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# European Journal of Geriatrics and Gerontology

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## REVIEW



## ORIGINAL ARTICLES



## CASE REPORTS



galenos yayınevi

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*Reviewing the articles' conformity to the publishing standards of the Journal, typesetting, reviewing and editing the manuscripts and abstracts in English and publishing process are realized by Galenos.*

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European Journal of Geriatrics and Gerontology

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# Aims and Scope

European Journal of Geriatrics and Gerontology is an international, open access, scientific, peer-reviewed journal in accordance with independent, unbiased, and double-blinded peer-review principles of the Academic Association of Geriatrics. It is a double peer-reviewed journal published quarterly in April, August and December electronically. The publication language of the journal is English.

Our mission is to provide practical, timely, and relevant clinical and basic science information to physicians and researchers practicing the geriatrics and gerontology worldwide. Topics of European Journal of Geriatrics and Gerontology include;

Aging
Aging Biology
Alzheimer's Disease
Biogerontology
Bone health in older people
Cell Biology
Clinical Geriatrics
Clinical Geropsychology
Cognitive Disorders
Demography of Older Populations
Dental and Oral Health
Delirium
Diabetes Mellitus
Dizziness
Disability
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Geriatric Depression
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Parkinsons Disease
Parkinsonian syndromes
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Psychological Gerontology
Sarcopenia
Sleep Disorders
Syncope
Social Gerontology
Stroke Medicine

Special features include rapid communication of important timely issues, surgeon' workshops, interesting case reports, surgical techniques, clinical and basic science review articles, guest editorials, letters to the editor, book reviews, and historical articles in geriatrics and gerontology.

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

The evaluation and publication processes of the European Journal of Geriatrics and Gerontology are shaped in acceptance with the guidelines of ICMJE (International Committee of Medical Journal Editors), COPE (Committee of Publication Ethics), EASE (European Association of Science Editors), and WAME ( World Association of Medical Editors). The journal also is in conformity with the Principles of Transparency and Best Practice in Scholarly Publishing (doaj.org/bestpractice).

European Journal of Geriatrics and Gerontology is indexed in the TUBITAK/ULAKBIM, EBSCO, Gale, ProQuest, J-Gate, CABI, Türk Medline and Turkey Citation Index.

All manuscripts should be submitted through the journal's web page at www.ejgg.org Instructions for authors, technical information, and other necessary forms can be accessed over this web page. Authors are responsible for all content of the manuscripts.

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# Ethical Policy

## Peer Review, Publication Ethics and Malpractice Statement

**Peer- Review**

Submission is considered on the conditions that papers are previously unpublished and are not offered simultaneously elsewhere; that authors have read and approved the content, and all authors have also declared all competing interests; and that the work complies with the Ethical Approval and has been conducted under internationally accepted ethical standards. If ethical misconduct is suspected, the Editorial Board will act in accordance with the relevant international rules of publication ethics (i.e., COPE guidelines).

Editorial policies of the journal are conducted as stated in the rules recommended by the Council of Science Editors and reflected in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication (http://www.icmje.org/). Accordingly, authors, reviewers, and editors are expected to adhere to the best practice guidelines on ethical behavior contained in this statement.

Submitted manuscripts are subjected to double-blinded peer-review. The scientific board guiding the selection of the papers to be published in the journal consists of elected specialists of the journal and, if necessary, selected from national and international experts in the relevant field of research. All manuscripts are reviewed by the editor, section associate editors and at least three internal and external expert reviewers. All research articles are interpreted by a statistical editor as well.

**Human and Animal Rights**

For the experimental, clinical and drug human studies, approval by ethical committee and a statement on the adherence of the study protocol to the international agreements (World Medical Association Association of Helsinki "Ethical Principles for Medical Research Involving Human Subjects," amended October 201, www.wma.net) are required. In experimental animal studies, the authors should indicate that the procedures followed were by animal rights (Guide for the care and use of laboratory animals, www.nap.edu.catalog/5140.html), and they should obtain animal ethics committee approval. The Ethics Committee approval document should be submitted to the European Journal of Geriatrics and Gerontology together with the manuscript.

The approval of the ethics committee, statement on the adherence to international guidelines mentioned above and that the patient's informed consent is obtained should be indicated in the "Materials and Methods" section and is required for case reports whenever data/media used could reveal the identity of the patient. The declaration of the conflict of interest between authors, institutions, acknowledgement of any financial or material support, aid is mandatory for authors submitting a manuscript, and the statement should appear at the end of the manuscript. Reviewers are required to report if any potential conflict of interest exists between the reviewer and authors, institutions.

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This journal uses "iThenticate" to screen all submissions for plagiarism before publication.

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**Plagiarism:** To Republish whole or part of a content in another author's publication without attribution.

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## A. DUTIES OF PUBLISHER:

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The publisher will take all appropriate measures to modify the article in question, in close cooperation with the editors, in cases of alleged or proven scientific misconduct, fraudulent publication, or plagiarism. This includes the prompt publication of an erratum, disclosure, or retraction of the affected work in the most severe case. Together with the editors, the publisher will take reasonable steps to detect and prevent the publication of articles in which research misconduct occurs and will under no circumstances promote or knowingly allow such abuse to occur.

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The editor of the journal keeps under control everything in the journal and strives to meet the needs of readers and authors. The editor is also responsible for deciding which articles submitted to the journal should be published

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Authors should not submit the same study for publishing in any other journals. Simultaneous submission of the same study to more than one journal is unacceptable and constitutes unethical behaviour.

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Authorship of a paper ought to be limited to those who have made a noteworthy contribution to the study. If others have participated in the research, they should be listed as contributors. Authorship also includes a corresponding author who is in communication with the editor of a journal. The corresponding author should ensure that all appropriate co-authors are included in a paper.

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Sleep Disorders
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Social Gerontology
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The European Journal of Geriatrics and Gerontology accepts invited review articles, research articles, brief reports, case reports, letters to the editor, and images that are relevant to the scope of geriatrics and gerontology, on the condition that they have not been previously published elsewhere. Basic science manuscripts, such as randomized, cohort, cross-sectional, and case control studies, are given preference. All manuscripts are subject to editorial revision to ensure they conform to the style adopted by the journal. There is a double blind kind of reviewing system.

As a peer-reviewed journal that is independent, impartial and in compliance with the principles of double-blinded peer review, after checking the compliance of the submitted manuscript with the writing rules and plagiarism control, all articles are reviewed by the editor-in-chief, section editor, at least two reviewers, and statistic editor. All evaluation process except Editor-in-Chief is done double-blinded. After all these processes are completed, the Editor-in-Chief decides whether to publish or reject the article. In the final stage, the plagiarism review is repeated once more

Following receiving each manuscript, a checklist is completed by the Editorial Assistant. The Editorial Assistant checks that each manuscript contains all required components and adheres to the author guidelines, after which time it will be forwarded to the Editor in Chief. Following the Editor in Chief's evaluation, each manuscript is forwarded to the Associate Editor, who assigns reviewers. Generally, all manuscripts will be reviewed by at least two reviewers selected by the Associate Editor, based on their relevant expertise. An associate editor could be assigned as a reviewer along with the reviewers. After the reviewing process, all manuscripts are evaluated in the Editorial Board Meeting.

European Journal of Geriatrics and Gerontology's editor and Editorial Board members are active researchers. It is possible that they would desire to submit their manuscript to European Journal of Geriatrics and Gerontology. This may be creating a conflict of interest. These manuscripts will not be evaluated by the submitting editor(s). The review process will be managed and decisions made by the editor-in-chief, who will act independently. In some situations, this process will be overseen by an outside independent expert in reviewing submissions from editors.

**Preparation of Manuscript**

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

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

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Preparation of research articles, systematic reviews and meta-analyses must comply with study design guidelines:

CONSORT statement for randomized controlled trials (Moher D, Schultz KF, Altman D, for the CONSORT Group. The CONSORT statement revised recommendations for improving the quality of reports of parallel-group randomized trials. JAMA 2001; 285: 1987-91) (http://www.consort-statement.org/);

PRISMA statement of preferred reporting items for systematic reviews and meta-analyses (Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 2009; 6(7): e1000097.) (http://www.prisma-statement.org/);

STARD checklist for reporting studies of diagnostic accuracy (Bossuyt PM, Reitsma JB, Bruns DE, Gatsonis CA, Glasziou PP, Irwig LM, et al., for the STARD Group. Towards complete and accurate reporting of diagnostic accuracy studies: the STARD initiative. Ann Intern Med 2003;138:40-4.) (http://www.stard-statement.org/);

STROBE statement, a checklist of items that should be included in reports of observational studies (http://www.strobe-statement.org/);

MOOSE guidelines for meta-analysis and systemic reviews of observational studies (Stroup DF, Berlin JA, Morton SC, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting Meta-analysis of observational Studies in Epidemiology (MOOSE) group. JAMA 2000; 283: 2008-12).

**Title Page**

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

The title page should include the authors' names, degrees, 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, listed separately. Please provide contact information for the corresponding author, including name, e-mail address, and telephone and fax numbers.

**Running Head:** The running head should not be more than 40 characters, including spaces, and should be located at the bottom of the title page.

**Word Count:** A word count for the manuscript, excluding abstract, acknowledgements, figure and table legends, and references, should be provided, not exceeding 3000 words. The word count for an abstract should not exceed 250 words.

**Conflict of Interest Statement:** This statement must be included in each manuscript to prevent potential conflicts of interest from being overlooked. In case of conflicts of interest, every author should complete the ICMJE general declaration form, which can be obtained at: http://www.icmje.org/coi_disclosure.pdf.

**Abstract and Keywords:** The second page should include an abstract that does not exceed 250 words. Moreover, as various electronic databases integrate only abstracts into their index, significant findings should be presented in the abstract.

**Abstract**

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

**Materials and Methods:** Important methods should be written, respectively.

**Results:** Important findings and results should be provided here.

**Conclusion:** The study's new and important findings should be highlighted and interpreted.

Other types of manuscripts, such as case reports, reviews and others, will be published according to uniform requirements. Provide at least 3 keywords below the abstract to assist indexers. Use terms from the Index Medicus Medical Subject Headings List (for randomized studies, a CONSORT abstract should be provided ( http://www.consort-statement.org ).

**Original Articles**

Original articles should have the following sections;

**Introduction:** The introduction should include an overview of the relevant literature presented in summary form (one page), and whatever remains engaging, 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 available information when 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 essential 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 essential findings, results, and observations in the text. 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 significant values (i.e. p-value and confidence interval) should be provided.

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

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

Conclusion: The conclusion of the study should be highlighted.

**References**

Cite references in the text, tables, and figures with numbers in parentheses. Number references consecutively according to the order they first appear in the text. Journal titles should be abbreviated according to the style used in Index Medicus (consult List of Journals Indexed in Index Medicus). Include among the references any paper accepted but not yet published, designating the journal and followed by, in press. Authors are solely responsible for the accuracy of all references.

**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. Acta Neurol 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.

**Case Reports**

**Case reports should be structured as follows:**

**Abstract:** An unstructured abstract that summarizes the case.

**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 of the disease process.

**Review Articles**

Review articles should not include more than 100 references. 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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REVIEW

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# Prevention, Diagnosis and Coping Strategies in Older Patients Suffering from COVID-19 During Its First Wave: An Overview in 6 Different Global European Initiative Countries (Hungary, Lebanon, Russian Federation, Slovenia, Tunisia and Turkey)

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## Abstract

Coronavirus disease-2019 (COVID-19) pandemic starts abruptly in March 2020 catching almost all countries unprepared. Older adults were one of the most adversely affected individuals. In 2020 EuGMS (European Geriatric Medicine Society) e-congress, a specific session was dedicated to identify and compare the approaches during the first wave of the pandemic among Global European Initiative countries, which include active members from Eastern Europe, South-Eastern Europe, the Balkans and Mediterranean countries. We aimed to outline the management actions across the six countries (i.e., Hungary, Lebanon, Russian Federation, Slovenia, Tunisia and Turkey) involved in the session. We formulated four main questions to outline interest of four areas related to COVID-19 in individual countries: (i) The diagnosis protocol of COVID-19 for older adults, (ii) The hospitalization protocol for older adults with COVID-19, (iii) The governmental and social coping strategies against the pandemic and geriatricians' roles, (iv) Protection for the nursing home residents. The main areas of interest were detailed with standardized sub-questions to have a comparable standardized data between the participant countries. Diagnostic protocols for COVID-19 in older adults showed some differences across European countries; as half of the countries applied the algorithm suggested by World Health Organization, the other half developed their own algorithms. Of note, all countries indicated that the diagnostic procedures, protocols regarding hospitalization and intensive care unit transfer of older adults generally did not differ from young age groups. Although older age was considered as a criteria for admission in half of the countries, geriatric syndromes like frailty and malnutrition were generally overlooked. The common coping strategy against pandemic was to ensure older people stay at home and limit their social contact; by few of countries applying lock-downs only for specific age groups including older adults. Although restrictions and precautions taken in nursing homes were generally similar and mostly worked in protecting residents from COVID-19, some countries have indicated their observation of restrictions causing significant psychosocial negative effects on older adults. Although management of COVID-19 in older individuals seemed to be similar between countries in the whole picture, it seems geriatric perspective still needs to be more active on the scene, to prevent this vulnerable group from once again being exposed to increased psychosocial problems, morbidities and mortalities in a future pandemic.

**Keywords:** COVID-19, older adults, pandemic, approach, Global European Initiative, first wave

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## Introduction

Coronavirus disease-19 (COVID-19) emerged abruptly with the report of first cases in Wuhan, China in December 2019. The increasing number of cases have been notified across the world in a short time due to its ability of rapid spreading. This quick global transmission urged the World Health Organization (WHO) to declare a pandemic on March 11, 2020 (1).

From its start, COVID-19 displayed peaks and decreases in incidence resulting in COVID waves. The first wave of the pandemic caught most of the countries unprepared to this highly demanding situation. The first wave was noted between March 2020 July/August 2020 with the ancestral variant (2-4). Until May 2020, the pandemic exerted a high negative impact on health and after that, negative effects declined from June 2020 onwards. The second wave of the pandemic begun at the end of August 2020. As a result of the rapid spread, there had been nearly 25 million confirmed cases and nearly 800,000 deaths as of 30 August 2020 (5).

Advanced age itself and underlying medical comorbidities such as morbid obesity, hypertension and cardiovascular disease are independent risk factors for severe COVID-19 (6-8). In many countries older adults were the most severely affected by the pandemic and every country developed its own strategy to fight it according to their socio-demographic characteristics, healthcare systems and resources.

From the beginning of the pandemic, EuGMS has tried to provide advice and instructions regarding adequate protection and medical care for older patients. The e-congress in 2020 has been thematically dedicated to COVID-19 and contributed to better awareness of many aspects of this disease. In this congress, a specific session was dedicated to identification of different approaches during the first wave of the pandemic (between March 2020-August 2020) (2) among Global European Initiative (GEI) countries that include active members of the EuGMS coming from Eastern Europe, South-Eastern Europe, the Balkans and Mediterranean countries (Hungary, Lebanon, Russian Federation, Slovenia, Tunisia and Turkey). The session named "Prevention and treatment - COVID-19 patients from community to hospitalization across the GEI countries" aimed to present the experiences and approaches in different countries. This comparison could provide an overview of different approaches and enable individual countries to analyse their own approaches. This might provide different perspectives to the countries and might help to reduce the adverse impact of the disease in older adults. Our objective in this paper was to outline these approaches across six GEI countries -Hungary, Lebanon, Russian Federation, Slovenia, Tunisia and Turkey- that were involved in the session.

## Methods

During the EuGMS e-congress GEI-COVID meeting, a session was organized with the participation of GEI countries from various regions around the globe, including Eastern Europe, South-Eastern Europe, the Balkans, and the Mediterranean. The aim of this session was to address inquiries and provide insights in four specific areas related to COVID-19 (i) The diagnosis protocol of COVID-19 for older adults, (ii) The hospitalization protocol for older adults with COVID-19, (iii) The governmental and social coping strategies against the pandemic and geriatricians' roles, (iv) Protection for the nursing home residents.

In this comparative observational study, six GEI countries (i.e., Hungary, Lebanon, Russian Federation, Slovenia, Tunisia and Turkey) actively participated in the 2020 EuGMS e-congress with a shared eagerness to address inquiries and contribute to a deeper comprehension of pandemic hotspots, particularly with a focus on older adults.

### To This End, the Following Four Questions Were Formulated:

Question 1. Which protocol was followed from the beginning of the pandemic to diagnose COVID-19 for older adults? Did this protocol differ from the one applied in younger adults?

Question 2. Which protocol was followed from the beginning of pandemic to hospitalize older adults with COVID-19? Did this protocol differ from the one applied in younger adults?

Question 3. What is the situation in your country for older adults now? What are governmental and social strategies to cope with the pandemic (the trend of the incidence, lock-down, screening.. etc.)?

Question 4. What are general governmental regulations applied to protect nursing home residents? How effective or not effective was the protection taken of older adults living in nursing homes?

Each question has been divided into specified sub-sections (Appendix 1). First, the answers of Turkey were outlined and sent to each country representative as a model, aiming to obtain a standardized way of answering to analyse similarities and differences across the involved countries. Following collection of responses to the standardized questions, table were created to present comparisons between countries. The reviewed answers were sent to the countries for their perusal and careful consideration.

The presenting members were informed to answer these questions regarding the time between March-August 2020 which represented the period of the first wave of COVID-19 pandemic (4).

While answering the questions, countries took the declarations of the Ministry of Health, Ministry of Family and Social Services, World Health Organization, Disaster Management Centers and various official social welfare centers as references.

## Results

The country representatives were asked to answer the standardized questions at the beginning of October 2020 and the answers were collected until the end of November 2020.

As a general overview, the diagnostic protocols were same in many aspects. Of note, atypical symptoms suggestive COVID-19 were considered on management of older adults in all countries. While the hospitalization protocols and intensive unit care transfer criteria for older adults did not differ from those for young adults, age itself was considered as a criteria for hospitalization in most of the countries. In general terms, governmental and social coping strategies for older ages against ongoing pandemic aimed to limit their social contact. The basic suggestion was "stay at home" warning. The lock-down was applied only for some local areas or specific age groups by few countries. In a word, nursing homes restrictions and precautions stepped up to ensure residents are protected from pandemic.

The answers to the questions are outlined in Table 1, Table 2, Table 3a, Table 3b, Table 4a and Table 4b.

## Discussion

We provided comparative overview of the actions against COVID-19 pandemic which were applied by six of the GEI. The six participated countries initially followed the general WHO recommendations. The rapid spread ability of the virus has increased the importance of early governmental measures in order to help to reduce the spread of the disease and negative consequences. Therefore, it is very understandable that these six countries rapidly have implemented their own protocols. They were asked 4 main questions and lots of sub questions about the precautions and steps they took against the virus especially regarding the older adults. Generally, the answers to many of the questions were similar, however, it differed in some points depending on national health system, social-economic conditions and governmental planning.

**Applied diagnostic protocol and indications for COVID-19 testing:** The diagnostic algorithm for detection of acute COVID-19 based on clinical experiences and laboratories was provided by the WHO (9). This algorithm has been updated from the beginning of the pandemic periodically. Symptoms of

**Table 1. The answers to the Question 1: "Which protocol was followed from the beginning of pandemic to diagnose COVID-19 for older adults? Did this protocol differ from the younger adults?"**

| | Q1(i) | Q1(ii) | Q1(iii) |
|---|---|---|---|
| Hungary | * | No | No† |
| Lebanon | * | No | No† |
| Russia | * | Yes | No† |
| Slovenia | * | Yes | No† |
| Tunisia | * | No | No† |
| Turkey | * | No | No† |

*Answer to the Q1(i) includes diagnostic flow diagram for detection of acute SARS-CoV-2 infection in suspected cases and are given in Appendix 2
Q1(i): Diagnostic flow diagram for detection of acute SARS-CoV-2 infection in individuals with clinical suspicion for COVID-19.
Q1(ii): Is it different from the WHO's diagnostic flow diagram for the detection of acute SARS-CoV-2 infection? In what way?
Q1(iii): Did this protocol differ from the younger adults? In what way?
†All countries declared that the atypical presentation symptoms of infections in older adults, i.e., delirium, functional deterioration, recent fall, hypothermia were regarded among symptoms suggestive of COVID-19 in the centres that are familiar to the management of older adults.
SARS-CoV-2: Severe acute respiratory syndrome-coronavirus-2, COVID-19: Coronavirus disease-2019, WHO: World Health Organization

**Table 2. The answers to the Question 2: "Which protocol was followed from the beginning of pandemic to hospitalize older adults with COVID-19? Did this protocol differ from the younger adults?"**

| | Q2(i) | Q2(ii) | Q2(iii) | Q2(iv) | Q2(v) | Q2(vi) |
|---|---|---|---|---|---|---|
| Hungary | * | Unchanged | No | No | No | No |
| Lebanon | * | N/A | No | No | No | No |
| Russia | * | Unchanged | No | No | No | No |
| Slovenia | * | Unchanged | No | No | No | Yes |
| Tunisia | * | No | Yes† | Yes‡ | No | No |
| Turkey | * | Changed γ | No | No | No | No |

*Answer to the Q2(i) includes indications for hospitalization at the beginning and are given in Appendix 4.
Q2(i) What was the indication for hospitalization at the beginning?
Q2(ii) What is the last version for hospitalization protocol/diagram by August 2020?
Q2(iii) Did this protocol differ from the younger adults?
Q2(iv) Is frailty screened for older adults if needed hospitalization
Q2(v) Are there differences in terms of ICU transfer in older adults? (at the beginning and currently)
Q2(vi) Have the older adults with serious disease been directed for palliative care transfer rather than ICU? (at the beginning and currently).
γ Any suggestive symptoms of COVID-19 and additionally one of "Shortness of breath or difficulty in breathing or malnutrition and impairment of oral food intake, †clinical symptoms suggestive of COVID-19 in older adults also included: delirium, sudden loss of autonomy, recent fall, hypothermia, ICU: Intensive care unit, COVID-19: Coronavirus disease-2019

**Table 3a. The answers to the Question 3: "What is the situation in your country for older adults now? What are governmental and social strategies to cope with the ongoing pandemic (the trend of the incidence, lock down, screening.. etc.)? Do you offer some actions to improve these strategies as a geriatrician in your country? If so, please give detail."**

| | Q3(i) | Q3(ii) | Q3(iiia) | Q3(iiib) | Q3(iva) | Q3(ivb) | Q3(va) | Q3(vb) | Q3(vi) | Q3 (vii) |
|---|---|---|---|---|---|---|---|---|---|---|
| Hungary | 58 | N/A | Increased | Decreased | Yes | No | No | No | * | Yes |
| Lebanon | 281 | N/A | Slightly Inc | Rapid Inc | On-off | No | On-off | No | * | Yes |
| Russia | 6000 | N/A | Increased | Increased | Yes | Yes | No | YesΨ | * | No |
| Slovenia | 139 | 22.3% | Increased | Increased | Yes | No | No | No | * | N/A |
| Tunisia | N/A | N/A | N/A | N/A | Yes | No | No | Yesλ | * | Yes |
| Turkey | 131 | ˆ | Increased | Decreased | Noϕ | Yes | No | No | * | Yes |

*Answer to the Q3(vi) includes various coping strategies and are given in Appendix 5
Q3(i) The COVID-19 incidence in total population (per 100,000) between March 31 and August 31
Q3(ii) The COVID-19 incidence of affected older adults %
Q3(iiia) Trend of incidence between March and April 2020
Q3(iiib) Trend of incidence between June and August 2020
Q3(iva) Was there a general population lock-down? (March-April 2020)
Q3(ivb) Was there an older people-specific lock-down? (March-April 2020)
Q3(va) Is there a general population lock-down? (June-August 2020)
Q3(vb) Is there an older people-specific lock-down? (June-August 2020)
Q3(vi) Please indicate if the following coping strategies are performed by the government? Please indicate if some of the below coping strategies are being performed by non-governmental organizations and if so, write their names (such as National Geriatrics Society, National Alzheimer Society…etc.)
Q3(vii) Specific geriatricians' suggestion
ϕ: Only on weekends
Ψ: Region based
λ: In case of frailty and chronic disease
ˆ: Death rate between March-August for older men aged 65-79: 16.6%
Death rate between March-August for older women aged 65-79: 8.84%
Death rate between March-August for older men over 80 years of age: 31.8%
Death rate between March-August for older women over 80 years of age: 22.69%
COVID-19: Coronavirus disease-2019

**Table 3b. The answers to the Question 3(vii) geriatricians' suggestion: "Do you offer some actions to improve these strategies as a geriatrician in your country? If so, please give detail."**

| Country | Geriatrician' specific suggestion |
|---|---|
| Hungary | The members of the Hungarian Association of Gerontology and Geriatrics were experts of the College of Medical Societies (advisory board for the Government) |
| Lebanon | 1. Through outreach teams or community volunteers, organise safe and accessible distributions of food packages/items, protective and hygiene materials as well as medicine to older people who cannot afford or face challenges in accessing sufficient food, health services and necessary medications.<br>2. Working with media service providers and/or national TV stations, develop COVID-19 information and prevention practices messages to broadcast on television to reach older people through their preferred method of communication. Ensure that information is also shared in other accessible ways for those who have different communication challenges considering the high number of older men and women with hearing and visual impairments.<br>3. Ensure that analysis of the pandemic's secondary impacts is inclusive of older people, including older people with disabilities and the specific risks they face are integrated into the Lebanon's humanitarian response plan and its socio-economic recovery plans.<br>4. Identify and train outreach teams and/or community volunteers on how to provide safe psychosocial support to older women and men, including older people with disabilities, so that they can manage their worry and anxiety (e.g., support via regular phone calls, mobilise neighbours to check on them, befriending, sharing information and details of other support available etc.)<br>5. Identify older people who can provide peer support safely to other older people who feel neglected and isolated and unable to cope. Also, engage with younger volunteers to befriend and safely support those struggling to cope, helping to reconnect them with their community.<br>6. Use and share with other service providers the Humanitarian inclusion standards for older people and people with disabilities and IASC Guidelines, Inclusion of Persons with Disabilities in Humanitarian Action to fully design inclusive activities that respond to the needs and rights of older people, including those with disabilities. |
| Russia | No special suggestion |
| Slovenia | N/A |
| Tunisia | Clinical practice guidelines for the management of older people were elaborated in collaboration with INEAS (Instance Nationale de l'Evaluation et de l'Acréditation en Santé) |
| Turkey | Academic Geriatrics Society published a booklet named "expert opinion on COVID-19" which includes twenty-eight answered questions about COVID-19. An exercises booklet and a video presentation were prepared by a skilled physiotherapist under the leadership of the Geriatrics Society |

COVID-19: Coronavirus disease-2019

COVID-19 infection got a strong focus in diagnosis (fever, dry cough, anosmia and dysgeusia) and consideration of physical examination (bronchitis, pneumonia) had an important place. Hungary, Lebanon and Tunisia have followed very similar paths WHO's diagnostic flow diagram for detection of acute severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) infection in the patients with clinical suspicion for COVID-19. The diagnostic flow diagrams were created by all countries and had very similarities (Appendix 2).

