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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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2020
Volume 2

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EJGG

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European Journal of Geriatrics and Gerontology is the official publication of Academic Association of Geriatrics. The publication language of the journal is English.

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

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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

Objective: The abstract should state the objective (the purpose of the study and hypothesis) and summarize the rationale for the study.

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European Journal of Geriatrics and Gerontology

2020
Volume 2

Academic Geriatrics Society

EJGG

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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.

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Examples of References:

1. List All Authors

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.

European Journal of Geriatrics and Gerontology

2020
Volume 2

Academic Geriatrics Society

EJGG

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Introduction: A brief introduction (recommended length: 1-2 paragraphs).

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.

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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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Each author should have participated sufficiently in the work to assume public responsibility for the content. Any portion of a manuscript that is critical to its main conclusions must be the responsibility of at least 1 author.

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Acknowledgments

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European Journal of Geriatrics and Gerontology

2020
Volume 2

Academic Geriatrics Society

EJGG

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2020
Volume 2

Academic Geriatrics Society

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EJGG
European Journal of Geriatrics and Gerontology
Academic Geriatrics Society
2020
Volume 2

CONTENTS

REVIEW

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Importance of Dried Fruits and Vegetables in the Older Adults

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Abstract

Several studies have shown that dietary factors play a role in the development and course of chronic diseases. In modern societies, we now observe a transition from a diet mainly comprising fruits and vegetables that are rich in fibres, micronutrients and antioxidants by way of which we have survived due to the adaptation mechanisms we have developed for centuries to a diet that is high in calories but poor in fibres and vitamins. Finding rational solutions to the problem of expanding elderly population would only be possible with a holistic and proactive approach. In this review, we aimed to investigate the positive effect of the long-term use of dried fruits and vegetables, which are as old as the history of mankind, on various pathologic processes that occur as a result of ageing in conjunction with the available studies.

Keywords: Aged, vegetables, fruit, diet, vitamins, micronutrient

Introduction

Communities all over the world are now analysing the problems of the expanding elderly population to find solutions, while the importance of preventive healthcare services comes up repeatedly. It has become more difficult to finance the healthcare system due to reasons such as the need for conducting follow-up and providing treatment for diseases after they occur and the loss of active workforce. Malnutrition is a common Geriatric syndrome in the elderly and it is caused by eating an insufficient and imbalanced diet; it might have various other aetiologies as well. The prevalence of malnutrition may be up to 50% among the elderly (1). Health problems become inevitable because older people become more vulnerable to malnutrition and we cannot develop accurate and effective eating strategies or be aware and predict the problems that might occur. During this critical period of human life, geriatric syndromes such as sarcopenia, falls and frailty increase in prevalence in the presence of decreasing physiological and functional reserves (2,3). Moreover, malnutrition leads to a decline in mental and physical functions, there by rendering older adults unable to pursue their lives independently, causing an increased need for nursing homes and caregivers (4). The majority of older people who need care survive with the assistance of their relatives in many countries. Efforts to be taken by patients' relatives and healthcare professionals would make it possible to identify older adults who are at risk of malnutrition and to provide rational advice. This review aims to underline the importance of dried fruits and vegetables in dietary models that would contribute to the health of the elderly and reduce the increasing socioeconomic burden of the elderly population.

History of Dried Fruits and Vegetables

Food begins to decay right after it is harvested. Therefore, our ancestors had to find a way to store and use food in the long term to survive (5,6). The storage and preservation of food dates back to 12.000 B.C. and sun-drying is one of the most frequently used methods during the prehistoric times (7). In late 1700s, Napoleon offered 12.000 French francs to anyone who could find a method to preserve food during transportation to feed his army during war (8). The Ottoman Sultan Selim I crossed

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the Sinai desert during a military campaign to Ridaniye and it is known that there was Kahramanmaraş tarhana, which is made by mixing and drying yoghurt, wheat and spices, in the supply convoy of his army (9). Moreover, the French inventors Masson and Chollet used vegetables that were dried by heating to 105 degrees Fahrenheit and used as long-lasting and light-weight food for the soldiers during World War II (10). Dried vegetables and fruits are still important and commonly used in daily life in the third world countries. Indeed, developed countries are faced with increasing incidence of malnutrition because people tend to eat cheap food that is low in nutritional value due to the high cost of living (11).

Drying and Storage Methods

Drying is one of the oldest food preservation methods. Fruits, meat, grains and vegetables have been dehydrated for long-term storage by methods such as sun-drying, wind-drying and smoking throughout history (12). These methods are fundamentally based on the removal of water by hot air passing through the food, which inhibits the activity of enzymes and bacteria in food. Our ancestors learnt to store meat by freezing in regions with very a cold climate and to store food by sun-drying in regions with hot, tropical climates. Eventually, they managed to establish a civilisation by settling in a region and abandoning nomadic life because they started to preserve and store food during the early times of humankind. The history of dried fruits and vegetables dates back to 12.000 B.C. and evidence shows that dried foods were actively used in the Middle East and in the oriental culture (13). In 1900s, people started to dry food using dehydrators in regions where the sun and wind were insufficient (13). The purpose of drying fruits and vegetables is to prolong storage, reduce the need for packaging and decrease the weight during transportation. Fibres, minerals and vitamins are among the important essential elements found in fruits and vegetables. They spoil easily when humidity is >80%.

Drying is the best way to maintain nutritional value at the optimal level. Throughout the world, nearly 20% of the produce is dried after harvest to prolong the shelf life and to enhance the long-term safety of the produce (14). Dried fruits and vegetables or foods that have a low level of water activity were previously thought to be microbiologically safe. However, it was later observed that such foods caused outbreaks of food poisoning because they provided a suitable environment for some pathogens. Dried foods are safe against microbial damage. It is difficult for microorganisms to reproduce below a critical water activity score, but this does not mean that the products are sterile (15). Existing bacteria can reproduce during rehydration. On the other hand, the microflora changes depending on the properties of the food, pH, composition, drying method, contaminating organism and pre-treatment. Moreover, the addition of salt remarkably reduces the microbial load (16). Later, with advancements in technology, new methods such as irradiation, high-pressure processing and pulsed electric field were found that enabled us to consume dried fruits and vegetables with the least harm and maximum benefit (14).

Benefits of Dried Fruits and Vegetables in the Elderly

1. Increased Need for Micronutrients

Ageing occurs with decreased appetite and disrupted tendency to eat due to decreased basal metabolic rate, which in turn leads to an increased need for micronutrients (17). Chronic diseases that increase with ageing result in increased need for micronutrients. Furthermore, the presence of concomitant Malabsorption syndromes disrupts micronutrient absorption as well as the utilisation processes. In addition, increased use of some medications that are frequently used in the elderly such as acid suppressants may lead to micronutrient deficiencies (18-20). Moreover, increased incidence of conditions that negatively affect the intestinal microflora such as the use of certain medications and frequent hospitalisation, recurring infections, changes in the intestinal morphology and physiology, decreased intestinal functions, weakened immune system, lower mobility and changing lifestyle and eating habits due to ageing also increase micronutrient deficiencies (21-25). Because of poor hygiene, parasitic diseases are more common in the elderly, leading to nutritional deficiencies (26,27).

A study that investigated dietary microelements intakes status in the elderly people from different areas in Zhejiang Province in 2010-2012 reported an increase in the need for microelements that further reached significant levels, especially in certain regions (28). Insufficient micronutrient intake in the elderly causes health problems, possibly leading to loss of labour and increased healthcare expenses. The increased need for micronutrients in the elderly can be met to some extent by the regular intake of dried fruits and vegetables (29). Dried fruits and vegetables are not rich in salt and vitamin B12; however, they are rich in vitamin C, vitamin D, vitamin E, thiamine, niacin, riboflavin and folate. In addition, they also contain high amounts of calcium, phosphorus, magnesium, iron, zinc and potassium. Dried tomatoes can preserve their vitamin C content at the highest possible level and can meet most of the daily vitamin C requirement (30-32). Another study showed that the consumption of frozen fruits and vegetables led to higher potassium, calcium, fibre and vitamin D intakes and lower sodium intake, wherein those who consumed frozen fruits and vegetables also had increased consumption of other forms of food such as fresh, canned or dried food (33). Furthermore, such high consumption of fruits and vegetables led to considerable reductions in the body mass indices of these individuals (33).

2. Decreased Consumption of Fibre

In addition to the above mentioned features, dried fruits and vegetables contain a high amount of fibre, which makes them more important for health (34,35). Like in other age groups, the dietary intake of fibre remains below the desired level in a majority of older adults (36). The Institute of Medicine recommends a daily intake of dietary fibre of up to 38 mg depending on age and gender (37). Increased fibre intake may lead to low blood pressure, low lipid levels and decreased fasting blood glucose and HbA1C levels and increased insulin sensitivity, there by resulting in a low incidence of diseases such as Diabetes Mellitus, hyperlipidaemia and cardiovascular diseases that have increased global health burden and cause considerable mortality and morbidity (38,39). According to the nurses' health study, there was a significant relationship between increased dietary fibre intake and decreased incidence of faecal incontinence among 60.000 older women (40). Another prospective cohort study that lasted for 13.1 years and included 1982 patient groups showed a statistically significant negative correlation between high dietary fibre intake and chronic obstructive pulmonary disease in ex-smokers and current smokers (41). Moreover, increased fibre intake was found to be associated with decreased incidence of ovarian cancer, premenopausal breast cancer, oesophageal cancer and colorectal cancer (42-45). Adding dried fruits and vegetables to the diet plan would make it easier to reach the target level of fibre intake in the elderly.

3. Increased Burden of Oxidants in the Elderly

Decreased intake of foods that contain antioxidants such as vitamin C, vitamin E and selenium and increased incidence of chronic diseases in the elderly lead to a high burden of oxidants in the body, which in turn may result in the development of new pathological conditions or negatively affect the course of existing diseases (46,47). The inadequacy of antioxidant mechanisms against the increased oxidant burden in the elderly points out the importance of foods that contain antioxidant components (48).

The oxidant burden that increases with age plays a role in the aetiology of various chronic diseases such as cancer, cardiovascular diseases, cataract, age-related macular degeneration and ageing; the oxidation of proteins and nucleic acids is believed to have a potential role in this increase (49). In western populations, the majority of deaths are caused by atherosclerosis, whereas potent antioxidants such as beta carotene, vitamin E, vitamin C, polyphenol and lycopene are considered to prevent atherogenesis (50-52). Thus, ageing populations can be recommended to consume dried fruits and vegetables because they contain a considerable amount of antioxidants. Thereby, it is possible to enhance the quality of life, decrease the incidence of diseases and reduce disease severity in the elderly.

4. Oral and Dental Health Problems

Concerning nutrient intake, decrease in the amount and diversity of consumed food has a negative effect on the oral and dental health (52,53). The deterioration of oral and dental health in the elderly constitutes a risk for malnutrition and causes the development of various Geriatric syndromes such as frailty, sarcopenia and falls or negatively affects the course of these diseases (54,55). Dried fruits and vegetables are associated with more positive outcomes in terms of dental health, suggesting that such food should be included in the diet plans for older adults (56). Such effects of dried fruits and vegetables can probably be attributed to the fact that they require more chewing because they are rich in fibre, leading to high production of saliva and they contain substances with antimicrobial properties such as sorbitol (56,57). In a study conducted in Korean adults, vitamin C intake was found to have a negative correlation with periodontitis (58). However, another study conducted in postmenopausal women in Buffalo reported no relationship between vitamin D and periodontal disease (59). Furthermore, another study reported a significant negative correlation among predicted vitamin D levels, tooth loss and periodontitis (60). Antonoglou et al. (61) showed a significant correlation between low doses of vitamin D and chronic periodontitis. Another systematic review suggests that antioxidant micronutrients that are rich in vitamin A (carotenoids and beta carotene), vitamin C, vitamin E, glutathione and melatonin could reduce reactive oxygen species-mediated periodontal tissue inflammation (62).

5. Snacking Habit

It is possible to win the battle against chronic diseases and malnutrition, which are commonly encountered in the elderly, because of the properties of dried foods such as their antioxidant effects, high content of micronutrients and fibre and the ability to store and use them in the long term. Snacking is a common eating habit that is observed in up to 85% older adults. Moreover, daily calorie intake decreases with age and this requires the use of suitable foods for snacking in the elderly (63). For instance, a systematic review showed that the prevention and even reversal of Frailty syndrome are associated with quantitative (energy intake) and qualitative (nutrient quality) factors (64). It is possible to improve the eating habits such as snacking or mini-meals by preferring dried fruits and vegetables. In addition, this can be beneficial in reducing the risk and managing metabolic disorders such as Diabetes Mellitus and obesity. A study found that the frequency of daytime eating increased and the mean frequency of daytime eating was six (65). This underlines the advantages of consuming dried fruits and vegetables as daytime snacks in the elderly. Therefore, the addition of such food to the diet plan of older adults in nursing homes and in caregiver trainings would help in developing healthy eating habits.

