivity of 72% and a specificity of 75%. The test is moderately accurate at classifying participants with and without fall history. The values of interrater reliability (0.928) and concurrent validity (r=0.926) were high (p<0.01). Additionally, the short-BESTest approximately takes 12 min.

Conclusion: Short-BESTest identifies the causes of balance deficits by classifying the postural control components. A low score in each of the short-BESTest sections indicates a defect in the postural control component of that section. Therefore, designing exercises using the short-BESTest to target the cause of the balance deficit can be performed better. Additionally, only section 5 of short-BESTest is used if a fall with low time and energy is to be predicted.

Keywords: Short balance evaluation systems test, posture, elderly, postural control

Introduction

Balance is an essential skill to avoid falls and balance disorders are common in older adults (1,2). Because of the high incidence of balance disorders and their potential impact on performance, interventions to improve balance have become the primary goal of experts in this field (3-5). To this end, many functional balance assessment scales have been introduced (6-8).

Balance control is no longer considered just as a system or a set of balance and standing reflexes. Balance control is a complex skill consisting of the interaction of multiple sensorimotor processes (9). Based on this view, Horak (9) stated the key components needed for balance control in postural control systems framework. Horak (9) has described various components of postural control and emphasized the importance of each of these components in assessment and treatment.

In clinical practice and exercise design, all components needed for postural control should be studied and, according to disrupted components, exercise design and treatment should be performed {Horak, 2006 #508; Pourmahmoudian, 2020 #543}. One of the important limitations of all functional balance assessment scales introduced so far, except the BESTest (10), is that they do not include all postural control components and BESTest has so far been the only scale that includes all postural control components (6).

Another important limitation of functional balance assessment scales is that they are unable to determine the cause of the balance deficit (10). These scales provide a total score that, through the cut-off points, can generally determine whether a person is in danger of falling, and does not specify the type of postural control component that is impaired (10).

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BESTest has taken steps to remove this limitation and by dividing the items into six sections, it has attempted to determine the cause of the balance deficit to some extent (10). Although this segmentation is a very valuable step in determining the cause of the balance deficit, it has some drawbacks and cannot determine the cause of the balance deficit. In fact, BESTest lacks a clear and accurate segmentation of all postural control components to identify the causes of balance deficit, and the reasons why each item is included in one of these 6 BESTest sections are not stated. For example, in order to perform timed get up and go test with dual task, components of movement strategies, sensory strategies, dynamic control, and perception processing from the postural control system framework are involved in doing this item (6), but this item is only in the dynamic control section of BESTest (10). That is, if a person is unable to perform timed get up and go test with dual task, according to the BESTest segmentation, it only affects the dynamic control section score and the balance deficit is related to the dynamic control subcomponents.

In performing the functional reach test, components in sections of biomechanical constraints, movement strategies, sensory strategies, and orientation in space are involved in this motion (6), but this item is only in the biomechanical constraints section of BESTest (10). That is, if a person is unable to perform a functional reach test, according to this segmentation, the biomechanical constraints score is only affected and the balance deficit is related to the biomechanical constraint subcomponents. However, this conclusion is wrong. Horak (9) did not provide any reasons for this classification of items among the postural control sections. Perception processing is also a key component of the postural control system framework (9), but does not contain any section in BESTest and is not mentioned in the scoring system (10). Items that perception have a role in doing those are placed in "Stability in Gait" section of BESTest, if the balance deficit is due to the perception, how is it determined in BESTest?

So far, two mini-BESTest and brief-BESTest scales have been created as brief versions of BESTest. But the mini-BESTest does not evaluate the subcomponent of functional stability limits and the brief-BESTest doesn't evaluate the subcomponents of verticality and perception processing from the postural control system framework (6), and none of these tests provide a solution to achieve the cause of the balance deficit and it is only generally stated if the person has an impaired balance or not. Therefore, the purpose of this study is to assist in the realization of the postural control systems framework by presenting a short and modified BESTest that has a clear classification of items among postural control components to determine the cause of the balance problems.

Materials and Methods

Participants

A total of 86 participants [one 28-person group at the item selection stage (23 males and 5 females) with a mean age of 72.53±9.32 and body mass index (BMI) of 24.13±2.59, and a 58-person group at the confirmation stage (46 males and 12 females) with a mean age of 70.82±9.39 and BMI of 24.69±2.72] who lived in the community and nursing homes were studied with different ranges of balance disorders. Inclusion criteria included: Being over 60 years old, being able to walk 6 meters with or without assistive devices (but without human assistance) and completing a research consent form. Participants were introduced to a definition of fall (any disturbance of balance during daily activities that causes a person's trunk, knee or hand to lean against the ground, wall, desk or other surface unintentionally) and based on this definition; they self-reported the number of their falls last year.

The study was approved by the Guilan University Research Ethics Committee and was carried out in Physical Education College of Guilan University (ID: IR.GUMS.1397.021). An 11-member expert team (Table 1), including experts of physiotherapy, and physical education-sport injury and corrective exercises who specialize in assessing and treating balance problems, participated in the preparation of the short and modified BESTest (Table 2).

Short-BESTest Preparation Process

1. The conceptual framework in this research for the preparation of short-BESTest is the framework of postural control systems proposed by Horak (9) and is considered as the reference paper in this research.

2. As Sibley et al. (6) have shown, BESTest is the only test in which all postural control systems components are involved in performing its items. Since there are several items for each of the subcomponents of the postural control systems components in BESTest, BESTest was evaluated.

3. Classifying items among postural control components: In the reference paper of the postural control systems framework, the postural control subcomponents are divided into 6 sections (9). In Table 3, we set out the sections based on the reference article sections of the postural control systems framework (9), and identified which of the postural control subcomponents were involved in the implementation of each of these items.

4. Which postural control subcomponents are involved in the implementation of each item: This step was done by 11 experts in this research using the definitions of each of these subcomponents in the postural control systems reference paper (9), as well as the research by Sibley et al. (6) who determined sixty-six balance assessment scales are consisted of which components of postural control. For example,

the subcomponents of stability limits (static stability) and strength from the biomechanical constraints section and the subcomponents of the sensory strategies section are involved in performing the one-leg stand test (6). The degrees of freedom and strength subcomponents of the biomechanical constraints section, the anticipatory and voluntary subcomponents of the motion strategies section, and the subcomponents of the sensory strategies section, are involved in performing the ankle strength and range of motion item (6).

5. Performing all BESTest items on 28 participants: 28 participants with different range of balance disorders, who had not previously performed BESTest, performed all BESTest items and their scores were given to 11 research experts for item selection.

6. Selecting items and summarizing BESTest: Items selected by experts should include all postural control components and obtain appropriate validity and reliability values. That is, there must be at least one item for each of the subcomponents of the postural control system components and this subcomponent must be involved in the implementation of this item. For example, among the thirty-six BESTest items, only the verticality subcomponent plays a role in performing these five items: BESTest 6 [lateral lean (left, right), sitting verticality (left, right)], and BESTest 20 (incline, eyes close). Therefore, at least one of these items should be selected to include the short-BESTest. Also, each section of the scale made should obtain good validity and reliability values. If each short-BESTest section obtained low values in validity, reliability, area under the curve (AUC), sensitivity and specificity, the items would have to be changed.

7. Based on the criteria outlined above, the content validity ratio (CVR) form for thirty-six BESTest items was completed by the experts. According to the number of the experts that was eleven, the CVR of 0.63 or above it indicates that the item is actually accepted (or 9 out of 11 experts must be in agreement) (11). The combination of items that achieve a CVR of 0.63 or above it creates the short-BESTest. $CVR = \frac{ne-\frac{N}{2}}{\frac{N}{2}}$

Table 1. Descriptive information of the research team and subjects

Descriptive information of the subjects				
Characteristics	**Total (n=58)**	**Without a history of falls (n=36)**	**With a history of falls (n=22)**	**p**
Age	68.62±8.05	68.44±8.29	68.92±7.69	0.485
BMI	25.09±3.13	25.29±3.28	24.74±2.84	0.546
BESTest	79.02±19.34	86.89±8.94	66.14±24.54	0.001*
Short-BESTest	22.03±7.61	24.86±4.47	17.41±9.37	0.001*
*: There is a significant difference between the faller group and the no-faller group				

Descriptive information of the research team		
Expert no.	**Scientific degree**	**Years of balance experience**
1	Ph.D. in Physiotherapy - Professor of Department of Sport Injury and Corrective Exercises in University of Guilan, Iran	22
2	Ph.D. in Physical Education- Professor of Department of Sport Injury and Corrective Exercises in University of Guilan, Iran	18
3	Ph.D. in Physical Education- Professor of Department of Sport Injury and Corrective Exercises in University of Kerman, Iran	11
4	Ph.D. in Physiotherapy-Assistant Professor of Physiotherapy Department in University of Kermanshah, Iran	10
5	Ph.D. in Physiotherapy-Assistant Professor of Physiotherapy Department in University of Isfahan, Iran	11
6	Ph.D. in Physical Education - Assistant Professor of Department of Biomechanics, University of Guilan, Iran	2
7	Ph.D. in Physical Education - Assistant Professor of Department of Biomechanics, University of Hamadan, Iran	1
8	Ph.D. in Physical Education- Assistant Professor of Department of Sport Injury and Corrective Exercises in University of Yazd, Iran	4
9	Ph.D. student in Physical Education - Department of Sport Injury and Corrective Exercises in University of Guilan, Iran	2
10	Ph.D. student in Physical Education - Department of Sport Injury and Corrective Exercises in University of Guilan, Iran	1
11	Ph.D. student in Physical Education - Department of Sport Injury and Corrective Exercises in University of Guilan, Iran	3

(N= the number of panel members; ne=the number of experts agreeing "essential")

8. Defining the short-BESTest scoring system: Given that this scale is a short version of BESTest, no changes were made to the scoring system of each item. Items are scored on a sequential scale from 0 (the worst performance) to 3 (the best performance).