**Table 4a. The answers to the Question 4: "What are general governmental regulations applied to protect nursing home residents?"**

| | Hungary | Lebanon | Russia | Slovenia | Tunisia | Turkey |
|---|---|---|---|---|---|---|
| Q4(i) | Yes | Yes λ | Yes | Yes | Yes | Yes |
| Q4(ii) | Yes | No φ | Yes θ | Yes | Yes | Yes |
| Q4(iii) | Yes | Yes | Yes | Yes | Yes | Yes |
| Q4(iv) | Yes | Yes | Yes | Yes | Yes | Yes |
| Q4(v) | Yes | Yes | Yes | Yes | Yes | Yes |
| Q4(vi) | Yes | No | Yes | No | Yes | Yes |
| Q4(vii) | Yes* | Yes | N/A | Yes | Yes | Yes |
| Q4(viii) | Yes | Yes | Yes | Yes | Yes | Yes |
| Q4(ix) | Yes | Yes Ω | Yes | No | Yes ψ | Yes |
| Q4(x) | Yes | Yes | N/A | Yes | Yes | Yes |
| Q4(xi) | Yes | No | Yes | Yes | Yes | Yes |
| Q4(xii) | Yes | Yes | N/A | Yes | Yes & | Yes |

Q4(i) Ban of external visits
Q4(ii)Postponement of new admissions
Q4(iii)Halting nursing homes club activities
Q4(iv)Providing protective gears
Q4(v)Reinforcement of hygiene measures such as regular disinfections
Q4(vi)Staff-specific transport services
Q4(vii) Avoidance of nursing home staff from outside contact as much as possible
Q4(viii) Education of nursing home staff and residents
Q4(ix) Regular PCR tests for the staff or resident's declaration of nursing home guidelines
Q4(x) Transfer of medical professional to nursing homes if needed
Q4(xi) Nomination of NH-hospital coordinators
Q4(xii) Case management directives (e.g., how were the residents affected by COVID isolated from the rest to protect others)
*locally
λ not all
φ PCR was required for admission
θ new admissions only for emergency cases (loss of autonomy, difficult social situation). If person was admitted – there were 1-week quarantine placement in separate part of the building.
ψ PCR tests were performed only in case of clinical suspicion of COVID-19.
Ω not all nursing home
& isolation room was prepared for those not required hospitalization
COVID-19: Coronavirus disease-2019, PCR: Polymerase chain reaction

**Table 4b. The answer to the Question 4: "How effective or not effective was the protection taken of older adults living in nursing homes?"**

| | |
|---|---|
| **Hungary** | During the first phase of the coronavirus pandemic, Hungary's protection against the virus was effective and the country's protection policy was one of the most successful one in Europe. The social institutions, especially the retirement homes performed outstandingly during the pandemic, especially if we compare those results to the Western European numbers. The spread of the virus has decelerated in these institutions and many old patients have recovered from the disease. |
| **Lebanon** | Since there was no obligatory regulation so the measures were not effective. |
| **Russia** | There were not cases of spreading infections in nursing homes. |
| **Slovenia** | Few NH have not prevented COVID to enter and to spread among residents. With population of 2 million, 20% older than 65 years, of which 23,000 NH residents, in first wave Slovenia suffered total 131 fatal cases, 95% older the 65 years, almost exclusively nursing home residents, 40% of NH fatal cases occurred in hospital. Fatal NH cases affected 0.59% of all NH residents. |
| **Tunisia** | Nursing home did not declare any case of COVID-19 up to August 2020. Such strict measures were associated however with negative socio-psychological effects on the older people. |
| **Turkey** | Precautions were strict at nursing house from the beginning of the pandemic in Turkey, that help to survive with no tragedy in nursing house up to now. However, the strict precautions and isolation brought some psychosocial negative effects on the older people. |

COVID-19: Coronavirus disease-2019

There are number of factors brought about differences between these six countries. First, differences between these countries' strategies might depended on inadequate knowledge about the virus at the beginning, including incubation period, obscurity of the asymptomatic cases. Second, the social-economic condition and the health care systems of the governments.

There were no significant differences in diagnostic protocols between older adults and younger patients between participated GEI countries. Although COVID-19 is a new virus, researches have shown that the severe outcomes of the virus are mostly presented in the older adults (Appendix 3) (6,10). Studies demonstrated that atypical presentation is common in older adults which may also result in worse outcomes such as organ damages requiring earlier management and special treatment (11,12). Development of special COVID-19 diagnostic indications for the older adults is an urgent need. Moreover, it has been emphasized by the British Geriatrics Society that an index or criterion of suspicion for atypical presentation of COVID-19 in older adults is needed. There were some warnings regarding diagnosis of older adults in diagnostic protocols applied by the GEI countries involved. In Tunisia, the unusual presentation such as falling, delirium, sudden loss of autonomy and hypothermia were also considered when assessing the necessity of real time-polymerase chain reaction (PCR) in older adults.

It would be greatly beneficial to establish guidelines on specific diagnostic criteria for the evaluation of older adults. This approach could aid in early identification of COVID-19 at the old age and providing closer follow-up for them, taking isolation measures and potentially decrease the adverse outcomes of the disease and the degree of socio-economic burden.

**Protocol following hospitalization for older adults with COVID-19:** At the beginning, the rapid spread and unknowledges of the virus put a major pressure on the healthcare system. Not every country in the world was adequately prepared to handle the crisis. Each country continued to develop protocols for hospitalization in addition to the WHO for the detection and follow-up of COVID-19 patients who had to be hospitalized to prevent health system collapse.

The hospital admission management in six GEI countries involved in the study was based on the point to protect health care system and there could be differences in the proper procedure of the diagnostic chain because of the differences of the structure of their systems. Hospital admission for the patient with COVID-19 was mainly focused on vital signs abnormalities, comorbidities, organ failures and low $O_2$ saturation in all involved countries (Appendix 4). Common criteria were the low oxygen saturation with different limits for the all-participant countries. Slovenia declared that there were no written admission criteria. Pneumonia and infiltrates were accepted as admission criteria in Hungary, Lebanon and Turkey. Lebanon, Tunisia and Turkey regarded comorbidities as admission point. Laboratory findings (lymphocyte <800/mm$^3$, CRP> 40 mg/L, ferritin >500 u/mL, D-dimer >1.000 ng/mL) which were supporting COVID-19 were applied as criterion in Lebanon and Turkey. Additionally, unlike all participant countries, delirium was accepted as criteria in Tunisia. In Tunisia, frailty screening and social assessment was routinely preformed (SEGAm) in this age group for the decision taking for admission to the hospital. It was updated by the end of the 1$^{st}$ wave of the pandemic and no longer were considered.

Malnutrition and impairment of oral food intake were considered at the hospitalization of patient in Turkey. Only Turkey declared changes on the hospitalization protocol by August 2020 in order to ensure the sustainability of the health care system.

It is known that age itself is a greater risk factor for negative outcomes during illnesses. As it was recognised as criteria for admission in Lebanon (>50 age), Tunisia (>65 age), Turkey (>50 age). There was no additional protocol specified for the older adults in any countries.

As a course of COVID nature, it can cause severe symptoms which require intensive care unit (ICU) admission or palliative care. The ratio may vary according to population, culture and local ICU admission criteria. ICU admission has been recorded in a wide range between 5 and 90 percent as per different countries (8,13,14). The admission to the palliative care due to severe COVID-19 was not the first option among the participating countries. Generally, all critically ill patients and those who met the ICU admission criteria regardless age were admitted to the ICU. While direction of older adults with serious disease for palliative care transfer rather than ICU was not considered in all countries. Despite that, Slovenia declared if locale admission criteria have not been met it was an option for the older adults.

Assessing age-related factors and atypical infection symptoms such as confusion, lethargy, delirium, impaired oral food intake, and deterioration in older adult could prove advantageous as part of hospitalization criteria. Action taken by these countries, along with the global publications will shape the criteria for the future pandemic situation.

**Governmental and social coping strategies:** Globally increasing cases of COVID-19 has forced governments to take strict prevention in order to minimize the public health effects. The timing and severity of the measures taken against pandemic might had created differences in incidence between the countries. As Russian Federation had the higher incidence between March and August, Hungary had the lowest at the same time among the participant countries (Table 3a). Each country has determined the fundamental coping strategies, according to social and economic background of the country. Some of the coping strategies were provided by the government, while some were supported by the social organizations. As the course of the

COVID-19 has revealed its most devastating effects on the older people. Incidence of the affected older adults was non-available in most countries while Slovenia reported as 22%. Research has shown that age was the most important factor for exposure to the virus (6), thus the governments measures were more directed towards older adults. Most important imposed governmental precaution was lock-down. At the duration of March 2020-April 2020 general lock-down was applied in most countries (Hungary, Lebanon, Russian Federation, Slovenia, Tunisia) while Turkey had applied lock down only for over 65 years of age in all week days and for the younger just at weekends. In the period of June 2020-August 2020, lock-down was lifted in most countries. At this time mostly age specific lock down was continued in some countries (some region in Russian Federation and for older with frailty and chronic diseases in Tunisia between May and June).

Most of the countries have formed coping strategies that prevent the spread of the new coronavirus. Various COVID related coping strategies such as TV spots, leaflets, telemedicine consultation, food delivery, bill payment assistance, supplemental payment, safe medication purchase, prevention of accumulation above certain numbers, interregional movement restriction were implemented by participating countries (Appendix 5). An increasing number of countries had made wearing face masks mandatory or strong recommendation in public areas all around the world despite WHO's early advices regarding use of masks published on 6 April (15). Although it was mandatory only in closed public areas in Hungary, there was masks requirement in outdoor and indoor areas in other five countries.

There were curfews in Hungary, Lebanon, Slovenia and Turkey. In Turkey, there was an age specific curfew for those over 65 age and for under 18 ages. Generally, in order to protect older adults, a state-controlled timespan determined for the people above the age of 65 as they only were allowed to go in shops, markets, supermarkets and pharmacies. In Russian Federation, staying at home was a recommendation for older adults. In Lebanon and Slovenia, there was no age specific restriction in this field. Some countries allowed citizens to leave homes only for work or to food stores/markets, pharmacy, sport activity (alone), or dog walking. As priority was given to serving older people at supermarkets and food stores in Russian Federation.

The guideline and booklet were published in Lebanon, Tunisia and Turkey by the geriatricians or psychogeriatricians, specifically targeting to help older people cope with the stressful situation and to clarify the questions about COVID-19. The Alzheimer Association of Lebanon helped dementia patients and their relatives in online way. Besides that, Tunisia was the only country that geriatricians issued a guideline concerning the management of patients of old age with COVID-19.

Differences and similarities between coping strategies among these six countries have drawn attention. A common approach observed among the countries was implementation of government-imposed curfews and lock-down measures to ensure that older individuals remained at home and minimized their social interactions. The variations mostly were depended on the social construction within each country. Commentary regarding the advantages and disadvantages of all coping strategies is early at this stage. In addition to the positive effect of reducing the impact of the pandemic, older adults may also experience certain physiological and psychological effects.

**Regulations regarding nursing homes:** Seniors living in nursing homes were more vulnerable with a higher risk for infection and adverse outcomes because of living close by each other and having more comorbidities (16). Hence, the governments of the most countries published guidelines or booklets regarding the provision of the nursing homes' seniors care during the pandemic. As stated in guideline published by WHO's for- long-term care facilities (17), nursing home measures in several countries were also based on recognition, personal protection, isolation and source control.

It is known that infections are the very common cause of acute hospitalization among nursing home residents (18), the most important one is pneumonia (19). The compliance with hygiene rule, such as hand washing or following infection control measures, are also less than optimal in nursing homes (20). Daily activities of nursing home residents are carried out in groups. Considering all these factors, the control of the pandemic was difficult in nursing homes. After the emergence of the COVID-19, the governments of several countries took strict measures in order to protect vulnerable home care residents. The most important implemented step of the six countries was making restriction of external visits. Additionally, new admissions were postponed in all countries, while Lebanon required PCR and Russian Federation set 1-week quarantine rule in separate part of the building for new admission to the nursing homes. Many different precautions were implemented to protect nursing homes in six GEI countries (Appendix 6). Additionally, Hungary, Russian Federation, Tunisia and Turkey created staff specific transport services. A 14-day shift system imposed for the staff in nursing homes in Turkey is a different remarkable measure in comparison with the other countries. Regular PCR tests were performed in Hungary, Lebanon (in some nursing homes), Russian Federation and Turkey, while Tunisia performed PCR in case of the suspected COVID cases and Slovenia declared no regular PCR testing in nursing homes. All countries referred the residents to hospital when necessary and those who just need isolation was isolated in hospital. For those who do not need to be isolated, isolation rooms were prepared only in Tunisia. The lack of knowledge made countries to appoint coordinators in nursing homes to adopt close management, such that persons were nominated in participating countries except Lebanon. The most effective measurements to protect nursing homes were denial of visitors and increased disinfection regulations.

Hungary declared that the management strategies were effective and the Hungary' protection policy was one of the most successful in Europe. Lebanon stated the measures were not effective due to the lack of obligatory regulations in their country. Russian Federation announced not any cases spreading in nursing homes. Slovenia expressed that the precautions were not effective enough to prevent cases spreading in all nursing homes. These might show the importance of regular PCR and keeping staff away from outside contact. Strict measures were told as effective however with some negative socio-psychological effects in Tunisia and Turkey.

## Conclusion

The whole world was unprepared for a pandemic like COVID-19. All countries have created their own measures against pandemic in order to protect people and their health care system. However, COVID-19 have had significant impact on human life. Since the older adults are the most vulnerable in society, they were affected deeply. According to the answers of the involved countries we can understand that some special precautions were taken for older adults among different countries. In summary, the responses from all participating countries regarding the management of COVID-19 in older adults exhibited a remarkable level of similarity in multiple aspects, with only minor variations observed among different countries. The global impact of COVID-19 and the preventative measures taken by different countries will serve as a guiding framework for future planning in the event of such a disaster. The valuable steps taken by different countries and interpreting their impact against the pandemic will contribute to enhancing global preparedness.

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### Ethics

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: Ş.G., Concept: Ş.G., A.L., Design: Ş.G., Data Collection or Processing: Ş.G., A.L., A.A., S.B., K.E., R.G., M.S.H., I.K., G.V., Analysis or Interpretation: Ş.G., A.L., Literature Search: Ş.G., A.L., A.A., S.B., K.E., R.G., M.S.H., I.K., G.V., Writing: Ş.G.

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**Appendix 1. Four questions and subsections formulated for the countries**

**Question 1. Which protocol was followed from the beginning of pandemic to diagnose COVID-19 for older adults? Did this protocol differ from the one applied in younger adults?**

- Diagnostic flow diagram for detection of acute SARS-CoV-2 infection in individuals with clinical suspicion for COVID-19
- Is it different from the WHO's diagnostic flow diagram for the detection of acute SARS-CoV-2 infection? In what way?
- Did this protocol differ from the younger adults? In what way?

**Question 2. Which protocol was followed from the beginning of pandemic to hospitalize older adults with COVID-19? Did this protocol differ from the one applied in younger adults?**

- **What was the indication for hospitalization at the beginning?**
- **What was the last version for hospitalization protocol/diagram by August 2020?**
- **Did this protocol differ from the one applied in younger adults?**
- **Role of factors to hospitalize the older adults.**

- Is frailty screened for older adults if needed hospitalization? (at the beginning and currently)
- Are there differences in terms of ICU transfer in older adults? (at the beginning and currently)
- Have the older adults with serious disease been directed for palliative care transfer rather than ICU? (at the beginning and currently)

**Question 3. What is the situation in your country for older adults now? What are governmental and social strategies to cope with the ongoing pandemic (the trend of the incidence, lock down, screening. etc.)? Do you offer some actions to improve these strategies as a geriatrician in your country? If so, please give detail.**
**(From March-31 August 2020)**

- **The COVID-19 incidence in total population %**
- **The COVID-19 incidence of affected older adults %**
- **Trend of incidence (compare March-April 2020 and June-August 2020):**
- **Was there a general population or older people-specific lock-down? (March-April 2020)**
- **Is there a general population or older people-specific lock-down? (June-August 2020)**
- **Please indicate if the following coping strategies are performed by the government? Please indicate if some of the below coping strategies are being performed by non-governmental organizations and if so, write their names (such as National Geriatrics Society, National Alzheimer Society...etc.)**

· COVID-related TV spots:
· Leaflets:
· Online information:
· Information via telephoning:
· Food/basic product supplies:
· Billing payment assistance for the older adults that do not have relatives/caregivers that can support them, telemedicine applications:
· Possibility to receive long-term medications without going to a hospital or without formal prescriptions:
· Obligatory wear of face masks (at indoors and outdoors):
· Curfews:
· Restricted freedom of movement among regions:
· Limited number allowed to gather:
· Minimum $m^2$ per person in services, stores etc.

- **Geriatricians' suggestion:**

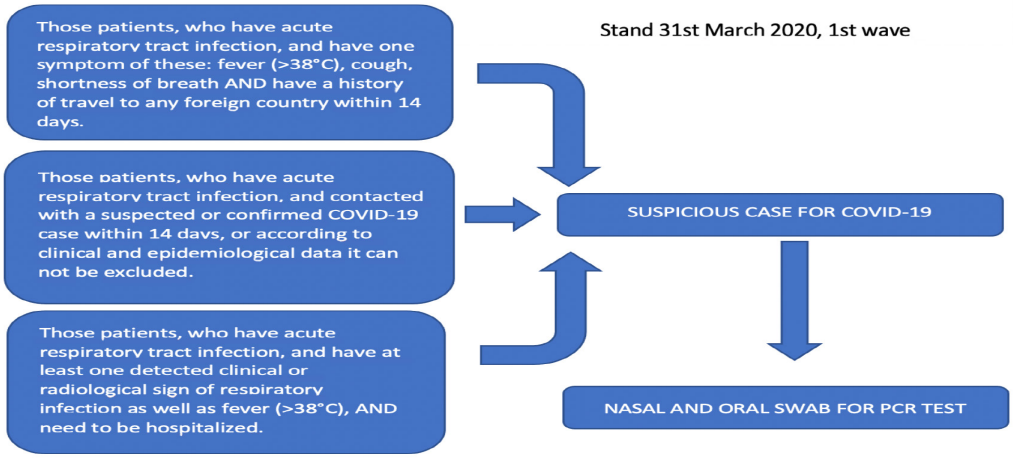
Question 4. What are general governmental regulations applied to protect nursing home residents? How effective or not effective was the protection taken of older adults living in nursing homes?

- **General governmental regulations applied in nursing homes**

· Ban of external visits:
· Postponement of new admissions:
· Halting nursing homes club activities:
· Providing protective gears:
· Reinforcement of hygiene measures such as regular disinfections:
· Staff-specific transport services:
· Avoidance of nursing home staff from outside contact as much as possible:
· Education of nursing home staff and residents:
· Regular PCR tests for the staff or resident's declaration of nursing home guidelines:
· Transfer of medical professional to nursing homes if needed:
· Nomination of NH-hospital coordinators: The nursing homes were strictly inspected by the government
· Case management directives (e.g., how were the residents affected by COVID isolated from the rest to protect others):

- **Please provide an overview for the effectiveness of these measures.**

COVID-19: Coronavirus disease-2019, SARS-CoV-2: Severe acute respiratory syndrome-coronavirus-2, PCR: Polymerase chain reaction, ICU: Intensive care unit, WHO: World Health Organization

<table>
<tr><td>Hungary</td><td> 
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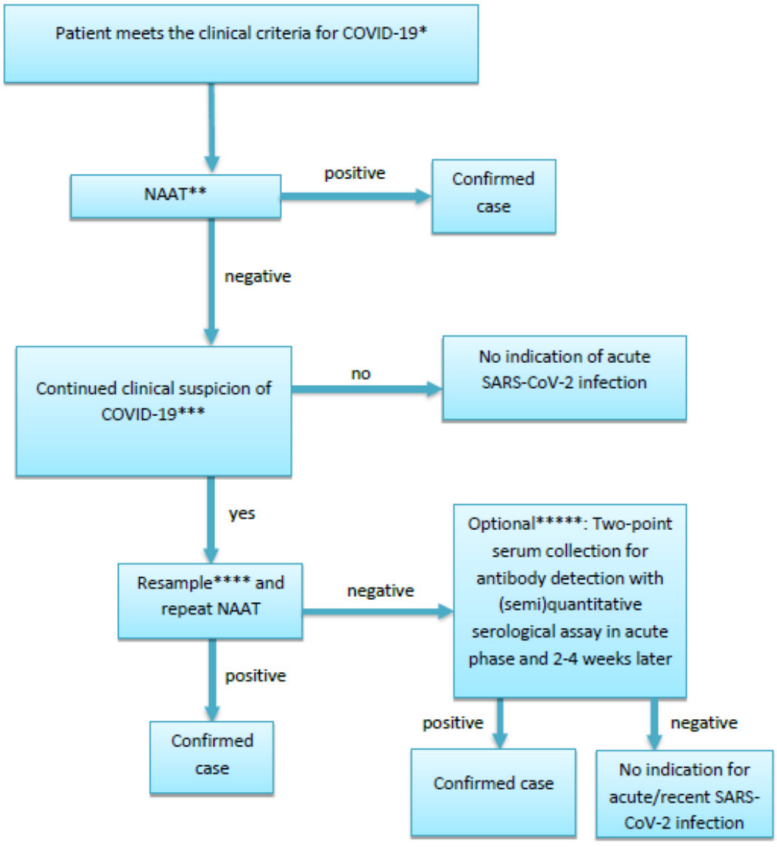
<tr><td>Lebanon</td><td>It was the same as the WHO protocol<br><br>Figure 1: Diagnostic flow diagram for the detection of acute SARS-CoV-2 infection in individuals with clinical suspicion for COVID-19<br> 