6. Recommended Oral Exercises for the Elderly

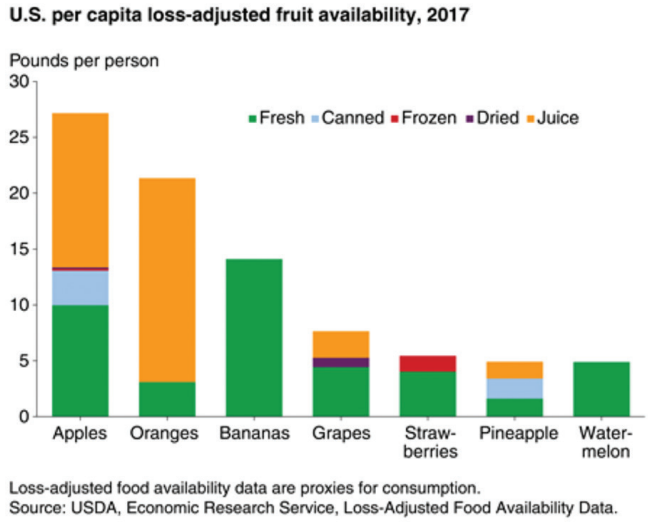
Neurodegenerative diseases, cerebrovascular events and other chronic diseases that occur due to ageing may prevent the maintenance of oral functions such as swallowing, salivation and chewing (66). During this period of life, when we are the most fragile, it is important to prevent or correct the impairment of oral functions to effectively consume foods in sufficient amounts. Simple oral exercises were shown to have positive effects on chewing, salivation and swallowing functions (67). Oral exercise programmes led to improved oral functions and higher quality of life (68,69). Salivation can be increased and the development of functional muscles involved in swallowing can be improved by consuming foods that are rich in fibre such as dried fruits and vegetables as well as by chewing them more. This can possibly contribute to regain the lost functions and to reduce the risk of malnutrition, similar to the simple oral exercises in older patients. Using dried fruits and vegetables is suggested to improve oral functions such as swallowing and chewing that can partly increase the chances of surviving life-threatening conditions such as pulmonary aspiration and malnutrition in the elderly, similar to the exercise programmes mentioned in previous studies.

7. Economic Vulnerability in the Elderly

Consuming fruits and vegetables that can be bought at reasonable prices in their respective season and then dried, particularly in the winter, can be recommended as an alternative solution to the economic vulnerability among the elderly. Many older adults have financial problems when they retire, which negatively affects their eating habits (70,71). Fresh fruits and vegetables or most of the foods that we consume daily are wasted because we cannot store them for long. The wastage of dried fruits and vegetables is lower than that of fresh fruits and vegetables because they can be stored and have a longer shelf life. In addition to the sharp increase in the off-season food prices, the fact that these products cannot be dried because of local individual's unawareness or lack of effective organisations causes considerable labour and financial losses in tropical countries such as India. Graphic I shows that the proportion of dried food consumption (72).

8. Physical Limitations of the Elderly

Older adults have an increased need for foods that do not spoil and can be stored for a long time, especially when they have to live alone. Dried foods and vegetables that can be stored at home for long become more important because of the psychological and physical limitations of older adults such as their inability to do gardening or to frequently visit a store or shopping mall (73,74). Making 'finger foods', which can be consumed by older adults who cannot hold a fork and spoon, available to the elderly at all times may partially prevent the development



Graphic I. Unites States per capita loss-adjusted fruit availability, United States Department of Agriculture Economic Research Service, 2017. This shows that awareness studies should be conducted to increase the consumption of dried foods

of malnutrition. The 2019 ESPEN guidelines underline the importance of the consumption of finger foods by older adults who cannot hold a fork and spoon (75,76). Thus, dried foods can be suggested as an alternative to prevent malnutrition and increase the tendency to eat as well as to ensure adherence to the diet in the elderly.

9. Effects on the Microbiota

Diet plays a key role in shaping the microbiome and a negatively affected intestinal microbiome is associated with chronic diseases such as cancer, inflammatory bowel disease, cardiovascular diseases, type 2 Diabetes Mellitus and obesity (77). Phytochemicals and fibres present in dried fruits affect the composition and activity of the intestinal microbiota (78). The bioactive components of dried fruits, i.e. polyphenols, are prebiotics and they render non-pathogenic microbiota dominant (79). In a study comparing diets that are rich in fruits and vegetables such as the Mediterranean diet and the modern low-fibre diets that are rich in fats and high in calories, it was found that the microbiome-related metabolomic profile improved in the group that received the Mediterranean diet (80).

10. Cardiovascular Benefits

The third most common risk factor for non-communicable diseases after hypertension and smoking is the low consumption of fruits and vegetables. The consumption of low fruits causes a higher risk of non-communicable diseases than the consumption of other foods such as vegetables, whole wheat products, fish, legumes etc (81). Cardiovascular disease is a global health problem and various studies have shown the importance of fresh as well as dried fruits and vegetables in protection against cardiovascular diseases (82,83). The positive effects of these food on the

cardiovascular system are thought to stem from their effects concerning the protection of the vascular endothelial function, regulation of the lipid metabolism and blood pressure, inhibition of platelet functions, reduction in ischaemic reperfusion injury, suppression of thrombosis and reduction in oxidative stress and inflammation (84). Phytonutrients comprising polyphenols have many health benefits because they have antioxidative effects, lead to vasodilatation and prevent postprandial glucose peaks etc (85). The cardiometabolic effects of phytonutrients (tocopherols, carotenoids, polyphenols and phenolic acids) are improved due to their antioxidant properties, because they reduce blood pressure via vasodilatation (polyphenols cause relaxation of venous smooth muscles) and have low sodium and high potassium contents (86). In a prospective study conducted in 34.489 postmenopausal women, it was shown that foods rich in flavonoids reduced the incidence of cardiovascular disease and all causes of cardiovascular deaths (87).

11. Improvement in Cognitive Functions

Age-related decline in cognitive functions and the risk of neurodegenerative diseases can be reduced by the intake of antioxidant and anti-inflammatory components present in high amounts in fruits and vegetables (88). According to a prospective study that investigated flavonoids and decline in cognitive functions in 1.640 geriatric subjects who were not diagnosed with dementia, high intake of flavonoids led to a better cognitive performance (89). A diet that is rich in flavonoids results in improved cognitive functions, delayed onset of Alzheimer's and decreased incidence of Parkinson's disease. The positive effects of flavonoids on memory and neurocognitive performance are believed to stem from their protective effect on fragile neurons as well as their improving effect on the existing neuronal functions and neuronal regeneration (90). The Kame Project cohort study underlined that the oxidative damage caused by beta-amyloid peptides in Alzheimer's disease could be partly reduced by the consumption of fruits and vegetables (91). Endogenous neurotoxins play a role in the aetiology of Parkinson's disease and polyphenols reduce neuronal damage in such patients (92). This study and other similar studies question the role of consuming dried fruits and vegetables due to the fact that there is no potent and effective treatment option for neurodegenerative diseases such as dementia, Alzheimer's and Parkinson's, which are public health problems; the long-term use of dried fruits and vegetables during the pre-geriatric period might potentially reduce the workload of the society and healthcare facilities and have a positive effect on the onset and course of chronic diseases.

12. Increased Acid Load in the Elderly

Buffer systems such as the kidneys and lungs that provide the acid-base balance become insufficient due to age-related decline in physiological functions and reserves as well as the increased incidence of chronic pathologies during the ageing process (93,94). The preservation of lean body mass is of great importance in terms of the development of chronic diseases and related comorbidities in the geriatric population (95). An alkaline diet preserves lean body mass (96). Our ancestors predominantly adopted vegan eating habits; therefore their systemic pH was rather alkaline. However, we now consume high amounts of animal proteins, which negatively affect the acid load that has already increased in the elderly (97). Micronutrient deficiencies that increase with ageing become more severe due to the increased acid load and homeostatic mechanisms also start to fail, e.g. urinary excretion of calcium increases, bone mineral density decreases, urolithiasis develops and renal failure becomes more severe (98,99). Thus, the acid load in the elderly may further increase in modern times, which can be explained by comparing the current dietary fibre consumption with that in the old times. Our ancestors used to daily consume >100 mg of dietary fibre, whereas in the modern age, the daily intake of dietary fibre has dropped to 10 mg, showing how dietary factors have changed over the years and exceeded the limits of adaptational change (100). It is possible to decrease the acid-base imbalance to some extent by adding dried fruits and vegetables to the dietary treatment plans prepared for the elderly.

Conclusion and Recommendations

With the elderly population increasing in number and proportion and healthcare systems on the verge of collapse, it would be wise to realise the importance of dried fruits and increase the awareness of disease prevention with the factors that could reduce the severity of diseases in the elderly. The course of chronic metabolic diseases and the ageing process can be improved by increasing dried fruit and vegetable consumption among the elderly. Literature data that include a multifaceted analyses and recommendations concerning the consumption of dried fruits and vegetables in the elderly are limited. Therefore, extensive and long-term studies on the use of dried foods in the elderly are needed.

Ethics

Peer-review: Internally peer-review.

Author Contributions

Concept: T.B., Design: T.B., Data Collection or Processing: T.B., A.Y., S.F.A., Analysis or Interpretation: T.B., A.Y., S.F.A., Literature Search: T.B., A.Y., S.F.A., Writing: T.B.

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ORIGINAL RESEARCH

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Malnutrition and Related Factors in Older Adults

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Abstract

Objective: Malnutrition is a treatable condition and an important cause of mortality and morbidity in the geriatric population. In this study, we aimed to investigate the risk factors for malnutrition in geriatric patients.

Materials and Methods: Patients aged 65 and over, who were admitted to our center between January 2016 and December 2017, were included in the study. Patients with edema, whose anthropometric measurements could not be performed and who did not agree to participate in the study were excluded from the study. The Mini Nutritional Assessment-Short-Form was used to evaluate nutritional status. The patients were divided into three groups according to nutritional status: normal, with the risk of malnutrition and malnourished. Demographic characteristics and geriatric syndromes were compared between the groups. The chi-square test was used to compare categorical variables, the Mann-Whitney U test was used to analyze non-parametric variables and logistic regression analysis was done to assess nutritional status.

Results: A total of 408 participants (284 female and 124 male) were included in this study. The median age of the patients was 77 years. Malnutrition and the risk of malnutrition were found in 4.9% (n=20) and 24% (n=98) of the patients, respectively. There was a significant difference in educational status, functional dependence, urinary incontinence, dementia and depression between malnourished and normal patients. In logistic regression analysis, dementia ($p<0.01$, odds ratio=4.33) was independently associated with malnutrition; whereas depression, gender and functional dependence were not associated with malnutrition.

Conclusion: Our study demonstrated that malnutrition was independently associated with dementia. We suggest that malnutrition and other geriatric syndromes should be screened routinely. Patients with low levels of educational attainment, functional dependence, urinary incontinence, dementia, and depression seem to be at a higher risk of malnutrition and therefore should be paid special attention.

Keywords: Malnutrition, geriatrics, geriatric syndromes

Introduction

Malnutrition (undernutrition or protein-energy-malnutrition) is a state that can be associated with lack of intake of nutrition caused by diseases (with or without inflammation), socioeconomic, psychologic (disabilities of taste and smell that result in "anorexia of aging") or hunger-related factors and results in a decrease fat-poor body mass and deterioration of body cell components, physical and mental health (1-3). Deficiencies in macronutrients (protein-energy) and micronutrients (vitamins and minerals) are seen very frequently among older adults. Prevalence over 65 years is 9% to 15% in outpatient clinics, 12% to 50% in hospitalized older persons, and 25% to 60% in older adults residing in nursing homes (4).

Malnutrition is a serious cause of increased morbidity and mortality, decreased functionality and quality of life that can be treated and prevented in the geriatric population. In some studies, malnutrition is a predictor of mortality (5,6). In a study, investigating the association between the risk of malnutrition and 7-year mortality, malnutrition increased the risk of mortality significantly (7). It also contributes to increased frequency and length of hospital stay and healthcare costs (8). A prospective study in adults aged over 70 years revealed that adjusted healthcare costs were 714 € per year more in patients with malnutrition or malnutrition risk compared to well-nourished patients (9).

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As malnutrition has been found correlated with Geriatric syndromes, it is important to identify and treat nutritional problems earlier (10,11). Nutritional status can be assessed by standard anthropometric (e.g., skinfold thickness, midarm muscle area, body mass index), biochemical and immunologic (e.g., albumin, prealbumin, transferrin and lymphocyte counts) measures; but they are not preferred because of difficulty to perform these measurements. The most widely used, validated and reliable screening tool for older adults is the Mini Nutritional Assessment-Short-Form (MNA-SF) (12,13).

In this study, we aimed to evaluate the malnutrition and related factors among older patients admitted to our outpatient clinic, due to the increasing prevalence of malnutrition and lack of studies assessing these factors in the Turkish community.

Materials and Methods

The medical records of patients, aged ≥65 years admitted to the geriatric outpatient clinic in our center between January 2016 and December 2017 were evaluated retrospectively. Four hundred eight patients were included in the study with consent forms. Demographic characteristics (age, gender, ambulation) and geriatric syndromes (urinary incontinence, fecal incontinence, difficulty in swallowing, chewing difficulty, dementia, depression) of the patients were investigated. Patients with edema, whose anthropometric measurements could not be performed and who did not agree to participate in the study were excluded from the study.