9. Performing BESTest on a 58-person group: After the items were selected based on the CVR form and scores of the first 28 people, another 58-person group performed the BESTest and AUC, sensitivity and specificity values were calculated for BESTest and short-BESTest using the scores of these participants (Table 4). Two experts independently were used to calculate the inter-rater reliability, and the reliability of each of the short-BESTest sections was also calculated (Table

Table 2. Content validity ratio results of experts

No	Item	Essential	Important, but not essential	Not necessary	CVR
1	BESTest 1 (Base of support)	6	4	1	0.09
2	BESTest 2 (COM alignment)	7	2	2	0.27
3	BESTest 3 (Ankle strength and ROM)	10	1	0	0.81*
4	BESTest 4 (Hip/trunk lateral strength)	8	1	2	0.45
5	BESTest 5 (Sit on floor and stand up)	7	2	2	0.27
6	BESTest 6 (Lateral lean-left)	9	1	1	0.63*
7	BESTest 6 (Lateral lean-right)	9	1	1	0.63*
8	BESTest 6 (Sitting verticality-left)	6	1	4	0.09
9	BESTest 6 (Sitting verticality-right)	6	1	4	0.09
10	BESTest 7 (Functional reach forward)	10	1	0	0.81*
11	BESTest 8 (Functional reach lateral-left)	6	2	3	0.09
12	BESTest 8 (Functional reach lateral-right)	6	2	3	0.09
13	BESTest 9 (Sit to stand)	7	2	2	0.27
14	BESTest 10 (Rise to toes)	7	2	2	0.27
15	BESTest 11 (Stand on one leg-left)	11	0	0	1.00*
16	BESTest 11 (Stand on one leg-right)	11	0	0	1.00*
17	BESTest 12 (Alternate stair touching)	7	1	3	0.27
18	BESTest 13 (Standing arm raise)	7	1	3	0.27
19	BESTest 14 (In-place response, forward)	7	3	1	0.27
20	BESTest 15 (In-place response, backward)	7	1	3	0.27
21	BESTest 16 (Compensatory stepping correction, forward)	9	1	1	0.63*
22	BESTest 17 (Compensatory stepping correction, backward)	7	2	2	0.27
23	BESTest 18 (Compensatory stepping correction, lateral-left)	6	2	3	0.09
24	BESTest 18 (Compensatory stepping correction, lateral-right)	6	2	3	0.09
25	Item 19-A (Stance on firm surface, eyes open)	8	2	1	0.45
26	Item 19-B (Stance on firm surface, eyes close)	8	2	1	0.45
27	BESTest 19-C (Stance on foam, eyes open)	8	1	2	0.45
28	BESTest 19-D (Stance on foam, eyes close)	11	0	0	1.00*
29	BESTest 20 (Incline, eyes close)	6	2	3	0.09
30	BESTest 21 (Gait, level surface)	8	3	0	0.45
31	BESTest 22 (Change in gait speed)	8	2	1	0.45
32	BESTest 23 (Walk with head turns, horizontal)	10	1	0	0.81*
33	BESTest 24 (Walk with pivot turns)	9	1	1	0.63*
34	BESTest 25 (Step over obstacles)	9	1	1	0.63*
35	BESTest 26 (Timed "Get Up & Go" test)	8	2	1	0.45
36	BESTest 27 (Timed "Get Up & Go" test with dual task)	9	1	1	0.63*

CVR: Content validity ratio, *: CVR score of 0.63 or above it is recognized as an appropriate score and the item is accepted

5). Short-BESTest concurrent validity was also calculated for BESTest (Table 6).

BESTest: It is composed of 36 items divided into 6 sections. Each item is scored from 0 (the most balance disturbance) to 3 (no balance disturbance) and the maximum possible score is 108 (10). BESTest measures all components of postural control systems and is the most comprehensive functional scale ever made to identify postural control disorders (6).

Postural control components: In this study, all the components of postural control are derived from the framework of postural control systems proposed by Horak (9), and each of these components has a comprehensive definition, and it is not correct to explain them briefly. Therefore, in this research, their explanation has not been discussed and we should refer to the reference article. It should be noted that the six sections of short-BESTest are exactly derived from the sections of the postural control framework (9), and are slightly different from the sections of BESTest. For example, in BESTest, the subcomponents of anticipatory postural adjustments and postural responses are placed as two separate sections (10), but in short-BESTest, these two subcomponents are in the section of movement strategies.

Interrater Reliability and Concurrent Validity

In this study, interrater reliability was obtained by two experts (one Ph.D. student in physical education -sport injury and corrective exercises with 2 years of balance experience and one master student in physical education- sport injury and corrective exercises with 1 year of balance experience), which was calculated with intra-class correlation coefficient (ICC). To teach the participants how to correctly perform each item, one examiner reads the item and the other examiner performs the item to teach them, then the subject performs the item. Each item was scored by two examiners independently. Participants were randomly assigned to each item to avoid the effect of fatigue on the last items. The participants were given short rest periods as needed.

ICC values were considered as follows: Between 0.9 to 0.99 as excellent reliability, between 0.75 to 0.9 as good reliability, between 0.75 to 0.5 as moderate reliability and less than 0.5 as poor reliability (12). Spearman correlation coefficient

Table 3. Each item in short-BESTest is consisted of what components of postural control systems

Items	6 sections of short-BESTest					
	Section 1: Biomechanical constraints (degrees of freedom, strength, limits of stability)	Section 2: Movement strategies (reactive, anticipatory, voluntary)	Section 3: Sensory strategies (integration, reweighting)	Section 4: Orientation in space (perception, verticality)	Section 5: Control of dynamics (gait, proactive)	Section 6: Cognitive processing (attention, learning)
Ankle strength and ROM	Degrees of freedom, strength	Anticipatory, voluntary	Integration, reweighting	-	-	-
Lateral lean (left, right)	Limits of stability	Anticipatory, voluntary	Integration, reweighting	Orientation, verticality	-	-
Functional reach forward	Limits of stability, strength	Anticipatory, voluntary	Integration, reweighting	Orientation	-	-
Stand on one leg (left, right)	Limits of stability, strength	-	Integration, reweighting	-	-	-
Compensatory stepping correction, forward	-	Anticipatory reactive	Integration, reweighting	Orientation	Proactive	-
Stance on foam, eyes close	Limits of stability	-	Integration, reweighting	Orientation	-	-
Walk with head turns, horizontal	-	Anticipatory, voluntary	Integration, reweighting	Orientation	Gait	Attention
Walk with pivot turns	-	Anticipatory, voluntary	Integration, reweighting	Orientation	Gait	-
Step over obstacles	Degrees of freedom, strength	Anticipatory, voluntary	Integration, reweighting	-	Gait	-
Timed "Get Up & Go" with dual task	-	Anticipatory, voluntary	Integration, reweighting	-	Gait	Attention

Ability to orientate body parts regarding to the gravity, level of support, range of vision, and internal components are important parts of postural control (Horak, 2006), which in "Orientation in space" section, orientation is used to express these abilities.
To distinguish each item in short-BESTest is consisted of what components of postural control systems, the 11 experts used the definitions of each of these components from the postural control systems framework, (Horak, 2006) as well as the research by Sibley et al. (2015) who determined sixty-six balance assessment scales are consisted of which components of postural control (Sibley et al. 2015)

was used to examine the validity of short-BESTest and its components with BESTest. Results 0 to 0.25 were considered as no correlation or very poor, 0.25 to 0.5 as poor correlation, 0.5 to 0.75 as moderate to good correlation, and above 0.75 as strong correlation (13).

Statistics

The subject's retrospective fall assessment was used as the gold standard in the diagnosis of a faller (i.e. one or more falls in the previous year) from non-faller (i.e. without any fall in the previous year). The receiver operating characteristic curve (ROC) was created for each balance scale (BESTest and short-BESTest) and the AUC of each ROC curve was calculated. The AUC is the probability of correctly identifying the faller from a pair of randomly selected patients (one faller and the other non-faller). The AUC range is 0.5 (non-detectable) to 1.00 (completely detectable). An AUC value of 0.9 and greater indicates high accuracy, 0.7 to 0.9 indicates moderate accuracy, 0.5 to 0.7 indicates low accuracy (14).

Sensitivity (number of correctly detected fallers) and specificity (number of correctly detected non-fallers) are calculated. Cut-off points were selected to distinguish between individuals with and without a history of falls using an intersection point that has the highest values of sensitivity and specificity (14).

Positive likelihood ratios are calculated as $\frac{\text{sensitivity}}{1-\text{specificity}}$. A positive likelihood ratio indicates how much the probability of being a faller increases with the positive test results. Negative likelihood ratios are calculated as $\frac{1-\text{sensitivity}}{\text{specificity}}$. The negative likelihood ratio indicates how much the probability of being a faller decreases with negative test results (14).

Data were analyzed using SPSS version 20 (SPSS Inc. Chicago, IL) and Stata 14 software (STATA, LIC. Texas). Significance level in the present study was 95% and alpha level was less than or equal to 0.05.