* Clinical management of COVID-19 (Interim Guidance), World Health Organization [99].<br>
** If antigen detection would be incorporated into the testing algorithm, how this needs to be done depends on the sensitivity and specificity of the antigen test and on the prevalence of SARS-CoV-2 infection in the intended testing population. For more information see section below on "Rapid diagnostic tests based on antigen detection" and the specific guidance Interim guidance on antigen-detection in diagnosis of SARS-CoV-2 infection using rapid immunoassays [5].<br>
*** Continued clinical suspicion can, for example, be the absence of another obvious etiology, the presence of an epidemiological link, or suggestive clinical finding (e.g. typical radiological signs).<br>
**** The selection of specimen type will depend on the clinical presentation, see section "Specimens to be collected". Increasing the number of samples tested will also increase the sensitivity of testing for COVID-19. More than two samples might be needed on some occasions to detect SARS-CoV-2 [73].<br>
***** For interpretation of serology, see section "Implementation and interpretation of antibody testing in the clinical laboratory". Serology cannot be used as a</td></tr>
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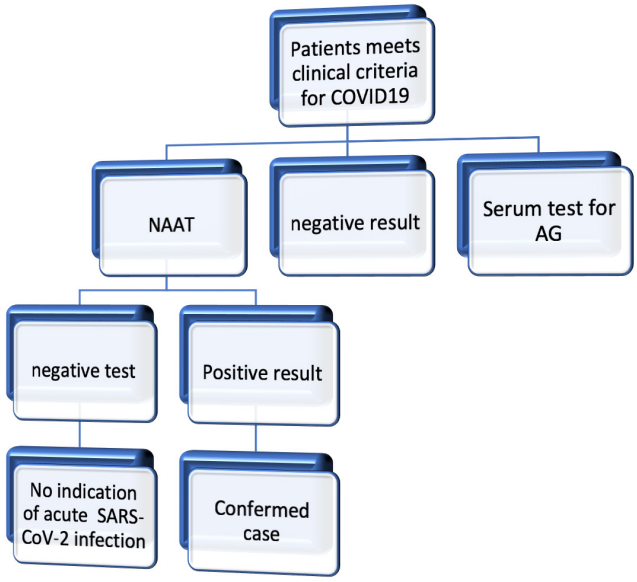
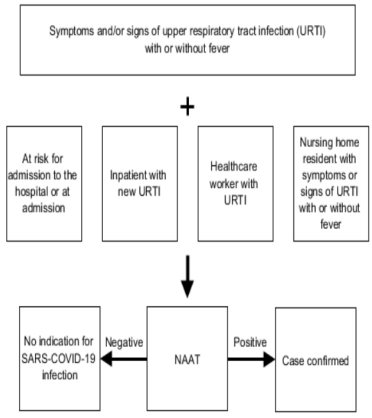
**Russian Federation**

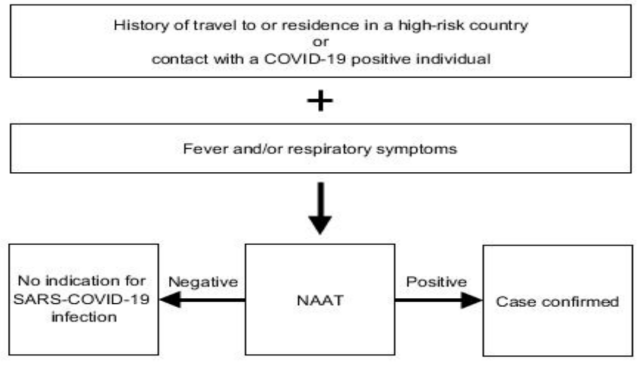



**Slovenia**

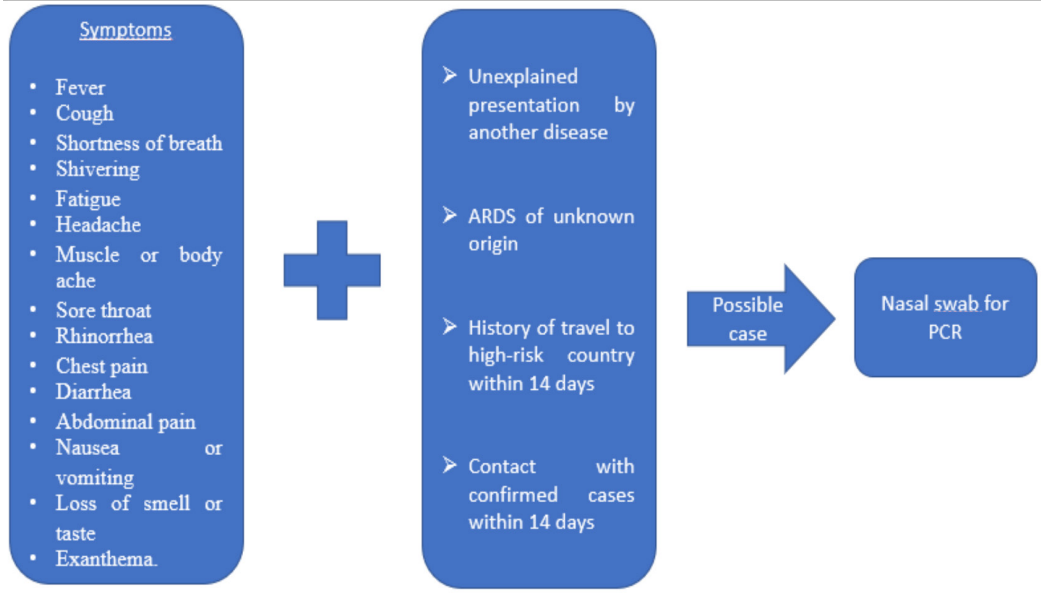
**Since 16th March 2020**




**Till 16th March 2020**



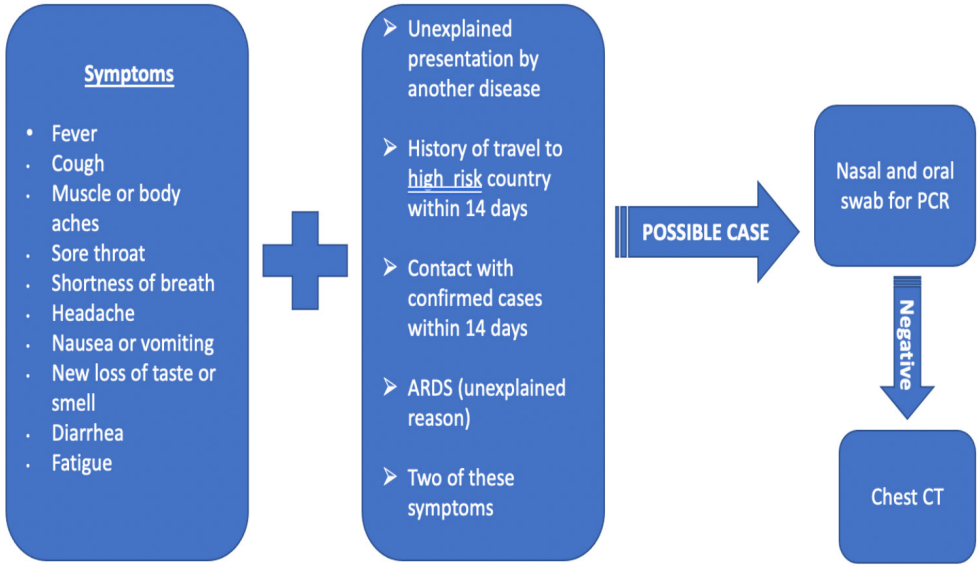

**Tunisia**



**Appendix 2. Diagnostic flow diagram for detection of acute SARS-CoV-2 infection in individuals with clinical suspicion for COVID-19**

*SARS-CoV-2: Severe acute respiratory syndrome-coronavirus-2, COVID-19: Coronavirus disease-2019, PCR: Polymerase chain reaction, WHO: World Health Organization, ARDS: Acute respiratory distress syndrome, CT: Computed tomography*

**Turkey**




**Appendix 3. Detailed information about "Applied diagnostic protocol and indications for COVID-19 testing"**

A) Russia pathways did not have additional steps when clinical suspicion was high. In Slovenia, negative Nucleic Acid Amplification Test (NAAT) has been considered conclusive even if symptomatic. Additionally, the attitude of the Slovenia was the same as Russian Federation in cases with continuing clinical suspicion after negative NAAT. It is important not the accept negative test for rule out the patient in case of the clinical suspicious. It has been shown that the false negative results decreased by days (1). Turkey stands out from other countries and the World Health Organization (WHO) by implementing chest-CT scans on individuals who have negative PCR test results and are considered suspicious cases (2).

B) Most patients hospitalized for Coronavirus disease-2019 (COVID-19) are in old age and have more than one chronic disease such as hypertension, cardiovascular disease, diabetes, chronic respiratory disease and chronic kidney disease (CKD) (3,4). The most common presenting symptoms in entire population were fever, fatigue, dry cough and dyspnoea (5,6). Less commonly reported symptoms were headache, loss of smell and taste, joint pains, chills, nausea/vomiting, and diarrhoea. Besides that, the older adults could present with atypical symptoms such as falls, mobility issues or generalized weakness, lethargy, reduce oral intake, delirium, sore throat, chest pain, tachycardia or tachypnoea (2,7,8). The presence of the two most common symptoms (cough and fever) were found less often in older adults compared to young people (8).

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| **Appendix 4. Indications for hospitalization at the beginning...** |
|---|
| **Hungary** |
| **More than 1 criteria of the followings:** |
| • Oxygen saturation ≤93% |
| • Respiratory distress (≥30 breaths/min) |
| • Pulmonary infiltrates occupy >50% of the total lung field within 24 to 48 hours. |
| • Partial pressure of oxygen ($PaO_2$)/fraction of inspired oxygen ($FiO_2$) ≤300 |
| • ARDS |
| • Acute respiratory failure requiring mechanical ventilation |
| • Shock included septic shock |
| • Other organ dysfunction requiring intensive care unit admission |
| **Lebanon** |
| **Any suggestive symptoms of COVID-19 and additionally one of:** |
| • Oxygen saturation <90% |
| • Affected lung by chest CT scan of the chest greater than 30% |
| • Pneumonia with respiratory distress |
| • Hypotension sepsis or septic shock |
| • Arrythmia |
| • Acute renal failure |
| • Persistent fever |
| • Age greater than 50 |
| • Comorbidities (CVD, DM, HT, chronic liver disease, immunodeficiency) |
| • Abnormal laboratory (lymphocyte <800/$mm^3$, CRP >40 mg/L, ferritin >500 u/mL, D-dimer >1.000 ng/mL) |
| **Russian Federation** |
| **Any suggestive symptoms of COVID-19 and additionally one of:** |
| • Shortness of breath or difficulty in breathing ($SpO_2$<95%, RR >22) |
| • Temperature >38 |
| Risk group: older age >65 years, history of immunodeficiency, comorbidities (cancer, COPD, CVD, DM, HT, autoimmune diseases, cirrhosis, CKD, cancer, immunodeficiency state) |
| **Slovenia** |
| • All community cases admitted to hospital in case of medical needs regardless of age (no written admission criteria, by far most often causes were low oxygen saturation, extensive pulmonary involvement without low oxygen saturation and prostration without proxy to provide care). NH residents treated in NH with help of staff from hospitals, transfer to hospital if needed if not in palliative care. |
| **Tunisia (depending on severity of the clinical presentation)** |
| • Asymptomatic/pauci-symptomatic patients unable to ensure self-isolation at home in order to interrupt transmission. |
| • SEGAm (modified short emergency geriatric assessment) >8 for older adults. |
| Criteria for admission for symptomatic patients at the beginning of the pandemic: |
| • Oxygen saturation ≤92% |
| • Respiratory distress (≥30 breaths/mn) |
| • Hypotension: Systolic ≤90 mmHg or diastolic ≤60 mmHg |
| • Age (≥65) |
| • Underlying medical conditions (at least two): Diabetes, hypertension, chronic kidney failure, known arrythmia |
| • Delirium |
| Turkey |
| Criteria for hospitalize the patients at the beginning of the pandemic **(suspected or confirmed cases displaying any of the following criteria)** |
| • Oxygen saturation ≤92% |
| • Respiratory distress (≥30 breaths/min) |

**Appendix 4. Continued**

| Hungary |
|---|
| • Bilateral pneumonia |
| • Higher pneumonia index (confusion or tachycardia >125/min) |
| • Hypotension |
| • Sepsis or septic shock |
| • Arrythmia |
| • Acute renal failure |
| • Age (>50) |
| • Comorbidities (CVD, DM, HT, chronic liver disease, immunodeficiency) |
| • Abnormal laboratory (lymphocyte <800/mm$^3$, CRP> 40 mg/L, ferritin >500 u/mL, D-dimer >1.000 ng/mL) |

ARDS: Acute respiratory distress syndrome, COVID-19: Coronavirus disease-2019, CT: Computed tomography, DM: Diabetes mellitus, HT: Hypertension, CRP: C-reactive protein, CVD: Cardiovascular diseases, COPD: Chronic obstructive pulmonary disease

**Appendix 5. Various coping strategies performed by the government and non-governmental organization**

| | S(i) | S(ii) | S(iii) | S(iv) | S(v) | S(vi) | S(vii) | S(viii) | S(ix) | S(x) | S(xi) | S(xii) | S(xiii) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hungary | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes* | Yes | No | No | Yes | Yes |
| Lebanon | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Russian Federation | Yes | No | Yes | Yes | Yes | YesΨ | Yes | Yes | No | Yes | No | Yes | Yes |
| Slovenia | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Tunisia | Yes | No | Yes | Yes | No | Yes | Yes | Yes | No | Yes | Yes | Yes | No |
| Turkey | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No |

Strategies(S)
S(i) COVID-related TV spots
S(ii) Leaflets
S(iii) Online information
S(iv) Information via telephoning
S(v) Food/basic product supplies
S(vi) Billing payment assistance for the older adults that do not have relatives/caregivers that can support them,
S(vii) Possibility to receive long-term medications without going to a hospital or without formal prescriptions
S(viii) Obligatory wear of face masks (at indoors and outdoors)
S(ix) Curfews
S(x) Restricted freedom of movement among regions
S(xi) Limited number allowed to gather
S(xii) Minimum m$^2$ per person in services, stores etc.
S(xiii) Telemedicine
*Only in closed public areas, not at outdoors
Ψ by social works and volunteers
COVID related TV spots, leaflets (except Russia and Tunisia) and online information were provided in most countries to help people have better understanding and to make them taking personal precautions. Telemedicine consultation was applied in Hungary and Lebanon, Russian Federation and Slovenia that helped older adults to stay away from highly risk areas as hospitals. Governmental and non-governmental organisations of all countries, except Tunisia, provided food and basic products to those in need. The essential shopping and food were delivered at their home in Turkey. Moreover, in areas where relatives of older adults were unable to help family members of old age, the government of Hungary provided food and products for basic needs. Billing payment assistance for the older adults was made in all countries. Additionally, the seniors who comply with all proposed restriction were granted with one-time supplementary payment for pensions in Russian Federation and the retirees get raise in pension and it was delivered to their homes if they apply in Turkey. The older adults received their medication safely without going to pharmacy in all participated countries. In order to prevent the rapid spread of the virus movement among the regions was restricted and was under control by the government in Lebanon, Russian Federation, Slovenia, Tunisia and Turkey. It was tried to prevent people from gathering above the certain numbers in all countries except Hungary and Russian Federation. Additionally, the guidelines of the all countries specified the minimum number of square meters required to comply with social distancing measures.

**Appendix 6. Detailed information about "Regulations regarding nursing homes"**

Social activities were stopped in all involved countries. All the countries provided protective gears to the staff and residents and hygiene measures such as regular disinfection was enhanced. Nursing staff was uneducated and unprepared for control the infection, as the countries needed to strict precautions for the staff as well as residents. As the course of the virus, evidences showed that staff and seniors in nursing homes might be asymptomatic (1). To this end, education was provided for both staff and residents in all participated countries. External contact of the staff was avoided as soon as possible in all countries

1. Organization, W.H., Critical preparedness, readiness and response actions for COVID-19: interim guidance, 22 March 2020. 2020, World Health Organization

ORIGINAL RESEARCH

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# Using the Study of Osteoporotic Fracture Frailty Index for Frailty Assessment in An Aging and Devoloping Country

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## Abstract

**Objective:** Frailty is one of the most important geriatric syndromes. In frailty, there is a cumulative decline in multiple physiological systems, a decrease in resistance to stress factors, resulting in vulnerability to adverse outcomes. In clinical practice, it is very important for physicians, especially those in the field of geriatrics, to recognize this syndrome. The aim of this study was to validate the Turkish version of the study of osteoporotic fracture (SOF) frailty index in geriatric population.

**Materials and Methods:** This study was performed in a geriatric medicine outpatient clinic. The study was conducted with 267 patients aged 65 and over. Patients with acute disease, delirium, diagnosis of malignancy and who did not give informed consent were excluded from the study.

**Results:** The median [interquartile range (IQR)] age of patients was 72 (68-78) and 64% of the participants were female. The median (IQR) SOF score was 1 (0-1). When frailty was examined within two groups [robust (robust + pre- frail) and frail group] the concordance of FRAIL and SOF score was strong (Cohen's K: 0.652, p<0.001) and the concordance of CFS and SOF score was also strong (Cohen's K: 0.611, p<0.001).

**Conclusion:** The results showed that the Turkish version of the SOF index is a valid scale for determining frailty in outpatient clinics.

**Keywords:** Older, frailty, scale, SOF index, correlation

## Introduction

Frailty is one of the most important geriatric syndromes. In frailty, there is a cumulative decline in multiple physiological systems, a decrease in resistance to stress factors, resulting in vulnerability to adverse outcomes. (1). Frailty is associated with increased mortality, hospitalization, disability, falls, fractures, worsening mobility, desolation, depression, cognitive decline, dementia and admission to long-term care (1-12). The prevalence of frailty increases as age increases in the community-dwelling older adults. While this rate is 4% between the ages of 65 and 69, it rises to 26% at the age of 85 and over (13).

Many scales are available to screen and assess frailty. Fried's frailty criteria, clinical frailty scale (CFS), edmonton frail scale, FRAIL scale are some of these scales (1,14-20). There are two basic approaches on which frailty scales are bases (21). The first approach involves the physical components defined by Fried et al. (1). The second approach includes social, psychological and cognitive components as well as physical components (14). When choosing an ideal frailty scale, a clinician should consider the instrument's validity and ultimate purpose across the field of interest (22,23).

In 2008, the osteoporotic fractures study (SOF) research group developed a simpler index to define frailty. This scale evaluates frailty with 3 components. These are weight loss, inability to get up five times without using arms, and person reporting low energy. It is practical to use this index in clinical settings (24). In previous studies SOF index was found to be a predictor of falls,

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disability, non-spine and hip fractures, emergency department (ED) admissions, overnight hospitalizations and deaths (24-26).

In clinical practice, it is very important for physicians, especially those in the field of geriatrics, to recognize this syndrome. For this, frailty scales that can be used practically and quickly are needed. SOF index is a practical and easy-to-apply scale compared to other scales. The purpose of this study was to validate the Turkish version of the SOF frailty index in geriatric population.

## Materials and Methods

### Participants

This study was performed in a geriatric medicine outpatient clinic. The study was conducted with 267 patients aged 65 and over. Patients with acute disease, delirium, diagnosis of malignancy and who did not give informed consent were excluded from the study. In order to assess its test-retest reliability, the scale was performed on 20 patients by the same geriatrician (İİ) seven days after the first administration. For interrater reliability, the SOF scale was performed to 20 patients by two geriatricians (İİ, MH) who were blind to each other's scores in a different examination room on the same day.

### Data Collection

Comprehensive geriatric assessment was performed to all patients. Functional status was assessed with the Katz activities of daily living (ADL) and the Lawton-Brody instrumental ADL (IADL) (27-30). Mini nutritional assessment-short form (MNA-SF) was used for nutritional status assessment (31,32). Emotional status was evaluated with the Yesavage geriatric depression scale (YGDS) (33,34). The age, gender, medical history and medications used by the patients were noted down. Laboratory values were recorded from the hospital system.

### SOF Index

Patients who scored 2 or more on the following items according to the SOF index were considered frail. These are: ≥5% weight loss in the previous year (involuntary), unable to get out of a chair five times without using arms, and answering "no" to the question "do you feel full of energy". For item 1, the patient is asked whether there has been any weight loss, and if so, how much weight has been lost. For item 2, the patient is given the get up and sit test from the chair 5 times. For item 3, the patient is asked if he or she feel full of energy. Those with a score of 0 on these items were considered as robust, those with a score of 1 were considered as pre-frail, while those with a score ≥2 were considered as frail (24,25).

### Reference Tools

The other 2 scales we used to assess frailty in the study are the FRAIL scale and the clinical frailty scale. The FRAIL scale is a form consisting of 5 questions and evaluates the patient's fatigue status, resistance, mobility, weight loss and other diseases. By giving 0 or 1 point from each item according to the answers given by the patients; in total, 0 point is considered normal (non-frail), 1-2 points are pre-frail, and those with >2 points are considered frail (16,17). On the CFS, the patient is given a score from 1 (very active) to 9 (terminal disease) after clinical evaluation. At each step, frailty is graded both visually and with written instructions. At the fourth score, patients are evaluated as vulnerable, and at scores ≥5, as frail (14,18). In the updated new version of CFS, the fourth score is also defined as frail (35).

### Translation

Language validation was performed by forward-backward translation. Two native target language translators translated the original SOF index into Turkish. The Turkish version was checked and agreed by all authors. Then, the Turkish version was retranslated into English by two native speakers of English and bilingual in the target language. Three geriatric medicine specialists compared the back-translated version with the original version. Finally, the Turkish SOF index was applied face-to-face to 267 community-dwelling older. The participants had no difficulty understanding and answering all three questions of the test. Finally, this improved translation was adopted to conduct the reliability and validity study of the SOF index in Turkish language.

### Statistics

IBM SPSS version 23 program was used in data analyses. As a result of the calculations made with the help of descriptive statistics obtained from the literature study, a statistically significant correlation of 0.19 effect size between 2 variables with 80% power at 95% confidence level would be found when samples with a minimum width of 267 were selected (Sample width was calculated using the PASS11 version program). Continuous variables were written as means ± standard deviations or medians [interquartile ranges]. Frequency and percentage values were written for categorical variables. Mann-Whitney U test or Student's t-test was used for continuous variables, and $\chi^2$ (chi-square) and Fisher precision tests were used for categorical variables. The construct validity of SOF index was analyzed by Cohen's Kappa. Intraclass Correlation Coefficient (ICC) was used to examine test-retest reliability and interrater reliability. Correlations between patients SOF score, CFS score and FRAIL score were calculated using the Spearman test. The p-value of <0.05 was considered statistically significant.

### Ethical Statement

The study was performed in accordance with the guidelines in the Declaration of Helsinki. The Local Ethics Committee of Hacettepe University approved the study (ID: GO 21/1164). Oral and written details about the study were explained to the patients and their consent was obtained.

## Results

There were 267 patients in the study. The median (IQR) age of patients was 72 (68-78) and 64% of the participants were female. The median (IQR) SOF score was 1 (0-1), the median (IQR) FRAIL score was 1 (0-2) and the median (IQR) CFS score was 3 (3-4). Number of frail patients were 52 (19%) according to CFS, 65 (24%) according to FRAIL scale and 58 (22%) according to SOF. Characteristics of the whole study group are shown in Table 1.

When we look at frailty as three groups (robust, pre- frail, and frail group) concordance of FRAIL and SOF score was strong (Cohen's K: 0.633, p<0.001) and the concordance of CFS and SOF score was moderate (Cohen's K: 0.404, p<0.001). FRAIL and SOF score were positively and strongly correlated (Spearman r=0.805, p<0.001). The correlation between the CFS and SOF score was moderate (Spearman r=0.578, p<0.001).

When frailty was examined within two groups [robust (robust + pre-frail) and frail group] concordance of FRAIL and SOF score was strong (Cohen's K: 0.652, p<0.001) and the concordance of CFS and SOF score was also strong (Cohen's K: 0.611, p<0.001). The correlation between the FRAIL and SOF score was strong (Spearman r=0.654, p<0.001) and the correlation between the CFS and SOF score was also strong (Spearman r=0.612, p<0.001). The concordance and correlation results of SOF score were given in Table 2.

When analyses were performed with the updated version of CFS (31), the concordance of CFS and SOF score was moderate (Cohen's K: 0.401, p<0.001) and the correlation between the CFS and SOF score was also moderate (Spearman r=0.460, p<0.001) results were given in Table 3.

Test-retest reliability of the SOF score was high (ICC: 0.939, CI: 0.846-0.976, p<0.001). The interrater reliability of the SOF score was also high (ICC: 0.981, CI: 0.953-0.993, p<0.001). Reliability results were shown in Table 4.