The MNA-SF test was used to evaluate nutritional status. MNA consists of 18 questions, 15 of which are based on verbal questioning, 3 of them are based on anthropometric measurement, and scoring is based on 30 points. It has two stages. In the first stage, MNA-SF is used and if there is a risk of malnutrition (if the score is 11 and less out of 14), the second stage is continued with the evaluation section. In our study, nutritional status was divided into three groups according to the MNA-SF scores, as normal nutritional status 12-14 points, malnutrition risk 11-8 points and malnutrition 7 or lower points. Patients were categorized as normal, with the risk of malnutrition and malnourished. Demographic characteristics and geriatric syndromes were compared between the groups. Swallowing and chewing difficulties were assessed by asking the patients if they experienced difficulty in swallowing and chewing. Ambulation status of the patients was questioned and grouped as immobile, walk with help and walk without help. Mini-Mental State Examination (MMSE) and the short and long-form geriatric Depression scale (GDS-SF and GDS-LF) were used to assess cognition and depression. The validity of the Turkish versions of the MMSE and GDS-SF has been confirmed (14,15). MMSE scores lower than 24 indicate cognitive impairment and GDS scores greater than 14 indicate depression. This study has been evaluated and approved by the local ethics committee (number: 956).

Statistics

Descriptions of patient demographic characteristics (age, gender, ambulation) and geriatric syndromes (urinary incontinence, fecal incontinence, difficulty in swallowing, chewing difficulty, dementia, depression) were performed through percentage for qualitative variables. For quantitative variables with normal distribution, the mean standard deviation was used. For variables not following normal distribution median and percentiles were used. The chi-square test was performed for qualitative variables, whereas the Mann-Whitney U test was used for qualitative variables with the nonparametric distribution. Conditional forward method of binary logistic regression analysis was used to establish the relationship between the demographic characteristics, geriatric syndromes, and malnutrition in terms of odds ratio (OR) and 95% confidence interval. Univariate logistic regression analysis was used to determine the factors related to malnutrition, and multivariate analysis was used for parameters found significant in univariate analysis. All tests were two-tailed, and a p value of less than 0.05 was considered significant. SPSS 15.0 (SPSS Inc., Chicago, IL) statistical software was used to analyze data.

Results

Four hundred eight participants were included in this study (284 female and 124 male). The median age of the patients was 77 years (minimum=65, maximum=95). Malnutrition and the risk of malnutrition were found in 4.9% (n=20) and 24% (n=98) of the patients, respectively. Demographic characteristics and geriatric syndromes of the patients were shown in Table 1. The results of logistic regression analyses were presented in Table 2. Univariate logistic regression analysis demonstrated that dementia and depression were related with malnutrition ($p<0.01$, OR=4.33; $p=0.01$, OR=3.14, respectively); however in multivariate analysis, only dementia was associated with malnutrition ($p=0.02$, OR=3.27).

Discussion

Malnutrition is a prevalent problem in older age. In our study, the prevalence of malnutrition was found as 4.9%. Malnutrition prevalence studies conducted in our country showed that 13-28% of the elderly in the outpatient clinics or living in the community, 25-45% of the elderly admitted to the hospital, 20-60% of the hospitalized elderly and 30-70% of the elderly living in institutions were at risk of malnutrition silinip yerine malnourished or with the risk of malnutrition (16). The reason for a wide range of prevalence may be the different criteria and assessment tools of malnutrition or studying populations with varying residential status (17). However, our malnutrition

Table 1. Demographic characteristics and geriatric syndromes

	Malnourished patients* (n=20)	Patients with malnutrition risk (n=98)	Non-malnourished patients* (n=290)	p
Age [median (min-max), years]	78.5 (67-92)	78.5 (66-95)	75 (65-94)	>0.05
Gender (n, %)				
Woman	13 (65%)	73 (74.5%)	198 (68.3%)	>0.05
Male	7 (35%)	25 (25.5%)	92 (31.7%)	
Education (n, %)				
Illiterate	7 (35%)	23 (23.4%)	33 (11.3%)	**<0.01***
Primary school graduate	8 (40%)	47 (47.9%)	172 (59.3%)	**<0.01***
Secondary school graduate	2 (10%)	6 (6.1%)	27 (9.3%)	>0.05
High school graduate	2 (10%)	13 (13.2%)	20 (6.8%)	>0.05
Graduated from a university	1 (5%)	9 (9.1%)	38 (13.1%)	>0.05
Ambulation (n, %)				
Immobile	5 (25%)	21 (21.4%)	96 (33.1%)	**<0.01***
Walk with help	2 (10%)	9 (9.1%)	1 (0.3%)	**<0.01***
Walk without help	13 (65%)	57 (58.1%)	154 (53.1%)	**<0.01***
Geriatric syndromes (n, %)				
Urinary incontinence	7 (35%)	51 (52%)	104 (35.8%)	**0.01***
Fecal incontinence	2 (10%)	4 (4%)	18 (6.2%)	>0.05
Difficulty in swallowing	3 (15%)	13 (13.2%)	20 (6.8%)	>0.05
Chewing difficulty	3 (15%)	15 (15.3%)	26 (8.9%)	>0.05
Dementia**	8 (40%)	20 (20.4%)	31 (10.6%)	**<0.01***
Depression**	10 (50%)	38 (38.7%)	55 (18.9%)	**<0.01***

Min: Minimum, max: Maxiumum, *: p-value is based on the comparison between 2 groups (malnourished and non-malnourished), **: MMSE scores were used for dementia, MMSE score <24 considered as cognitive impairment and GDS scores were used for depression. GDS >14 considered as depression, MMSE: Mini-Mental State Examination

Table 2. Results of univariate and multivariate logistic regression analyses

Variables	Univariate analysis		Multivariate analysis	
	Odds ratio (Confidence interval)	p	Odds ratio (Confidence interval)	p
Age	1.05 (0.98-1.22)	0.13	-	-
Gender	1.24 (0.48-3.20)	0.64	-	-
Education	0.75 (0.53-1.05)	0.10	-	-
Ambulation	1.16 (0.70-1.90)	0.57	-	-
Urinary incontinence	1.24 (0.48-3.81)	0.65	-	-
Fecal incontinence	1.84 (0.40-8.47)	0.43	-	-
Difficulty in swallowing	2.60 (0.68-9.69)	0.16	-	-
Chewing difficulty	1.96 (0.52-7.45)	0.32	-	-
Dementia	**4.33 (1.70-11.19)**	**<0.01**	**3.27 (1.19-8.96)**	**0.02**
Depression	**3.14 (1.26-7.77)**	**0.01**	**2.23 (0.84-5.92)**	**0.10**

prevalence is not in accordance with the literature. Identification of malnutrition risk as a separate group may have caused our malnutrition prevalence to be underestimated. Therefore, it is important to screen the nutritional status of older adults living in the community, admitted to the outpatient clinics and to develop a treatment plan through a detailed evaluation of the individuals at risk.

In our study, we found a statistically significant relationship between the malnutrition and urinary incontinence. However, data on this issue are conflicting. Positive correlation of worse nutrition with higher grade of incontinence (r=0.53, p<0.0001) was previously reported (18). On the other hand, in another study, the presence of urinary incontinence was not higher in malnourished patients compared to non-malnourished (19). These converse results can be explained by the differences of the study population, definitions of incontinence and concomitant comorbidities.

In our study, difficulty in swallowing was not interestingly associated with malnutrition. In a study among hospitalized older adults, swallowing disorders are an independent risk factor for malnutrition (20). In another study, 44% had malnutrition and malnutrition risk correlated with other geriatric syndromes

in an outpatient clinic (10). On the other hand, the prevalence of swallowing difficulties varies due to gender-related differences, definitions and measurement methods (20). However, we suggest that difficulties in swallowing should be detected and promptly treated.

In our study, we found a statistically significant relationship between dementia and malnutrition and it was similar to the literature. In a study by Soundararajan et al. (19), dementia was significantly higher in malnourished patients compared to non-malnourished. In another study, also dementia was associated with poor nutritional status (20). Although the types of dementia (e.g. frontotemporal lobar degeneration is generally considered to be associated with overeating) and stages of dementia also had an impact on the results, our results did not include these parameters (21).

Depression is a very common cause of weight loss in older adults and the relationship between those two conditions is interactive. In previous studies, depression was determined as an independent predictor of malnutrition (17,22). In our study, although there was a significant difference between the groups in terms of depression frequency, this difference could not be demonstrated in multivariate logistic regression analysis. The reason for the differences in results may depend on the prevalence of depression in Turkish people and the severity of depression.

In our study, poor educational status and functional dependence also were associated with malnutrition similar to previous studies (10,17,23).

There are several limitations in our study. The sample size was small and the assessment for malnutrition was performed with only MNA-SF. Also, we didn't further analyze the concomitant diseases, other possible related factors with malnutrition (e.g. sarcopenia, frailty, falls, insomnia, etc). Furthermore, the types and stages of dementia and depression were not investigated. Besides, our study mostly represents a geriatric population in outpatient clinics and does not truly reflect the whole population. The differences in our results can be caused by Turkish demographic characteristics, due to these reasons, the results cannot be generalized to all geriatric patients. Also, our results may have been biased since some of the data was based on personal statements. Although malnutrition is a highly prevalent medical burden and known to cause many poor health outcomes, there are a few studies evaluating the prevalence of malnutrition and possible related factors among outpatients. Therefore, our study was one of the few examples in this area.

Conclusion

Our study demonstrated that malnutrition was independently associated with dementia. We suggest that malnutrition and other geriatric syndromes should be screened routinely in institutions. Patients with poor educational status and functional dependence, urinary incontinence, dementia, and depression seem to be at more risk to have malnutrition and therefore should be paid special attention. Nevertheless, further investigations should be needed to better understand the factors that influence malnutrition in older adults.

Ethics

Ethics Committee Approval: This study has been evaluated and approved by the local ethics committee (number: 956).

Informed Consent: Four hundred eight patients were included in the study with consent forms.

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The Frequency of Sarcopenia and Associated Factors in Older Patients with Rheumatoid Arthritis

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Abstract

Objective: Rheumatoid arthritis (RA) is a progressive, systemic, and autoimmune disease. On the other hand, sarcopenia is a Geriatric syndrome characterized by a decrease in muscle mass and strength. Identifying and detecting factors associated with sarcopenia is critical for screening and treatment of older patients with RA.

Materials and Methods: First off, Muscle Mass index and Free Fat Mass index in 30 young, healthy males and 30 young, healthy females were assessed using a bioimpedance analyzer to find cut-off values for sarcopenia diagnosis. Then, 100 RA patients over 65 years were recruited for the same test, and patients with a value 2 standard deviation below the calculated cut-off levels were diagnosed as having low muscle mass. Patients who had low muscle mass plus (low handgrip strength or low gait speed) were diagnosed as sarcopenic. In addition, the sample was divided into two groups as sarcopenic and non-sarcopenic. Demographic characteristics, medication history, bioimpedance value, daily life activities, frailty rate, malnutrition rate, hemoglobin level, 25-OH vitamin D level, glomerular filtration rate, rheumatoid factor, anti-cyclic citrullinated peptide seropositivity, and erythrocyte sedimentation rates (ESR) and C-reactive protein (CRP) level were compared between the groups.

Results: The sarcopenic group was older than the other group. Nobody was found to use any biological agent in the sarcopenic group, but 8 non-sarcopenic patients had used biological agents previously. Malnutrition and frailty rate and level of dependence in activities of daily living were higher in the sarcopenic group than in the non-sarcopenic group. Not with standing, both groups had similar Disease Activity score-28; ESR and CRP level were higher in the sarcopenic group.

Conclusion: The prevalence of sarcopenia rises with aging, malnutrition, and frailty. Accompanying with an autoimmune disease like RA, sarcopenia causes disabilities, dependence, and mortality at higher rates. Overall, sarcopenia and its consequences should be considered for the geriatric population.

Keywords: Rheumatoid arthritis, sarcopenia, bioimpedance analysis

Introduction

Sarcopenia is a generalized and progressive skeletal muscle disorder that is associated with an increased likelihood of adverse outcomes, including falls, physical disability, and mortality. The disease is characterized by low muscle strength, low muscle quantity or quality, and low physical performance (1). The European Working Group on Sarcopenia in Older People (EWGSOP) held another meeting to update the definition of sarcopenia in early 2018 and emphasized the importance of muscle quality (2). Etiopathogenesis of sarcopenia includes age, endocrinological changes, nutritional status, comorbidities, defective immune response, chronic drug use, etc (3). On the other hand, rheumatoid arthritis (RA) is a chronic, progressive, and autoimmune disorder that leads to deformities, disabilities, impairment of physical acitivity and extraarticular involvements. RA is the most frequent one between inflammatory arthritis. Also, muscle-specific symptoms and signs are common in

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patients with RA (4). It is shown that sarcopenia is common in RA patients because of multidrug treatments and the effects of the disease itself (5).

Many changes occur in the metabolism and physiological reserve decrease by aging (6). Various studies show that sarcopenia affects physiological reserve adversely and worsen prognosis. The disease can also lead to disabilities and impair quality of life or dependence in activities of daily living (ADL) (7-9). Sarcopenia is a significant health problem and expected to be increasingly prevalent in the next decades (10). Therefore, identifying sarcopenia-associated factors in older RA patients may be a useful guide for the diagnosis and management of the disease. The present study aimed at investigating the prevalence of sarcopenia and associated factors in the geriatric population with RA.