Table 4. The values of the AUC, sensitivity, specificity, cut-off points, LR+ and LR- for each of the balance scales

	AUC (95% CI)	Cut-off score	% Sensitivity (95% CI)	% Specificity (95% CI)	LR+/LR-
BESTest	0.75 (0.60-0.89)	≤83/108	80% (51-95)	76% (61-88)	3.44/0.26
Section 1 of BESTest	0.72 (0.58-0.86)	≤11/15	50% (31-68)	75% (55-89)	2.00/0.67
Section 2 of BESTest	0.69 (0.54-0.84)	≤15/21	50% (28-71)	69% (51-83)	1.64/0.72
Section 3 of BESTest	0.72 (0.57-0.87)	≤11/18	60% (38-80)	77% (59-89)	2.66/0.51
Section 4 of BESTest	0.76 (0.62-0.90)	≤12/18	60% (38-80)	77% (59-89)	2.66/0.51
Section 5 of BESTest	0.73 (0.59-0.87)	≤13/15	66% (41-86)	75% (58-87)	2.67/0.44
Section 6 of BESTest	0.72 (0.56-0.87)	≤13/21	59% (36-79)	75% (57-87)	2.36/0.55
Short-BESTest	0.72 (0.57-0.87)	≤20/36	66% (41-86)	75% (58-87)	2.67/0.44
Section 1 of Short-BESTest	0.70 (0.56-0.85)	≤15/24	53% (33-73)	75% (56-88)	2.15/0.62
Section 2 of Short-BESTest	0.75 (0.61-0.89)	≤16/27	60% (36-80)	73% (56-86)	2.28/0.54
Section 3 of Short-BESTest	0.72 (0.57-0.87)	≤20/36	66% (41-86)	75% (58-87)	2.67/0.44
Section 4 of Short-BESTest	0.75 (0.60-0.90)	≤14/21	62% (40-81)	79% (62-91)	3.04/0.47
Section 5 of Short-BESTest	0.68 (0.52-0.84)	≤8/15	75% (47-92)	76% (60-87)	3.15/0.33
Section 6 of Short-BESTest	0.70 (0.55-0.84)	≤3/6	51% (34-68)	82% (61-95)	2.96/0.59

AUC: Area under the curve, LR+: Positive likelihood ratio, LR-: Negative likelihood ratio, CI: Confidence interval

Results

Initially, 28 participants (23 males and 5 females) with a mean age of 72.53±9.32 and BMI of 24.13±2.59 performed all BESTest items and their scores were used to select short-BESTest items. Then, a group of 58 others (46 males and 12 females) who had not previously performed BESTest performed all of the BESTest items, and this group's scores are listed in this article (Table 1). In the group with a history of falling 6 participants had one fall and 16 participants had more than one fall in the past 12 months. Participants with and without history of falls exhibited significantly different scores for the BESTest (p=0.001) and short-BESTest (p=0.001).

Table 2 reports the results of expert surveys. As the number of experts is 11, the CVR score of 0.63 or above it means acceptance of the item, that 12 items totally were accepted.

Table 3 reports that each item in short-BESTest is consisted of what components of postural control systems. As can be seen in Table 3, all components of postural control systems are involved in short-BESTest. The components of sensory strategies are involved in the execution of all items, and the perception processing is involved in the execution of the 2 items.

Results from the ROC analyses are shown in Table 4. The BESTest, short-BESTest and all sections (except section 2 of BESTest and section 5 of short-BESTest) were moderately accurate at classifying participants with and without history of falls (between 0.70 and 0.76).

The cut-off points specified for BESTest are 83 out of 108 with 80% sensitivity and 76% specificity. Also, short-BESTest consists of 12 selected items with a cut-off point of 20 out of 36 and a sensitivity of 72% and a specificity of 75%.

BESTest scores were more sensitive than the short-BESTest to identify older adults with balance disorders. The average of sensitivity between all sections of BESTest was 4% lower than the average of short-BESTest sections, and the average of specificity between all sections of BESTest was 2% lower than the average of short-BESTest sections. In addition, the LR+ and LR- analyses of the BESTest, short-BESTest and all sections indicated that they are relatively similar for classifying participants with and without history of falls.

Interrater Reliability

The ICC results are presented in Table 5 to evaluate the inter-rater reliability of the short-BESTest. The inter-rater reliability of short-BESTest with ICC=0.928 was excellent (p=0.001). Sections 1 and 3 also obtained excellent reliability values (0.911 and 0.909) and Sections 2, 4, 5 and 6 obtained good reliability values (0.834-0.893).

Table 5. Inter-rater reliability results for short-BESTest

	First rater (mean ± SD)	Second rater (mean ± SD)	95% CI	ICC	p
Short-BESTest	21.98±7.12	22.19±5.23	0.879-0.958	0.928	0.001
Section 1 of short-BESTest	15.02±5.23	14.67±4.05	0.850-0.947	0.911	0.001
Section 2 of short-BESTest	18.21±5.43	17.88±4.04	0.819-0.937	0.893	0.001
Section 3 of short-BESTest	21.98±7.12	22.19±5.23	0.846-0.946	0.909	0.001
Section 4 of short-BESTest	14.02±4.29	14.45±3.04	0.744-0.910	0.848	0.001
Section 5 of short-BESTest	8.95±3.05	9.10±2.40	0.758-0.915	0.856	0.001
Section 6 of short-BESTest	3.28±1.24	3.50±1.14	0.720-0.902	0.834	0.001

SD: Standard deviation, CI: Confidence interval, ICC: Intra-class correlation coefficient

Table 6. Spearman correlation coefficient results to examine the relationship between short-BESTest and BESTest

	Spearman correlation	p	Number of participants
Short-BESTest with BESTest	0.926*	0.001	58
Section 1 of short-BESTest with BESTest	0.864*	0.001	58
Section 2 of short-BESTest with BESTest	0.912*	0.001	58
Section 3 of short-BESTest with BESTest	0.941*	0.001	58
Section 4 of short-BESTest with BESTest	0.900*	0.001	58
Section 5 of short-BESTest with BESTest	0.855*	0.001	58
Section 6 of short-BESTest with BESTest	0.819*	0.001	58

*: There was a significant relationship between the two variables (p<0.001)

Concurrent Validity with BESTest

To investigate the concurrent validity, the correlation between Short-BESTest and BESTest was calculated. Spearman correlation coefficient was 0.926, which was significantly related with BESTest ($p<0.01$) (Table 6). All sections of short-BESTest also have a strong correlation with BESTest (0.819-0.941).

How to Enter the Scores Into the Short-BESTest Table? (Table 7)

Each item is consisted of one or more postural control system components, so any scores obtained for each item are placed in front of those components, i.e. if the subject obtains 2 in doing the item of ankle strength and range of motion, score 2 is written in front of these sections: Biomechanical constraints, movement strategies, sensory strategies, and the short-BESTest total score. By summing the scores below each of the sections, the overall score for that section is obtained. Also by adding up the score for each item, the short-BESTest overall score is obtained.

Discussion

Using the values of the AUC, sensitivity, specificity, Spearman correlation coefficient and reliability the following 12 items were selected according to postural control system framework.

Table 7. Short-BESTest scores calculation table

	Items	6 Sections of short-BESTest						Short-BESTest
		Section 1: Biomechanical constraints (degrees of freedom, strength, limits of stability)	Section 2: Movement strategies (reactive, anticipatory, voluntary)	Section 3: Sensory strategies (integration, reweighting)	Section 4: Orientation in space (perception, verticality)	Section 5: Control of dynamics (gait, proactive)	Section 6: Cognitive processing (attention, learning)	
1	Ankle strength and ROM							
2	Lateral lean (right)							
3	Lateral lean (left)							
4	Functional reach forward							
5	Stand on one leg (right)							
6	Stand on one leg (left)							
7	Compensatory stepping correction, forward							
8	Stance on foam, eyes close							
9	Walk with head turns, horizontal							
10	Walk with pivot turns							
11	Step over obstacles							
12	Timed "Get Up & Go" with dual task							
Total of scores								
Maximum scores		24	27	36	21	15	6	36
Cut-off score		15	16	20	14	8	3	20

ROM: Range of motion, Total of scores: The sum of the subject scores in each section is, Maximum scores: It's the maximum scores a person can earn, it is based on the number of items in a section. Cut-off point: Scores below that point are at risk of falling and indicate defects in that section

Ankle strength and ROM, lateral lean (right, left), functional reach forward, stand on one leg (right, left), compensatory stepping correction (forward), stance on foam (eyes close), walk with head turns (horizontal), walk with pivot turns, step over obstacles, timed "Get Up & Go" with dual task.

In the results the sensitivity for BESTest and short-BESTest are 80% and 66%, respectively, and the average of sensitivity between sections of BESTest is 4% less than short-BESTest sections. In researches of Padgett et al. (15), Schlenstedt et al. (16), Duncan et al. (17), Godi et al. (18) and Yingyongyudha et al. (19) the values of sensitivity and specificity for BESTest, mini-BESTest and brief-BESTest have been reported by various researchers, that if we get the average value of them, we get 77.85, 73.22 and 67 for sensitivity, respectively, and 72.42, 77.88 and 83 for specificity. This indicates that as number of items decreases from BESTest, the sensitivity values decrease and the specificity values increase. Therefore, the decrease in the sensitivity of short-BESTest to BESTest is in line with the findings of other researchers (15-19). But the important point is that the sensitivity level is too low among the BESTest sections, especially sections 1 and 2 of this test (50%, 50%).