## Discussion

With this study, we aimed to validate the SOF frailty measurement scale for frailty assessment. Results showed that Turkish version of the SOF is a valid and reliable scale for screening frailty in older people. It has high test-retest and interrater reliability. In

**Table 1. Demographic properties and general characteristics of the study population**

| | Patients (n=267) |
|---|---|
| **Age** | 72 (68-78) |
| **Sex**<br>**Women (n, %)** | <br>172 (64%) |
| **SOF score** | 1 (0-1) |
| **FRAIL scale** | 1 (0-2) |
| **CFS** | 3 (3-4) |
| **Number of drugs** | 5 (2-7) |
| **Katz ADL** | 6 (6-6) |
| **Lawton IADL** | 8 (7-8) |
| **MMSE** | 27 (25-29) |
| **Yesavage GDS** | 2 (0-5) |
| **MNA-SF** | 14 (12-14) |
| **Hemoglobin, g/dL** | 13.6 (12.3-14.6) |
| **Creatinine, mg/dL** | 0.8 (0.69-1) |
| **AST, U/L** | 20 (17-24) |
| **Vitamin D, ng/mL** | 19.9 (11.2-28.8) |
| **Vitamin B12, pg/mL** | 253 (176.5-348) |
| **TSH, mIU/L** | 1.7 (1-2.5) |
| **DM (n, %)** | 109 (41%) |
| **HT (n, %)** | 170 (64%) |
| **CAD (n, %)** | 51 (19%) |
| **COPD (n, %)** | 13 (5%) |

*Categorical values were given as number and percentages, continuous values were given as median (IQR)
SOF: Study of osteoporotic fracture, CFS: Clinical frailty scale; ADL: Activities of daily living, IADL: Instrumental activities of daily living, MMSE: Mini-mental state examination, GDS: Geriatric depression score, MNA-SF: Mini nutritional assessment-short form, AST: Aspartate aminotransferase, TSH; Thyroid stimulating hormone, DM: Diabetes mellitus, HT: Hypertension, CAD: Coronary artery disease, COPD: Chronic obstructive pulmonary disease

**Table 2. Results of correlation analyses between SOF and other frailty scales**

| **Two group analysis (frail/robust)** | | | **Three group analysis (frail/pre-frail/robust)** | |
|---|---|---|---|---|
| **Kappa analysis** | | | **Kappa analysis** | |
| | **Cohen's Kappa** | **p** | **Cohen's Kappa** | **p** |
| **SOF-FRAIL** | 0.652 | **<0.001** | 0.633 | **<0.001** |
| **SOF-CFS** | 0.611 | **<0.001** | 0.404 | **<0.001** |
| **Correlation analysis** | | | **Correlation analysis** | |
| | **Correlation coefficient** | **p** | **Correlation coefficient** | **p** |
| **SOF-FRAIL** | 0.654 | **<0.001** | 0.805 | **<0.001** |
| **SOF-CFS** | 0.612 | **<0.001** | 0.578 | **<0.001** |

SOF: Study of osteoporotic fracture, CFS: Clinical frailty scale

| Table 3. Results of correlation analyses between SOF and updated version of CFS | | |
|---|---|---|
| **Two group analysis (frail/robust)** | | |
| **Kappa analysis** | | |
| | **Cohen's Kappa** | **p** |
| SOF-CFS | 0.401 | **<0.001** |
| **Correlation analysis** | | |
| | **Correlation coefficient** | **p** |
| SOF-CFS | 0.460 | **<0.001** |
| SOF: Study of osteoporotic fracture, CFS: Clinical frailty scale | | |

| Table 4. Results of reliability analyses of SOF scale | | | |
|---|---|---|---|
| | **ICC** | **p** | **95% CI** |
| Test-retest | 0.939 | **<0.001** | 0.846-0.976 |
| Interrater | 0.981 | **<0.001** | 0.953-0.993 |
| ICC: Intraclass correlation coefficient, CI: Confidence interval | | | |

addition, the FRAIL and CFS total score and SOF were strongly correlated, while the updated version of CFS and SOF were moderately correlated.

It is of great importance for physicians who deal with geriatric patients not to miss the geriatric syndromes. Frailty is one of the most common geriatric syndromes. In the Frail TURK project, the prevalence of frailty in Turkey was found to be 39%. In another study conducted in Turkey, the prevalence of frailty among community-dwelling older people was 15.4-27.8%. In another study examining geriatric outpatient clinic patients, the prevalence of frailty ranged from 12% to 15% (36-38). Frailty can have negative consequences in the elderly, such as mortality, hospitalisation, disability, falls, fractures, worsening mobility, lower quality of life, depression, cognitive decline, dementia and admission to long-term care (1-12). It is important to recognize and diagnose frailty early in older patients. There is a need for a quick and practical scale which can be applied in clinical practice to recognize frailty. There are many tools used to diagnose frailty, but SOF frailty index stand out among them because it is practical and fast. Turkish validation of SOF frailty index was not performed. Our study demonstrated that Turkish version of the SOF is a valid and reliable tool.

It is necessary to give more importance to frailty as it causes negative consequences, high workload and economic burden. If frailty is detected early in older patients, the medical, biological, psychological and social status of the patient can be protected more easily. Frailty is a major risk factor for disability and death in geriatric patients and can be reversible with clinical interventions. Therefore, frailty evaluation is very important in defining the treatment plans of geriatric patients.

Comprehensive geriatric assessment (CGA) is the gold standard for frailty screening. In clinical practice, there is sometimes not enough time for comprehensive geriatric evaluation. To be more practical, various tools have been developed in frailty screening. The most important advantage of the SOF index over other indexes is its simplicity and its practical application in the clinical setting. The SOF index includes two short questions answered with "yes or no" and a physical test that does not require special equipment. The test can be administered in less than 5 minutes. The SOF index was compared with the cardiovascular health study (CHS) index in two large studies and together with the CHS index effectively predicted adverse health outcomes (24,25).

There are many frailty scales to detect frailty. Among these; Fried frailty scale and FRAIL scale are suitable screening methods for both community-dwelling and inpatient older people (1,16). Tilburg frailty index and PRISMA-7 are mostly used in community-dwelling older people (39,40). CFS and Edmonton frailty scales are mostly used in hospitalized older patients (14,15). For pre-surgical risk assessment; CGA, CFS, Edmonton scale, FRAIL scale, Groningen frailty ındicator are used in frailty screening (41,42). SOF frailty index is suitable for both community-dwelling and hospitalized older patients (24,25). In this study, we showed that the SOF index is valid and relieable in older Turkish outpatients.

While some of the frailty scales measure only the physical component, some also measure the social, psychological and cognitive component in addition to the physical component (1,14). CFS asses cognitive frailty in addition to physical frailty, and is therefore more multidimensional. Edmonton scale asses both cognitive and social frailty. SOF scale asses only physical frailty. Therefore, while a strong correlation was found between SOF scale and FRAIL scale, moderate correlation was found between SOF scale and CFS in our study. It should not be forgotten that we screen only physical frailty with the SOF scale. Cognitive, social and emotional states should also be evaluated differently for a comprehensive assessment.

In our study, it was found that vitamin D levels were low in patients. The results in our study were compatible with the literature. Vitamin D deficiency is common in the older people and has many causes. Some of these causes are decreased daily sun exposure, diseases such as chronic renal failure and gastrointestinal malabsorption, and decreased oral intake (43,44). Low vitamin D levels are associated with various geriatric syndromes in the older people, such as frailty, sarcopenia, osteoporosis, falls and fractures (45-48). Vitamin D deficiency should be screened in older patients and treated if there is a deficiency.

This was a cross-sectional study. The ability of SOF scale to predict future disability or death rates could not be evaluated. Prospective studies are needed to determine the predictive value of the SOF index on disability or mortality. We would also like to add that, this study was carried out in a single center and

on outpatients. Therefore, it cannot be generalized for other settings such as nursing homes. Further studies at different settings are needed to generalize these results to the general population.

## Conclusion

This study showed that the Turkish version of the SOF score is a valid scale for the assessment of frailty in outpatient clinics.

### Acknowledgements

Ebru Öztürk assisted in the statistical process.

### Ethics

**Ethics Committee Approval:** The study was performed in accordance with the guidelines in the Declaration of Helsinki. The Local Ethics Committee of Hacettepe University approved the study (ID: GO 21/1164).

**Informed Consent:** Oral and written details about the study were explained to the patients and their consent was obtained.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Concept: İ.İ., C.A., S.C., B.B.D., Design: İ.İ., D.K., C.B., P.Ü., Data Collection or Processing: İ.İ., Z.Ş., S.C., A.O.B., B.B.D., Analysis or Interpretation: M.H., C.A., M.G.O., M.C., Literature Search: İ.İ., M.H., A.D., Y.Ö., M.G.H., B.B.D., Writing: İ.İ., B.B.D.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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ORIGINAL RESEARCH

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# Comparison of Physical Activity, Functional Fitness and Fatigue According to Gender in Young-old

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## Abstract

**Objective:** The aim of this study was to compare physical activity, functional fitness and fatigue levels according to gender in young-old.

**Materials and Methods:** The International Physical Activity Questionnaire-short form was administered to a total of 55 young-old. Muscle strength, functional capacity, and fatigue were respectively evaluated with the Lafayette manual muscle tester, a 6-minute walking test, and the fatigue severity scale.

**Results:** It was observed that there was no difference in terms of physical activity, functional capacity, and the percentage of normal values in the proximal muscles ($p>0.05$). The proximal muscle force of males was higher than female individuals ($p<0.05$). The scores of female individuals on the fatigue severity scale were higher than male individuals ($p<0.05$).

**Conclusion:** The young-old stage, a major transition period for old adults, is an adoption process to the changing work and family life. The similarity of parameters may be due to the fact that major health differences reflected by gender were not observed in this period.

**Keywords:** Young-old adults, fatigue, physical fitness, gender role, muscle strength

## Introduction

Aging is a chronic and universal process that is seen in every living thing, starts in intrauterine life and continues until death, is irreversible, and affects all body systems (1). The aging can be divided into different stages. The young-old population (YOP) consists of people aged 65-74 years (2). In this stage, people adapt to aging and lifestyle transitions. YOP have often retired from jobs (3). Thus, this stage includes dramatic changes for YOP, such as work and family life (4). Work and family life, and leisure time activities generally differ during daily life activities for the young-old stage, a major transition period (4). The young-old stage is the first step for healthy and successful aging (5). The changing proportion of activities can affect physical activity, functional fitness, and fatigue.

Physical activity is any bodily movement produced by skeletal muscle that results in energy expenditure (6). It is the most important factor for physical and mental well-being in the elderly. Regular physical activity in the elderly has multiple effects on physical fitness and health (7). There are benefits of physical activity on physical, cognitive, and psychosocial levels in the elderly (2). Physical activity is a health determinant and preventive factor against cognitive decline and functional limitations. It may exert neuroprotective effects by bolstering the cardiovascular, immune, and metabolic systems, which might be especially important in cardiovascular-based degenerative conditions (8). It helps older adults to improve their flexibility and strength (9). Muscular strength and cardiorespiratory fitness are essential for physical functioning in the elderly (10). As higher levels of both functional capacity

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and muscular strength are related to improve functional performance, these physical components are key targets for intervention (11). Muscle weakness is a major cause of recurrent falls, morbidity, and mortality in the elderly. The physiological mechanisms of old muscles contribute to function and mobility (12). Functional fitness is a comprehensive term that consists of physical functions, independence of life, muscle strength, flexibility, and cardiorespiratory endurance (13). Besides, fatigue which is a common complaint among adults aged 50 years, may affect physical activity, and complaint-related fatigue causes a low level of physical performance (14). Therefore, all these components (physical activity, functional performance, muscle strength, fatigue, functional capacity, etc.) are interrelated in the elderly. Many studies investigate physical activity, functional fitness, and fatigue in the elderly (2,7,13,15). These studies focus on the oldest age. There is a gap in the literature related to the young-old stage. YOP is a major transition period; thus, older adults change activities in daily life. The situation can affect the physical status and fatigue levels. Thus, this topic has become of major scientific and clinical importance.

When the elderly population is examined, activities are more negatively affected than men as women age (16). Although it has been shown that women do less physical activity than men (17) there is also a study in the literature that proves that women are more active in other activities such as housework and walking (16,18). Compared to women, men are more physically active and have higher body strength (19). While research has shown gender differences in physical activity separately, it is not known whether there are differences in physical activity, functional capacity, and fatigue in the young-old population. Both physiological and psychological conditions in old age differ according to gender. It is thought that the health status of men and women is different at every stage of old age (20). Since the young-old period is the beginning of aging, it is seen as the forerunner of other levels, and the comparison of functionality by gender in this period will be descriptive.

In light of this knowledge, as the world population ages, it is important to understand aging and how to increase physical activity with the goal of healthier aging. The effect of gender on physical activity, functional capacity, and fatigue should be investigated in the young-old population. The aim of this study was to compare physical activity, functional fitness and fatigue according to gender in young-old.

## Materials and Methods

### Participants and Study Design

The study was planned as cross-sectional. To reduce bias, the statistician in the study was blinded. Patients were 22 recruited at Kalyon Medicine Center. The study was reviewed prospectively between May 2021 and September 2021. In our study, a total of 55 individuals, 28 male, and 27 female, aged 65-74 were evaluated. Individuals aged 65-74 years, with a standardized mini mental test score of 24 and above, without neurological and musculoskeletal problems that may affect walking and balance, and who did not need a walking device for ambulation were included in the study. Individuals with psychiatric or severe cognitive dysfunction, vision or hearing problems, and acute the disease and acute pain were excluded from the study. The flowchart is shown in Figure 1. Sixty individuals were included in the study. Five subjects were excluded from the study (female 3, male 2) due to acute pain, out of age range, and cognitive dysfunction. Twenty-seven women and 28 men were analyzed.

### Measurement Tools

### Data Collection Form

In the data collection form; demographic information, physical activity levels, muscle strength, physical performance, and fatigue levels were questioned. The procedure chart is shown in Figure 2.

### International Physical Activity Questionnaire-short Form (IPAQ-SF)

Physical activity levels were evaluated using the IPAQ-SF Turkish version of Saglam et al. (21,22). IPAQ-SF is a questionnaire that determines the duration and frequency of different types of activities by questioning the last 7 days. Physical activities in this survey; it is divided into 4 categories: High-intensity, medium-intensity, walking, and sitting. In the calculation of the questionnaire, the total number of hours and days for each physical activity level was calculated. IPAQ has been validated for use in adults, and older adults (22).

### Manual Muscle Testing

Muscle strength, one of the physical fitness parameters, was evaluated with the Lafayette manual muscle tester (Lafayette manual muscle tester 01165, USA digital handheld dynamometer) (23). The muscle test was measured for the middle part of the deltoideus muscle and the quadriceps muscle. Measurements will be made by a single researcher and each muscle test was recorded bilaterally by making 3 repetitive measurements. The peak force obtained from isometric muscle contraction was recorded. The expected percentage was obtained by taking the arithmetic mean of both sides and dividing it by the norm values (24).

### 6-Minute Walk Test

Functional capacity, which is another parameter of physical fitness, was evaluated with the 6-minute walk test. The distance traveled by the individuals by walking in a 30-meter corridor for 6 minutes was calculated. The test under the control of the physiotherapist was performed once and the distance covered

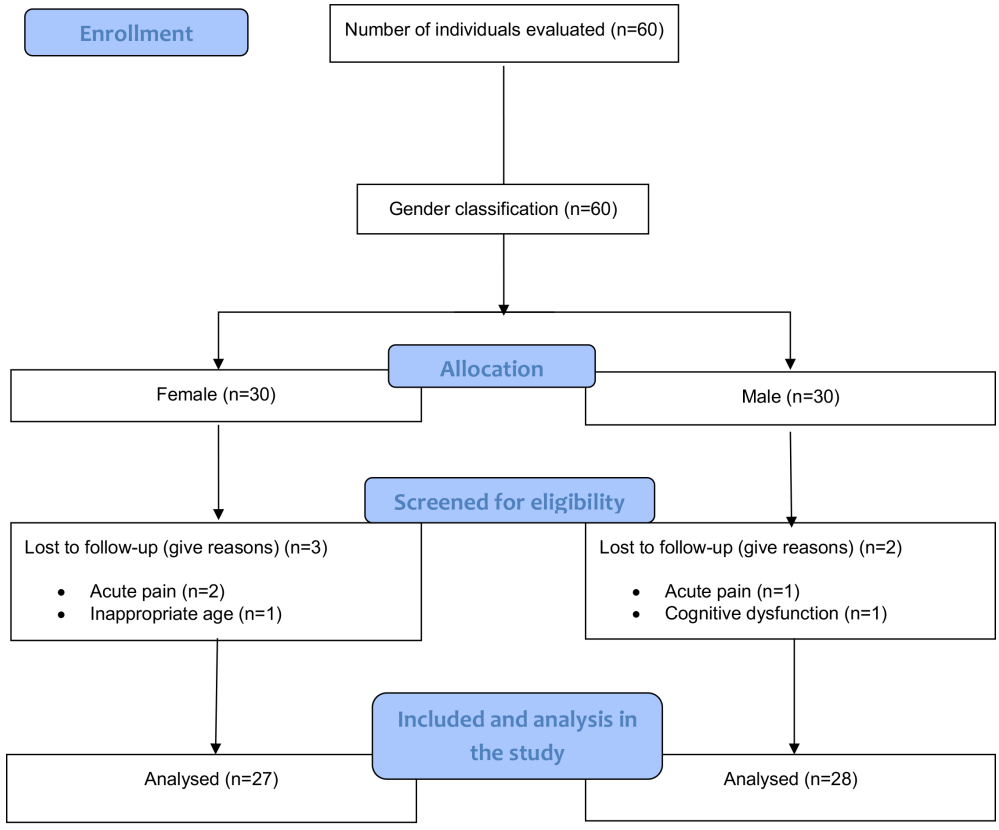


**Figure 1.** Flow chart

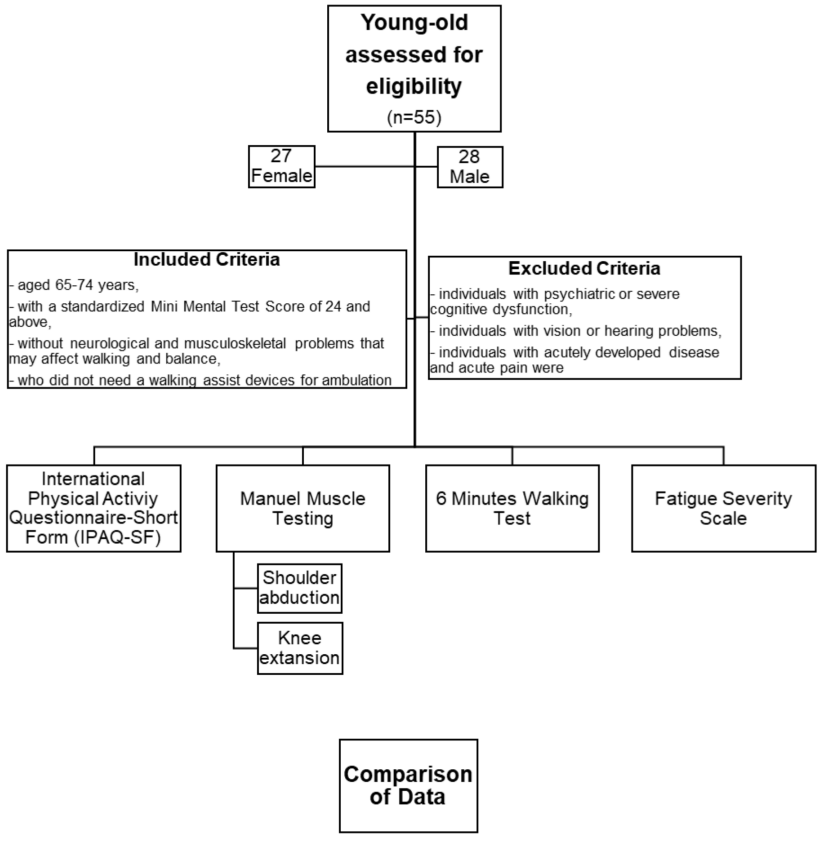


**Figure 2.** Procedure chart

was recorded. The 6-minute walk test is reliable and valid in adults and seniors (25).

### Fatigue Severity Scale

Fatigue was assessed with the Fatigue Severity scale. This questionnaire is a nine-item questionnaire that evaluates the effect of fatigue in the past week on daily functions. Each item is scored between 1-7. "1" indicates strong disagreement, and "7" indicates strong agreement. The total score is calculated by taking the arithmetic average of 9 items. A score of 4 and above usually indicates severe fatigue (26). The Turkish validation of the FSS was conducted by Armutlu et al. (27).

### Statistics

Statistical analyses were performed using the SPSS 25 package program. For descriptive analyses, the variables determined by numerical measurement were stated as the arithmetic mean and standard deviation (X ± SD). The data to the normal distribution was assessed using the Shapiro-Wilk test. An Independent t-test was used for the mean comparison of the data between groups. The statistical significance level was set at $p<0.05$. A significance level of 5% and a power (1-b) of 80% were assumed, and medium effect size (d=0.62) in the population was assumed (28). The G*Power analysis was used to estimate the minimum sample size needed. The sample size was calculated to be 26 subjects in each group (29).

## Results

There was no significant difference in the demographic characteristics of the individuals but not education and occupation status. Shoulder abduction muscle strength % of women was found to be higher than that of men (see Table 1). In addition, the score of female individuals on the fatigue severity scale was higher than that of male individuals (see Table 1). There was no significant difference in the values of shoulder abduction muscle strength (N), knee extension muscle strength (N), and knee extension muscle strength % (see Table 1). Functional capacity measurement indicator 6 minute walk test distance was found to be similar in both genders $p>0.05$.

## Discussion

The present study provides comparative data on the proximal muscle strength, fatigue, functional fitness, and physical activity levels of young elderly according to gender. In the study, which

**Table 1. Comparison of demographic information, physical activity, functional fitness, and fatigue levels according to gender**

| | Female (n=27) | Male (n=28) | | |
|---|---|---|---|---|
| | X ± SD | X ± SD | t | p-value |
| Height (cm) | 158.9±4.6 | 172.1±5.2 | 9.787 | 0.000* |
| Weight (kg) | 73.7±10.9 | 79.9±12.4 | 1.968 | 0.054 |
| BMI (kg/cm²) | 26.1±4.7 | 27.6±4.3 | 0.960 | 0.455 |
| Age | 70±4.8 | 70.1±6.8 | 0.089 | 0.930 |
| **Profession** | | | | |
| Housewife (n) | - | 26 (92%) | | |
| Retired (n) | 9 (33%) | 1 (3%) | | 0.000** |
| Working (n) | 18 (66%) | 1 (3%) | | 0.000** |
| **Comorbidities** | | | | |
| Diabetes mellitus (n) | 13 (48%) | 14 (50%) | | 0.847 |
| Hypertension(n) | 12 (44%) | 18 (64%) | | 0.650 |
| Asthma (n) | 1 (3%) | 7 (25%) | | 0.001** |
| Heart failure (n) | 5 (18%) | 5 (17%) | | 0.990 |
| Other (n) | 6 (22%) | 5 (17%) | | 0.910 |
| IPAQ (MET-h/wk) | 837.5±949.2 | 1236.8±1035.5 | 0.589 | 0.446 |
| SAMS (N) | 50.8±24.3 | 86.2±30.4 | 4.687 | 0.000* |
| SAMS (%) | 48.6±22.6 | 43.5±15.8 | 0.952 | 0.346 |
| KEMS (N) | 61.8±25.5 | 95.1±32.3 | 4.184 | 0.000* |
| KEMS (%) | 25.5±8.9 | 25.4±9.6 | 0.045 | 0.964 |
| 6MWT (meter) | 241±144.7 | 285.5±138.7 | 0.843 | 0.407 |
| FSS (score) | 51.2±11.1 | 40±14.3 | 3.250 | 0.002* |

*p<0.05 independent samples t-test, **p<0.05 chi-square, SAMS: Shoulder abduction muscle strength, KEMS: Knee extension muscle strength, FSS: Fatigue severity scale, 6MWT: 6-minute walking test distance, IPAQ: International physical activity questionnaire, SD: Standard deviation

included male and female participants with similar functional capacities and physical activity levels, it was discovered that the severity of fatigue levels of women was greater than that of men. Besides, the percentage of normal values by age and sex in the proximal muscles was similar to both of them. We think that the similarity of physical activity and functional capacity according to the groups is compatible with the similarity of the normalized values in proximal muscles.

It has been emphasized that proximal muscle strength was related to the functional measurements in the elderly (30). Peripheral and proximal muscles affect an individual's quality of life and the level of independence in life. The weakness of muscle strength cause physical incompetence and functional disability. On the other hand, physical immobility causes weakness of muscle strength in the elderly. There is a vicious circle here and it repeats in older individuals (31). It is known that there are many factors affecting this cycle, such as chronic diseases, fatigue, gender, and psychological status in the elderly. There are studies investigating the effects of gender on physical activity, functional capacity, and fatigue (32,33). Outcome parameters were analyzed separately in different age groups and especially in the elderly (34). The investigation of outcome parameters together in YOP is the original aspect of our study.

Gender-related alterations of proximal muscles have been reported with increasing age, such as an earlier and more severe decline in muscular strength has been observed in females as compared to males (35). It shows that the loss of muscle mass and strength in proximal aging-related physical function, mobility, and vitality in old age. Proximal muscle strength is a critical component of physical activity and functional capacity (35). The annualized rates of strength decline (3.6% in males and 2.8% in females) in these relatively healthy older adults were higher than the typical 0.8-2.0% per year previously reported in either cross-sectional studies or longitudinal investigations of relatively younger individuals (36). The fact that female individuals had less muscle strength than males in our sample is compatible with the literature.

Normalized proximal muscle values are found by dividing the muscle strength value of individuals by the expected value according to age and gender (31). It stated that knee extension strength differs as a function of age and gender (37). In another study, Fayet et al. (38) found that muscle activity may reflect an earlier decline in deltoid muscle strength in females. Nevertheless, Bullo et al. (39) emphasized that knee extension strength does not differ between groups in men or women according to age. The reason why there was no difference between normalized proximal muscle strength values according to gender in our study can be explained that the physical activities and functional capacities of the individuals are similar to those of males and females.