Materials and Methods

The cross-sectional study included 100 RA patients over 65 years admitted to Ankara University, Geriatrics, and Rheumatology Outpatient Clinics between March 2014 and October 2014. All patients were diagnosed based on the ACR/EULAR 2010 criteria. Sarcopenia was diagnosed with EWGSOP 2010 criteria (1). According to this criteria; the diagnosis is based on documentation of low muscle mass plus (low muscle strength or low physical performance). We evaluated muscle strength with Handgrip test (low handgrip strength <30 kg for males, <20 kg for females) and physical performance with gait speed test (low speed <0.8 m/sec). At the time of data collection, there were no widely acceptable standart validated values of TANITA results for Turkish people; for this reason, before the evaluation of RA patients, we analysed a healthy young Turkish control group with TANITA in order to find index values. 30 young, healthy females (median age: 33) and 30 young, healthy males (median age: 35) were recruited to be assessed with TANITA-BC 420 MA® to identify the cut-off value for determining the status of muscle mass. Fat-free mass (FFM), fat percentages, fat-free mass indices (FFMIs), and muscle mass indices (MMIs) were calculated, and the value 2 standard deviation below the cut-off level for the young was identified as the cut-off level for low muscle mass. FFMIs were calculated as FFM/(height x height), and MMIs were calculated as muscle mass/(height x height). Apart from such calculations, demographic characteristics of admitted RA patients were noted, and these patients were interrogated for diease duration, comorbidities, such as diabetes and hypertension, smoking, and alcohol use. Disease Activity score-28 DAS-28 was used to determine the severity of RA. Uses of glucocorticoids, nonsteroid anti-inflammatory drugs, conventional disease modified anti-rheumatic drugs (cDMARDs), biological DMARDs (bDMARDs), and statin were checked for the medication history. It was assessed if urinary incontinence was present. The comprehensive geriatric assessment was also examined. While the Katz index was used for ADL, the Lawton-Brody index was used for instrumental activities of daily living (IADL). The Yesavage Geriatric Depression scale-short form was used to evaluate the depression status of the patients. While the frailty was assessed with the Fried Frailty index, the nutritional status was evaluated with the Mini Nutritional Assessment. The lengths of middle upper arm and calves were obtained from initial anthropometric measurements. Body mass indices were calculated as weight/(height x height). A handgrip test by a hand dynamometer was used to assess muscle strength. Total body water, fat percentages, FFMIs, and MMIs of all RA patients were calculated. Hemoglobin levels, estimated GFR (with modified diet renal disease formula), erythrocyte sedimentation rates (ESR), C-reactive protein (CRP) levels, and 25-OH vitamin D levels were evaluated in laboratory analyses. Rheumatoid factor (RF) and anti-cyclic citrullinated peptide (anti-CCP) were examined for seropositivity.

Statistics

SPSS for Windows 15® was used for all statistical analyses. Accordingly, descriptive statistics were given as mean ± standart deviation for normally distributed data, and as median (minimum-maximum) for the data showing a non-normal distribution. Nominal variables were given as the number of cases (N) and percentages (%). While the groups were compared with the t-test or the Mann-Whitney U test, nominal variables were compared with the chi-square test or the Fisher's exact test. The significance level was taken as $p<0.05$.

Results

A total of 100 RA patients (78 females and 22 males) participated in the study, and the mean age of the participants was found to be 69.2. While the cut-off levels of FFMIs were found to be 19.45 kg/m² for males and 17.85 kg/m² for females, the cut-off levels of MMIs were found to be 18.47 kg/m² for males and 17.64 kg/m² for females. Therefore, the patients with values 2 standard deviation below the calculated cut-off levels were considered as sarcopenic, and all RA patients were divided into two groups. Accordingly, it was found that 35 patients had sarcopenia, which indicated that the prevalence rate was 35% among the patients.

The sarcopenic group was older than the non-sarcopenic one. Female/male ratio, smoking, alcohol use, disease duration, DAS-28 scores, and the numbers of patients with deformities were similar between the two groups. Uses of cDMARD, glucocorticoids, non-steroidal anti-iflammatory drugs, and statin did not show a significant difference between the groups. However, there were eight non-sarcopenic patients using bDMARD, while there was no bDMARD user in the sarcopenic group (Table 1).

Considering anthropometric measurements, calf circumference was found to be shorter in the sarcopenic group, but the middle upper arm circumference was similar between the groups. Gait speed was slower, and handgrip strength was poorer in the sarcopenic group. While Body Mass index (BMI), FFMI, and MMI were significantly lower, the fat percentage was significantly higher in the sarcopenic group (Table 2).

Table 1. The demographics comorbidities and drug history of patients

	Sarcopenic (n=35)	Non-sarcopenik (n=65)	Significance
Age (M ± SD)	71.8±7.16	67.94±5.67	p=0.006
Female gender, n	28 (80%)	50 (76.9%)	p=0.466
RA median duration, years	6	4	p=0.613
Patients with deformity, n	6 (17.1%)	11 (16.9%)	p=0.592
Diabetes	10 (28.1%)	15 (23.1%)	p=0.355
Hypertension	17 (48.6%)	40 (61.5%)	p=0.15
Cigarette smoking	7 (20%)	16 (24.6%)	p=0.397
Alcohol consumption	2 (5.7%)	5 (7.7%)	p=0.712
DAS-28 score	2.65±1.2	2.42±0.96	p=0.284
Glucocorticoid use	30 (75.7%)	52 (80%)	p=0.337
NSAID use	19 (54.3%)	41 (63.1%)	p=0.266
cDMARD use	31 (88.6%)	61 (93.8%)	p=0.287
bDMARD use	0	8 (12.3%)	p=0.027
Statin use	4 (11.1%)	7 (10.7%)	p=0.92

cDMARD: Conventional disease modified anti-rheumatic drugs, bDMARD: Biological disease modified anti-rheumatic drugs, SD: Standard deviation, DAS-28: Disease Activity score-28, RA: Rheumatoid arthritis, NSAID: Non-steroidal anti-iflammatory drugs, M: Mean

Table 2. Anthropometric measurements and the results of bioimpedence anlayzes

Measures	Sarcopenic	Non-sarcopenic	Significance
Calf circumference (cm)	32.4±3.94	36.28±4.54	p<0.001
Middle upper arm circumference (cm)	27.8±3.94	28.78±3.66	p=0.258
BMI (kg/m²)	27.7±5.31	32.1±5.03	p<0.001
Handgrip strength (kg)	14.71±6.51	18.17±8.32	p=0.039
Gait speed (m/sn)	0.77±0.15	0.89±0.13	p<0.001
MMI (kg/m²)	14.7±4.25	19±2.1	p<0.001
FFMI (kg/m²)	14.78±1.82	19.97±2.54	p<0.001
Body fat percentage (%)	43.87±10.83	36.7±9.33	p=0.002
Total body water (%)	40.68±9.51	44.28±7.31	p=0.219

BMI: Body Mass index, MMI: Muscle Mass index, FFMI: Fat-free mass index, cm: Centimeter, kg: Kilogram, m: Meter

The number of patients having depression and urinary incontinence was found to be similar between the groups. The dependence on ADL and IADL were significantly higher in the sarcopenic group. Frailty and malnutrition were found to be significantly more frequent in the sarcopenic group (Table 3).

In laboratory analyses, hemoglobin, estimated glomerular filtration rate, 25-OH vitamin D levels were found to be similar by two-group comparisons. Both groups had similar RF and anti-CCP positive cases. The acute phase reactant (ESR and CRP) levels were significantly higher in the sarcopenic group (Table 4).

Discussion

The results of the present study showed that nearly one-third of RA patients had sarcopenia, and bDMARD use was less common in the sarcopenic group. The patients with sarcopenia also had higher acute phase reactant levels and higher dependence in ADL. There were no significant relationships between sarcopenia and diabetes, hypertension, alcohol use, smoking, medication history, hemoglobin levels, renal function, and vitamin D levels.

Both RA and sarcopenia were more prevalent in female patients, but it is known that prevalence rates become closer by aging (11,12). The findings revealed that there was no association between sarcopenia and diabetes and hypertension, although

Table 3. The comparison of groups with comprehensive geriatric assessment

	Sarcopenic	Non-sarcopenic	Significance
Urinary incontinence	12 (34.3%)	14 (21.4%)	p=0.126
Dependence on ADL	10 (28.6%)	0	p<0.001
Dependence on IADL	20 (57.1%)	23 (35.4%)	p=0.03
Depression	17 (48.6%)	31 (47.7%)	p=0.55
Frailty	19 (54.3%)	22 (33.8%)	p=0.039
Malnutrition	11 (31.4%)	7 (10.8%)	p=0.012

ADL: Activities of daily living, IADL: Instrumental activities of daily living

Table 4. Two-group comparisons of laboratory values

	Sarcopenic	Non-sarcopenic	Significance
Hemoglobin level, g/dL	12.28±1.27	12.54±1.55	p=0.820
eGFR, mL/min/1.73 m²	76.06±22.27	77.98±21.8	p=0.677
25-OH vitamin D, nmol/L	20.1±2	21±1.8	p=0.480
RF seropositivity, n	17 (48.6%)	37 (56.9%)	p=0.278
Anti-CCP positivity, n	17 (48.6%)	33 (50.6%)	p=0.834
ESR, mm/h	26 (3-93)	21 (5-104)	p=0.033
CRP, mg/L	10.9 (1-78)	4 (1-28)	p=0.015

eGFR: Estimated glomerular filtration rate, RF: Rheumatoid factor, CCP: Cyclic citrullinated peptide, ESR: Eritrocyte sedimetation rate, CRP: C-reactive protein

the relevant literature showed controversial results (13-16). The relationship between alcohol use and sarcopenia was also not clear (15,17).

In a study conducted by Giles et al. (18), smoking, disease activity, seropositivity with RF, and uses of cDMARD, bDMARD, and glucocorticoid among the participants showed a similarity with the relevant data in our study. However, they found the sarcopenia prevalence as 25.9%.

Scott et al. (19) showed that statins might decrease muscle performance and increase falls. In our study, there was no significant difference in the use of statin, which could have toxic effects on muscle, among the participants.

Although the findings regarding biological DMARDs were not clear, a study showed that etanercept might cause weight gain in the early stages of RA before the involvement of cachexia (20).

Yamada et al. (21) concluded that RA patients using glucocorticoids at a dose above 3.25 mg through a year had a higher risk for developing sarcopenia. Such a finding was also contradictory to our findings of glucocorticoid use.

Another study conducted with female RA patients aged 35-50 years showed that sarcopenia had no significant relationship with disease activity and medication. Moreover, CRP levels were found to be higher in patients with sarcopenia, which is similar to our study (22).

A study investigated sarcopenia-related factors in Japanese patients with RA. The prevalence was found to be 29.6%. Furthermore, age, BMI, CRP levels, and hip bone mineral density were significant sarcopenia-related factors, which supports our findings. Nevertheless, the study found bDMARD had no relationship with sarcopenia, and MNA was not significant in the multivariate analysis (23). These findings are different from ours.

Barone et al. (24) conducted a study to investigate sarcopenia in different rheumatic diseases, such as RA, psoriatic arthritis, and ankylosing spondylitis. The patients were aged between 40 and 75 years. Although the study employed a different design, it also included presarcopenia. The prevalence of sarcopenia was found to be 20%. They concluded that only age and presence of disability were associated with an increased risk of sarcopenia.

Torii et al. (25) investigated sarcopenia-associated factors in RA patients. The prevalence was found to be 37.1%. Age, RA duration, MNA score, and bDMARD use were significant factors affecting sarcopenia. The findings were similar to ours, except for the RA duration.

Ngeuleu et al. (26) found that sarcopenic and non-sarcopenic patients with RA had different ages and CRP levels, but similar disease duration and activity, RF, and anti-CCP seropositivity. These findings are similar to ours. Additionally, they showed that excessive fat and bone erosion, increased cardiometabolic risk, and BMI were related to sarcopenia.

It has been approved by various studies that malnutrition is a major factor in the etiology of sarcopenia (27). In our findings, malnutrition was found to be more frequent in RA patients with sarcopenia. Besides, there are controversial results in some studies conducted with RA patients (25).

Urinary incontinence was more frequent in the sarcopenic group while it was not statistically significant. A study showed that hospitalized sarcopenic patients with coronary heart disease had higher urinary incontinence rates (28). Nevertheless, it could not be found a study assessing urinary incontinence in RA patients with sarcopenia.

Calf circumference was found to be lower in the sarcopenic group, while middle upper arm circumference was similar in the two groups. Some studies showed that calf circumference was an essential predictor of sarcopenia prognosis and diagnostic tools. Sarcopenia may decrease upper arm circumference (29). The middle upper arm circumference was not different between sarcopenic the groups in our study, as contradictory to literature, but it may be related to the sample characteristics.