The low amounts of sensitivity in sections 1 and 6 of short-BESTest is other point. It shows components of biomechanical constraints (degrees of freedom, strength, limits of stability) and cognitive processing (attention, learning) have low sensitivity in elderly population, and section 5 of short-BESTest that is pertain to control of dynamics (gait, proactive) only with five items has good amounts of sensitivity (75%) and specificity (76%). It should also be noted that we must do all the items and sections of short-BESTest, because the reason for the problem of balance of an elderly person may be due to a defect in the subcomponents of section 1 or 6 of short-BESTest, and it should not be assumed that because in a whole society control of dynamic components can better predict fall occurrence, other components of postural control are not important. Rather it shows that the components of perception and biomechanical constraints are not good predictors of fall occurrence, but many older adults may have problems in these components. In general, if we want to predict a fall, we need to focus on dynamic control items, but to address the cause of the imbalance, each of these components must be considered.

The cut-off point specified for BESTest is similar to the research already specified (20). These cut-off points represent a superficial of the balance disorder associated with the risk of falling. Given the cut-off points selected, the short-BESTest was able to correctly identify 7 out of 10 fallers in this sample of the older adults, and it also correctly identified 7 out of 10 non-fallers. Also the high correlation between the BESTest and short-BESTest supports the concurrent validity of the short-BESTest and its sections, and the inter-rater reliability of short-BESTest is approved.

One of the most important tasks for assessing balance status in the older adults is the construction and standardization of various tools including scales that can identify the causes of defects (10). Short-BESTest attempts to understand the causes of balance deficits by classifying the postural control components. One of key benefits of short-BESTest is that the researchers get familiar with the sub-components that have a role in doing each item, which enables the researchers to design exercises for all postural control components.

To eliminate the "being too long" constraint of BESTest, Franchignoni et al. (21) introduced its 14-item version (mini-BESTest). By focusing on the dynamic balance, they eliminated two sections (biomechanical constraints and stability constraints) from the six BESTest sections. Although mini-BESTest and BESTest have achieved relatively similar values of sensitivity, specificity and reliability in fall risk prediction (17), mini-BESTest is inconsistent with the postural control systems framework due to the removal of components from postural control systems (15). Padgett et al. (15) published the 8-item version (brief-BESTest) since mini-BESTest contradicts the BESTest theoretical framework. But they only focused on choosing the best item from each of the BESTest sections and did not notice that some of these sections were composed of several postural control components, so the components of vertical stability and perception processing are not considered in brief-BESTest (6).

Disruption of one or a combination of postural control subcomponents can lead to postural disorder. In designing the balance exercises, a dedicated exercise design should also be designed for each postural control components that is impaired (9,10). So, using short-BESTest, the design of the exercises can be done more accurately. For example, if a person obtains a score less than 16 in "the movement strategies" section, this indicates that the subcomponents in this section are the cause of the balance deficit and special exercises should be performed to strengthen the subcomponents in this section. The subject may also score lower than the cut-off points in some sections of the scale and obtain appropriate points in several sections, so exercise designing should be done based on weak components.

Already many training protocols have been designed and implemented to improve balance, but most of them don't cover all postural control components (6). Most of these protocols aren't purposefully designed to remove the underlying cause of the balance deficit; this reduces the efficiency of the protocols (9,10). Using short-BESTest, it is hoped that more targeted training protocols can be designed and improved.

Study Limitations

In this study, we came up with a new classification to find the cause of balance deficit. However, one of the most important limitations of short-BESTest is that each section is composed of a number of sub-components, so this makes it difficult to identify the main cause of the balance defect. For example, the subcomponents of degrees of freedom, strength, and stability limits are in the biomechanical constraints section and the individual who is impaired in this section cannot determine which of these sub-components is most affected. So it might be better to increase the number of these sections and place each postural control source in a separate section.

Balance deficits need to be identified using short-BESTest and training protocols must be implemented for these balance deficits to determine the effectiveness of short-BESTest.

Because of religious limitations that there are between males and females in Iran, this study was mostly conducted on old men and the sample size of the women was small. Construct validity tests are need to determine whether the short-BESTest sections accurately identify discrete balance defects. It is still unclear to what extent sections 3 (sensory strategies) and 4 (orientation in space) make similar measurements and overlap. Further psychometric tests are needed to determine construct validity, concurrent validity, sensitivity, specificity, and the ability to guide the effective treatment for people with balance problems.

The classification of items among postural control sections is controversial. For example, in the single leg stance item, perception processing is also required, but this perception processing rate is low and as the difficulty of the test increases, the amount of perception processing increases (9). Therefore, only two items BESTest 23 (Walk with head turns, horizontal), and BESTest 27 (Timed "Get Up & Go" with dual task) that require higher perception processing were considered perception processing items. This topic also applies to other items.

Conclusion

Short-BESTest is the second scale that includes all the components of the postural control systems and the most important advantage of the scale is that it determines each item is composed of which components of the postural control systems. So by using this classification, we can determine which component of the postural control systems is impaired and focus training programs on strengthening and improving this component. One of the other short-BESTest benefits is that it has fewer items than BESTest. Also it takes about 12 minutes to do the short-BESTest, compared to about 40 minutes to do the BESTest.

If we only want to predict the fall with low time and energy, we can only use section 5 of short-BESTest (control of dynamic), and in order to determine the cause of the balance defect, it is necessary to focus on all sections of short-BESTest and their cutting points, which indicates whether there is a defect in the subcomponents of each section or not.

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Ethics

Ethics Committee Approval: The study was approved by the Guilan University Research Ethics Committee and was carried out in Physical Education College of Guilan University (ID: IR.GUMS.1397.021).

Informed Consent: Informed consent was obtained.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: P.P., A.A.N., H.D., Design: P.P., A.A.N., H.D., Data Collection or Processing: P.P., Z.A.K.R., Analysis or Interpretation: P.P., Z.A.K.R., Literature Search: P.P., A.A.N., Writing: P.P.

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Short Balance Evaluation Systems Test

Examiner Instructions for Short-BESTest

Subjects should be tested with flat heeled shoes or shoes and socks off. If subject must use an assistive device for an item, score that item one category lower. If subject requires physical assistance to perform an item score the lowest category (0) for that item.

1. ANKLE STRENGTH & RANGE

(3) Normal: Able to stand on toes with maximal height and to stand on heels with front of feet up

(2) Impairment in either foot of either ankle flexors or extensors (i.e. less than maximum height)

(1) Impairment in two ankle groups (eg, bilateral flexors or both ankle flexors and extensors in 1 foot)

(0) Both flexors and extensors in both left and right ankles impaired (i.e. less than maximum height)

2. LATERAL LEAN

Left Right

(3) (3) Maximum lean, subject moves upper shoulders beyond body midline, very stable

(2) (2) Moderate lean, subject's upper shoulder approaches body midline or some instability

(1) (1) Very little lean, or significant instability

(0) (0) No lean or falls (exceeds limits)

3. FUNCTIONAL REACH FORWARD Distance reached: _____ cm OR_____inches

(3) Maximum to limits: >32 cm (12.5 in)

(2) Moderate: 16.5 cm-32 cm (6.5-12.5 in)

(1) Poor: <16.5 cm (6.5 in)

(0) No measurable lean – or must be caught

4. STAND ON ONE LEG

Left Right

(3) (3) Normal: Stable for >20 s

(2) (2) Trunk motion, OR 10-20 s

(1) (1) Stands 2-10 s

(0) (0) Unable

5. COMPENSATORY STEPPING CORRECTION- FORWARD

(3) Recovers independently a single, large step (second realignment step is allowed)

(2) More than one step used to recover equilibrium, but recovers stability independently OR 1 step with imbalance

(1) Takes multiple steps to recover equilibrium, or needs minimum assistance to prevent a fall

(0) No step, OR would fall if not caught, OR falls spontaneously

6. STANCE ON FOAM SURFACE, EYES CLOSED

(3) 30s stable

(2) 30s unstable

(1) <30s

(0) Unable

7. WALK WITH HEAD TURNS - HORIZONTAL

(3) Normal: Performs head turns with no change in gait speed and good balance

(2) Mild: Performs head turns smoothly with reduction in gait speed

(1) Moderate: Performs head turns with imbalance

(0) Severe: Performs head turns with reduced speed AND imbalance AND/OR will not move head within available range while walking.

8. WALK WITH PIVOT TURNS

(3) Normal: Turns with feet close, FAST (<3 steps) with good balance

(2) Mild: Turns with feet close SLOW (>4 steps) with good balance

(1) Moderate: Turns with feet close at any speed with mild signs of imbalance

(0) Severe: Cannot turn with feet close at any speed and significant imbalance

9. STEP OVER OBSTACLES Time_____sec

(3) Normal: Able to step over 2 stacked shoe boxes without changing speed and with good balance

(2) Mild: Steps over 2 stacked shoe boxes but slows down, with good balance

(1) Moderate: Steps over shoe boxes with imbalance or touches box

(0) Severe: Cannot step over shoe boxes AND slows down with imbalance or cannot perform with assistance.

10. Timed "Get Up & Go" With Dual Task Dual Task: Time _____sec

(3) Normal: No noticeable change between sitting and standing in the rate or accuracy of backwards counting and no change in gait speed.

(2) Mild: Noticeable slowing, hesitation or errors in counting backwards OR slow walking (10%) in dual task

(1) Moderate: Affects on BOTH the cognitive task AND slow walking (>10%) in dual task

(0) Severe: Can't count backward while walking or stops walking while talking

INSTRUCTIONS FOR SHORT-BESTEST

1. ANKLE STRENGTH & RANGE

Examiner Instructions: Ask the patient rest their fingertips in your hands for support while they stand on their toes has high as possible and then stand on their heels. Watch for height of heel and toe lift.

Patient: Rest your fingers in my hands for support while you stand on your toes. Now stand on your heels by lifting up your toes. Maintain each position for 3 sec.