There is evidence showing that physical activity and functional capacity are at lower levels in female individuals (40). One of the consequences of the aging process is the decline in muscle strength, and respiratory and functional capacity. The low respiratory capacity and muscle strength cause a decrease in physical activity over time, especially in the female elderly. The endurance of older individuals decreases and they begin to tires more quickly (40). Gender factors in outcome measurement might reflect differences in underlying health conditions, as well as lifestyle and behavioral factors (17). For example, a significant reduction in bone mineral density after menopause has been frequently suggested to predispose women to a higher risk of falling and bone fracture so they decrease the level of physical activity. However, male and female young-old adults did not stay inactive, they just tried to adapt to the changing work and family life during this period. The period changes physical activity type, duration, etc. according to our findings, the similarity of physical activity and functional capacity may be because major health differences reflected by gender were not observed in this period. It is emphasized that the young old age period is a transitional period, and activities vary during this period. When our data, especially on physical activity, is viewed, the high standard deviation supports this variability.

Fatigue has been widely studied in the general population. Several studies found that there was a higher incidence and level of fatigue in women than in men (41,42). Also, fatigue is an important geriatric syndrome and a common complaint among the elderly, which is accompanied by low physical activity (43). Fatigability is known as highly prevalent in older adults and strongly associated with age (41).

### Study Limitations

The main limitation of this study was the use of self-reported data to measure the level of physical activity. Also, the diseases that met the inclusion criteria and other existing comorbid diseases were determined according to the statements of the individuals. At the same time, almost 50% of our sample was diabetic and hypertensive. It should be taken into account that this situation may affect the functional status. Furthermore, the sample is nearly 50% housewives and daily housewife physical activities could be characteristics according to culture. The smoking and drinking behaviors of the participants were not recorded.

## Conclusion

The young-old period is a major transition period over their life for males and females. Although females' muscle strength is lower than men's, they experience the young-old period similarly in terms of normalized muscle strength values, physical activity, and functional capacity but not fatigue. We believe that the major health differences caused by gender due to aging do

not occur in young-old age. However, our findings need to be supported by further studies. In terms of parameters that do not vary by gender, they can be examined in clinical studies in larger samples regardless of gender. A more detailed examination of the parameters that vary according to gender from different perspectives will provide a better understanding of the young-old period. There is a need for studies in which factors such as skill areas, individual differences and comorbid diseases are homogenized. Considering the gender factor in exercise and physical activity training in elderly individuals may be important in terms of both fatigue and muscle strength development.

### Ethics

**Ethics Committee Approval:** Ethics committee approval was obtained from Hasan Kalyoncu University Faculty of Health Sciences Non-Interventional Research Ethics Committee on 18.05.2021 (decision no: 2021/068) and it was done according to the Helsinki Declaration criteria.

**Informed Consent:** Before the study, individuals were informed about the purpose and content of the study. The consent form was obtained from the individuals.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Concept: T.M., B.T., Ç.M., Design: T.M., B.T., Data Collection or Processing: T.M., Ç.M., Analysis or Interpretation: E.O.S., Ç.M., Literature Search: T.M., E.O.S., B.T., Writing: T.M., E.O.S., B.T., Ç.M.

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ORIGINAL RESEARCH

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# Assessment of Sarcopenia by Ultrasound. A Feasibility Study in Acutely Admitted Danish Geriatric Inpatients

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## Abstract

**Objective:** Sarcopenia is a major geriatric syndrome diagnosed by assessing strength, quantity, and quality of muscles. We aimed to describe the feasibility of assessing sarcopenia by bedside assessment including the emerging tool ultrasound.

**Materials and Methods:** Participants were recruited consecutively among patients acutely admitted to the Department of Geriatrics, Odense University Hospital, Denmark. Ultrasound examination and handgrip-test (muscle strength) were performed at admission and minimum 5 days later. Muscle thickness of m. rectus femoris was measured and appendicular lean mass (ALM) (muscle quantity) was calculated using a validated regression model, two ultrasound scanning sites (dominant upper arm and thigh), and three anthropometric measures. Echo intensity was measured as an indicator of muscle quality.

**Results:** Out of 25 eligible participants, 17 were included. There was a significant (p=0.002) decline in m. rectus femoris thickness [1.7 cm (SD ±0.2) to 1.6 cm (SD ±0.3)], and a significant (p=0.04) decline in echo intensity [121.4 A.U (SD ±18.4) to 133.6 A.U (SD ±19.1)]. All ultrasound ALM and handgrip strength measurements showed non-significant declines. According to EWGSOP2's criteria, one participant was sarcopenic, while 12 met the threshold criteria by low handgrip strength. Thirteen participants had a lower handgrip strength compared to reference values from an age-and-gender-matched normal population.

**Conclusion:** It is feasible to perform bedside assessments on geriatric inpatients. A short period of hospitalization may result in a significant reduction of localized muscle thickness and echo intensity. Further studies including validation by DXA scans are needed.

**Keywords:** Ultrasound, sarcopenia, handgrip strength, geriatric assessment, muscle assessment

## Introduction

Sarcopenia is a skeletal muscle disorder and a major geriatric syndrome (1) characterized by the loss of muscle strength, endurance, and muscle mass (2,3). The prevalence of sarcopenia is reported as high as 30% in a community-dwelling population (1,4). In older adults this can lead to functional decline, impairing the ability to perform activities of daily living (5,6) and decreasing quality of life (7). Sarcopenia shows significant overlap with the frailty syndrome (8), as low handgrip strength (HGS) and slow gait speed are characteristics of both conditions (9). In addition, sarcopenia increases the risk of falls and fractures (10,11) as well as the rate of hospital admission and mortality (6,12), and carries a high personal, social, and economic burden when untreated (8). Early identification of sarcopenia is therefore essential for effective prevention and treatment.

To address the need for standardization in identifying, examining, and treating sarcopenia, the EWGSOP2 developed guidelines in 2018 (8). These guidelines involve the assessment of muscle strength, muscle quantity, muscle quality, and physical performance as an indicator of severity (8). Muscle strength can be assessed by HGS, a simple, inexpensive measurement, and a powerful predictor of poor patient outcomes (8,13). Low HGS correlates moderately with low strength in other body compartments (14,15). Muscle quantity is usually assessed by gold-standard techniques such as magnetic resonance imaging (MRI), computed tomography (CT), and dual-energy

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X-ray absorptiometry (DXA) (8,16). In contrast, the assessment of muscle quality remains a conflicted area with little standardization (17), but consensus exists that muscle quality is of even greater importance than previously thought (8). Echo intensity (EI) is one of the functions evaluating muscle quality, and a high EI has been associated with poor muscle performance (18,19) and may be an indirect measure of adipocyte infiltration or fibrosis (19).

Ultrasound is a patient-safe and patient-centred method for examining various conditions and has shown great potential in examining muscle quantity and quality (8,20). Assessment of pennate muscles such as the quadriceps femoris can detect a decrease in muscle thickness (MT) and cross-sectional area (CSA) within the first week of critical illness in middle-aged adults (8,21). Studies in young adults have shown that muscle atrophy can be detected after 5 days (22,23). Compared to other imaging techniques ultrasound measurements are inexpensive and radiation-free. Furthermore, the device is mobile, examination can be done bedside (24), and requires minimal training (25).

Other studies assessing sarcopenia use nonportable imaging tools (CT, MRI, or DXA) to assess muscle mass, but we have not been able to identify any previous studies assessing sarcopenia in geriatric inpatients using ultrasound. The aim of this study was to assess the feasibility of using ultrasound for diagnosing sarcopenia and to describe how muscle strength (HGS), muscle quantity (ultrasound-ALM and thickness of m. rectus femoris), and muscle quality (echo intensity) change in a population of acutely admitted geriatric patients hospitalized for a minimum of 5 days.

## Materials and Methods

### Study Design

This study was carried out as a single-center feasibility study.

### Setting

A medical student (J.S.H) received training and supervision (written material, instructional videos, and two months of daily supervised scans prior to the start of this study) in carrying out all assessments including ultrasound by a physician (K.S.B) in geriatric medicine with large experience and certification in the use of point-of-care ultrasound.

### Study Population

During May 2022 participants were recruited consecutively among patients acutely admitted to the Department of Geriatric Medicine, Odense University Hospital (OUH), Denmark. The department is a 32-bed acute medical ward treating frail, multimorbid older adults with acute medical conditions. Patients were eligible for inclusion if they consented to participate within 24 hours of admission and had an expected hospitalization of minimum 5 days.

### Exclusion Criteria

Patients with known moderate or severe dementia, and patients who were cognitively impaired due to delirium and thus unable to provide informed consent were excluded, as were patients developing delirium after inclusion, and those discharged after less than 5 days of hospitalization.

### Intervention

The following information was retrieved from the medical record in order to describe the health and functional level of the study population: Height, weight, body mass index, Barthel index [(BI)-100] (26,27) number of diseases, and diagnosis upon admission. Multimorbidity was assessed by the Charlson comorbidity score (CCI) (28). Frailty was assessed by the clinical frailty scale (CFS) at baseline (29,30).

All participants were informed orally and in writing about the purpose of the study. It was made clear to the participants that they could withdraw at any stage of the study, and that withdrawal would have no consequences for their treatment and care.

Participants went through an ultrasound examination and a handgrip measurement immediately after obtaining consent (baseline) and again immediately before discharge from the hospital, but not earlier than day 5 (follow-up). All patients discharged before day 5 were omitted. As the average in-hospital stay in the department is 6.7 days (personal communication), day 5 was chosen to obtain a representative geriatric population.

### Ultrasound Examination

A CE-certified ultrasound device MindrayTE7 was used with the L14-6Ns probe for the 2-D real time B-mode ultrasound. All ultrasound measurements were done with the probe in a neutral tilt with a minimum of pressure applied and with a generous amount of conductive gel. The scanning sites were marked with a pen and three sets of measurements were performed, and the mean value used.

### Quantitative Muscle Measures

B-mode ultrasound was carried out to quantify muscle mass by estimating ALM, which corresponds approximately to appendicular skeletal muscle mass (ASM) (8,24). An easily feasible and validated ultrasound scanning protocol with a high correlation to DXA estimates of ALM was chosen (24).

To calculate ALM via a validated regression model (24), two scanning sites (dominant upper arm and thigh) (A), and three anthropometric measures (B) were used as shown in Figure 1 and described in the appendix.

The participants' height in meters, weight in kilograms, gender, the measured MT, and anthropometric values were used in the equations listed in the appendix to calculate ultrasound-ALM (24).

In addition, MT of m. rectus femoris was obtained according to the recommendation by SARCUS (20). In short, with the patient in a neutral and horizontal position, B-mode ultrasound was carried out on the middle part of the muscle, defined as half the length from the trochanter major (upper landmark of the muscle) to the superior border of the patella (the lower landmark of the muscle) to measure MT defined as the distance between the upper and the lower muscle fascicle on a cross-sectional image.

### Qualitative Muscle Measure

EI was used to assess muscle quality as recommended by SARCUS (20). EI is a function evaluating muscle quality from ultrasound imaging on a grey scale, ranging imagining contrast from black to white (18,19). We used the image obtained during measurements of m. rectus femoris MT, and performed EI analysis in ImageJ (Version 1.53t, National Institute of Health, USA, http://rsb.info.nih.gov/ij) as described in previous studies (31,32).

### Muscle Strength Measure-HGS

Muscle strength was assessed by HGS (kg) using a Smedley dynamometer (TTM; Tokyo, Japan). The width of the handle was adjusted to fit the individual hand size, and HGS was measured using the dominant hand with the elbow in a 90° position and the upper arm tight against the trunk. Depending on the participant's mobility, HGS was measured preferably standing, alternatively as sitting, or even in the supine position if the patient was unable to be in a vertical or sitting position, respectively. The best of three measurements with the dominant hand was used and matched to Danish reference values by Frederiksen et al. (15).

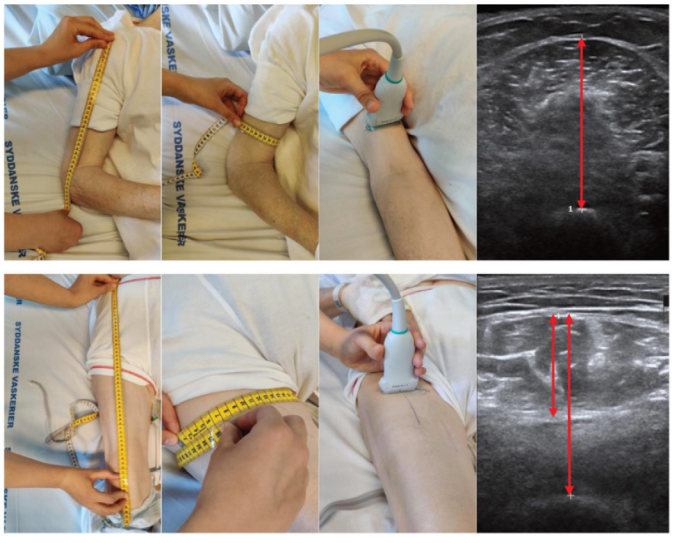

**Figure 1.** Qualitative and quantitative muscle measurements. The two scanning sites (dominant upper arm and thigh) and the anthropometric measures are demonstrated. UL measurements are shown together with the scanning sites and muscle thickness from the upper muscle fascicle to humerus (biceps) and femur (rectus femoris) are marked with a red arrow. The same applies to the muscle thickness of rectus femoris measured from the upper fascicle to the lower fascicle

### Data Management

The study was approved on April 28th, 2022, by the Data Protection Agency (journal nr: 21/50801). All data was stored in a secure Redcap Open database [OPEN (OP_1499)].

### Statistics

Statistical analyses were carried out in Microsoft Excel version 2016 (Microsoft: Redmond Seattle USA). Normality was assessed using the Shapiro-Wilk test. Normally distributed data are presented as a mean ± standard deviation (SD). Non-normally distributed data are presented as median with interquartile range (IQR). Results of numeric data were compared using parred t-test or Wilcoxon-rank sum test (analysis carried out in R-statistics version R-4.2.0 for Windows) depending on the normality of the data. As a limit for statistical significance, a two-sided $p<0.05$ was chosen.

### Reliability of Measurements

To assess the quality of ultrasound measurements, we estimated the intrarater reliability. As J.S.H was the only rater and performed three sets of measurements for each participant, we used the intra class coefficient (ICC) (2.1) model (33,34). As stated in the literature, we considered an ICC of 0.5 or less as poor, 0.5-0.75 as moderate, 0.75-0.9 as good and an ICC of 0.9 or above as excellent reliability (33).

### Ethics

Ultrasound is a widely used non-invasive method and does not expose the participant to any radiation, nor does it provide any other physical harm.

The study has been approved by the Local Ethics Committee (Videnskabsetisk Komité for Region Syddanmark) (S-20210100).

## Results

In total, 25 participants were included in this study. Eight participants were excluded because of discharge before 5 days after baseline examination. The final sample comprised 17 participants (characteristics are presented in Table 1). The intrarater reliability using the ICC was calculated to 0.92.

### Baseline Demographics

Median age was 85 years (IQR: 81-89), ranging from 60 to 93 years. The median length of hospitalization was 5 days (IQR:

5-7), ranging from 5 to 8 days. Nine participants were admitted because of an infection (53%), while two participants were admitted with rhabdomyolysis (12%), two with dehydration (12%), two with reduced general condition (12%), one with dyspnoea (6%) and one with hypotension (6%). The mean BI-100 was 52.1 (SD: ±30.1), the mean CFS was 5.1 (SD: ±1.17) and the mean CCI was 6.4 (SD: ±1.7).

### Ultrasound-measurements and HGS

All ultrasound-ALM medians showed a reduction from baseline to follow-up (Table 2), but none were significant. The same applies to HGS showing a non-significant reduction from a mean 16.5 kg (SD: ±9.6) at baseline to a mean 16.2 kg (SD: ±9.9) at follow-up. There was a significant (p=0.002) fall in the rectus femoris MT between baseline [1.7 cm (SD: ±0.2)] and follow-up [1.6 cm (SD: ±0.3)] (Figure 2 shows MT of m. rectus femoris at baseline and follow-up for each participant). Grey scale analysis revealed a significant (p=0.04) increase in EI from baseline [121.4 A.U (SD: ±18.4) and follow-up (133.6 A.U (SD: ±19.1)].

### Sarcopenic Participants

Based on the ALM without circumference measures, one participant (6%) was categorized as sarcopenic by meeting both cut-off points made by the EWGSOP2 (8), i.e., low HGS (<27 kg and <16 kg men and women, respectively), and low muscle quantity (ASM <20 kg for men and <15 kg for women). When comparing to Danish gender, age, and height stratified reference values (15) thirteen participants (76%) had a lower HGS both at baseline and follow-up, while twelve participants (70%) had both at baseline and follow-up a lower HGS than the cut-off values for sarcopenic strength according to the EWGSOP2 (8).

## Discussion

This study demonstrates that it is feasible to assess sarcopenia in a vulnerable population of acutely admitted geriatric patients by bedside ultrasound and anthropometric measures. Moreover, although the population under study is small, we found a reduction in calculated ALM measurements, MT of rectus femoris, EI, and HGS from baseline to follow-up, i.e., after five days of admission, although only the reduction in MT (quantitative parameter) and EI (qualitative parameter) was significant. Thus, while an isolated significant difference is seen in the rectus femoris, there was no difference in overall ALM, which may be interpreted as a possible development of local sarcopenia during a short period of hospitalization and is in line

**Table 1. Baseline demographics**

| n | 17 |
|---|---|
| Age (years), median [IQR] | 85 [81;89] |
| Female (%) | 8 (47) |
| Days between 1. and 2. ultrasound scans, median [IQR] | 5 [5;7] |
| Height (m), mean (SD) | 1.7 (0.1) |
| Weight (kg), mean (SD) | 72.5 (16.1) |
| BMI (kg/m²), mean (SD) | 25.0 (4.4) |
| Falls (within the last 12 months), median [IQR] | 1 [1;2] |
| Arm dominance (%) | Right (100) |
| Leg dominance (%) | Right (94) |
| **Primary diagnosis upon admission** | |
| Infectious disease (%) | 9 (53) |
| Rhabdomyolysis (%) | 2 (12) |
| Dehydratio (%) | 2 (12) |
| Reduced general condition (%) | 2 (12) |
| Dyspnoea (%) | 1 (6) |
| Hypotension (%) | 1 (6) |
| Charlson comorbidity index, mean (SD) | 6.4 (1.7) |
| Clinical frailty scale, mean (SD) | 5.1 (1.2) |
| Barthel-100 index (Shahs version), mean (SD) | 52.1 (30.1) |

Data is presented as mean for normally distributed variables, median for non-normally distributed variables and numbers (%) for categorical variables.
N: Number of individuals, BMI: Body mass index, SD: Standard deviation, IQR: Interquartile range

**Table 2. Ultrasound measurements and handgrip strength**

| | Baseline | Follow-up | |
|---|---|---|---|
| Ultrasound ALM with circumference measures (kg), mean (SD) | 21.3 (4.24) | 21.2 (4.1) | 0.52 |
| Ultrasound ALM (kg), mean (SD) | 21.5 (4.0) | 21.4 (3.8) | 0.40 |
| Ultrasound ALM/height² (kg/m²), median [IQR] | 7.6 [6.5;7.9] | 7.5 [6.8;7.9] | 0.38 |
| Muscle thickness (cm), mean (SD) | 1.7 (0.2) | 1.6 (0.3) | 0.002* |
| Echo intensity (A.U), mean (SD) | 121.4 (18.4) | 133.6 (19.2) | 0.04* |
| Handgrip strength (kg), mean (SD) | 16.5 (9.6) | 16.2 (9.9) | 0.71 |

Data is presented as mean for normally distributed variables and median for non-normally distributed variables. P-values were tested using t-test (normally distributed variables), Wilcoxon's rank sum test (non-normally distributed variables).
*Differences among measurements at baseline and follow-up was interpreted as significant if p<0.05.
ALM: Appendicular lean mass, SD: Standard deviation, IQR: Interquartile range

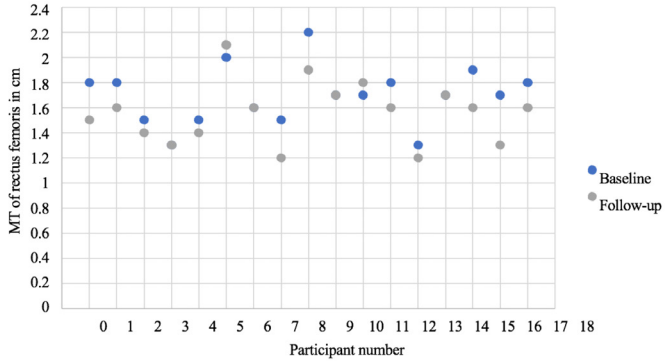


**Figure 2.** Muscle thickness (MT) of m. rectus femoris at baseline and follow-up for each participant

with findings from a study on hospitalized hip fracture patients using a similar method (35). To our knowledge, no previous studies have described ultrasound assessed sarcopenia in non-fracture geriatric inpatients.

A minimum of 5 days was chosen since the median length of stay at the department of geriatric medicine, OUH is 6.7 days (personal communication). Other studies in younger adults have shown that muscle atrophy can be detected after 5 days of bed rest (8,22,23), and dramatic changes in muscle mass occur within 4-6 weeks of bed rest in healthy individuals (22), which indicates that a significant change in ALM may first be identified after a longer period of hospitalization.

The participants in this study were all older adults without dementia and delirium, but with a moderate degree of frailty [mean CFS score: 5.1 (SD 1.2)]. By excluding patients with dementia and delirium it may be questioned whether the studied population is representative. If more vulnerable participants, i.e., those with cognitive impairment, dementia, and delirium, were included, the muscle assessments may have been lower, as sarcopenia is associated with dementia, mild cognitive impairment, and cognitive decline (36). However, we do not know whether the decline during at least 5 days of bed rest for these patients would affect the rate of decline in muscle status more than cognitively intact older patients. Another factor is, that acute illness in most cases starts in the preceding days before the acute hospitalization with bed rest at home. Ideally, the baseline measurements should have been performed at home when the first signs of illness with reduced physical activity or bed rest began. Furthermore, at the department of geriatrics, OUH, there is a very high focus on good nutrition, mobilisation, and physiotherapy, which may contribute to preventing deterioration of muscle functions and only a minor reduction in ALM.

Both equations of ALM (ALM with circumferences and the "abbreviated" version) were used since the reliability of circumference assessments can be compromised by clinical conditions like oedema (24) and changes in body composition in older patients (37). When comparing the ALM estimates without circumferences, only one participant (6%) met the EWGSOP2 criteria for being sarcopenic (ASM <20 kg for men and <15 kg for women) (8). In an acute hospital setting with older adults (>65 years), the prevalence of EWGSOP-defined sarcopenia was 10% (1,38), which is in line with our results based on a much smaller sample. In contrast, another Danish study based on geriatric out-patients referred for falls assessment or general geriatric assessment, the prevalence of sarcopenia was 26% according to the criteria from the EWGSOP (39), which may be explained by a longer period of disabling conditions (falling, fear of falling, uncovered non-acute somatic disease) leading to a more sedentary lifestyle and sarcopenia.

Thirteen participants (76%) had lower HGS both at baseline and follow-up compared to reference values adjusted for gender, age, and height (15). Following the EWGSOP2 recommendation the number was 12 (70%). However, the EWGSOP2 recommendation takes only into account the gender, not the height and age, and there is no recommendation of which hand-dynamometer to use, nor definitions of HGS cut-offs for the varying hand-dynamometers. Looking at the prevalence of sarcopenia when based on strength (HGS) in this study, the prevalence is much higher compared to the prevalence of sarcopenic muscle mass (ALM). Studies have shown that the greatest decline in muscle strength occurs in the earliest stages of bed rest (23). Furthermore, it has been shown that a decline in muscle strength happens much faster than muscle atrophy during the first 2 weeks of bed rest (23), which underlines the fact that rectus femoris was a significant statistical parameter, not HGS. However, the finding of rectus femoris atrophy needs to be controlled in a larger population of geriatric inpatients.

The strength of this small study is that the ICC showed a value of 0.92, indicating an excellent reliability (33). As no other investigator was involved in the measurements interrater reliability could not be assessed. Considering that ultrasound is easily available, can be done bedside (20), and can be carried out after a few weeks of training (25), ultrasound should have a greater place in the diagnosis of sarcopenia. The MT measurements are easy to perform, and no equipment restrictions exist (24).

### Study Limitations

A major limitation of this study is the relatively small sample size and the exclusion of the most vulnerable patients with dementia or delirium. Therefore, our results should be interpreted with caution. The prevalence of sarcopenia could have been higher if patients with these diagnoses had been included, as well as a larger sample size, and including patients with longer bedrest would increase the validity of the estimated prevalence as well as the representativeness of this patient group. Also, the muscle mass assessments by ultrasound and circumference

measurements of the geriatric in-patient population should be validated by DXA scans. In addition, we cannot rule out that small alterations in the contrast-enhancement software on the ultrasound device could have interfered with the results of the EI-measurements.