Finally, the study has several limitations. First off, the sample size was rather small. Secondly, more certain diagnostic tools, such as quantitative computerized tomography, magnetic resonance, etc, were not used. Secondly, the deformity and activity of RA may lead to mobility problems and some tests such as gait speed or handgrip strength may prevent the correct assessment. Then, this was a cross-sectional study, and more comprehensive follow-up studies are considered to explain the associated factors in detail. On the other hand, this is the first study investigating the relationship between sarcopenia and certain factors such as depression, alcohol use, urinary incontinence, etc.

Conclusion

Overall, sarcopenia is a significant clinical problem that affects the geriatric population. The patients with autoimmune disorders, such as RA, suffer from disabilities, and dependence in ADL. Sarcopenia, nutritional status, and frailty should always be kept in mind for RA patients. Moreover, RA patients should be evaluated for sarcopenia through anthropometric measurements, analysis of body components, and laboratory tests. Finally, the increase in acute phase reactants should be assessed in terms of sarcopenia.

Ethics

Ethics Committee Approval: Ankara University Institutional Review Board approved the study (number: 10-427-14, date: 09/06/2014).

Informed Consent: The signed informed consent form was obtained from all participants.

Peer-review: Internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: İ.K., E.Ç., Ö.K.C., Concept: S.A., E.Ç., Ö.K.C., Design: S.A., M.V., T.A., Data Collection or Processing: İ.K., E.Ç., Ö.K.C., Analysis or Interpretation: İ.K., M.V., T.A., Literature Search: İ.K., M.V., T.A., Writing: İ.K., S.A., T.A.

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ORIGINAL RESEARCH

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Best Items to Identify Fall Status in Male Older Adults

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Abstract

Objective: The correct identification of older adults at risk for falling is so important. This study compared the ability of the Balance Evaluation Systems test (BESTest), Berg Balance scale (BBS), Functional Gait Assessment (FGA), and Fullerton Advanced Balance (FAB) scale to identify fall status, and to investigate which of the items of these scales are more accurate to identify fall status in male older adults.

Materials and Methods: A cross-sectional study design was used. Fifty-eight male older adults (66.0±8.09 y) participated in this study. The participants reported their number of falls during the past year, and the ability of each balance test was investigated by receiver operating characteristics analysis.

Results: The BESTest, BBS, FGA and FAB scale had acceptable ability to differentiate participants with and without a history of falls (i.e. 0.78, 0.75, 0.79 and 0.76 respectively), a suggested model combining the items hip/trunk lateral strength, lateral lean, functional reach, sit to stand, stand on one leg, compensatory stepping correction (forward and lateral), gait, timed "get up & go", turning 360 degrees, placing alternate foot on stool, gait with eyes closed, and tandem walk exhibited better levels of overall accuracy (88%) compared with all of them.

Conclusion: The BESTest, BBS, FGA and FAB scale showed similar accuracy in differentiating fallers. Also, the suggested model showed better accuracy to differentiate fallers from no fallers than each of the 4 balance scales.

Keywords: BESTest, BBS, FGA, FAB scale

Introduction

The adult population has increased rapidly in the last century (1). Approximately a third of adults who are more than 65 years old and live in the community, fall each year (2,3). Approximately 20% to 30% of falls result in injuries with increased morbidity and mortality as well as high health care costs (1,3); so, falling has an enormous impact on quality of life and health of older adults (4).

Many of the components that contribute to balance, such as muscular strength, vision, cognition and proprioception are impaired in elderly people (5). Hazards in the community and home (e.g. lack of stair railing, poor lighting) also contribute to heightened fall risk (1). To understand why older adults are at high risk of falls, a number of clinical and laboratory measures of balance have been developed (6-9).

Commonly used balance tests are the Balance Evaluation Systems test (BESTest), Berg Balance scale (BBS), Functional Gait Assessment (FGA), and Fullerton Advanced Balance (FAB) scale; which are using in predicting falls in older adults (6-9). The BBS is one the most favorite tests for balance evaluation and for a long time it was considered the gold standard of clinical balance scales (6). The BBS has a limitation when assessing older adults who have balance deficits but are high functioning (10,11). Berg et al. (6) acknowledged that when using the scale for active older adults who have less deficits, these omissions might limit the accurately of the scale. These limitations have been confirmed by other researchers (10,11). So other scales for balance evaluation like the BESTest, FGA and FAB scale with the aim of solving these limits and increasing the fall prediction ability is made (6-8).

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Unlike the tries of researchers to increase the ability of scales to identify fall status, there are not any significant differences between them. For example, Marques and et al. (12) declared the ability of BBS, BESTest, Mini-BESTest and Brief-BESTest to identify fall status are 0.78, 0.71, 0.76, 0.76 of area under the curve (AUC) and all the tests are significantly correlated with each other (0.83-0.96). Schlenstedt and et al. (13) declared, The FAB scale, Mini-BESTest, and BBS displayed similar properties to predict fallers, with AUC of the receiver operating characteristics (ROC) curve of 0.68, 0.65, and 0.69, respectively. So it's not clear which of these tests, the best predictor of falls in older adults are.

Recently, Schlenstedt and et al. (13) introduced a new method to increase the ability of the scales to identify fall status in Parkinson disease individuals. For the first time they specified which of the items of the FAB scale, BBS and Mini-BESTest are the best predictors of future falls, and showed only some of the items of these scales are perfect for fall prediction, and with a collection of the selected items the ability of fall prediction in Parkinson disease individuals will increase (13). So they showed a better method to select items to identify fall status.

To our knowledge, no study has analyzed which items of the BESTest, BBS, FGA, and FAB scale might contribute to the detection of fall risk in older adults. So an independent investigation of the items of these scales would help in better accuracy to differentiate fallers from no fallers in older adults.

Consequently, this study has two aims. The first aim wanted to independently investigate each of the items of these four scales and specify which of the items are better to differentiate fallers from no fallers in male older adults. Second, we anticipated that a model combining of the selected items in the first aim will result in better accuracy to differentiate fallers from no fallers in older adults in compare to the BESTest, BBS, FGA, and FAB scale.

Materials and Methods

A cross-sectional study was conducted from February 2017 to May 2017. Ethical approval was obtained by the Guilan University Research Ethic Board. Fifty eight older men with or without balance deficits participated in this study (46 men living in the community and 12 men living in seniors' residents). Recruitment occurred with the purpose to include individuals with a wide range of balance deficits. Participants who met the following criteria were recruited: (1) aged 60 years or older, (2) able to ambulate 6 m independently (without the assistance of another person or gait aid), (3) able to understand and follow instructions, (4) had no uncorrected hearing or visual deficits. Participants were excluded if they (1) had a history of dizziness, (2) diseases and conditions like peripheral neuropathy and orthopedic injuries that could influence stance and gait performance (3). Were taking medication(s) that they felt caused dizziness or affected their balance (e.g. psychotropic medications). Written informed consent was obtained prior to each data collection session.

Each session for data collection was completed within a 70-minute period in a silent laboratory setting at the University of Guilan. Individuals were instructed to wear comfortable, flat shoes. The order of doing these items for each subject was randomly (so exhaustion could not have a persistent effect on an item). Each item that was replicated among the various balance scales was performed only once and scored using criteria from each scale. To teach the subjects how to correctly perform each item of the BESTest, BBS, FGA and FAB scale, one examiner reads the item and the other examiner performs the item to teach them, then the subject performs the item. The space was arranged to facilitate transitions from one item to the next in order to reduce movement and fatigue. To insure that all the participants do each test under the best conditions, 10 minute rest periods were considered and participants were instructed to ask additional rest if needed. Two trained examiners who had experience doing these tests in older adults, collected the data. Participants were provided with an obvious definition of falls (an event when you find yourself unintentionally on the ground, floor or lower level). Participants reported if they had sustained any falls during the previous 12 months. Individuals with one or more falls were considered fallers.

Balance Evaluation Systems Test

The BESTest contains 36 items classified into six categories: biomechanical constraints, stability limits and verticality, anticipatory postural adjustments, postural adjustments, postural responses to external perturbations, sensory orientation during stance, and stability in gait (7). Each item is scored on an Ordinal scale from zero (severe balance impairment) to three (no balance impairment) and the maximum score is 108 points (7). BESTest has test-retest reliability (ICC=0.80-0.99) and inter-rater reliability (ICC=0.91-0.99) in patients with Parkinson disease, in subjects with and without balance disorders and in older cancer survivors (7,14,15).

Berg Balance Scale

The BBS is composed of 14 items with a five-point grading (0-4) for each item. The top score is 56 points and it takes up to 20 minutes to execute the scale (6). It has high inter-rater and test-retest reliability in patients with Parkinson disease and stroke (14,16,17) and in personal care home residents (18).

Functional Gait Assessment

The FGA is a 10 item balance scale that each item is from zero (severe balance impairment) to three (no balance impairment) and the maximum score is 30 points. The FAB scale requires

approximately 15 to 20 minutes to complete (9). The FGA has been found to be accurate in identifying fallers (9,19,20).

Fullerton Advanced Balance Scale

The FAB scale is a 10 item Balance scale with a 5-point Ordinal scale (0-4) with a maximum score of 40 points. The FAB scale requires approximately 10 to 20 minutes to complete (8). The FAB scale has shown high intra-rater reliability (0.92-1.00) and inter-rater reliability (0.91-0.95) and also high test-retest reliability (0.96) (8,21).

Statistics

Descriptive statistics were used to describe the sample. Participants' characteristics were compared between fallers and non-fallers with non-parametric tests for independent groups (Mann-Whitney U tests). The participants' retrospectively assessed faller status was used for diagnosis as a faller or non-faller.

The ROC was created for each balance scale and the AUC of each ROC curve was calculated. The AUC is an index of the diagnostic accuracy of the test. The AUC ranges from 0.5 to 1. 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 (22). The sensitivity (i.e. number of correctly recognized fallers) and specificity (i.e. number of correctly recognized non-fallers) values were calculated (23). Cutoff values were computed as the intersection point which maximized both, sensitivity and specificity by electing the smallest sum of (1-sensitivity) and (1-specificity) (22).

The likelihood ratio integrate both the sensitivity and specificity of the test. The positive likelihood ratio tells how much the likelihood of a person being a faller increases when a test is positive. For determining positive likelihood ratios used from sensitivity/ (1-specificity). The likelihood ratio for a negative result tells how much the likelihood of a person being a faller decreases when a test is negative. Negative likelihood ratios were computed as (1-sensitivity)/specificity (23).

An approach which is described by other authors (13,24) was used for choosing the best items of all four Balance scales to differentiate fallers from no fallers. First, univariate logistic regression analysis was applied for each item as the independent variable and faller statues as the dependent variable. Second, odds ratios were specified for each item dichotomized by a median split. Odd ratios <0.5 were candidate predictors in the univariate regression analysis ($p<0.5$).

Spearman's correlation coefficient (rho) was assessed to examine the relationship between the candidate predictor variables. In the multivariate logistic regression, to keep away from multicollinearity, a candidate predictor with a strong correlation (rho≥0.7) was excluded if the predictor had a higher odds ratio than the other item (25).

All these steps were used to carry out the first objective of the study, i.e. selecting the best items. For the second objective of the research, all the selected items in the first aim put together and are checked together. All statistical analysis were conducted with SPSS software (version 20.0 for Windows, SPSS Inc, Chicago, Illinois). The level of significance was set at 0.05.

Results

A total of 67 men were invited to participate. However, 9 refused to perform the assessment. So, 58 participants were included (46 men living in the community and 12 men living in a seniors' residents). Participants' characteristics and balance scores are presented in Table 1.

Twenty-one of 58 participants (37%) were considered as fallers as they declared having one or more falls within the previous year. The difference in balance scores between non-fallers and fallers was borderline statistically significant for the BESTest (p=0.000), BBS (p=0.002), FGA (p=0.001) and FAB scale (p=0.001) (Table 1).