2. VERTICALITY AND LATERAL LEAN

Examiner Instructions: Patient is sitting comfortably on a firm, level, armless surface (bench or chair) with feet flat on floor. It is okay to lift ischium or feet when leaning. Watch to see if the patient returns to vertical smoothly without over or undershooting. Score the worst performance to each side Patient: Cross your arms over your chest. Place feet shoulder width apart. I'll be asking you to close your eyes and lean to one side as far as you can. You'll keep your spine straight, and lean sideways as far as you can without losing your balance OR using your hands. Keeping your eyes closed, return to your starting position when you've leaned as far as you can. It's okay to lift your buttocks and feet. Close your eyes Lean now (REPEAT other side).

3. FUNCTIONAL REACH FORWARD

Examiner Instructions: Examiner places the ruler at the end of the fingertips when the arms are out at 90 degrees. The patient may not lift heels, rotate trunk, or protract scapula excessively. Patient must keep their arms parallel to ruler and may use less involved arm. The recorded measure is the maximum horizontal distance reached by the patient. Record best reach

Patient: Stand normally. Please lift both arms straight in front of you, with fingertips held even. Stretch your fingers and reach forward as far as you can. Don't lift your heels. Don't touch the ruler or the wall. Once you've reached as far forward as you can, please return to a normal standing position. I will ask you to do this two times. Reach as far as you can

4. STAND ON ONE LEG

Examiner Instructions: Allow the patient two attempts and record the best. Record the sec they can hold posture, up to a maximum of 30 sec. Stop timing when subject moves their hand off hips or puts a foot down.

Patient: Look straight ahead. Keep your hands on your hips. Bend one leg behind you. Don't touch your raised leg on your other leg. Stay standing on one leg as long as you can. Look straight ahead. Lift now (REPEAT other side).

5. COMPENSATORY STEPPING CORRECTION-FORWARD

Examiner Instructions: Stand in front to the side of patient with one hand on each shoulder and ask them to push forward (Make sure there is room for them to step forward). Require them to lean until their shoulders and hips are in front of their toes. Suddenly release your support when the subject is in place. The test must elicit a step. Be prepared to catch patient.

Patient: Stand with your feet shoulder width apart, arms at your sides. Lean forward against my hands beyond your forward limits. When I let go, do whatever is necessary, including taking a step, to avoid a fall.

6. SENSORY INTEGRATION FOR BALANCE (MODIFIED CTSIB)

Examiner Instructions: Do the tests in order. Record the time the patient was able to stand in each condition to a maximum of 30 seconds. Repeat condition if not able to stand for 30 s and record both trials (average for category). Use medium density Temper® foam, 4 inches thick. Assist subject in stepping onto foam. Have the subject step off the foam between trials. Include leaning or hip strategy during a trial as "instability."

Patient: For the next 4 assessments, you'll either be standing on this foam or on the normal ground, with your eyes open or closed. Place your hands on your hips. Place your feet together until almost touching. Look straight ahead. Each time, stay as stable as possible until I say stop.

7. WALK WITH HEAD TURNS – HORIZONTAL

Examiner Instructions: Ask the patient to turn their head and hold it so they are looking over their shoulder until you tell them to look over the opposite shoulder every 2-3 steps. If the patient has cervical restrictions allow combined head and trunk movements.

Patient: Begin walking at your normal speed, when I say "right", turn your head and look to the right. When I say "left" turn your head and look to the left. Try to keep yourself walking in a straight line.

8. WALK WITH PIVOT TURNS

Examiner Instructions: Demonstrate a pivot turn. Once the patient is walking at normal peed, say "turn and stop." Count the steps from turn until the subject is stable. Instability is indicated by wide stance width, extra stepping or trunk and arm motion.

Patient: Begin walking at your normal speed. When I tell you to "turn and stop", turn as quickly as you can to face the opposite direction and stop. After the turn, your feet should be close together.

9. STEP OVER OBSTACLE

Examiner Instructions: Place the 2 stacked boxes (9 inch or 22.9 cm height) 10 ft away from where the patient will begin walking. Use a stopwatch to time gait duration to calculate average velocity by dividing the number of seconds into 20 feet. Look for hesitation, short steps and touch on obstacle.

Patient: Begin walking at your normal speed. When you come to the shoe boxes, step over them, not around them and keep walking.

10. TIMED "GET UP & GO" WITH DUAL TASK

Examiner Instructions: Before beginning, practice with the patient how to count backward from a number between 90 and 100 by 3s, to make sure they can do the cognitive task. Then ask them to count backwards from a different number and after a few numbers say GO for the GET UP AND GO TASK. Time the patient from when you say "go" until they return to sitting. Stop timing when the patient's buttocks touch the chair bottom. The chair should be firm with arms to push from if necessary.

Patient: a) Count backwards by 3's starting at 100 OR b) List random numbers and when I say "GO," stand up from the chair, walk at your normal speed across the tape on the floor, turn around, and come back to sit in the chair but continue listing numbers.

ORIGINAL RESEARCH

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Factors Associated with Mortality in Geriatric Patients Presenting to the Emergency Department After Falls

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Abstract

Objective: Few studies have investigated the impact of falls on mortality in older patients presenting to the emergency departments in our country. Thus, this study aimed to investigate the prognostic factors in geriatric patients with falls and identify the variables associated with repeated falls and mortality in the first 2 months after the fall.

Materials and Methods: The study included patients over 65 years of age who presented to the emergency department of our university due to falls between January and December 2019.

Results: A total of 170 patients were included in this study, with a mean age of 77.98±8.23 years (median 78 years, range 65-99 years), and 87 (51.2%) were male. Albumin level of <3.53 mg/dL was associated with an 8.066-fold higher risk of post-fall mortality [95% confidence interval (CI) 1.585-41.062, p=0.012], whereas hemoglobin level of <11.55 g/dL was associated with a 5.488-fold higher risk (95% CI 1.078-27.931, p=0.040).

Conclusion: Among older adults who presented to the emergency department after falls, those with anemia and hypoalbuminemia at the time of admission had higher mortality. These two conditions were found to be independent risk factors for mortality. Thus, priority triage is recommended for these patients.

Keywords: Aging, older adults, falls, geriatrics, mortality

Introduction

Falls are a common geriatric syndrome in the older population. Studies have shown that about 1 in 3 older adults fall at least once every year and that of those who fall, about half fall more than once. Falls can result in serious injury and even death (1). This has been supported by findings from recent studies (2). Although the causes of falls are known to be multifactorial, the literature has shown that most falls are associated with physical fragility and cognitive dysfunction (3). Major risk factors for falls include sarcopenia, polypharmacy, orthostatic hypotension, arrhythmia, cognitive impairment, and cerebrovascular diseases. However, as with other geriatric syndromes, falls in older adults may be an indicator of underlying disease (4).

Approximately 40% of individuals aged 50 years or older present to the emergency department because of falls (5,6). Most of these patients are sent home without being hospitalized (7) but they frequently return to the emergency department with another fall (8). Determining the factors associated with mortality in patients presenting with falls will facilitate triage and improve management of these patients with more efficient use of time.

In the literature, falls have been shown to be associated with hypoalbuminemia (9), anemia (10,11), and electrolyte imbalances such as hyponatremia and hypokalemia (12). In the present study, we aimed to investigate prognostic factors in geriatric patients with falls and identify variables associated with repeated falls and mortality in the first 2 months post fall.

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Materials and Methods

Inclusion criteria: The study included patients over 65 years of age who presented to the emergency department of our university due to falls between January and December 2019.

Exclusion criteria: Patients who were under 65 years of age and presented to the emergency department for complaints other than falls were not included.

Data were collected retrospectively from the hospital information system and patient files. Demographic data (such as age and sex), chronic diseases, medications used, and date of admission to the emergency department were recorded. The patients' chronic diseases were determined from the hospital information system according to International Statistical Classification of Diseases and Related Health Problems codes.

Degree of fall-induced injury was assessed and recorded as none, minor (such as bruises and abrasions not requiring medical intervention), moderate (serious wounds requiring stitches), or severe (head trauma, fractures), and the location of any fractures was noted. Biomarkers such as hemoglobin (g/dL), white blood cells (µL/mL), lymphocytes (mcl), platelets (10^9/L), mean platelet volume (fL), alanine aminotransferase (U/L), aspartate aminotransferase (U/L), alkaline phosphatase (IU/L), gamma glutamyl transferase (U/L), total bilirubin (mg/dL), direct bilirubin (mg/dL), blood urea nitrogen (BUN) (mg/dL), creatinine (mg/dL), total protein (g/dL), albumin (mg/dL), biomarker values, sodium (mEq/L), potassium (K) (mmol/L), chlorine, calcium (mg/dL), phosphorus (mg/dL), magnesium (mg/dL), and glucose (mg/dL) measured upon admission to the emergency department were obtained from the hospital system. Post-fall survival information was obtained from the official death reporting system of the Republic of Turkey Ministry of Health, General Directorate of Public Health using the patients' citizenship numbers.

Statistics

The data were analyzed using a commercial statistical software package. Categorical data were presented as frequency distribution and percentage, continuous variables as mean ± standard deviation or median (minimum-maximum values). For comparisons between groups, chi-square test was used for categorical data and the non-parametric Kruskal-Wallis and Mann-Whitney U tests were used for continuous data due to the non-normal data distributions. Receiver operating characteristic analysis was used to assess the predictive power of the biomarkers by determining the sensitivity and specificity of the identified cut-off points. Youden index (J=sensitivity + specificity - 1) was used to determine optimal cut-off values. Factors significantly associated with survival time were identified using Kaplan-Meier analysis. These factors were then used to generate a Cox regression model (forward: LR, entry: 0.05 and removal: 0.10). P-values <0.05 were considered statistically significant.