## Conclusion

Our study suggests that it is feasible to perform assessment of sarcopenia using bedside assessments of geriatric inpatients and even a short period of hospitalization (5 days) seems to result in a significant reduction in both MT and EI of the m. rectus as measured by ultrasound, thereby suggesting a process of sarcopenia in a large muscle that has important functions for keeping normal posture and balance. Future studies addressing hospitalized geriatric patients should validate the bedside muscle quantity assessment by DXA scan, as well as doing in-home assessment for sarcopenia after discharge, to see how muscles of geriatric patients are affected by longer immobilisation and sedentary living during convalescence and rehabilitation.

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### Ethics

**Ethics Committee Approval:** The study has been approved by the Local Ethics Committee (Videnskabsetisk Komité for Region Syddanmark) (S-20210100).

**Informed Consent:** All participants were informed orally and in writing about the purpose of the study.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: K.K.B., K.A.R., Concept: J.S.H., K.K.B., K.A.R., Design: J.S.H., K.K.B., K.A.R., Data Collection or Processing: J.S.H., Analysis or Interpretation: J.S.H., K.K.B., Literature Search: J.S.H., K.K.B., K.A.R., Writing: J.S.H., K.K.B., K.A.R.

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ORIGINAL RESEARCH

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# Frailty and Factors Affecting It Among Older People Living in Nursing Home: A Cross-sectional Study

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## Abstract

**Objective:** The aim of this study was to examine the relationship between frailty and activities of daily living (ADLs), nutrition, pain, falling, and fear of falling in older people living in a nursing home.

**Materials and Methods:** The study was descriptive and cross-sectional design. Data were collected from older people who were aged ≥65 years using a socio-demographic characteristics form, the comorbidity index, the Edmonton frail scale, the Katz index of independence in activities of daily living, the visual analogue scale, nutritional risk screening, and the fear of falling scale.

**Results:** The mean age of the 183 older people participating in the study was 74.64±7.58, and prevalence of frailty among older people living in the nursing home was 47.6%. As a result of the multiple linear regression analysis, dependency levels for ADLs (β=-0.240, p<0.001), age (β=0.121, p=0.043), being single (β=-0.148, p=0.028), having undergone surgery in the past year (β=-0.207, p=0.005), feeling exhausted (β=-0.214, p=0.005), pain scores (β=0.152, p=0.035), and having had a fracture associated with a fall (β=0.164, p=0.030) were statistically significant predictors of frailty.

**Conclusion:** It was determined that the frailty levels of the older people living in the nursing home were associated with their dependency levels for ADLs, age, being single, feeling exhausted, having undergone surgery in the past year, pain levels, and fractures due to falling.

**Keywords:** Aging, frailty, activities of daily living, nutrition, pain, falling, fear of falling

## Introduction

The population of the elderly is increasing rapidly worldwide. It is estimated that this population will reach 1.97 billion (17.6%) in 2050 globally (1). According to the 2018 statistics of the Turkey Statistical Institute (TURKSTAT), the proportion of the older population to the total population has increased from 8.2% to 9.5% in the last five years in Turkey. It is predicted that the proportion of the older population will be 12.9% in 2030, and 16.3% in 2040 (2). Old age is characterized by the emergence of various complex health problems. Nursing homes are institutions that allow individuals to live somewhere they can continue their daily lives while receiving more care (3). In developed countries, 1.5% to 8% of older adults aged ≥65 years live in nursing homes (4). However, due to the increasing functional, cognitive, and economic problems of older adults, their need for nursing homes is increasing (5). It is known that older adults living in nursing homes have difficulty in carrying out activities of daily living (ADLs), and their independence and activity levels and nutritional status are lower than those of the individuals in the community (5). Staying in a nursing home can lead to negative psychological effects in older adults in addition to a decrease in independence and quality of life (6,7). The frailty levels of older adults living in nursing homes are also higher than the levels of those in the community (4).

Frailty is characterized by a syndrome that causes loss of dynamic homeostasis, decreased physiological reserve, increased morbidity, and mortality. It is composed of five physical components, namely, weight loss, exhaustion, weakness, a slower walking speed, and limited physical activity (8). It has also

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been defined as a condition in which difficulty in performing ADLs, prolonged hospital stays, weakness, decrease in muscle mass, malnutrition, and decrease in cognitive functions co-exist (9). Frailty in older adults in the community is associated with falls, hospitalizations, and mortality (10). The incidence of frailty among older adults living in the community is approximately 10% (11). However, it is seen in more than half of those residing in nursing homes (4). Older adults may tend to have co-existing risk factors for frailty (12,13). Therefore prevention, and management of frailty in nursing homes may be more difficult. To slow or prevent it in nursing homes, it is important to identify how frailty develops, and the factors that affect it. Studies on factors related to frailty in older adults living in nursing homes are limited (4,14). The aim of this study was to examine the relationship between frailty, ADLs, nutrition, pain, frequency of falling, and fear of falling among older adults living in nursing homes.

## Materials and Methods

### Design

The study was conducted using a descriptive and cross-sectional research design. It was carried out in a nursing home located in western Turkey between May and August 2022.

### Sample

The research sample consisted of 183 older adults who lived in a nursing home. The inclusion criteria for the research sample were an age ≥65 years, the ability to understand and speak Turkish, voluntary participation in the study, and having no hearing or speech impairment that would prevent them from answering the questionnaires. Patients who had a score of <24 on the mini-mental state examination or were diagnosed with neurological (e.g., dementia/Alzheimer's) or psychiatric (e.g., schizophrenia) diseases were excluded from the study. In this study, G*Power version 3.1 was used for calculating the sample size. After the study, the power was calculated as 0.92 based on an effect size of 0.25, a p-value of 0.05, and a sample size of 183.

The approval of the nursing home and the Non-Invasive Clinical Research Ethics Committee of a Dokuz Eylül University was obtained to conduct the study (no: 22/32-07, date: 12.10.2022). Finally, the older people who agreed to participate in the study were asked for their verbal consent.

### Data Collection

Questionnaires were completed by the researcher during in-person interviews with the patients who met the inclusion criteria.

The researchers prepared the descriptive characteristics form according to the relevant literature. The form included questions related to socio-demographic (the individuals' age, gender, marital status, education) and other factors (chronic disease, presence of a caregiver, fall history (for the last year), history of falls at the nursing home, and the number of falls, operating status, smoking status, status of using alcohol, experiencing dizziness, experiencing a decrease in walking speed in the past year, having a stated problem with balance, having a decreased appetite, feeling exhausted).

The visual analog scale (VAS) was developed by Price et al. (15). The VAS starts at the low end with a score of 0 for "no pain" and ends at the high end with a score of 10 for "severe pain."

The modified Charlson comorbidity index (MCCI) was created by Charlson et al. (16) to estimate mortality by classifying comorbid disease status. The reason for using the modified CCI in our study was that in the MCCI, one comorbidity point is added to the scores of individuals aged ≥40 for every 10 years of age, and our study was conducted with individuals aged ≥65. The comorbidity classification according to the scores is as follows: Low (≤3), moderate (4 and 5), high (6 and 7), and very high (≥8) comorbidity.

The Edmonton frail scale was developed by Rolfson et al. (17) to assess frailty in older adults. The scale consists of 11 items, and nine frailty sub-dimensions, namely cognitive status, general health status, functional independence, social support, medication use, nutrition, mood, continence, and functional status. The "clock test" is used to assess cognitive status, and the "timed get up and go test" is used to assess functional performance (17,18). Scores on the scale range between 0, and 17. Scores on the total scale between 0 and 4 are interpreted as no presence of frailty; 5-6 as apparent vulnerability to frailty; 7-8 as mild frailty; 9-10 as moderate frailty; and ≥11 as severe frailty. In this study, the dependent variable results were split into two levels for the analysis of data: Without frailty (final score ≤6), and with frailty (final score >6). The Turkish validity and reliability study of the scale was performed by Aygör et al. (18).

The Nutritional Risk Screening-2002 (NRS) tool was developed by Kondrup et al. (19). This screening tool is used to evaluate the malnutrition levels and malnutrition risk of individuals. Irregularity in nutritional status, and disease severity is evaluated by the percentage of weight loss as follows: None (0 points); mild (1 point); moderate (2 points); severe (3 points). If the total score is ≥3, the patient is classified as at risk of malnutrition. If the total score is <3, the screening test is repeated at specific intervals.

The Likert-type fear of falling scale consists of a one-item Likert question that asks participants to rate the level of their fear of falling on a five-point scale: "Are you afraid of falling?". The scores are interpreted as follows: 0= not afraid; 1= slightly

afraid; 2= moderately afraid; 3= very afraid; 4= extremely afraid.

The Katz index of Independence in ADLs was developed by Katz et al. The scale assesses the degree of dependence on others in self-care activities such as feeding, dressing, bathing, transferring, continence, and toileting. The scale score is calculated by adding up the scores of all items, and the score range is between 6 and 18. Scores on the scale are interpreted as follows: 0-6= dependent; 7-12= semi-dependent; 13-18= independent. The Katz index measures six self-care tasks using a dichotomous rating [dependent (0) and independent (1)] in hierarchical order of decreasing difficulty as listed: Bathing, dressing, toileting, transferring to and from a chair, maintaining continence, and feeding. Those with a score of 6 points are considered independent, while those with 0 points are considered fully dependent. The Turkish validity and reliability study of the scale was conducted by Arik et al. (20).

### Statistics

The IBM SPSS Statistics 23 software was used to analyze the research data. Descriptive statistics of frequency, percentage, mean, and standard deviation were used for the descriptive information about older adults. In the study, all independent variables related to frailty were evaluated using Spearman's correlation analysis. Independent variables having a significant relationship with frailty were included in the regression model. Before the regression model was established, standardized residual was examined for the dependent variables and multicollinearity was examined for the independent variables. The presence of multicollinearity was evaluated by calculating the tolerance (<0.20), and variance inflation factors (>5) for all independent variables in the regression model. The level of statistical significance was accepted as $p<0.05$ to include the variables in the regression equation.

## Results

The mean age of the 183 older adults participating in the study was 74.64±7.58 (min=60, max=90). 53% were female, 84.2% were single; and 62.3% were primary or secondary school graduates. Of the participants, 61.2% had an income equal to their expenditure, 38.3% did not smoke, and 14.2% of them did not use alcohol. It was determined that 31.1% of the older adults living in the nursing home had undergone surgery in the past year, 23.5% had fallen, 4.9% had experienced fractures due to falling, and 9.8% had been hospitalized for some reason in the past year. The older adults in the study had a moderate (31.7%) to severe fear of falling (14.8%). According to the results of the MCCI, 39.9% of the older adults were at intermediate risk and 31.1% at high risk. In addition, 89.7% of participants were independent, while 21.9% were at risk of malnutrition. In the study, 29% of older adults obtained 0-4 points on the Edmonton frail scale and were therefore classified as "not frail", 23.5% got 5-6 points, and were classified as "vulnerable", and 10.4% got ≥11 points and were classified as "severely frail". The clinical and socio-demographic characteristics of the older adults are given in Table 1.

A statistically significant positive correlation was found between the frailty index score of the older adults, the MCCI (r=0.259), the NRS score (r=0.150), age (r=0.234), smoking (r=0.197), alcohol use (r=0.257), the status of doing regular sports (r=0.257), fatigue level (r=0.218), pain level (r=412), and fractures due to falling (r=0.163) ($p<.05$). A statistically significant negative correlation was found between the frailty index score of the older adults staying in the nursing home and difficulty with ADLs (r=-0.502), being female (r=-0.173), weight (r=-0.237), being single (r=-0.305), the status of having undergone surgery in the past year (r=-0.363), a slower walking speed (r=-0.273), and feeling exhausted (r=-0.240) ($p<0.05$) (Table 2).

Multiple linear regression analysis was performed to determine the contribution of factors associated with the frailty index. Variables that were found to have a moderate and severe correlation with the frailty index score of the older adults were included in the regression model. It was found that difficulty with ADLs (β=-0.240, $p<0.001$), age (β=0.121, $p=0.043$), being single (β=-0.148, $p=0.028$), having had surgery in the past year (β=-0.207, $p=0.005$), feeling exhausted (β=-0.214, $p=0.005$), pain scores (β=0.152, $p=0.035$), and fall-related fractures (β=0.164, $p=0.030$) were statistically significant predictors of the frailty level of the older adults. These variables explained 40% of the variances (Table 3).

## Discussion

In the present study, the prevalence of frailty among the older adults living in the nursing home was 47.6%. Kojima (4) stated in a meta-analysis and systematic review that approximately half of older adults living in nursing homes were frail. However, due to the variety of scales used, the prevalence of frailty among older adults living in nursing homes varies between 3.76%, and 70.1% (21). The prevalence of frailty in the present study was lower than the frailty of older adults living in nursing homes in Brazil (68.8%) (22), but higher than in Egypt (19%) (23) and in Spain (36.3%) (24) in those without cognitive impairment according to the mini-mental state examinations (MMSE >24) (25). These findings are consistent with previous research showing a higher prevalence of frailty and vulnerability in low- to middle-income countries compared to high-income regions (26,27). This is thought to stem from the fact that negative socio-economic conditions often cause inequalities in access to healthcare services, poor diet, physical inactivity, and multiple diseases and disabilities (28). The high prevalence of frailty among older adults living in nursing homes

**Table 1. Descriptive information about the older people living in nursing home**

| | | Total | Not frail (n=53) | Apparent frailty (n=43) | Mild frailty (n=41) | Moderate frailty (n=27) | Severe frailty (n=19) | |
|---|---|---|---|---|---|---|---|---|
| | | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | p |
| **Age** | 65-74 | 91 (49.7) | 29 (54.7) | 26 (60.5) | 21 (51.2) | 11 (40.7) | 4 (21.1) | 0.024* |
| | 75-84 | 66 (36.1) | 20 (37.7) | 14 (32.6) | 15 (36.6) | 7 (25.9) | 10 (52.6) | |
| | 85 and over | 26 (14.2) | 4 (7.5) | 3 (7) | 5 (12.2) | 9 (33.3) | 5 (26.3) | |
| **Sex** | Female | 97 (53) | 20 (37.7) | 25 (58.1) | 25 (61) | 14 (51.9) | 13 (68.4) | 0.082 |
| | Male | 86 (47) | 33 (62.3) | 18 (41.9) | 16 (39) | 13 (48.1) | 6 (31.6) | |
| **Marital status** | Married | 29 (15.8) | 3 (5.7) | 4 (9.3) | 6 (14.6) | 5 (18.5) | 11 (57.9) | 0.000* |
| | Single | 125 (84.2) | 50 (94.3) | 39 (90.7) | 35 (85.4) | 22 (81.5) | 8 (42.1) | |
| **Education** | Literate | 7 (3.8) | 34 (64.2) | 30 (69.8) | 27 (65.9) | 19 (70.4) | 11 (57.9) | 0.908 |
| | Primary school | 114 (62.3) | 15 (28.3) | 11 (25.6) | 12 (29.3) | 6 (22.2) | 6 (31.6) | |
| | High school | 50 (27.3) | 4 (7.5) | 1 (2.3) | 2 (4.9) | 2 (7.4) | 2 (10.5) | |
| | University | 12 (6.5) | 0 (0) | 1 (2.3) | 0 (0) | 0 (0) | 0 (0) | |
| **Level of income** | Income<expenses | 61 (33.3) | 10 (18.9) | 12 (27.9) | 18 (43.9) | 12 (44.4) | 9 (47.4) | 0.025* |
| | Income=expenses | 112 (61.2) | 40 (75.5) | 29 (67.4) | 18 (43.9) | 15 (55.6) | 10 (52.6) | |
| | Income>expenses | 10 (5.5) | 3 (5.7) | 2 (4.7) | 5 (12.22) | 0 (0) | 0 (0) | |
| **Status of smoking** | Yes | 70 (38.3) | 24 (45.3) | 17 (39.5) | 16 (39) | 8 (29.6) | 5 (6.3) | 0.534 |
| | No | 113 (61.7) | 29 (54.7) | 26 (60.5) | 25 (61) | 19 (70.4) | 14 (73.7) | |
| **Status of using alcohol** | Yes | 26 (14.2) | 12 (22.6) | 7 (16.3) | 6 (14.6) | 1 (3.7) | 0 (0) | |
| | No | 157 (85.8) | 41 (77.4) | 36 (83.7) | 35 (85.4) | 26 (96.3) | 19 (100) | 0.065 |
| **Having undergone surgery in the past year** | Yes | 57 (31.1) | 9 (17) | 9 (20.9) | 14 (34.1) | 15 (55.6) | 10 (52.6) | 0.001* |
| | No | 126 (68.9) | 44 (83) | 34 (79.1) | 27 (65.9) | 12 (44.4) | 9 (47.4) | |
| **Experiencing dizziness** | Yes | 83 (45.4) | 22 (41.5) | 16 (37.2) | 22 (53.7) | 14 (51.9) | 9 (47.4) | 0.541 |
| | No | 100 (54.6) | 31 (58.5) | 27 (62.8) | 19 (46.3) | 13 (48.1) | 10 (52.6) | |
| **Slower walking speed** | Yes | 133 (72.7) | 30 (56.6) | 28 (65.1) | 39 (95.1) | 21 (77.8) | 15 (78.9) | 0.001* |
| | No | 50 (27.3) | 23 (43.4) | 15 (34.9) | 2 (4.9) | 6 (22.2) | 4 (21.1) | |
| **Balance problem** | Yes | 107 (58.5) | 22 (41.5) | 18 (41.9) | 31 (75.6) | 19 (70.4) | 17 (89.5) | 0.000* |
| | No | 76 (41.5) | 31 (58.5) | 25 (58.1) | 10 (24.4) | 8 (29.6) | 2 (10.5) | |
| **Decreased appetite** | Yes | 67 (36.6) | 21 (39.6) | 15 (34.9) | 17 (41.5) | 11 (40.7) | 3 (15.8) | 0.351 |
| | No | 116 (63.4) | 32 (60.4) | 28 (65.1) | 24 (58.5) | 16 (59.3) | 16 (84.2) | |
| **Feeling exhausted** | Yes | 75 (41) | 19 (35.8) | 12 (27.9) | 13 (31.7) | 18 (66.7) | 13 (68.4) | 0.0001* |
| | No | 108 (59) | 34 (64.2) | 31 (72.1) | 28 (68.3) | 9 (33.3) | 6 (31.6) | |
| **Status of doing regular exercise** | Yes | 39 (21.3) | 14 (26.4) | 17 (39.5) | 7 (17.1) | 1 (3.7) | 0 | 0.001* |
| | No | 144 (78.7) | 39 (73.6) | 26 (60.5) | 34 (82.9) | 26 (96.3) | 19 (100) | |
| **Fall history (in the past year)** | Yes | 43 (23.5) | 9 (17) | 21 (48.8) | 6 (14.6) | 9 (33.3) | 3 (15.8) | 0.001* |
| | No | 140 (76.5) | 44 (83) | 22 (51.2) | 35 (85.4) | 19 (66.7) | 16 (84.2) | |
| **Fractures due to falling** | Yes | 9 (4.9) | 0 (0) | 5 (11.6) | 0 (0) | 0 (0) | 4 (7.5) | 0.052 |
| | No | 174 (95.1) | 19 (100) | 38 (88.4) | 41 (100) | 27 (100) | 49 (92.5) | |
| **Hospitalization in the past year** | Yes | 18 (9.8) | 7 (13.2) | 2 (4.7) | 3 (7.3) | 6 (22.2) | 4 (22.1) | 0.061 |
| | No | 165 (90.2) | 46 (86.8) | 41 (95.3) | 38 (92.7) | 21 (77.8) | 15 (78.9) | |

**Table 1. Continued**

| | | Total | Not frail (n=53) | Apparent frailty (n=43) | Mild frailty (n=41) | Moderate frailty (n=27) | Severe frailty (n=19) | |
|---|---|---|---|---|---|---|---|---|
| | | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | p |
| **Fear of falling** | Not afraid | 36 (19.7) | 18 (34) | 9 (20.9) | 6 (14.6) | 0 (0) | 3 (15.8) | 0.000* |
| | Slightly afraid | 25 (3.7) | 5 (9.4) | 6 (14) | 10 (24.4) | 4 (14.8) | 0 (0) | |
| | Moderately afraid | 58 (31.7) | 9 (17) | 7 (16.3) | 7 (16.3) | 15 (55.6) | 13 (68.4) | |
| | Very afraid | 37 (20.2) | 13 (24.5) | 13 (30.2) | 13 (30.2) | 3 (11.1) | 3 (15.8) | |
| | Strongly afraid | 27 (14.8) | 8 (15.1) | 8 (16.6) | 8 (18.6) | 5 (18.5) | 0 (0) | |
| **Modified Charlson comorbidity index** | 0 | 12 (6.6) | 8 (15.19) | 0 (0) | 2 (4.9) | 2 (7.4) | 0 (0) | 0.005* |
| | 1-3 | 73 (39.9) | 19 (35.8) | 26 (60.5) | 16 (39) | 8 (29.6) | 4 (21.1) | |
| | ≥4 | 98 (53.5) | 26 (49.1) | 17 (39.5) | 23 (56.1) | 17 (63) | 15 (78.9) | |
| **KATZ *** | Semi-dependent | 19 (10.3) | 1 (1.9) | 1 (2.3) | 1 (2.4) | 5 (18.5) | 1 (5.3) | 0.012* |
| | Independent | 164 (89.7) | 52 (98.1) | 42 (97.7) | 40 (97.6) | 22 (81.5) | 18 (94.7) | |
| **NRS*** | No risk of malnutrition | 143 (78.1) | 40 (75.5) | 38 (88.4) | 29 (70.7) | 18 (66.7) | 15 (78.9) | 0.54 |
| | Risk of malnutrition | 40 (21.9) | 13 (24.5) | 5 (11.6) | 12 (29.3) | 9 (33.3) | 4 (22.1) | |

* Katz index of independence in activities of daily living, * Nutritional risk screening (NRS-2002)

compared to older adults in the community is because many of the factors affecting the development of geriatric syndromes and frailty are more common in this population. Older adults living in nursing homes may be more likely to be vulnerable due to their being away from their families, having to change their lifestyle, feeling lonely, and experiencing a loss of appetite (13,29). In addition, it has been stated that the frailty of older adults living in nursing homes is a reflection of their cognitive decline and disabilities (4,30). More studies are needed to find the most effective practices to prevent and reduce vulnerability in nursing homes.

In the present study, the frailty levels of older adults were associated with advanced age, difficulty with ADLs, being single, the status of having undergone surgery in the past year, fractures due to falling, and pain scores. Similar to the literature, it was determined that the prevalence of frailty increased with increasing age (13). It is known that there is a higher probability of frailty in older adults with advancing age (4,31). People of advanced age are more vulnerable, and it is more difficult for them to maintain homeostasis. This suggests that the higher the chronological age is, the higher the tendency to frailty is (31). Living alone and being single affect frailty. In the present study, it was determined that being single was associated with frailty among the older adults living in the nursing home. The absence of a spouse, and being single, widowed, or divorced are also associated with vulnerability (32). Older adults living in a nursing home with their spouses are less vulnerable because they have better social relationships and mental status than those who live alone or have to share a room with a stranger (33). Increasing the participation of older adults in social activities in nursing homes is important to reduce frailty, and the correlation between social relationships and frailty needs to be investigated in more detail. In the current study, it was determined that the frailty levels of older adults who had difficulty in fulfilling ADLs were higher. Frailty has a negative impact on ability to perform ADLs and instrumental ADLs (IADLs). About 60% of those with frailty are adversely affected, compared to about 14% of older adults who are not frail (34). It is known that the frail older people have lower functional levels and poor fulfillment of ADLs independently (35).