Table 2 shows the candidate predictors for the multivariate regression analysis. Some of the candidate items were strongly correlated with each other (rho>0.7), so we excluded the candidate items that had fewer odds ratios (i.e. BEST 10, BEST 12, BEST 17, BEST 19C, BEST 19D, BBS 1, BBS 8, FGA 2, FGA 5, FGA 7, FAB 3, FAB 10). In finally, 13 items (i.e. hip/trunk lateral strength,

Table 1. Participants' characteristics and balance scores (n=58)

Characteristics	Without a history of falls (n=37)	With a history of falls (n=21)	p
Age (year)	69.6 (9.3)	66.8 (4.7)	0.745
BMI (kg/m^2)	24.9 (3.2)	25.2 (3)	0.539
Fall history	0	8.8 (21.8)	0.001*
BESTest	79.2 (19.1)	56.0 (19.3)	0.000*
Section 1 of the BESTest	12.8 (2.1)	10.3 (2.3)	0.010*
Section 2 of the BESTest	16.7 (4)	13.5 (4)	0.003*
Section 3 of the BESTest	13.0 (3.8)	8.5 (4.2)	0.001*
Section 4 of the BESTest	11.1 (4.2)	5.7 (4.8)	0.001*
Section 5 of the BESTest	11.9 (3)	9.0 (2.9)	0.002*
Section 6 of the BESTest	13.5 (4)	8.7 (4)	0.001*
BBS	46.2 (8.8)	39.5 (9.4)	0.001*
FGA	18.5 (5.1)	13.1 (5.6)	0.001*
FAB scale	26.4 (7.7)	18.9 (7.3)	0.001*
Suggested model	30.5 (6.2)	18.3 (7.1)	0.001*

BMI: Body Mass index, BESTest: Balance Evaluation Systems test, BBS: Berg Balance scale, FGA: Functional Gait Assessment, FAB scale: Fullerton Advanced Balance scale, *: Significant difference (p<0.05)

Table 2. Candidate predictor variables		
Test	**OR**	**p**
BESTest		
Item 1 (Base of support)	1.73	0.373
Item 2 (COM alignment)	0.00	1.000
Item 3 (Ankle strength and ROM)	0.838	0.854
Item 4 (Hip/trunk lateral strength)	0.038 $^{\alpha}$	0.001
Item 5 (Sit on floor and stand up)	2.424	0.443
Item 6 (lateral lean-left)	0.097	0.002
Item 6 (lateral lean-right)	0.031 $^{\alpha}$	0.002
Item 6 (Sitting verticality-left)	2.530	0.196
Item 6 (Sitting verticality- right)	2.220	0.271
Item 7 (Functional reach forward)	0.029 $^{\alpha}$	0.001
Item 8 (Functional reach lateral-left)	0.511	0.226
Item 8 (Functional reach lateral-right)	0.150	0.002
Item 9 (Sit to stand)	0.020 $^{\alpha}$	0.001
Item 10 (Rise to toes)	0.048 $^{\alpha}$	0.001
Item 11 (Stand on one leg-left)	0.097	0.001
Item 11 (Stand on one leg-right)	0.023 $^{\alpha}$	0.001
Item 12 (Alternate stair touching)	0.046 $^{\alpha}$	0.001
Item 13 (Standing arm raise)	0.989	0.985
Item 14 (In-place response, forward)	0.258	0.031
Item 15 (In-place response, backward)	0.379	0.115
Item 16 (Compensatory stepping correction, forward)	0.032 $^{\alpha}$	0.001
Item 17 (Compensatory stepping correction, backward)	0.038 $^{\alpha}$	0.001
Item 18 (Compensatory stepping correction, lateral-left)	0.062	0.001
Item 18 (Compensatory stepping correction, lateral-right)	0.039 $^{\alpha}$	0.001
Item 19-A (Stance on firm surface, eyes open)	0.804	0.723
Item 19-B (Stance on firm surface, eyes close)	0.992	0.990
Item 19-C (Stance on foam, eyes open)	0.046 $^{\alpha}$	0.001
Item 19-D (Stance on foam, eyes close)	0.046 $^{\alpha}$	0.001
Item 20 (Incline, eyes close)	0.528	0.255
Item 21 (Gait, level surface) $^{\beta}$	0.046 $^{\alpha}$	0.001
Item 22 (Change in gait speed) $^{\beta}$	0.046 $^{\alpha}$	0.001
Item 23 (Walk with head turns, horizontal)	0.278	0.026
Item 24 (Walk with pivot turns) $^{\beta}$	0.029 $^{\alpha}$	0.001
Item 25 (Step over obstacles)	0.664	0.577
Item 26 (Timed "Get Up & Go" test)	0.049 $^{\alpha}$	0.001
Item 27 (Timed "Get Up & Go" test with dual task)	0.406	0.107
BBS		
Item 1 (Sitting to standing)	0.046 $^{\alpha}$	0.001
Item 2 (Standing unsupported)	1.185	0.788
Item 3 (Sitting unsupported)	2.222	0.271
Item 4 (Standing to sitting)	0.317	0.044
Item 5 (Transfers)	0.688	0.515
Item 6 (Standing with eyes closed)	0.846	0.776
Item 7 (Standing with feet together)	0.583	0.400
Item 8 (Reaching forward with outstretched arm)	0.046 $^{\alpha}$	0.001
Item 9 (Retrieving object from floor)	0.804	0.723
Item 10 (Turning to look behind)	0.552	0.331
Item 11 (Turning 360 degrees)	0.025 $^{\alpha}$	0.001
Item 12 (Placing alternate foot on stool)	0.039 $^{\alpha}$	0.001
Item 13 (Standing with one foot in front)	0.116	0.001
Item 14 (Standing on one foot)	0.148	0.002
FGA		
Item 1 (Gait, level surface)	0.046 $^{\alpha}$	0.001
Item 2 (Change in gait speed)	0.046 $^{\alpha}$	0.001
Item 3 (Walk with head turns, horizontal)	0.278	0.026
Item 4 (Walk with head turns, vertical)	0.241	0.015
Item 5 (Walk with pivot turns)	0.029 $^{\alpha}$	0.001
Item 6 (Step over obstacles)	0.664	0.577
Item 7 (Gait with narrow base of support)	0.049 $^{\alpha}$	0.001
Item 8 (Gait with eyes closed)	0.048 $^{\alpha}$	0.001
Item 9 (Ambulating backwards)	0.061	0.001
Item 10 (Steps)	0.596	0.352
FAB scale		
Item 1 (Stand with feet together and eyes closed)	2.220	0.271
Item 2 (Reach forward)	0.148	0.002
Item 3 (Turn 360 degrees in right and left directions)	0.039 $^{\alpha}$	0.001
Item 4 (Step up onto and over a 6-inch bench)	0.465	0.177
Item 5 (Tandem walk)	0.038 $^{\alpha}$	0.001
Item 6 (Stand on one leg)	0.078	0.001
Item 7 (Stand on foam with eyes closed)	0.129	0.001
Item 8 (Two-footed jump)	0.492	0.203
Item 9 (Walk with head turns)	0.169	0.003
Item 10 (Reactive postural control)	0.046 $^{\alpha}$	0.001

OR: Odds ratio, BESTest: Balance Evaluation Systems test, FAB scale: Fullerton Advanced Balance scale, BBS: Berg Balance scale, FGA: Functional Gait Assessment, $^{\alpha}$: Candidate predictor variable with $p<0.05$ in the univariate logistic regression and an odds ratio <0.5, $^{\beta}$: These items are duplicated from FGA, so we omitted them, ROM: Range of motion, COM: Center of mass

lateral lean (right), functional reach forward, sit to stand, stand on one leg(right), compensatory stepping correction (forward), compensatory stepping correction (lateral-right), gait, timed "get up & go", turning 360 degrees, placing alternate foot on stool, gait with eyes closed, and tandem walk) were included as independent variables in the multivariate model, with faller status as the dependent variable (suggested model).

Results from the ROC analyses are shown in Table 3. The BESTest, BBS, FGA and FAB scale had acceptable ability to differentiate participants with and without a history of falls (with AUCs of the ROC curve of 0.78, 0.75, 0.79 and 0.76 respectively). The specified cut-offs are 66 points for BESTest (sensitivity=64%, specificity=84%), 48 points for BBS (sensitivity=61%, specificity=92%), 15 points for FGA (sensitivity=63%, specificity=76%), and 26 points for FAB scale (sensitivity=58%, specificity=86%). Sensitivity to differentiate fall status was similar across Balance tests (58%- 64%). Specificity, was higher for the BBS (92%), and FAB scale (86%) than for the BESTest (84%) and FGA (76%). Also, the suggested model, combining the 13 selected items exhibited better levels of overall accuracy (88%) compared with all of them. Figure 1 shows the AUC of the tests.

Discussion

This is the first study to analyze which items of the BESTest, FAB scale, BBS and FGA might contribute to the detection of fall risk in older adults living in the community and in seniors' residents. These results showed that performing worse on the items hip/trunk lateral strength, lateral lean (right), functional reach forward, sit to stand, stand on one leg (right), compensatory stepping correction (forward), compensatory stepping correction (lateral-right), gait, timed "get up & go", turning 360 degrees, placing alternate foot on stool, gait with eyes closed, and tandem walk was strongly associated with higher fall risk.

Compensatory stepping correction (forward and lateral) is an important item to differentiate fallers from no fallers. Evaluating reactive control is necessary because the ability to successfully recover from instability is the most crucial component of balance for fall avoidance (26). Defect in postural responses is independently associated with falls, resulting in as much as a 6 fold increase in fall occurrence (27).

The incapability to execute tandem walk of patients at risk for falls is in line with the findings of other authors (25). For this item, lateral postural control mechanisms are necessary to obtain balance because of the narrow base of support. Lateral postural instability, which is increasing in older adults (28,29), seems to be an important indicator for future falls.

The 13 selected items of the BESTest, FAB scale, BBS and FGA includes many assessments reported to be most frequently executed by physical therapists (e.g. one leg stance, functional reach, and timed "Up & Go" test) (30). Thus the suggested model items appear to provide valid representative assessments for balance impairment. Clinicians should focus

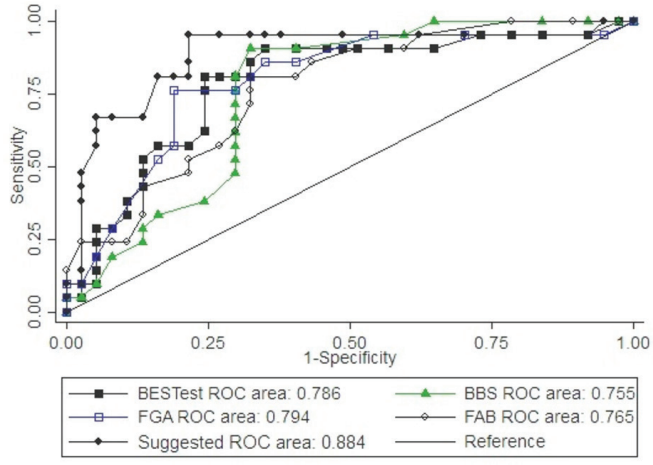

Figure 1. Receiver operating characteristic curves of the Balance Evaluation System test (BESTest), Berg Balance scale (BBS), functional gait assessment (FGA), and fullerton advanced balance (FAB) scale, and suggested model, ROC: Receiver operating characteristic

Table 3. Predictive values for the BESTest, FAB scale, BBS, FGA and suggested model

Test	AUC (95% CI)	Cutoff score	% Sensitivity (95% CI)	% Specificity (95% CI)	Positive likelihood ratios	Negative likelihood ratios
Sec 1	0.70 (0.56, 0.83)	≤11/15	50% (28, 71)	72% (54, 85)	1.8 (0.91, 3.53)	0.69 (0.43, 1.1)
Sec 2	0.73 (0.60, 0.86)	≤15/21	50% (27, 72)	71% (54, 84)	1.73 (0.89, 3.35)	0.70 (0.43, 1.14)
Sec 3	0.80 (0.67, 0.94)	≤9/18	75% (47, 92)	78% (63, 89)	3.5 (1.84, 6.67)	0.31 (0.13, 0.75)
Sec 4	0.77 (0.64, 0.91)	≤8/18	61% (38, 81)	78% (61, 90)	2.86 (1.42, 5.76)	0.48 (0.27, 0.86)
Sec 5	0.74 (0.62, 0.87)	≤10/15	63% (40, 82)	80% (64, 91)	3.27 (1.57, 6.83)	0.45 (0.25, 0.80)
Sec 6	0.80 (0.68, 0.91)	≤13/21	58% (38, 76)	86% (68, 96)	4.25 (1.63, 11.1)	0.48 (0.30, 0.75)
BESTest	0.78 (0.65, 0.91)	≤66/108	64% (42, 82)	84% (68, 94)	4.22 (1.79, 9.97)	0.42 (0.24, 0.73)
BBS	0.75 (0.63, 0.88)	≤48/56	61% (42, 78)	92% (75, 99)	8.27 (2.12, 32.3)	0.41 (0.26, 0.65)
FGA	0.79 (0.66, 0.91)	≤15/30	63% (38, 83)	76% (60, 88)	2.74 (1.4, 5.34)	0.47 (0.25, 0.88)
FAB scale	0.76 (0.64, 0.88)	≤26/40	58% (38, 76)	86% (68, 96)	4.25 (1.63, 11.1)	0.48 (0.30, 0.75)
Suggested model	0.88 (0.78, 0.98)	≤27/45	69% (48, 85)	90% (75, 98)	7.38 (2.44, 22.3)	0.34 (0.18, 0.61)

BESTest: Balance Evaluation Systems test, BBS: Berg Balance scale, FGA: Functional Gait Assessment, FAB scale: Fullerton Advanced Balance scale, AUC: Area under the curve, CI: Confidence interval, Suggested Model consists of 13 items: hip/trunk lateral strength, lateral lean (right), functional reach forward, sit to stand, stand on one leg (right), compensatory stepping correction (forward), compensatory stepping correction (lateral-right), gait, timed "get up & go", turning 360 degrees, placing alternate foot on stool, gait with eyes closed, and tandem walk

on these 13 selected items to identify older adults being at risk for falls.

The results are also in line with Schlenstedt et al. (13) that said ''A model combining the items "tandem stance," "rise to toes," "one-leg stance," "compensatory stepping backward," "turning," and "placing alternate foot on stool" had an AUC of 0.84 of the ROC curve'', which is higher than the AUC of the FAB scale (68%), Mini-BESTest (65%) and BBS (69%) in Parkinson disease individuals.

The another important finding of this study was that the BESTest, BBS, FGA and FAB scale exhibited similar accuracy in differentiating fallers with one or more falls from non-fallers in older adults. Also, the suggested model combining the 13 selected items showed better accuracy than each of the four Balance scales, exhibiting that some of the items of the four Balance tests do not contribute to recognize fall status.