The study was conducted after obtaining approval from the Atatürk University Ethics Committee (dated 17/12/2020, ethics committee number 554).

Results

The 170 patients included in the study had a median age of 78.0 (minimum-maximum: 65-99) years and 87 (51.2%) were male. The median follow-up time was 441 (minimum-maximum: 9-651) days. The prevalence of recurrent falls was 6.5% (n=11) in the first month, 12.9% (n=12) within 6 months, and 20.0% (n=34) within 1 year after a fall. We analyzed 60-day mortality after recurrent falls. It was also noted whether the patient was hospitalized after the fall, and if hospitalized, what ward they were admitted to and how they were discharged. Surviving patients lived for between 364 and 651 days after recurrent falls according to follow-up records. Comparisons of the patients' demographic characteristics, comorbidities, and biomarker values between cases with and without mortality within 60 days post fall are presented in Table 1.

Hemoglobin, total protein, and albumin levels were significantly lower and age, BUN, and creatinine values were significantly higher among patients who died within 60 days after the fall when compared with survivors. The post-fall mortality rate was significantly higher among patients with chronic heart failure and patients who had fall-induced fractures or severe injury ($p<0.05$). In terms of fracture location, hip/femur fractures were the most common and associated with significantly more deaths ($p<0.05$).

For biomarkers that differed statistically between cases with and without 60-day post-fall mortality, their predictive power, sensitivity, and specificity according to the determined cut-off values are presented in Table 2. With a cut-off value of 11.55 g/dL, hemoglobin had the highest predictive power for post-fall mortality.

Some of the variables that were significantly associated with survival time are presented in Table 3. A Cox regression model was created to determine the risk factors associated with average survival time after a fall. The last row is presented in Table 4.

Discussion

Falls occur frequently in the older population and lead to reduced functional capacity, hospitalization, and increased health expenditures. In the present study, in oldest-old adults had higher mortality after falls, consistent with the literature (13). This finding may be explained by higher rates of chronic diseases that increase with age, such as osteoporosis, dementia,

Table 1. Demographic characteristics, comorbidities, and presenting biomarker levels in older patients with falls

	60-day post-fall mortality		
	Yes (n=11)	**No (n=159)**	**p**
Age**	85 (73-95)	77 (65-99)	**0.003**
Sex			
Male	6 (54.5%)	81 (50.9%)	**0.817**
Female	5 (45.5%)	78 (49.1%)	-
Comorbidities			
Hypertension	7 (63.6%)	102 (64.2%)	0.973
Diabetes mellitus	2 (18.2%)	48 (30.2%)	0.398
Coronary artery disease	5 (45.5%)	41 (25.8%)	0.156
Chronic heart failure	3 (27.3%)	8 (5.0%)	**0.025**
Depression	2 (18.2%)	23 (14.5%)	0.736
Chronic kidney disease	2 (18.2%)	7 (4.4%)	0.107
COPD	1 (9.1%)	28 (17.6%)	0.409
Cerebrovascular event	3 (27.3%)	15 (9.4%)	0.096
Parkinson's disease	1 (9.1%)	7 (4.4%)	0.478
Alzheimer's disease	-	29 (18.2%)	0.120
Malignancy	1 (9.1%)	8 (5.0%)	0.561
Hyperthyroidism	-	4 (2.5%)	0.594
Hypothyroidism	1 (9.1%)	8 (5.0%)	0.561
Number of diseases**	3 (0-6)	3 (0-7)	0.216
Number of medications used**	5 (0-9)	4 (0-10)	0.245
Polypharmacy	**6 (54.5%)**	**62 (39.0%)**	0.309
Use of antipsychotics	**1 (9.1%)**	**19 (11.9%)**	0.776
Fall-induced injury			
Physical damage	8 (72.7%)	74 (46.5%)	0.093
Minor	-	19 (11.9%)	0.224
Moderately	2 (18.2%)	12 (7.5%)	0.215
Severe physical damage	6 (54.5%)	42 (26.4%)	**0.045**
Fracture	6 (54.5%)	37 (23.3%)	**0.021**
Femur/hip	5 (83.3%)	9 (24.3%)	**0.010**
Costa	1 (16.7%)	9 (24.3%)	0.680
Humerus	-	4 (10.8%)	0.398
Vertebra	-	6 (16.2%)	0.288
Radius	-	4 (10.8%)	0.398
Orbita/maxilla/frontal	-	5 (13.5%)	0.338
Laboratory results**			
Hemoglobin (g/dL)	10.6 (8.9-14)	13.30 (8.5-18.8)	**0.001**
WBC count (µL/mL)	8600 (3040-14860)	8490 (1870-16410)	0.778
Lymphocyte count (mcl)	1290 (300-2470)	1520 (260-4230)	0.214
Platelet count (10^9/L)	228000 (91000-386000)	236000 (48000-789000)	0.262
Glucose (mg/dL)	128 (94-238)	120 (69-443)	0.504
BUN (mg/dL)	35 (21-75)	20.5 (2.1-76.6)	**<0.001**
Creatinine (mg/dL)	1.30 (0.70-2.84)	0.89 (0.40-5.00)	**0.006**

Table 1. Continued

	60-day post-fall mortality		
	Yes (n=11)	No (n=159)	p
Sodium (mEq/L)	137 (131-141)	139 (125-147)	0.059
Potassium (mmol/L)	4.37 (3.30-6.40)	4.00 (2.62-6.01)	0.070
Chloride (mEq/L)	103 (93-110)	103 (102-116)	0.620
Calcium (mg/dL)	8.7 (8.2-10.4)	9.1 (4.5-10.5)	0.112
Phosphorus (mg/dL)	3.3 (2.5-4.9)	3 (1.2-13.9)	0.072
Magnesium (mg/dL)	1.97 (1.18-2.20)	1.90 (1.20-3.00)	0.562
Total protein (g/dL)	6.7 (6.3-7.8)	7.2 (4.4-8.3)	**0.013**
Albumin (mg/dL)	3.4 (3-3.8)	3.8 (2.4-4.65)	**0.001**

*Mann-Whitney U or chi-square test. **Median (minimum-maximum)

Table 2. The predictive power, sensitivity, and specificity of biomarkers for post-fall mortality determined by ROC analysis with Youden index to determine cut-off point

Variable	Cut-off point	AUC (95% CI)	Sensitivity (%)	Specificity (%)	p
Hemoglobin (g/dL)	11.55 g/dL	82.8 (69.6-96.1)	82.4	72.7	**0.001**
BUN (mg/dL)	26.55	81.6 (71.7-91.5)	81.8	72.4	**<0.001**
Creatinine (mg/dL)	0.93	74.8 (61.3-88.2)	81.8	59.6	**0.006**
Total protein (g/dL)	6.95	73.3 (58.2-88.5)	67.6	80.0	**0.014**
Albumin (mg/dL)	3.53	80.3 (70.6-90.0)	78.0	80.0	**0.001**

AUC: Area under the curve, BUN: Blood urea nitrogen, CI: Confidence interval, ROC: Receiver operating characteristic

Table 3. Relationship between selected variables and post-fall survival time (Kaplan-Meier analysis)

	Mean survival days (95% CI)	p
Age >84 years	543.4 (471.5-615.3)	**0.001**
Chronic heart disease	480.9 (320.4-641.3)	**0.003**
Hemoglobin <11.55 g/dL	510.3 (424.9-595.7)	**<0.001**
BUN >26.55 mg/dL	542.6 (478.7-606.4)	**<0.001**
Creatinine >0.93 mg/dL	572.4 (525.0-619.8)	**0.008**
Total protein <6.95 g/dL	561.0 (504.0-618.1)	**0.002**
Albumin <3.53 mg/dL	527.6 (451.6-603.7)	**<0.001**
Fracture	539.5 (477.5-601.5)	**0.019**
Severe physical damage	571.8 (513.3-630.3)	**0.042**

BUN: Blood urea nitrogen, CI: Confidence interval

Table 4. Cox regression model for risk factors associated with survival

	Beta	Hazard ratio	95% CI	p
Creatinine >0.93 mg/dL	1.503	4.494	0.951-21.245	0.058
Hemoglobin <11.55 g/dL	1.703	5.488	1.078-27.931	**0.040**
Albumin <3.53 mg/dL	2.088	8.066	1.585-41.062	**0.012**

CI: Confidence interval

and Parkinson's disease, as well as the presence of geriatric syndromes such as polypharmacy, malnutrition, dementia, reduced mobility, and greater functional dependence. In addition, we observed that the mortality rate was higher among patients who had fall-induced fracture or severe injury, which is expected.

Studies of older people with hip fractures have shown that those with low hemoglobin and albumin levels have higher mortality rates at 1 month and 1 year (14,15). In the present study, hemoglobin level <11.55 g/dL was found to increase the risk of mortality within the first 2 months by 5.488 times. Anemia in older adults can be caused by blood loss, malignancy, decreased iron intake or absorption, chronic inflammation, endocrine and metabolic causes, increased rate of red blood cell destruction, reduced dietary intake, and drug-related side effects (16). Although the causes of anemia were not elucidated in our study, there are similar reports in the literature associating anemia with higher mortality after falls.