It is known that older adults with frailty have more chronic diseases and are less independent. Therefore, frail older adults may experience conditions that require more surgical procedures. In the present study, it was determined that the status of the older adults who had undergone surgery in the past year was associated with frailty. The fact that the prevalence of frailty in older adults undergoing surgery is more than 10% compared to those living in the community highlights the vulnerability of this patient group (36). Frailty was determined as an independent risk factor for complications in older adults who had undergone surgery, and the rate of complication was found to be higher (10,37). It was found that the risk of complications increased in older patients with frailty treated for traumatic periprosthetic fractures, and that there was a significant difference between frail and non-frail patients in terms of both major and minor complications. It has also been stated that there is a relationship between frailty and postoperative mortality (38). In addition, major surgeries affect frail patients more than minor

**Table 2. The relationship between frailty and activities of daily living, pain, nutritional status, and affecting factors**

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Frailty | 1 | | | | | | | | | | | | | | | | | | | | | | |
| 2. Activities of daily living (KATZ) | -0.502** | 1 | | | | | | | | | | | | | | | | | | | | | |
| 3. Charlson comorbidity index | 0.259** | -0.179* | 1 | | | | | | | | | | | | | | | | | | | | |
| 4. Nutritional risk screening | 0.150* | 0.052 | 0.412** | 1 | | | | | | | | | | | | | | | | | | | |
| 5. Age | 0.234** | -0.097 | 0.221** | 0.015 | 1 | | | | | | | | | | | | | | | | | | |
| 6. Gender | -0.173* | 0.110 | -0.096 | -0.025 | -0.033 | 1 | | | | | | | | | | | | | | | | | |
| 7. Weight | -0.237** | 0.142 | -0.076 | -0.097 | -0.134 | 0.241** | 1 | | | | | | | | | | | | | | | | |
| 8. Marital status | -0.305** | 0.200* | -0.154* | -0.063 | -0.186* | 0.169* | 0.172* | 1 | | | | | | | | | | | | | | | |
| 9. Education | -0.014 | 0.028 | -0.057 | -0.026 | -0.144* | 0.017 | 0.309** | -0.079 | 1 | | | | | | | | | | | | | | |
| 10. Smoking[a] | 0.197* | -0.177 | 0.149 | -0.105 | 0.262 | -0.385 | -0.169 | -0.157 | -0.008 | 1 | | | | | | | | | | | | | |
| 11. Alcoholuse[a] | 0.257** | -0.091 | 0.278** | 0.035 | 0.173* | -0.305** | -0.212** | -0.240** | -0.035 | 0.338** | 1 | | | | | | | | | | | | |
| 12. Status of having undergone surgery in the past year[a] | -0.322** | 0.243** | -0.164* | -0.016 | 0.022 | 0.019 | 0.291** | 0.257** | 0.193* | -0.068 | -0.207** | 1 | | | | | | | | | | | |
| 13. Are you experiencing dizziness?[a] | -0.168* | 0.062 | -0.362** | -0.226** | -0.017 | 0.242** | -0.024 | 0.086 | -0.122 | -0.198** | -0.194* | 0.146** | 1 | | | | | | | | | | |
| 14. Have you had any balance problems in the last year?[a] | -0.363** | 0.271** | -0.247** | -0.235** | -0.093 | 0.317** | 0.112* | 0.092 | 0.101 | -0.204** | -0.140 | 0.256** | 0.478** | 1 | | | | | | | | | |
| 15. Have you had a decrease in walking speed in the past year?[a] | -0.273** | 0.160* | -0.195 | -0.220** | -0.096 | 0.209* | 0.096 | 0.031 | 0.103 | -0.199** | -0.129 | 0.068 | 0.288** | 0.479** | 1 | | | | | | | | |
| 16. Have you felt burnout in the last year?[a] | -0.240** | 0.142 | -0.129 | -0.202** | -0.003 | 0.095 | -0.141 | -0.027 | -0.086 | -0.130* | -0.094 | -0.153* | 0.156* | 0.184* | 0.087 | 0.170* | 1 | | | | | | |
| 17. Doing regular sports[a] | 0.257** | -0.349** | 0.139** | -0.058 | 0.130 | 0.009 | -0.049 | 0.030 | 0.095 | -0.080 | 0.055 | -0.120 | -0.179** | -0.157* | -0.280** | -0.091 | -0.217** | 1 | | | | | |
| 18. Fatigue level | 0.218** | -0.057 | 0.087 | 0.112* | 0.056 | -0.112 | -0.045 | -0.195 | 0.070 | 0.240** | 0.230 | -0.078 | -0.101 | -0.093 | -0.120 | -0.177 | -0.388** | -0.017 | 1 | | | | |
| 19. Pain level | 0.412** | -0.284** | 0.293** | 0.193* | 0.067 | -0.164* | -0.076 | -0.176* | 0.060 | 0.098 | 0.267** | -0.204** | -0.146 | -0.177* | -0.237** | -0.185* | -0.297** | 0.260** | 0.320* | 1 | | | |
| 20. History of falling in the past year[a] | 0.055 | -0.190* | -0.077 | -0.131* | -0.017 | 0.185* | 0.070 | -0.165* | 0.052 | -0.056 | -0.226** | -0.004 | -0.017 | -0.084 | 0.072 | 0.114 | 0.058 | 0.049 | -0.083 | -0.168** | 1 | | |
| 21. Fractures due to fall[a] | 0.163* | -0.184 | -0.026 | -0.006 | 0.212 | 0.062 | 0.131 | -0.099 | 0.173 | 0.029 | -0.074 | 0.174 | -0.207 | -0.167 | 0.026 | -0.028 | 0.067 | 0.190 | 0.025 | -0.036 | 0.394 | 0.1 | |
| 22. Fear of falling | 0.034 | 0.073 | -0.019 | 0.084 | -0.019 | -0.155 | -0.081 | -0.061 | -0.041 | 0.097 | 0.014 | -0.082 | -0.122 | -0.148 | -0.193* | -0.074 | -0.097 | 0.043 | 0.196 | -0.083 | -0.229** | 0.154* | 1 |

*p<0.05, ** p<0.01, [a]Spearman's correlation [a]1=yes, 2= no

**Table 3. Factors affecting the frailty levels of older people living nursing home**

| | Beta | t | p |
|---|---|---|---|
| **Frailty** | | | |
| Daily living activities | -0.240 | -3.389 | 0.001* |
| Charlson comorbidity index | 0.029 | 0.410 | 0.683 |
| NRS nutrition | 0.010 | 0.144 | 0.886 |
| Gender | -0.029 | -0.400 | 0.690 |
| Age | 0.121 | 1.984 | 0.043* |
| Weight | -0.048 | -0.726 | 0.469 |
| Marital status | -0.148 | -2.212 | 0.028* |
| Smoking | 0.003 | 0.039 | 0.969 |
| Alcohol use | 0.072 | 1.049 | 0.296 |
| Status of having undergone surgery in the past year | -0.207 | -2.815 | 0.005* |
| Experiencing dizziness | 0.049 | 0.663 | 0.509 |
| Have you had any balance problems in the last year? | -0.084 | -1.030 | 0.305 |
| Have you had a decrease in walking speed in the past year? | -0.092 | -1.234 | 0.219 |
| Have you felt burnout in the last year? | -0.214 | -2.817 | 0.005* |
| Doing regular sports | 0.032 | 0.456 | 0.649 |
| Fatigue level | -0.023 | -0.324 | 0.747 |
| VAS | 0.152 | 2.125 | 0.035* |
| History of falling | -0.013 | -0.194 | 0.846 |
| Fractures due to falling | 0.164 | 2.196 | 0.030* |
| Fear of falling | 0.050 | 0.767 | 0.444 |
| Model $R^2$: 0.469, Adjusted $R^2$:0.404, F:7.164, p<0.001 | | | |

surgeries (39). It is important to determine the frailty level of all older adults who have and have not undergone surgery (40). Diagnosing and following up the frailty of older adults living in nursing homes may help in terms of taking the necessary precautions for post-operative care.

In the present study, it was determined that older adults with fractures had higher levels of frailty, and that there was a significant positive correlation between frailty and age, which supports the results of previous studies (41,42). Frailty reduces the ability to perform ADLs and the quality of life in older adults and increases the likelihood of fractures (41). In addition to older people who are frail, the older people in the "pre-frail" stage are also at risk for fractures (42). The healing process may also be longer for older adults after fractures.

The pain experienced by the older adults was found to be one of the predictors of frailty in the present study. One in five of the older adults living in the nursing home stated that they had experienced pain but had not been treated (43). In studies conducted with older adults in the community, a relationship has been found between pain and frailty (44). Pain has a serious impact on the physical, psychological, and social aspects of older people's lives (26). Fried et al. (8) stated that pain was closely associated with each of the five criteria of frailty in the vulnerability phenotype. Chronic pain can cause fatigue and decreased physical activity (44). Pain was associated with decreased physical performance (grip strength and normal walking speed) in older adults in the United States. Pain-related anorexia and loss of appetite are also common in older adults. The cognitive, behavioral, and social limitations caused by pain can also increase frailty.

### Study Limitations

The limitation of the study is that patients whose mini mental test scores were <24 were not included in the study. Cognitive dysfunction is also considered one of the indicators of frailty. It is necessary to conduct studies on the frailty level of older adults with cognitive impairment, and the factors that affect it.

## Conclusion

It was determined in the present study that approximately half of the older adults living in the nursing home were frail. With the increase in the older population, the need for nursing homes is increasing, and of those who apply to enter nursing homes, those older adults requiring more healthcare tend to be most admitted. This highlights the importance of informing nursing home workers about frailty, as it may cause more older adults with frailty to look to nursing homes in the future. The predictors of frailty in older adults were found to be advanced age, difficulty with ADLs, being single, having undergone

surgery in the past year, fractures due to falling, and pain scores. It is recommended that future studies be conducted comparing the status of frail older adults with fractures before and after surgery. In addition, it is recommended that interventional and longitudinal studies be conducted to determine the effect of social participation and physical exercise on older adults living in nursing homes. More well-designed researches are needed to determine the effects of nutritional supplements, exercise, and their combination for nursing home residents.

### Ethics

**Ethics Committee Approval:** The approval of the nursing home and the Non-Invasive Clinical Research Ethics Committee of a Dokuz Eylül University was obtained to conduct the study (no: 22/32-07, date: 12.10.2022).

**Informed Consent:** The older people who agreed to participate in the study were asked for their verbal consent.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Concept: H.T.D., A.Ö.G., Design: H.T.D., Data Collection or Processing: H.T.D., Ö.B., A.Ö.G., Analysis or Interpretation: H.T.D., Ö.B., A.Ö.G., Literature Search: H.T.D., Ö.B., Writing: H.T.D., Ö.B.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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ORIGINAL RESEARCH

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# Are Fear of COVID-19, Anxiety of Death, and Fear of Death Different Among Medical Ilnesses in the Elderly?

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## Abstract

**Objective:** In this study, we aimed to investigate the relationship between older patients with various illnesses' anxiety and Coronavirus disease-2019 (COVID-19) fear of death.

**Materials and Methods:** An elderly population made up the study participants who applied to the Gaziantep University Faculty of Medicine, Department of Geriatrics Outpatient in order between 01.02.2022 and 01.05.2022, had at least one disease, and were under treatment. The socio-demographic data form and the COVID-19 fear scale, the death anxiety scale, and the fear of death scale were administered to all patients. SPSS for Windows 22 (Statistical Package for Social Sciences for Windows 22) was used in the calculations.

**Results:** Two hundred and fifty patients who met the inclusion requirements received examination with a variety of tools. Two hundred and thirty four patients who completely filled out the forms were used in the analysis. The mean age of the patients was 70.51±6.11 years, 114 (48.7%) were male, and 120 were female (51.3%). COVID-19 fear scale and fear of death scale were statistically significantly higher in women (p=0.037, p=0.010, respectively). Cardiovascular, respiratory, gastrointestinal, neurological, musculoskeletal, genito-urinary, and multisystem-related diseases were diagnosed in the participants. The groups' differences on the death anxiety scale were statistically significant (F: 2.805, p=0.012) as a consequence of the comparison of the groups.

**Conclusion:** This was the first study to group the diseases in the elderly according to the systems and compared with the fear of COVID-19, anxiety of death, and fear of death. To generalize the results, prospective controlled research with bigger samples is required.

**Keywords:** Elderly, geriatric patient, COVID-19, fear, anxiety

## Introduction

According to predictions, contagious new epidemics will rank among the most significant public health issues of the twenty-first century because of factors including increasing travel opportunities brought on by globalization, human-animal interaction, socio-economic anomalies, and climate change (1). As a matter of fact, severe acute respiratory failure in 2003, H1N1 virus (influenza) in 2009, Middle East respiratory syndrome in the Middle East in 2012, and Ebola epidemic in West Africa in 2014 reinforced these thoughts. Finally, it was reported on 31 December 2019 that an undiscovered coronavirus was encountered in China as a result of the examination of a group of viral pneumonia patients whose etiology is not fully known, and on March 11, 2020, the World Health Organization declared it a Coronavirus disease-2019 (COVID-19) Outbreak. It has been included in the pandemic category (2).

The fact that COVID-19 resulted in a significant number of fatalities worldwide in a short period of time, and the lack of knowledge of scientists and health authorities about the transmission routes of the illnesses and their therapies, has strengthened the sense of uncertainty about the disease in people. In addition, epidemics can be characterized as a crisis or disaster because their nature changes daily life, requires measures that disrupt it, and rapidly increases the number of people who need medical treatment (3,4).

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These psychological effects have deepened in certain age groups in society due to both the direct disease and the precautions taken. High morbidity and mortality rates due to COVID-19 observed among adults (elderly) over the age of 65 have been widely discussed both in the media and in social media, and many governments around the world have emphasized age in their statements and measures.

With its direct and indirect effects, COVID-19 has increased the levels of fear and anxiety in society (5,6). Studies have found that the most common neuropsychiatric symptoms, especially during the lockdown, are depression, anxiety, agitation, irritability, and apathy (7). Systematic reviews have shown that COVID-19 exerts varying degrees of mental health effects among different populations (8,9). The elderly and the young are two notable groups. Due to physiological and biochemical changes in their organs and systems with age, as well as an underlying chronic illness or disease, older persons are more likely to get the virus and may also experience worse outcomes, such as death. A major worry is how to handle depression, suicide risk, and feelings of neglect in vulnerable subpopulations including the elderly (10). Among the elderly population, it was emphasized that there is a growing concern with the intensification of cases and deaths related to COVID-19 among those staying in nursing homes (11).

The psychological effects of COVID-19 were compared to the prevalence of certain diseases in the older population (7,12,13). Nevertheless, a comparative analysis of the association between the existence of disease affects several systems and COVID-19 fear and anxiety has not been done. In this study, it we aimed to elucidate the relationship between the fear of COVID-19 and fear of death and anxiety in the elderly with other diseases. Identifying differing groups will facilitate the intensification of psychological approaches.

## Materials and Methods

The participants in the research were aged individuals over 65 years who resided in Turkey, had at least one systemic illness, and were receiving therapy for it. The scales were administered to 250 people who applied to the Gaziantep University Faculty of Medicine, Department of Geriatrics Outpatient between February 1, 2022, and May 1, 2022 and who satisfied the inclusion and exclusion criteria. The study was conducted with 234 people who filled out the applied forms completely. At the beginning of the study, approval was obtained from the Gaziantep University Clinical Research Ethics Committee (ethics committee decision no: 2021/398). All procedures were carried out in line with the ethical requirements of the relevant committee on human experimentation (institutional and national) as well as the Helsinki Declaration of 1975, as amended in 2008. Informed consent has been obtained from all participants.

### Inclusion Criteria

Being 65 years of age or older, having an illness that had been definitely identified before the pandemic, and willingly agreeing to be a participant.

### Exclusion Criteria

Patients who were not diagnosed before the pandemic, those with a confirmed psychiatric disorder, and under the age of 65.

Socio-demographic data form is a semi-structured form prepared by the authors by reviewing the literature and considering clinical experience. All participants' ages, gender, marital status, education level, place of residence, presence of disease and related system, whether they were infected with COVID-19, and whether they had been vaccinated or not were recorded.

The Fear of COVID-19 scale (FCS) was created by Ahorsu et al. (14) to gauge COVID-19-related anxiety and fear states. The FCS is a single-factor, seven-item scale. Satici et al. (15) accomplished the scale conversion to Turkish. The adapted scale's Cronbach's alpha coefficient was reported to be 0.87.

The death anxiety scale developed by templer to determine the level of death anxiety consists of a total of 15 questions (16). Scale questions are answered as true/false. It was adapted into Turkish by Ertufan (17), taking some studies in the literature as an example, and it was converted into a seven-point Likert type scale with the belief that a more reliable measurement would be achieved.

Lester and Abdel-Khalek (18) suggested that the fear of death is different from the fear of dying, and it would be more useful to measure these separately for oneself and others. The scale consisted of 4 subgroups, each questioning a different fear of death. One's own death, one's own dying, others' death, others' dying (18). Just the "self-death" portion of these subscales was included in this study because Ertufan's Turkish validity and reliability study only covered that portion (17).

### Statistics

SPSS for Windows 22 (Statistical Package for Social Sciences for Windows 22) was utilized for calculations. Numerical data was shown as mean and standard deviation, while categorical data was shown as numbers and percentages. Categorical data were compared using the chi-square test. The parameters' normal distribution was checked using the Kolmogorov-Smirnov test. The independent t-test was employed to compare variables that had a normally distributed distribution between the two groups. Linear association between the variables was examined by Pearson Correlation analysis.

One-Way ANOVA (F-test) test was used to compare the variables with normal distribution in three or more independent groups.

The multiple comparisons Tukey and Sheffe test (post-hoc test) was used to reveal which group the difference originated from and to determine the groups with different means from each other. In all analyses, a value of $p<0.05$ was regarded as statistically significant.

## Results

The mean age of the participants included in the study was 70.51±6.11 years. When the participants' socio-demographic and clinical traits were looked at, 114 were men, 120 of whom were women. There were 101 (43.2%) with high school or higher education level, and 133 (46.8%) below high school. The marital status of the participants was mostly (66.7%) married and 90.6% of them lived in their own houses. Considering their clinical features, 54 (23.1%) had COVID-19, and 130 (55.6%) had experienced the death of a relative/friend due to COVID-19. It was observed that 91.5% (n=210) of the participants had had the COVID-19 vaccine. Socio-demographic and clinical features are elaborated in Table 1.

**Table 1. Socio-demographic and clinical characteristics of the participants**

| | Mean ± SD |
|---|---|
| **Age** | 70.51±6.11 |
| | **n (%)** |
| **Gender** | |
| Female | 120 (51.3%) |
| Male | 114 (48.7%) |
| **Marrital status** | |
| Married | 147 (62.8%) |
| Widow | 59 (25.2%) |
| Divorced | 7 (3%) |
| **Single** | 21 (9%) |
| **Residence** | |
| Own house | 212 (90.6%) |
| Caregivers house | 18 (7.7%) |
| Nursing home | 2 (0.9%) |
| Care center | 2 (0.9%) |
| **Educational status** | |
| Illiterate | 41 (17.5%) |
| Literate | 43 (18.4%) |
| Primary school | 49 (20.9%) |
| High school | 33 (14.1%) |
| University | 68 (29.1%) |
| **The system to which the medical illness relates** | 41 (17.5%) |
| Cardiovascular | 31 (13.2%) |
| Respiratory | 31 (13.2%) |
| Gastrointestinal | 32 (13.7%) |
| Neurological | 30 (12.8%) |
| Musculoskeletal | 32 (13.7%) |
| Genito-urinary | 37 (15.8%) |
| Multiple systems | |
| **COVID-19 infection** | |
| Yes | 54 (23.1%) |
| No | 180 (76.9%) |
| **COVID-19 vaccination** | |
| Yes | 214 (91.5%) |
| No | 20 (8.5%) |
| **Death of a relative/friend due to COVID-19** | 130 (55.6%) |
| Yes | 104 (44.4%) |
| No | |

SD: Standard deviation, COVID-19: Coronavirus disease-2019

Considering the mean scores of the scale scores applied in the study, the COVID-19 FCS was 18.48±6.74, the death anxiety scale was 67.44±13.37, while the fear of death scale was 13.73±3.15 in the sample. When the relationship between age and scale scores was examined, only a low level of positive correlation was found between age and death anxiety scale ($r=0.158$, $p=0.016$). When the scales were compared in terms of gender in the participants, the COVID-19 FCS ($p=0.037$) and the fear of death scale ($p=0.010$) were statistically significantly higher in women. When the scales were compared in terms of marital status, no statistically significant difference was found ($p=0.290$ for the COVID-19 FCS, $p=0.862$ for the fear of death scale, $p=0.422$ for the death anxiety scale). There was no statistically significant difference when the scale scores were compared in terms of COVID-19 transmission status, presence of relative/friend death due to COVID-19, and COVID-19 vaccine status ($p>0.05$ for all). Scale scores and comparisons are denoted in Table 2.

According to the systems that concern the diseases of the study population, scale scores were compared by dividing them into "cardiovascular, respiratory, gastrointestinal, neurological, musculoskeletal, genito-urinary and multisystem-related"

**Table 2. Comparison of scale scores and clinical features**

| | COVID-19 fear scale | Death anxiety scale | Fear of death scale |
|---|---|---|---|
| **Gender** | | | |
| Male | 17.54±6.64 | 65.90±12.46 | 13.19±2.89 |
| Female | 19.38±6.74 | 68.91±14.08 | 14.25±3.31 |
| p-value | **0.037** | 0.86 | **0.010** |
| **COVID-19 infection** | | | |
| Yes | 19.48±6.76 | 67.14±14.23 | 14.05±3.67 |
| No | 18.17±6.72 | 67.53±13.14 | 13.63±2.97 |
| p-value | 0.213 | 0.853 | 0.395 |
| **Death of a relative/ friend due to COVID-19** | | | |
| Yes | 18.77±6.67 | 67.81±13.77 | 13.90±3.19 |
| No | 18.11±6.84 | 66.98±12.91 | 13.52±3.09 |
| p-value | 0.450 | 0.636 | 0.372 |
| **COVID-19 vaccination** | | | |
| Yes | 18.74±6.67 | 67.14±13.21 | 13.76±3.14 |
| No | 15.60±6.98 | 70.65±14.98 | 13.45±3.3 |
| p-value | 0.066 | 0.263 | 0.673 |

COVID-19: Coronavirus disease-2019

groups. As a result of the comparison of the groups, there was a statistically significant difference between the groups in the death anxiety scale (F: 2.805, p=0.012). COVID-19 FCS and fear of death scale did not differ between disease groups (F: 1.528 p=0.170, F: 0.652 p=0.689, respectively).

In the ANOVA test, it was observed that there was no difference in the Tukey and Scheffe multiple comparison tests performed to determine between which groups the difference observed in the death anxiety scale was. The comparison of the applied scales between the groups is indicated in Table 3.

## Discussion

This research evaluated fear of COVID-19, fear of death, and death anxiety in the elderly. The relationship between the fear of COVID-19 and the fear and anxiety of death was examined and compared according to the medical diseases of the people.

The emergence of the COVID-19 pandemic, the excess of obscurity, and the influence of the media and social media have created psychological effects on all segments of society. The COVID-19 pandemic has turned into a global trauma that significantly affects the social and economic order, questions values, and is dominated by uncertainty and fear. Over the pandemic era, all of the psychological responses anticipated following trauma were gradually seen (19). It has been stated that the elderly have a high risk of mortality and morbidity related to this virus, and taking special precautions for this group of society (such as the curfew over the age of 65) has increased these psychological effects in individuals over the age of 65. One of the important psychosocial problems of old age is the fear and anxiety of death. Although there are studies showing that death anxiety and fear increase with age, there are also studies showing that there is no relationship (20). Our findings supported the relationship between death anxiety and age. It has also been shown that death anxiety and fear are associated with variables such as gender, health status, and religiosity. In our study, fear of COVID-19 and fear of death scale scores were found to be higher in the female gender. This finding is consistent with many studies in the literature (20-22). However, previous research found no appreciable variations in death anxiety between men and women (23).

Another demographic factor that may affect death anxiety is living conditions. A person who lives with his or her family may receive support and assistance in managing problems from the family. A comparison of the participants of our study in this respect could not be made due to the lack of a sufficient number of place groups. The scales were compared according to the clinical characteristics of the elderly, such as having COVID-19, being vaccinated, and loss of relatives/friends due to COVID-19, but no significant difference was found. The abundance of speculative information regarding the technology, efficacy, and side effects of COVID-19 vaccines has influenced the belief in vaccine willingness and protection (24).

In support of these comments, in our study, fear of COVID-19, fear of death, and anxiety did not differ between those who had and did not have the COVID-19 vaccine. The other finding in our study is that there is no difference between the scale scores according to the situation of having COVID-19 and loss of relatives/friends. News about the effects of the epidemic can be as effective as learning by experience or socially. This finding shows how the impact of pandemics can change over time with the influence of social media and the press. Studies showing that psychological effects occur in healthcare workers in many hospitals before COVID-19-positive patients were detected also support our finding (25).

Another important finding of our study was that it compared the COVID-19 fear, death anxiety, and fear of death scales among the medical systems related to the disease. Studies that assessed various patient groups may be found in the literature. However, as far as we know, this study was the first to group and compare the systems to which the diseases belong. In a study investigating the psychiatric symptoms caused by COVID-19 in elderly Parkinson's patients, 82.6% of the participants had depression and 52.2% had insomnia (12).