One of the benefits of the suggested model is that it is quick to administer, compared with the BESTest. Also fewer equipment is required to perform the model when compared with the BESTest, FAB scale, BBS and FGA (6-9). The model is inexpensive and easily accessible. Additional studies will be needed on the model. For example, it will be necessary to assessment the relative strengths of this scale in comparison to other tests or scales currently used to evaluate balance.

Although the BESTest, FAB scale, BBS and FGA scores of our participants was similar to that reported in other studies (12,13,21,31), we found different accuracy in the BBS and BESTest scores in some studies (12,32). These findings may have been obtained because we did not control for participants' activity levels, which are in relation to balance (33). We did not control the effect of comorbidities on balance, and it is likely that our participants living in seniors' residents had more comorbidities (34). Also, these researches investigated the prediction of recurrent versus no recurrent fallers (35). In contrast, we investigated between fallers with one or more falls versus no fallers.

In this sample of older adults with cutoff points chosen in this research, the BBS and suggested model were able to correctly recognize approximately 9 out of 10 participants who had no fall in the previous year. Whereas the FAB scale detected only a little fewer than 9 out of 10 true non-fallers, the BESTest detected a little more than 8 out of 10 true non-fallers, and the FGA detected a little fewer than 8 out of 10 true non-fallers. The suggested model identified almost 7 out of 10 true fallers, whereas the BESTest, BBS, FGA and FAB scale identified almost 6 out of 10 true fallers.

Study Limitations

As this was a cross-sectional study, the ability of the balance tests to recognize fall status in older people was analyzed retrospectively. Longitudinal studies is necessary for assessing the ability of these tests in identifying fallers prospectively. Because of religious limitations that there are between males and females in Iran, this study was conducted only on old men.

Conclusion

With regard to the economics of clinical evaluation allowing a very limited amount of patient-clinician contact time, it becomes important to develop an efficient examination. Our results fill an important knowledge gap and may promote the use of which items for balance evaluation in older adults by clinicians. The suggested model proposed the highest sensitivity and specificity to recognize older adults with and without fall in the previous 12 months.

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Ethics

Ethics Committee Approval: Ethical approval was obtained by the Guilan University Research Ethic Board (approval number: 1399.1147, date: 23.06.2020).

Informed Consent: Written informed consent was obtained prior to each data collection session.

Peer-review: Internally 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., Analysis or Interpretation: P.P., Z.A., Literature Search: P.P., A.A.N., Writing: P.P.

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ORIGINAL RESEARCH

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Is Malnutrition Most Associated with Dynamic or Static Physical Performance?

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Abstract

Objective: Malnutrition is a state resulting from lack of uptake or intake of nutrition that leads to altered body composition, decreased fat-free mass and body cell mass. Its prevalence varies according to health conditions and the level of care dependency. The prevalence in individuals over 65 years of age attending outpatient clinics varies in 9% to 15%. Malnutrition can be associated with decreased physical and mental function and impairment of body cell components. Decreased physical capacity causes shortened mobility and difficulties in daily activities such as shopping, cooking, eating, etc. Malnutrition and decline in functional status are two important factors contributing to loss of independence. The aim of this work was to describe the association between nutritional and functional status.

Materials and Methods: This retrospective study included 406 patients aged 60 and older who were referred to the geriatric outpatient clinic at Istanbul University Istanbul Medical Faculty. The nutrition status was determined using the Mini Nutritional Assessment-short form (MNA-SF, cut off ≤11) including six questions specific to diet and anthropometric measurements. The total score can be as high as 14 points. A score of 12 to 14 signifies normal nutritional status and 11 or lower indicates possible malnutrition. Both dynamic and static functional status were evaluated. Measures of dynamic physical performance included the Timed Up and Go test (TUG), Gait Speed test, and Chair Stand test (CST). Static performance was determined by balance tests and hand grip strength (HGS). Linear regression analysis was used to study the association between malnutrition with physical performance.

Results: The study sample comprised 406 participants with the mean age of 74.8±6.7 years. 69.7% were female and 30.3% were male. Malnutrition was found in 28.8% of the patients (n=117). Malnutrition was found most strongly associated with HGS ($p<0.018$) and less strong with Balance test $p=0.046$. There was no significant association between TUG, CST, gait speed and two components of Balance test.

Conclusion: Malnutrition is an important problem which could result in diminished physical and mental function in older people. In our study, malnutrition defined by the MNA-SF was associated with physical performance tests, especially HGS, which is an indicator of static physical performance rather than dynamic functionality measures. MNA-SF might be a useful screening tool as a surrogate marker of functional status, especially if a specific functionality testing cannot be applied.

Keywords: Malnutrition, physical performance, Static and Dynamic test

Introduction

Malnutrition has been defined as "a state, resulting from lack of uptake or intake of nutrition that leads to altered body composition (decreased fat free mass) and body cell mass leading to diminished physical and mental function and impaired clinical outcome from disease" and this definition is synonymous with undernutrition (1). New criteria for diagnosis of malnutrition were introduced in 2018 from the Global Leadership Initiative on Malnutrition. The criteria require the combination of at least one phenotype and one etiologic feature (2). Screening tools for malnutrition include measuring weight, calculating weight loss, and other questionnaires. Mini Nutritional Assessment (MNA) is one of the screening tools that include questions specific to diet and anthropometric measurements.

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Malnutrition is accompanied by loss of body weight, muscle mass and strength (3) that is common in older individuals and may have greater impact on outcomes such as physical function (4). Muscle mass is a key linking substrate between malnutrition and physical performance. Either malnutrition and poor physical function may be highly interrelated and may potentiate each other. Assessment of the physical function of the older people has importance in clinical risk evaluation (5). There are some different ways of determining both the dynamic and static physical functions. Dynamic physical performance measures include tests of Timed Up and Go test (TUG), gait speed (4-m walk test), and Chair Stand test (CST). Static performance measurements include balance test (side-by-side, semi-tandem, and full tandem stand) and hand grip strength (HGS).

In this study, we aimed to evaluate the malnutrition status and its correlation with dynamic and static physical performance among older patients presented to our outpatient clinic, due to the increasing prevalence of malnutrition and lack of studies assessing these factors in the Turkish community.

Materials and Methods

Study Design

This retrospective study included 406 community dwelling older patients aged ≥60 who were referred to Istanbul University's geriatric outpatient clinic from January 2018 to January 2020. The study has been approved by Istanbul University, Istanbul Medical Faculty, Ethical Committee (approval no: 90767, date: 06.06.2020).

Measurement of Nutritional Status

MNA has two parts - short and total form. The total form consists of 18 questions in five sub-categories. Functionality, general assessment, anthropometry, dietary assessment and subjective assessment are evaluated in these tests (6). Previous study revealed that short form MNA (MNA-SF) was strongly correlated with the total MNA score. In this study the presence of malnutrition status was determined by using MNA-SF (7). The MNA-SF consists of six questions related to acute disease, neuropsychological problems, body mass index, weight loss, mobility and decline of food intake. According to the short form score (0-14 points) the subjects are classified as well nourished (>11 points), at risk of malnutrition (8-11 points) and malnourished (0-7 points). In this study poor nutrition status was defined as scores ≤ 11 points in MNA-SF.

Performance Status

Measurement of both dynamic and static physical performance were evaluated. Measures of dynamic physical performance included TUG, 4-m Walk test and CST. Static performance was determined by Balance tests and HGS. As TUG test measures the patient's time while they stand up from a chair, walk three meters, return to the chair and sit down again (8). The cut off score was ≥20 sn. To determine 4-m walk test, patients were instructed to walk at their comfortable speed. To avoid of slowing patient down walking distance exceeded the required four meters. The time they reached at 4 meters was expressed as m /s. To perform CST test patient were told to fold their arms across their chest and try to stand up once from a chair for 5 repeats. The total time that required to perform five rises was measured.

Handgrip strength was measured by Jamar hydraulic hand dynamometer. The patients were instructed to squeeze the tool with whole strength three times with each hand, the maximum score was used for analyses. Values <27 kg for men and <16 kg for women were classified as weak. Other test for measuring static analyzes was Balance test. Balance test recorded as side by side, semi-tandem, and tandem.

Statistics

The characteristics of the participants were described. When data were distributed normally continuous variables were presented as mean and standard deviation. Dichotomous variables were reported by the number (n) and percentage (%). Linear regression analysis was used to study the association between malnutrition with both dynamic and static measures of physical performance. Results for the linear regression analysis are presented as beta, or for the logistic regression as odds ratios, and 95% confidence intervals with p values.

For all statistical analyses, SPSS version 21.0 program were used. A p value of less than 0.05 was considered as statistically significant.

Results

This study included 406 geriatric outpatients [283 (69.7%) women and 123 (30.3%) men]. The mean age of the participants was 74.8±6.7. Characteristics of the patients are shown in Table 1.

More than half of the participants (71.2%) had a normal nutritional state but 28.8% (n=117) suffered from malnutrition or were at risk of malnutrition. The measures of both dynamic and Statics test are shown in Table 2.

Table 3 shows the correlation between malnutrition based on MNA-SF and measures of different physical performance. Malnutrition was most strongly associated with HGS (p<0.018) and Balance test (tandem) (p<0.046).

Discussion

The purpose of this study was to compare the associations between malnutrition and risk of malnutrition based on

MNA-SF questionnaire; and dynamic and statics physical performance measures in geriatric outpatients. We use TUG test, 4-m Walk test and CST as dynamic physical measures and balance test and HGS as static physical measures. Malnutrition was most associated with HGS and Tandem Balance test which were pointers of static performance. There was no significant association between TUG, 4-m Walk test and CST. Dynamic and static physical performance tests are used for assessment of muscle strength and muscle power. Although dynamic physical performance tests rely more on muscle power; static physical performance tests are associated more with muscle strength.

Table 1. Characteristics of geriatric outpatients

Measure	Total (n)=406	SD
Age, mean Female Male	74.8 74.3 (min=61-max=91) 76 (min=62-max=90)	6.7 6.8 6.5
Gender (n) Female (%) Male (%)	 283 (69.7) 123 (30.3)	 - -
BMI (kg/m^2) BMI female (kg/m^2) BMI male (kg/m^2)	30.2 (min=13.3-max=58.7) 31.2 (min=13.4-max=58.7) 27.9 (min=13.3-max=40.2)	5.8 6 4.5
Number of medications, mean	6.3 (min:0- max:21)	3.6
Multimorbidity[1] (%)	362 (89.2)	-

[1]: Multimorbidity as defined as two or more diseases, SD: Standard deviation, n: Number, BMI: Body Mass index, kg: Kilogram, min: Minimum, max: Maksimum, m: Meter

Table 2. The measures of the dynamic and statics test

Measure	Total	SD
Malnutrition[1]	117 (28.8%)	-
Gait speed (m/s), mean	0.84 m/s (0-1, 59 m/s)	0.2
CST time (s), median	13.4 (min 5.7-max 36/s)	5.3
TUG (s), median	11.4 (min 5-max 36.7/s)	5.4
HGS[2] (kg), mean HGS (kg) female HGS (kg) male	24.2 (min 6-max 52 kg) 20.7 (min 6-max 40 kg) 32.2 (min 10 -max 52)	8.1 5.1 8
SPPB score, mean	9.3 (min 0-max 12)	3
Balance test[3] Side by side (able: 0 point, unable: 1 point) Semi tandem (able: 0 point, unable: 1 point) Tandem (able: 0 point, unable: 1 point)	 0 point: 392 (93.6%) 1 point: 14 (3.4%) 0 point: 380 (93.6%) 1 point: 26 (6.4%) 0 point: 71 (17.5%) 1 point: 335 (82.5%)	 - - - - - -

[1]: Malnutrition status was determined from the MNA-SF using a cut-off of ≤11, [2]: Balance tests were dichotomized into unable and able to maintain for 10 s, [3]: HGS cut offs were <27 kg for men and <16 kg for women, SPPB: Short physical performance battery, CST: Chair Stand test, TUG: Timed Up and Go test, HGS: Hand grip strength, SD: Standard deviation, min: Minimum, max: Maksimum, kg: Kilogram, MNA-SF: Mini Nutritional Assessment- short form

As we expected there was significant association between malnutrition and HGS cause of being direct measure of muscle function. There is a contradiction between HGS and malnutrition. Some authors have offered for the extra value of HGS in nutritional assessment (9). Furthermore, the result of a study that aimed to show effect of the nutritional supplementations on physical performance showed a significant improvement in HGS compared to other physical performance test (11). Despite that some previous studies showed that HGS may be of limited use as a predicting malnutrition (12,13).

In this study, the tandem test as one of the standing balance tests was correlated with malnutrition status. A previous study found positive association between HGS and standing balance test, that both relies on muscle strength and it is explained by the differences between characteristics of muscle strength and muscle mass (14). Muscle strength is affected by neuromuscular system and measurement values are determined by neural, mechanical and muscular factors (15). Furthermore, the age appears to be more contributed to the decline of muscle strength rather than muscle mass (16).