Malnutrition is among the risk factors for falls. Studies in the United States and Australia have shown that 12% to 16% of older adults presenting to emergency departments are malnourished (17,18). Although malnutrition screening was not performed in our study, the results demonstrated that albumin level <3.53 mg/dL in older adults with falls increased the risk of mortality by 8.066 times. In the literature, there are studies showing a relationship between serum albumin level and mortality in

studies conducted among the elderly (19). For example, among older adults hip fractures, rates of postoperative complications such as sepsis and mortality were higher in those with albumin levels below 3.5 mg/dL (20). Studies conducted among patients undergoing elective surgery for various reasons have also shown that albumin level is the strongest predictor of mortality (21,22). In patients with sarcopenia and in inflammatory conditions, cytokines such as IL-6 and TNF-α are among the causes of low albumin level (23). However, it was also not determined in these studies whether hypoalbuminemia was due to malnutrition, disease progression, nephrotic syndrome, chronic liver injury, or systemic inflammation. As in these studies, our results showed that the presence of hypoalbuminemia was associated with higher mortality after falls, but the causes of this hypoalbuminemia were not investigated.

Although we did not evaluate glomerular filtration rate or whether the patients received renal replacement therapy, patients with renal dysfunction showed a higher mortality rate in the first 2 months post fall. This is also consistent with the literature (24,25). Falls are an important cause of morbidity and mortality among individuals with chronic kidney disease. These patients are at increased risk of falls due to the presence of muscle, hematologic, endocrine, and metabolic disorders, comorbidities, vitamin D deficiency (26), orthostatic hypotension after hemodialysis, diabetic neuropathy, sarcopenia (27,28), and polypharmacy (29,30).

Studies of older patients with hip fractures have also shown that the presence of pulmonary disease, dementia, chronic lung disease, and malignancy increased mortality (15,31). In the present study, heart failure was associated with higher mortality. This may be because heart failure patients usually use antihypertensive drugs that can cause orthostatic hypotension as a side effect, and the use of anticoagulant and antiaggregant drugs increases the risk of bleeding and severe fall-related injury.

Study Limitations

This study has certain limitations. Firstly, it was conducted retrospectively, in a single center, and with a relatively small patient sample. Geriatric syndromes such as malnutrition, decubitus ulcers, delirium, depression, and dementia that may be associated with post-fall mortality were not investigated. Furthermore, the study did not take into account other prognostic indicators that could have been used, such as the patients' vital signs or the Charlson comorbidity index.

The aging global population makes the issue of falls in older adults increasingly important. As the first analysis of factors associated with mortality in geriatric patients presenting to the emergency department after falls, we believe that this study will make a valuable contribution to the literature and guide future studies on this subject.

Conclusion

Among older adults who presented to the emergency department after falls, mortality was higher among those with anemia and hypoalbuminemia at the time of admission, and these two conditions were found to be independent risk factors for mortality. Priority triage is recommended for these patients.

Ethics

Ethics Committee Approval: The study was conducted after obtaining approval from the Atatürk University Ethics Committee (dated 17/12/2020, ethics committee number 554).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: P.T.T., Concept: P.T.T., T.B.U., C.S., Design: P.T.T., E.U.K., C.S., Data Collection or Processing: Ö.K., E.U.K., B.N.S., S.T.A.G., Analysis or Interpretation: P.T.T., Ö.K., S.T.A.G., Writing: P.T.T., Ö.K., C.S.

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ORIGINAL RESEARCH

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The Correlation Between Total Protein Level in 24-hour Urine Sample and Spot Urine Protein-to-creatinine Ratio in the Old Aged

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Abstract

Objective: This study aimed to determine the correlation between the total protein level in the 24-hour urine sample and the protein-to-creatinine ratio in spot urine to measure protein excretion in elderly patients and determine the reliability of protein-to-creatinine ratio in spot urine threshold for proteinuria.

Materials and Methods: A total of 50 patients, aged ≥65 years, wıth a spot urıne protein value of ≥15 mg/dL using urine dipstick and without the risk factors for transient proteinuria were included in the study. Daily protein excretion was determined by two different methods-protein-to-creatinine ratio in spot urine and total protein level in the 24-hour urine sample. The correlation between these two methods was evaluated.

Results: A strong positive correlation was found between the total protein level in 24-hour urine samples and the protein-to-creatinine ratio in spot urine ($r=0.879$, $p<0.005$). The sensitivity and specificity of the protein-to-creatinine ratio in spot urine increase as the proteinuria level increases to ≥3.5 g/day.

Conclusion: The protein-to-creatinine ratio in spot urine is a highly sensitive and specific test with a high agreement using the gold-standard method for proteinuria diagnosis and follow-up in elderly patients with chronic diseases. This will help clinicians to decide for elderly patients, especially when they are frail, with restricted mobility, incontinence, or difficulty in transferring due to medical, social, or economic reasons.

Keywords: 24-hour urine, clinical geriatrics, protein/creatinine ratio, proteinuria, spot urine

Introduction

Proteinuria is an independent risk factor for cardiovascular and renal diseases and is an indicator of target organ damage. It is the most common clinical finding of underlying renal disease. In addition to being an early sign of renal disease, it is also a guide for differential diagnosis, determining prognosis and following treatment (1). The gold-standard method used to determine daily protein excretion in urine is the total protein level in 24-hour urine sample (24-HUP) (2,3). The collection of 24-HUP is a time-consuming method highly dependent on patient cooperation, frequently interfering with the health quality of the patient.

Besides, geriatric syndromes, including cognitive disorders, restricted mobility, incontinence and increased frequency of chronic diseases, both interfere with convenience, sensitivity and specificity of 24-HUP results and make sample collection more cumbersome for the old aged. Furthermore, it may also increase hospital admission rates since the patient has to come at least once more to the clinics for leaving samples.

Protein-to-creatinine ratio in spot urine (PCR-SU) from an untimed specimen is the alternative method for proteinuria measurement (4). Since cheaper, more convenient and less time-consuming, PCR-SU is frequently used for the quantitative evaluation of proteinuria in practice (3,5,6).

Although there are studies that demonstrate a moderate-to-high correlation between 24-HUP and PCR-SU, this association is less evaluated in the old aged (7-9). This study aimed to determine whether there is a correlation between 24-HUP and PCR-SU for

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measuring protein excretion in old aged patients and determining the reliable PCR-SU threshold value for proteinuria.

Materials and Methods

All patients hospitalized between August 2015 and April 2016 in the Geriatrics Clinic of Ankara University Hospital were examined for inclusion into this study. All included patients were ≥65 years of age. Patients with urine pH >8, gross hematuria, presence of semen/leukocyte in the urine and history of iodinated contrast agent exposure in the last 24 hours were excluded since these may result in a false-positivity of proteinuria in the urine dipstick examination. Patients with urinary incontinence were also excluded since they would be unable to make a proper unine collection. Seventy-three in-patients were enrolled, of whom 23 were excluded [17 due to inadequate collection (missing some urine, pouring out, the wrong container), six due to over-collection]. Totally, 50 patients (27 males and 23 females) with proteinuria were included in the study. Daily urinary protein excretion was determined by two different methods: PCR-SU and 24-HUP. 24-HUPs were collected, excluding the first urine of the day and including the first-morning urine sample of the next day. Spot urine samples were taken as the first urine in the morning. The samples were collected during two consecutive days.

Total protein concentration levels were measured by a turbidometric assay using benzethonium chloride and creatinine level by Jaffe test in the Ankara University biochemistry laboratory. Serum creatinine levels were measured spectrophotometrically. The patients were categorized into three groups according to the glomerular filtration rate (GFR) levels: GFR <30 mL/min/1.73 m^2, GFR between 30-60 mL/min/1.73 m^2 and GFR >60 mL/min/1.73 m^2 per the National Institute for Health and Care guidelines. The modification of diet in renal disease Formula was used for GFR calculations.

Excellence

All tests for this study were performed in the Ankara University Biochemical Laboratory, a standardized laboratory inspected regularly by the ministry of health of Turkey.

Ethic

The protocol of this study was approved by the Ankara University Faculty of Medicine Medical Research Ethics Committee as dated 28.4.2014 and numbered 07-292-16. The study conforms to the provisions of the World Medical Association's Declaration of Helsinki. All of the patients signed the informed consent forms.

Statistics

All analyses were performed in Windows XP using SPSS version 22.0 (IBM Co., New York, USA). The Pearson correlation test was used to determine the relationship between the PCR-SU and the protein levels in 24-hour urine sample. P<0.05 was considered statistically significant. Differential thresholds, sensitivity and specificity of protein-to-creatinine ratio levels in spot urine were calculated using the receiver operator curves (ROC) curve for thresholds of ≥0.3, ≥0.5, ≥1 and ≥3.5 g/day proteinuria in 24-HUP, corresponding to the upper and lower limits of 1+ ,2+, 3+ proteinuria in dipstick analysis and nephrotic range proteinuria, respectively. The limits of agreement between the two parameters were analysed by the Bland-Altman Plot, using the Med Calc statistical software version 7.6.0. This method depicts the mean difference and 95% confidence interval of the difference and limits agreement as mean difference ±1.96 standard deviation.

Results

The mean age of the study group was 74.9 (±6.795) (minimum 65, maximum 91) years. Hypertension (HT) was detected in 92% (n=46), chronic kidney disease (CKD) in 70% (n=35), diabetes mellitus (DM) in 58% (n=29) and coronary arterial disease (CAD) in 46% (n=23) of the patients. The mean serum creatinine level was 1.31 g/dL (0.60-5.18), and the GFR was 42.50 mL/min/1.73 m^2 (minimum 8, maximum 103) (Table 1).