On the other hand, there is still unclearness about the relationship between malnutrition and poor physical performance. Some previous papers fenced that muscle strength and muscle power were less strong associated compared to association of malnutrition and muscle mass (17,18). Additionally, previous studies from Turkey showed significant relations between low scores of MNA and low skeletal Muscle Mass index in nursing homes residents (19), and sarcopenic males in nursing home (20).

Table 3. Correlation matrix of mini nutritional assesment and functional parameters (linear correlation)

	Z balance side by side	Z balance semi tandem	Z balance tandem	Z CST	Z gait speed	Z TUG	Z HGS
β (95% CI)	0.008 (-0.185, 0.200)	0.081 (-0.092, 0.254)	-0.128 (0.002, 0.254)	-0.076 (-0.274, 0.122)	0.071 (-0.156, 0.296)	-0.016 (-0.211, 0.178)	-0.134 (-0.246, -0.023)
p	0.938	0.35	0.046*	0.451	0.540	0.869	0.018*

*: p<0.05, CST: Chair Stand test, HGS: Hand grip strength, TUG: Timed Up and Go test, CI: Confidence interval

Lower muscle mass may cause mobility difficulties in malnourished patients which effects negatively to muscle strength and power and contributes to interference with physical activity (21). Otherwise some recent study' authors found that there was no association between muscle mass and physical performance measured by standing balance test (14).

MNA-SF was used to define malnutrition status in our study. There is no gold standard for screening of malnutrition. Prevalence of malnutrition can change cause of using different nutritional screening tools.

Our study showed malnutrition is associated with static physical performance rather than dynamic physical performance. Although a previous study advocated that malnutrition was most associated with dynamic physical performance (13). The authors argue that functional decline is associated not only with muscle strength also with muscle power. The fact that, muscle strength was found to be effected from neural, mechanical, muscular, metabolic problems as well as age rather than muscle mass (22). Addition to this elderly patient are more likely to have several multimorbidity and multisystem health problems as cognitive impairment, cardiological problems and joint function that can negatively effect on muscle strength.

The strength of this study was that nutritional and functional status were deeply analyzed by validated instruments in a comparatively large sample of Turkish older adults. Despite that, this study has some limitations. The participants were limited to the elderly with physical functional dependency, so the results of this study might not be generalizable to all Turkish older adults. Also, participants were only community outpatient, the home care dwellers and inpatient were not included which might also limit the generalizability. In this study we could not ignore the causative relationship that nutritional status influences the onset and the progress of a poor physical performance; on the other side, poor physical performance itself may provoke malnutrition.

Summering up, our results suggest that almost one third of elderly population was at nutritional risk. Malnutrition according to MNA-SF was mostly associated with static functionality measures. As a result, MNA-SF might be useful screening tool as a surrogate marker of functional status, especially if specific functionality testing cannot be applied; besides poor physical performance can provide information involved malnutrition state. Further studies are needed for a better understanding of the interaction between malnutrition status and different kinds of poor functional impairment in older people.

Ethics

Ethics Committee Approval: The study has been approved by Istanbul University, Istanbul Medical Faculty, Ethical Committee (approval no: 90767, date: 06.06.2020).

Informed Consent: The study is a retrospective study, no additional patient consent form has been created.

Peer-review: Internally peer-reviewed.

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Signet Ring Cell Carcinoma Finding after Thoracentesis: When a Routine Procedure Reveals Something Else

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Image Discussion

An 83-year-old male consulted the cardiologist for New York Heart Association functional classification functional class deterioration, anemia and chronic fatigue. He had a history of heart failure with preserved ejection fraction, Diabetes Mellitus, dyslipidemia, hyperuricemia, primary hypothyroidism, herpetiform dermatitis, alleged Sjögren's syndrome, arterial hypertension, hypertensive heart disease, mitral sclerosis with mild regurgitation, ischemic cardiomyopathy (present unstable angina and past myocardial infarction), stent placement in the left anterior descending artery, transient ischemic attack and bilateral carotid disease treated by angioplasty and stenting.

Two weeks earlier the patient complained about chest pain, dyspnea and cough with hyaline expectoration. He was diagnosed with community acquired pneumonia and received antibiotics, reporting incomplete clinical improvement. The day of the consult, transthoracic echocardiography revealed a bilateral parapneumonic pleural effusion (PPE). The patient was admitted and referred to the pneumologist, who performed a thoracentesis and extracted 1.420 mL of mildly hematic liquid. Laboratory examination gave the result of cellular atypia. Hence, samples from right and left effusions were sent for pathology assessment, reporting evidence of numerous epithelial cells distributed in small groups in isolation. They presented eccentric nuclei, clear cytoplasm with vacuolated aspect, and some adopted the form of signet ring cells (SRC). The specimen was positive for malignant neoplastic elements, compatible with SRC adenocarcinoma (Figure 1). The patient decided not to continue with the diagnostic procedure and was discharged.

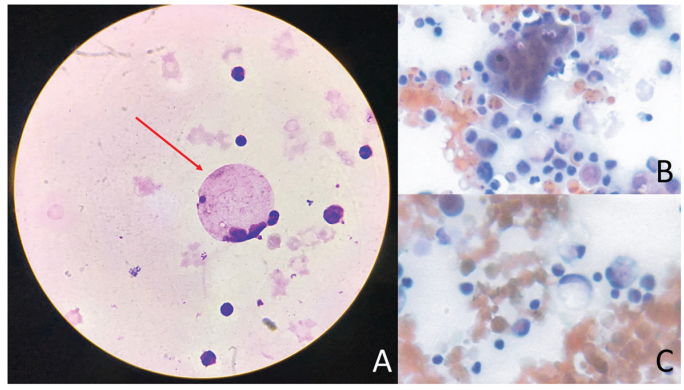

Figure 1. A) Cellular atypia later identified as signet ring cell adenocarcinoma. Various cells with the same morphology were found on the initial pleural effusion analysis by the clinical laboratory. Gram stain, 40x. B) Left pleural effusion pathology analysis. Papanicolaou stain, 40x. C) Right pleural pathology analysis. Papanicolaou stain, 40x

SRC carcinoma is a subtype of mucin-producing adenocarcinoma. It is rare, aggressive, poorly differentiated and often originates from the gastrointestinal tract (1). Furthermore, it has a late presentation and carries a poor prognosis (1). According to the guidelines, PPE's treated with antibiotics that show a poor evolution need a prompt clinical reassessment, analysis of a sample of the fluid (repeat if previously collected) and, probably, effusion drainage by chest tube (2). Hence, since the patient presented a poor clinical progress in spite of being treated with antibiotics, we decided to drain the PPE by needle aspiration, with good results. Thus, we believe that PPE drainage in old patients with unsatisfactory clinical evolution is justified, adding symptomatic improvement and the possibility of discovering hidden pathologies like neoplasia. Finally, this case is a reminder

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that should alert us to consider the presence of malignancies as the cause of clinically unwell elder patients when other conditions are ruled out.

Keywords: Signet ring cell carcinoma, thoracentesis, old age, parapneumonic pleural effusion

Ethics

Informed Consent: Written consent was obtained.

Peer-review: Internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: P.D.L.A., A.L.R.G., Concept: P.D.L.A., A.L.R.G., J.M.G.R., J.M.G.Y., Design: J.M.G.R., J.M.G.Y., Data Collection or Processing: P.D.L.A., A.L.R.G., J.M.G.R., Analysis or Interpretation: P.D.L.A., A.L.R.G., J.M.G.R., Literature Search: J.M.G.R., Writing: J.M.G.R.

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Elderly Fall and Glaucoma: Vision Assessment in Geriatrics

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To the editor,

A 67-year-old glaucoma man fell on level ground with left sided tripod fracture (Figure 1). He suffered from both eyes primary open angle glaucoma, but failed pharmacological treatment and trabeculectomy surgery. His visual field (VF) loss is extensive, (Figure 2), so left eye Baerveldt glaucoma implant, followed by right eye Ahmed glaucoma valve were implanted for intraocular pressure control.

Primary glaucoma, being a top cause of blindness worldwide, is generally more prevalent in elderly (1). Secondary glaucoma like angle closure, phacomorphic glaucoma are particularly related to aging cataract lens. Fall in geriatric glaucoma patients is not rare, and occasionally causes serious sequelae (2).

Vision assessment not only counts on visual acuity (VA), but also contrast sensitivity, colour vision and VF. In geriatric patients, both near and distance VA should be assessed, as uncorrected presbyopia is common cause for poor vision, where management is simply a pair of glasses. VA charts' testing with black letters on white background is under high contrast, thus possibly missing early diagnosis of glaucoma patients who suffered slight decrease in contrast sensitivity only (3). Loss in contrast sensitivity is associated with increased falls in elderly, and sometimes explain discrepancy between reasonable acuity in clinic, but poor functional vision in dimly lit elderly home (4). Vistech chart, Pelli-Robson chart or Cambridge chart are possible testing tools for contrast sensitivity, and aiding diagnosis of low vision and glaucoma. Most optic neuropathies give characteristic red-green colour deficiency, however in early glaucoma, blue-yellow colour deficiency is detected instead (5).

VF testing helps detecting and monitoring diseases of optic nerve and intracranial visual pathway. Normal VF is 50, 60, 70 and 90-degree respectively over superior, nasal, inferior and temporal directions. However, refractive status, VA, presence of dermatochalasis, senile ptosis and tremor in old people could hinder a reliable interpretation of VF defect. In clinic, simplest qualitative method for peripheral VF is by confrontation, whereas central 10-degree by Amsler grid. For more accurate and detailed quantification, perimetry could be used. Kinetic perimetry is based on a moving stimulus of known luminance from a non-seeing area to a seeing area. In contrast, static perimetry involves a static on-off stimuli of variable luminance presented throughout the potential field. Automated static perimetry is commonly used for glaucoma progression analysis, (Figure 2) yet patient's cooperation and concentration is of paramount importance, which sometimes is difficult for the elderly.

Mobility helps people to navigate, driving and continue to use public transport with confidence. Elderly mobility is particularly affected by inferior and central field defects, and geriatricians should bear in mind for assessing rehabilitation potential. In glaucoma patients, common visual field defects include blind spot enlargement, nasal stepping, or paracentral scotoma in early stage; progressing to arcuate scotoma later, subsequently enlarging to become altitudinal field defects in late stage. Eventually, only residual temporal or central island of vision left form dense constriction of peripheral fields (Figure 2), before complete blindness occurs.

In conclusion, contrast sensitivity and VF are important parameters for vision assessment in elderly, coincidentally glaucoma causes loss in both.

Keywords: Vision, glaucoma, computed tomography, eye

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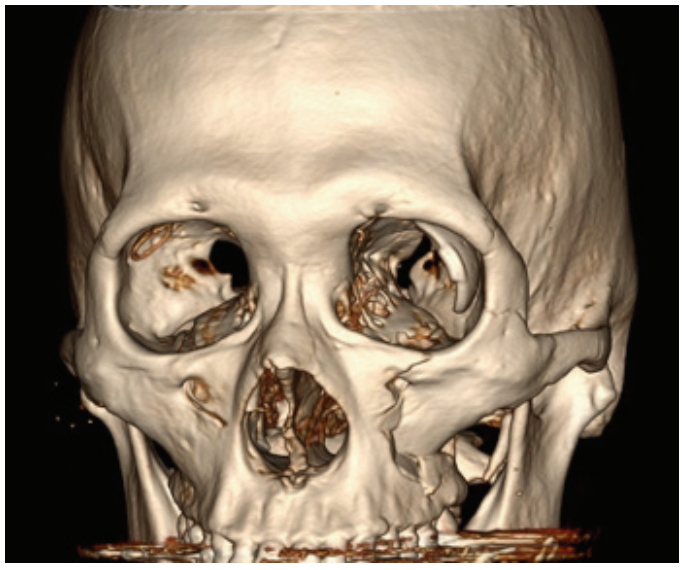

Figure 1. Computed tomography of the skull and face. Left tripod fracture is evidenced by cracks over zygomatic arch, lateral and inferior orbital wall. The large plate of Baerveldt glaucoma implant and the small ring-shaped Ahmed glaucoma valve implant could be seen respectively over left and right orbit

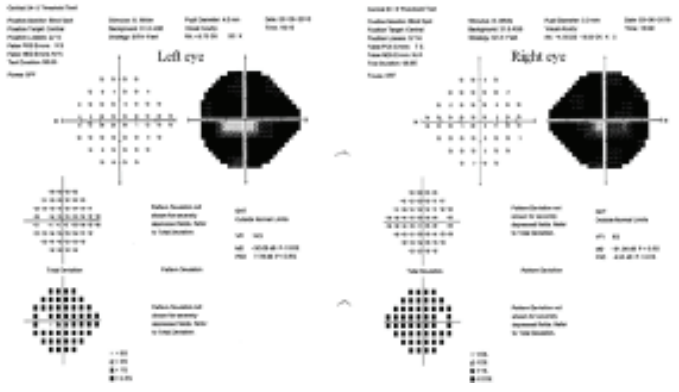

Figure 2. Visual Field test by static automated Humphrey 24-2 perimetry. This Threshold test showed bilateral altitudinal defects over superior field, and bilateral dense constriction over peripheral inferior fields, more severe over right eye. Residual central island of vision left was 10-degree and <5 degree for left and right eye respectively

Authorship Contributions

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