A strong and positive correlation was found between 24-HUP and PCR-SU (r=0.879, p<0.005) (Figure 1). Although, there was a significant correlation between the two methods in all three groups, GFR <30 mL/min/1.73 m^2 had the strongest correlation (r=0.937, p<0.005). Correlation values decreased as GFR increased (GFR between 30-60 mL/min/1.73 m^2: r=0.801, p<0.005 and GFR >60 mL/min/1.73 m^2: r=0.635, p<0.005). The ROC analyses, detected PCR-US discriminant values of 0.545, 0.465, 0.812, 3.683 mg/mg as indicators of ≥0.3, ≥0.5, ≥1.0 and

Table 1. Clinical and laboratory findings of the study population

Variable	
Male/female, percentage (number)	54/46% (27/23)
Age, years (mean ± standard deviation)	74.9±6.7
Hypertension, percentage (number)	92% (46)
Diabetes mellitus, percentage (number)	58% (29)
Coronary arterial disease, percentage (number)	46% (23)
Chronic renal disease, percentage (number)	70% (35)
Serum creatinine (gr/dL) (mean, min-max)	1.31 (0.60-5.18)
Glomerulary filtration rate (MDRD) (mL/min/1.73 m^2) (mean, min-max)	42.50 (8-103)
24-hour urine protein mg/day (mean, min-max)	388 (50-6.655)
Spot urine protein/creatinine ratio (mean, min-max)	0.545 (0.77-10.080)

MDRD: Modification of diet in renal disease

≥3.5 g/day of proteinuria in 24-HUP, respectively (Table 2). When the proteinuria level increased to ≥3.5 g/day, the sensitivity, specificity and discriminant values of PCR-SU also increased.

Discussion

This study detected a strong correlation between PCR-SU and 24-HUP in old aged patients with underlying HT, DM, CKD and CAD.

The world population is ageing. According to the World Health Organisation, first time in history, most people are expected to live over their sixties. Therefore, any medical laboratory test should be evaluated for coherence to use in the old aged. HT and DM are the most common chronic diseases in elderlies, and the main complication of these two diseases are kidney damage (10,11). Furthermore, CKD and CAD incidence is increasing in this age group (12). So, it is evident that any test should be quick, cheap and reliable. In this regard, proteinuria detection in a urine sample is essential since both elderlies and disease burden with renal complications also increase. In our study, we demonstrated that proteinuria detection in spot urine is a reliable, sensitive and specific method. We found 80-85% sensitivity levels and 81-100% specificity levels of proteinuria detection with PCR-SU in elderlies. Our results are compatible with studies conducted on younger-aged populations (3,6). Studies analysing the correlation between 24-HUP and PCR SU are frequently disease-specific and have younger populations (3,4,13).

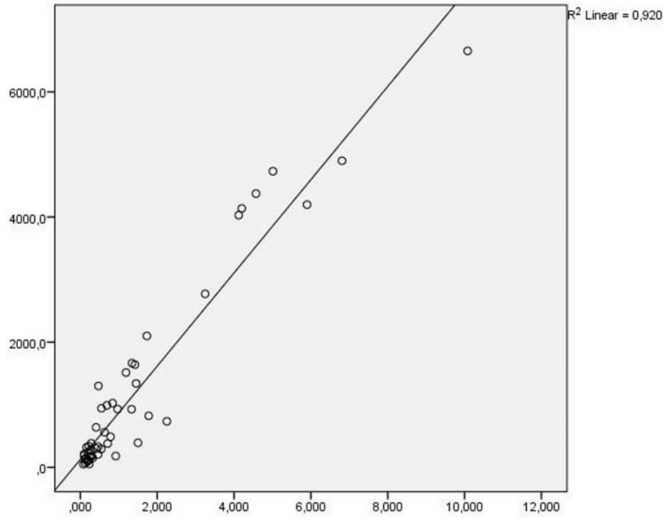

Figure 1. Correlation between spot urine protein-to-creatinine ratio and total protein level in 24-hour urine sample of the elderlies

According to our results, PCR-US is a convenient method for screening, diagnosis and follow-up of proteinuria in the elderlies. This correlation seems to be true for specific diseases and most common chronic conditions with renal complications in this age group.

The National Kidney Foundation/Kidney Disease Outcomes Quality Initiative Guidelines support the use of PCR-SU (preferably in the first morning urine or in the spot urine sample at any hour if there is no first morning urine sample) to detect and monitor proteinuria (14). In our study, we collected our specimens as the first urine in the morning. Since our patients were hospitalised, we could also observe the patients' specimen collection appropriateness. This may be among the reasons of our higher specificity and sensitivity levels. Other studies are conducted mostly on outpatients (3,6,15,16).

Various studies reported that 10-20% of the patients who collect 24-hour urine cannot follow the procedures of urine collection (16,17). Due to cognitive losses, physical barriers and social problems in elderlies, it is more challenging to perform the examination correctly. Improper sample collection rates are, therefore, estimated to be much higher in the old aged. Not surprisingly, in our study, we detected that 31% of the patients collected their urine samples inappropriately. Although our rates are slightly higher than reported in the literature, this may be because our patients were older, had geriatric syndromes impeding proper collection, and all were in-patients with acute problems. We also excluded patients with urinary incontinence, which has up to 30% prevalence and is among the main problems in collecting 24-hour urine

Table 2. Disriminant protein- to-creatinine levels that predict threshold levels for proteinuria at 0.3, 0.5, 1.0 and 3.5 g/day

24-h urine total protein Threshold (g/day)	Discriminant values of spot urine PCR (mg/mg)	Sensitivity (95% CI)	Specificity (95% CI)	Area under the ROC curve (95% CI)
≥0.3	0.545	80.0 (62.69-90.49)	95.0 (76.39-99.11)	0.927 (0.856-0.998)
≥0.5	0.465	95.6 (79.01-99.23)	81.4 (63.30-91.82)	0.948 (0.892-1.0)
≥1.0	0.812	93.3 (70.18-98.81)	82.8 (67.32-91.90)	0.937 (0.873-1.0)
≥3.5	3.683	87.5 (52.91-97.76)	100.0 (91.80-100.00)	1.0 (1.0-1.0)

CI: Confidence interval, PCR: Polymerase chain reaction, ROC: Receiver operator curves

in this age group. Therefore, we estimate that inappropriate specimen collection might be more frequent among the geriatric age group. From this point of view, we believe that proteinuria detection by PCR-SU in the old aged has more significant importance when compared with younger groups as 24-hour urine collection has higher rates of inappropriateness in the old aged.

Price et al. (18) in their review of 16 articles comparing 24-HUP and PCR-SU for detection of proteinuria recorded that PCR-SU has a 69-96 % sensitivity and a 41-98% specificity for the detection of proteinuria of ≥300 mg/day. In this review, it was stated that evaluating proteinuria by the PCR-SU method may rule out the presence of significant proteinuria (18). In our study, by using the ROC curve and taking 24-HUP as the gold- standard method for proteinuria detection, we calculated the discriminant values of PCR-SU as 0.545 mg/mg, 0.465 mg/mg, 0.812 mg/mg and 3.683 mg/mg for ≥0.3, ≥0.5, ≥1.0, and ≥3.5 g/day proteinuria in 24-HUP with 80%, 95%, 93% and 87% sensitivity, and 95%, 81%, 82% and 100% specificity levels, all respectively. According to our results, we can say that PCR-SU has a high correlation and agreement with 24-HUP in old aged patients with different chronical diseases. Besides, when the patients were grouped according to GFR levels, there was a significant correlation between both methods in all groups, but GFR levels of <30 mL/min/m^2 was detected to have the highest correlation. In clinical practice, this will help clinicians since follow-up frequency increases as CKD progresses and more specific results are essential for clinical decision making of patients with advanced clinical diseases.

In summary, the main aim of geriatrics is comprehensive assessment of patients in a single centre with a multidisciplinary approach (19). Diminishing application rates to the hospital is among the aims of geriatric approach, especially for patients with transfer and mobilization difficulties. This study detected that PCR-SU is a highly sensitive and specific method with a high agreement with the gold-standard method. Since HT prevalence is up to 50-75%, and DM prevalence is up to 30% in the elderlies, at least three out of four patients admitting to geriatrics clinics will be analysed for proteinuria, which is among complications of these and many other chronic diseases (10,20,21). Using PCR-SU instead of 24-HUP will decrease caregiver burden, patient burden as well as healthcare utilisation and health personnel burden. This is essential in the old-aged group, especially in those with limited mobility and transfer options, both economically, medically and socially. According to our results, we consider that PCR-SU can be used for proteinuria detection in old aged patients with chronic diseases affecting renal function, both for diagnosis and follow-up reliably. Malnutrition is a common geriatric syndrome, and proteinuria may alert clinicians for the planning of nutrition (22).

Study Limitations

This study has some limitations and strengths. First, our sample size was limited. Thus, specific analyses for patients with different chronic diseases could not be performed. On the other side, to our knowledge this is the only study conducted in the old aged. Second, since our study population were in-patients, we can not generalise our findings for all patients. However, we were able to monitor the in-patients for appropriateness of sample collections. Futhermore, the same physician followed up the specimens collection process.

Conclusion

PCR-SU is a highly sensitive and specific test with a high agreement with the gold-standard method for proteinuria diagnosis and follow-up in old aged patients with chronical diseases. This will help clinicians for clinical decision making in old aged patients, especially when they are frail, have restricted mobility or have difficulty in transfer secondary to medical, social or economic reasons.

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Ethics

Ethics Committee Approval: The protocol of this study was approved by the Ankara University Faculty of Medicine Medical Research Ethics Committee as dated 28.4.2014 and numbered 07-292-16. The study conforms to the provisions of the World Medical Association's Declaration of Helsinki.

Informed Consent: All of the patients signed the informed consent forms.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Ö.K.C., V.A., Concept: Ö.K.C., V.A., Design: Ö.K.C., V.A., Data Collection or Processing: Ö.K.C., V.A., Analysis or Interpretation: Ö.K.C., V.A., Literature Search: Ö.K.C., V.A., Writing: Ö.K.C., V.A.

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