A study was conducted to investigate the frequency of psychiatric diagnosis with the effect of COVID-19 in patients

**Table 3. Comparison of scales according to systems related to medical diseases**

| | Cardiovascular | Respiratory | Gastrointestinal | Neurologic | Muscle & skeleton | Genito-urinary | More than once | p-value |
|---|---|---|---|---|---|---|---|---|
| **COVID-19 fear scale** | 18.02±6.53 | 18.96±7.92 | 20±6.46 | 16.56±5.45 | 18.13±6.90 | 17.09±6.52 | 20.43±6.90 | 0.170 |
| **Death anxiety scale** | 68.21±13.51 | 70.77±14.34 | 70.45±12.68 | 61.59±13.03 | 66.93±13.60 | 62.75±11.38 | 70.81±12.72 | **0.012** |
| **Fear of death scale** | 13.58±3.10 | 13.83±3.48 | 14±3.41 | 13.84±3.07 | 13.43±2.89 | 13±3.22 | 14.37±2.95 | 0.689 |

COVID-19: Coronavirus disease-2019

with type-2 diabetes. The incidence rates of newly diagnosed depressive disorders in people with type 2 diabetes decreased somewhat over the research period, but the incidence rates of anxiety and stress disorders remained mostly stable (13). In another study, the death anxiety scale and death depression scale scores of the elderly with chronic diseases were found to be higher without evaluating the diseases one by one (22). When the cause of death statistics in the elderly population is examined, it is seen that the most common cause of death is chronic diseases with 78.7% in Turkey and 86% in developed countries (26).

However, in some studies conducted with the elderly, it has been suggested that the chronic health problems of the elderly do not affect death anxiety and fear of death (27,28). In our study, the scores of the COVID-19 FCS, the fear of death scale, and the death anxiety scale did not show statistically significant differences between the systems related to the diseases in the elderly. It is known that the risk of severe disease and mortality from COVID-19 is high mainly in adults with advanced age or underlying medical comorbidities. It is said that among these comorbidities, respiratory system, cardiovascular, and immune system deficits including chronic obstructive pulmonary disease, obesity, and diabetes may create a more severe clinical condition in elderly patients (29).

There is evidence that common comorbid diseases have greater death rates in COVID-19 patients (30). Recent research has indicated that older people have more health worry when they have a chronic illness (31). As all of the individuals in our research had at least one systemic ailment, it's possible that these patients had significant levels of health anxiety. As a result, there was no difference in COVID-19 fear, death anxiety, or fear of death across the groups.

### Study Limitations

One of the limitations of our study was the absence of an evaluation for the measuring of health anxiety. Another drawback might be the lack of a control group made up of people over the age of 65 who do not have a medical ailment.

## Conclusion

Grouping the diseases in the elderly according to the systems, comparing the fear of COVID-19, anxiety of death, and fear of death among the groups, and examining the differences in terms of any system is the strength of our study. In order to generalize the findings, there is a need for studies with a larger sample, including the elderly who are hospitalized and living in nursing homes and rest homes.

### Ethics

**Ethics Committee Approval:** Gaziantep University Clinical Research Ethics Committee (ethics committee decision no: 2021/398). All procedures were carried out in line with the ethical requirements of the relevant committee on human experimentation (institutional and national) as well as the Helsinki Declaration of 1975, as amended in 2008.

**Informed Consent:** Informed consent has been obtained from all participants.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: B.D., Concept: B.D., Design: B.D., Data Collection or Processing: B.D., H.D.K., Z.A.Ö., Analysis or Interpretation: B.D., H.D.K., Z.A.Ö., Literature Search: B.D., Z.A.Ö., Writing: B.D., H.D.K., Z.A.Ö.

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ORIGINAL RESEARCH

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# Investigation of Knowledge and Attitudes of African and Turkish Nursing Students Regarding the Older Adults; A Comparative Descriptive Study

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## Abstract

**Objective:** The aim of the study is to determine the attitudes and knowledge of African and Turkish Nursing Students with regard to the older adults.

**Materials and Methods:** This comparative descriptive study was conducted in a private university in Northern Cyprus. A total of 455 African and Turkish nursing students participated in this study. Personal information form, Palmore's facts on aging quiz (FAQ) and Kogan attitudes towards older people scale (KAOPS) were used to collect data. Descriptive statistics, Kruskal-Wallis test, Mann-Whitney U tests and multivariate linear regression were used for data analysis.

**Results:** The mean FAQ score of the Turkish students was determined to be 30.64±7.15 and the mean KAOPS score was 125.33±13.14, whereas the mean FAQ score of the African students was 26.33±7.82 and the mean KAOPS score was 122.97±10.30. No significant difference was found in the students' attitudes towards the elderly in terms of nationality. The Turkish students' knowledge about old age was 3.43 times higher than the African students' knowledge [$R^2$=8.9%, odds ratio=3.43 (1.93-6.11)].

**Conclusion:** It was determined that both the Turkish and African students had similar and positive attitudes towards the elderly; however, Turkish students had more knowledge about the elderly.

**Keywords:** Aging, geriatric care management, geriatric nursing, geriatrics, long-term care

## Introduction

"The population aged 60 years and over" is increasing worldwide due to an increase in life expectancy and a decrease in the death rate (1). The increase in the older adults population generally brings with it a new and increased demand for health services. Health care services and those working them, in particular nurses, should have the skills and abilities to be able to meet the needs of this group. In the future, it will become ever more likely that nurses will be involved in the care of older adults (2).

In general, studies examining health professionals' and students' choices about whether to work in geriatric care, as well as their attitudes towards the older adults, have found various noteworthy differences and inconsistencies. Some determined that nursing students had positive, negative, and neutral attitudes towards the older adults, and that attitudes were less positive in studies conducted since 2000 (3-6). It was stated in a systematic review that both health professionals and students had a negative attitude towards the older adults and that health professionals had even more negative attitudes than students; this change was discussed in the context of social sensitivity and the use of preparatory courses about older adult care in education programs (7-10).

Despite the differences in the results of all these studies, a common finding was that opinions, prejudices, values, beliefs, and attitudes about and towards aging and older adult people directly affect the healthcare services provided to the older adults and may negatively affect the quality of care (2,3,11).

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Culture is an important factor affecting the development of attitudes. Attitudes toward aging and older adult people originate from the cultures in which people live (12-14). Determining the attitudes and knowledge of nursing students from different cultures with regard to the older adults is important in terms of defining the students' levels of awareness and their learning needs. This knowledge will serve to guide educational planning, and practices that develop nursing students' competence to understand the needs of older adults and respond to them effectively, as well as to develop their own self-awareness. The aim of the study was to determine the attitudes and knowledge of African and Turkish Nursing Students with regard to the older adults.

## Materials and Methods

### Study Population and Design

The research was planned as a comparative descriptive study. The population of the research consisted of 650 Turkish students enrolled in the Turkish formal undergraduate education program of the faculty of nursing and 240 African students (from Nigeria, Zimbabwe, Kenya, Uganda, and Tanzania) enrolled in the English nursing program. No sample selection was made and the aim was to reach all students. Students who agreed to participate in the study were included in the research. A total of 455 students (overall response rate, 51.46%), 329 of whom were Turkish, and 126 of whom were African, participated in the study. The research was conducted in a private university in Northern Cyprus. The nursing undergraduate program in the faculty of nursing lasts four years. The course has both theoretical and practical aspects.

### Instruments and Measures

The research data were collected through students' "self-reports using a personal information form to determine the socio-demographic characteristics of the students, "the Palmore's facts on aging quiz" to assess students' knowledge about old age, and the Kogan attitudes towards older people scale."

Questionnaire form: This information form consisted of 13 questions and examines the socio-demographic characteristics of the students and whether they had taken the relevant courses.

**"Palmore's facts on aging quiz (FAQ)":** The original "FAQ" was developed by Palmore in 1977 and consists of 50 questions, aiming to measure knowledge about old age. It is designed as a true/false test. The form tests the knowledge of the individuals about the physical, psychological and social aspects of aging, as well as misinformation or false ideas about aging. It was revised in 2015 (15). The participants respond by stating whether a statement is true (T) or false (F); a score of 1 is assigned if the answer is right; the score is 0 if the answer is wrong. Therefore, the total scores range from 0 to 50, with a high score representing high knowledge about the older adults" (15).

**"Kogan attitudes towards older people scale":** This scale was developed by Kogan (16) to measure the attitudes of individuals towards the older adult. The Turkish validity and reliability study of the scale was conducted by Erdemir et al. (17). The Cronbach alpha value was calculated as 0.84 for the total scale, 0.79 for the negative items, and 0.77 for the positive items. For this study the Cronbach's alpha value was calculated as 0.63 for the total scale, 0.85 for the negative items, and 0.88 for the positive items. The scale is a two-dimensional measurement tool consisting of 34 items: 17 positive and 17 negative items. The score obtainable from the scale ranges between 34 and 204 points. A high score on the scale represents a positive attitude towards the older adults and a low score represents a negative attitude. A score of 102 exactly indicates a neutral attitude towards older adults. The original scale, which was developed by Kogan for African students, was used.

### Statistics

The data were evaluated in the "Statistical Package for the Social Sciences (SPSS) 18.0" program. Descriptive statistical methods (number, percentage, mean, standard deviation) were used and statistical significance was taken to be $\alpha$=0.05. In the selection of appropriate hypothesis tests, the "Kolmogorov-Smirnov normality test" was used for the distribution of quantitative variables. The Mann-Whitney U test"" was used for comparisons of two independent groups and the "Kruskal-Wallis test" was used to compare more than two independent groups. For data with statistical significance in the "Kruskal-Wallis test", "Mann-Whitney U tests" were performed for paired-group comparisons. The Tukey test was used to determine the source of the difference in the significant multiple data. A multiple linear regression analysis was performed to examine the scale score and relational models.

### Ethical Considerations

Prior to the research, ethics committee approval was received from the "Scientific Research Ethics Committee of the University" and institutional permission was obtained from the faculty of nursing (656-2018). Students consent was received after they had been informed about the purpose, process, and the forms of the research, and that their participation in the study was voluntary.

## Results

Of the nursing students included in the sample, 72.3% were Turkish and 27.7% were African, and 37% were aged 20 or below. The mean age of the students was 21.78±2.61 years. 63.7% of the students were female, 95.8% were single, 31.1% were in the fourth year (eighth semester). 68.4% of the Turkish

students and 74.6% of African students had a nuclear family. According to their statements, 68.7% had an income equal to expenditure. 74.2% of students received the most significant social support from their families. 42.9% of the Turkish students lived in a suburban area and 46.5% shared a house with friends, while 74.6% of the African students lived in the city center and 41.3% lived with their families. 23.7% of the Turks lived with their grandparents, while 17.5% of Africans lived with their grandmothers only.

Of the Turkish students, 38.3% perceived the older adults as wise, 54.1% as weak, 16.1% as happy, 57.8% as sick, 54.7% as dependent, 50.8% as lonely, 7.9% as isolated, 80.2% as having normal mental abilities, 90.9% as still being able to function, and 70.2% as compassionate. Of the African students, 43.7% perceived the older adults as wise, 43.7% as weak, 24.6% as happy, 14.3% as sick, 36.5% as dependent, 30.2% as lonely, 8.3% as isolated, 69.6% as having normal mental abilities, 92.9% as still being able to function, and 34.1% as compassionate.

For our sample, 7% of the Turkish students and 9.5% of the African students stated that they wanted to work with older adults after graduation. 6.5% of the Turkish students and 88.9% of the African students had not received training or courses on gerontology; 63.6% of the Turkish students and 66.8% of the African students wanted to receive such courses or training. 18.6% of the Turkish students and 20.7% of the African students did voluntary work in an institution for the older adults.

Table 1 shows the students' mean scores from the FAQ and the KAOPS according to the relevant variables. No statistically significant difference was determined between the mean FAQ and KAOPS scores in terms of students' ages, the place of longest residence, family structure, members of the household, having experience of living with older adults and the status of taking courses about geriatric healthcare.

The mean FAQ score of the Turkish students was determined to be 30.64±7.15 and the mean KAOPS score was 125.33±13.14, whereas the mean FAQ score of the African students was 26.33±7.82 and the mean KAOPS score was 122.97±10.30. No significant difference was found in the students' attitudes towards the older adults in terms of nationality. The Turkish students obtained higher scores for the FAQ and the difference between Turkish and African students was statistically significant ($p<0.01$).

No difference was found between the mean KAOPS scores of the students in terms of marital status, while the FAQ scores of the single students were statistically significantly higher ($p=0.03$, $F=0.81$).

The mean scores of the third- and fourth-year students for both the FAQ ($p=0.04$, $x^2_{K-W}=8.330$) and the KAOPS ($p=0.02$, $x^2_{K-W}=9.21$) were higher, and the difference between the mean scores of the first- and second-year students, and the third- and fourth-year students was statistically significant.

No statistically significant difference was found in the mean FAQ scores of the students in terms of family structure and status of voluntarily working in an institution for the older adults, whereas the mean KAOPS scores of those who had a nuclear family ($p=0.01$, $^2_{K-W}=8.32$) and who did voluntary work in an institution for the older adults ($p=0.04$, $Z=-1.99$) were higher. The difference was statistically significant.

For the logistic regression analysis, the KAOPS scores and p-values below 0.20 were analyzed according to nationality, year of study, family structure, status of taking a course, status of voluntarily working in an institution for the older adults, and the FAQ scores in Table 2. The difference between the scores of the groups was not statistically significant ($R^2=3.8\%$, $p>0.05$).

For the FAQ, the OR was performed in a 95% confidence interval with the variables with a p-value of 0.20 and below: Nationality, marital status, year of study, place of residence, household members, family structure, status of taking courses, and KAOPS scores. Only the nationality was significant as a result of logistic regression analysis. The Turkish students' knowledge about old age was 3.43 times higher than the African students' knowledge [$R^2=\%8.9$, OR=3.43 (1.93-6.11)].

## Discussion

There was "no significant difference between the groups in the students' attitudes" towards the older adults, and both groups had scores that were at a similar level above neutral. When the lowest and highest scores obtainable from the scale are considered, it can be said that both groups had slightly "positive attitudes" towards the older adults. In the literature, Turkish nursing students generally perceived older adults positively (18-20). Studies on the attitudes and perceptions of African nursing students towards the older adults have also showed that they generally had "positive attitudes" towards the older adults (21-23). Studies conducted in both cultures have thus reported that nursing students perceived older adults in a positive light and it has been claimed that this arose from the ongoing presence of traditional family life.

In an other study nursing students who had lived with an older adult individual at home, had cared for older adult family members, and who communicated with older adults every day had "positive attitudes" towards the older adults (19). Similarly, Lambrinou et al. (24) found that most of the students in their study had older adults in their family, had experienced living with them, and had a "positive attitude towards the older adults" in general. In the current study, some of the Turkish students were found to live with their grandparents. Traditional African culture, similarly

to Turkish culture, promotes a positive perception of older adults. In most African societies, older adults are perceived to be worthy of respect and their experience is valued (21,23). According to the ideal of a traditional family, children, grandchildren, and relatives should treat older adults with respect, and help and support them in their daily activities (25). Older adults in African societies are neither physically nor socially isolated, and they also have fewer psychological problems (26). In the current study similar positive ideas were found in both groups when they were asked about the connotations of "old age". The African students perceived the older adults to be wise, happy, functional, and mentally normal; however, they also

**Table 1. Differences in knowledge and attitude scores among different charecteristics of students (n=455)**

| Variables | n (%) | FAQ scores | p-value | Test statistics | KAOP score | p-value | Test statistics |
|---|---|---|---|---|---|---|---|
| | | Mean ± SD | | | Mean ± SD | | |
| **Place of origin** | | | | | | | |
| Turkey | 329 (72.3) | 30.64±7.15 | **p<0.01** | z=-5.90 | 125.33±13.14 | p=0.10 | z=-1.64 |
| Africa | 126 (27.7) | 26.33±7.82 | | | 122.97±10.30 | | |
| **Gender** | | | | | | | |
| Female | 290 (63.7) | 29.44±7.15 | p=0.65 | z=0.445 | 124.12±11.20 | p=0.38 | z=0.875 |
| Male | 165 (36.3) | 29.39±8.35 | | | 125.66±14.39 | | |
| **Marital status** | | | | | | | |
| Single | 436 (95.8) | 29.57±7.50 | **p=0.03** | z=0.81 | 124.81±12.65 | p=0.26 | F=5.50 |
| Married | 19 (4.2) | 25.89±9.06 | | | 121.52±5.61 | | |
| **Year of study** | | | | | | | |
| 1st year | 198 (43.5) | 29.92±7.46 | **p=0.04** | **$x^2$=8.330** | 123.38±11.38 | **p=0.02** | **$x^2$= 9.21** |
| 2nd year | 83 (18.2) | 27.38±9.88 | | | 122.25±8.99 | | |
| 3rd year | 98 (21.5) | 29.50±6.31 | | | 127.82±14.92 | | |
| 4th year | 76 (16.7) | 30.23±6.25 | | | 126.65±13.96 | | |
| **Place of longest residence** | | | | | | | |
| City | 220 (48.4) | 29.21±8.25 | p=0.78 | $x^2$=0.49 | 125.37±12.01 | p=0.26 | $x^2$=2.67 |
| Suburbs | 165 (36.3) | 29.66±6.56 | | | 124.33±13.69 | | |
| Village | 70 (15.4) | 29.52±7.81 | | | 123.31±10.67 | | |
| **Family structure** | | | | | | | |
| Nuclear family | 319 (70.1) | 29.41±7.55 | p=0.20 | $x^2$=3.14 | 125.42±12.19 | **p=0.01** | $x^2$=8.32 |
| Extended family | 124 (27.3) | 28.96±7.37 | | | 123.29±13.23 | | |
| Fragmented family | 12 (2.6) | 34.33±9.97 | | | 119.33±9.12 | | |
| **Living place and who lives with** | | | | | | | |
| Lives alone at home | 50 (11) | 28.84±7.64 | p=0.10 | $x^2$=6.21 | 123.60±10.22 | p=0.51 | $x^2$=2.30 |
| Friends in shared house | 192 (42.2) | 28.95±7.81 | | | 125.72±13.60 | | |
| Family at home | 116 (25.5) | 29.06±7.82 | | | 123.36±10.83 | | |
| Friends in dormitory | 97 (21.3) | 31.08±6.70 | | | 124.75±12.93 | | |
| **Experience of living with an older adult person** | | | | | | | |
| Yes | 81 (17.8) | 29.20±7.45 | p=0.67 | z=-0.413 | 127.79±12.49 | p=0.70 | z=-0.38 |
| No | 374 (82.2) | 29.47±7.64 | | | 124.65±12.46 | | |
| **Status of taking a course on older adult** | | | | | | | |
| Yes | 121 (26.6) | 30.01±7.49 | p=0.19 | z=-1.30 | 127.09±14.20 | p=0.08 | z=-1.74 |
| No | 334 (73.4) | 29.20±14.20 | | | 123.80±11.66 | | |
| **Status of voluntarily working in an institution for the older adult** | | | | | | | |
| Yes | 94 (20.7) | 28.68±8.61 | p=0.72 | z=0.351 | 126.40±12.76 | **p=0.04** | z=-1.99 |
| No | 360 (79.1) | 29.61±7.32 | | | 124.21±12.36 | | |

Significant p-values (<0.05) are bolded. SD: Standard deviation, FAQ: Facts on aging quiz, KAOP: Kogan attitudes towards older people

**Table 2. Logistic regression analysis of the independent variables (n=455)**

| Variable | B(SE) | OR | 95% CI for OR | | p-value |
|---|---|---|---|---|---|
| | | | Lower | Uper | |
| Place of origin | 1.234 (0.294) | 3.434 | 1.931 | 6.105 | <0.000 |
| Marital status | 0.002 (0.505) | 1.002 | 0.372 | 2.694 | 0.997 |
| Year of study (Ref: 1st year) | | | | | 0.852 |
| 2nd year | 0.244 (0.420) | 1.276 | 0.560 | 2.906 | 0.562 |
| 3rd year | -0.035 (0.359) | 0.965 | 0.478 | 1.950 | 0.921 |
| Living place and who lives with (Ref: Lives alone at home) | | | | | 0.850 |
| Friends in shared house | -0.198 (0.2649) | 0.821 | 0.489 | 1.376 | 0.453 |
| Family at home | -0.049 (0.2989) | 0.953 | 0.531 | 1.708 | 0.871 |
| Family structure | | | | | 0.161 |
| Nuclear family | -1.329 (0.706) | 0.265 | 0.066 | 1.055 | 0.060 |
| Extended family | -1.355 (0.718) | 0.258 | 0.063 | 1.052 | 0.059 |
| Status of taking a course on older adult | 0.073 (0.287) | 1.076 | 0.613 | 1.887 | 0.799 |
| KAOP score | 0.028 (0.204) | 1.029 | 0.689 | 1.535 | 0.890 |

KAOP: Kogan attitudes towards older people, OR: Odds ratio, CI: Confidence interval

negatively perceived the older adults to be sick, lonely and isolated. In the study of Faronbi et al. (21), nursing students stated that they did not see sickness as a necessary part of old age. The majority of the Turkish students in the current study perceived the older adults as mentally normal, functional, and compassionate; however, they also negatively perceived the older adults to be weak, dependent, and lonely. Nevertheless, most of the students in both groups perceived old age positively. In a relatively recent study conducted with nursing students in Turkey, old age was associated with positive expressions, such as "love", "compassion", "trust", "understanding", and "gratitude", as well as with negative expressions such as "whining" and "strange behaviors" (27).

The Turkish students in the current study obtained higher scores from the FAQ, and the difference was statistically significant compared with the scores of the African students. This difference can be explained by the fact that only 6.5% of Turkish students had not taken a geriatrics/gerontology course, whereas most of the African students (88.9%) had not yet taken such a course. Due to the cultural structure of Turkish society, people tend to spend more time with their families or older adults in their close circle, and consider older adult care to be a family responsibility. It can be surmised that this had an effect on the Turkish students' knowledge about the older adults. Another finding in our study was that the percentage of nursing students doing voluntary work in a geriatric healthcare institution was low. This probably arose due to the low number of nursing homes in Northern Cyprus, the relative lack of private care centers for older adults, and the language barrier (their incompetence in Turkish) preventing the African students from working in these types of institutions. When the students' mean scores were examined according whether they did voluntary work in an institution for the older adults, it was determined that students who did such work had more positive attitudes towards old age. According to the literature, having specific experiences can positively affect an individual's perceptions and attitudes (28,29). Zehirlioğlu et al. (29) found that the scale scores of the nurses who had previously spent time in a nursing home were higher than those who had never visited one. These findings are similar to the results of the current study.

Another striking finding in this study was that very few of the students, only 7% of the Turkish students and 9.5% of the African students, stated that they wanted to work with the older adults after graduation. This result may be associated with the fact that, although students perceived old age positively, both groups found older adults to be dependent. It was determined that 54.7% of the Turkish students and 36.5% of the African students perceived old age to be a state of dependence. It may have been thought that giving care to a dependent patient is both psychologically and physically more difficult than caring for other groups. Moreover, the inadequacy of gerontology education in the curriculum and the lack of knowledge and skills regarding old age and older adult care may lead students to have decreased interest in this field (11,18). Likewise, in other studies found that the number of student nurses who stated a preference to work with older adults was low (4,8,10,30). In the study of Faronbi et al. (21), African nursing students stated that providing older adult care went beyond the requirement of standard nursing care, that it was necessary to have very good knowledge and experience in order to care for the older adults, and that nurses needed to be more patient, happier, and more empathetic. King et al. (30) qualitative study with

nursing students regarding their desire to work with the older adult; they found that students did not wish to work with older adults since older adult care was complex and they did not feel adequately prepared. These findings are similar to those in the current study.

## Conclusion

Despite coming from two different continents with different cultures, it was determined that both the Turkish and African students had similar and "positive attitudes towards the older adults;" however, Turkish students had more knowledge about the older adults. It was determined that as the years of study increased, so their knowledge about old age and their "positive attitudes towards the older adults" also increased. The family structure of the students and their status of voluntary working in an institution for the older adults positively affected their attitudes towards old age and older adults. Students' "positive perceptions and attitudes towards the older adults" and old age should be supported by improving geriatric education in the curricula. Given the increasing demand of the older adults population for health services, geriatric education should be an integral part of nursing education to better prepare students for their future professional roles. It is important for graduates to acquire the competencies that will allow them to meet the care needs of the older adults, develop positive attitudes, and adopt a unique nursing perspective in order to provide better care. According to study results; despite "the positive attitudes" of the students, the fact that very few of them prefer to work with older adults and find it difficult to work with elderly individuals both physically and psychologically shows that they do not feel ready to work with older adults with the education they had. These results will contribute to increasing to students' positive perceptions and attitudes towards the older adults by improving geriatric education in the curricula.

### Acknowledgment

We would like to thank the nursing students who participated in the study.

### Ethics

**Ethics Committee Approval:** Prior to the research, ethics committee approval was received from the "Scientific Research Ethics Committee of the University" and institutional permission was obtained from the Faculty of Nursing (656-2018).

**Informed Consent:** Students consent was received after they had been informed about the purpose, process, and the forms of the research, and that their participation in the study was voluntary.

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### Authorship Contributions

Concept: F.E., N.T.A., E.A.Ç., Design: F.E., N.T.A., E.A.Ç., Data Collection or Processing: F.E., N.T.A., E.A.Ç., Analysis or Interpretation: F.E., N.T.A., E.A.Ç., Literature Search: F.E., N.T.A., E.A.Ç., Writing: F.E., N.T.A., E.A.Ç.

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ORIGINAL RESEARCH

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# The Relationship Between Polypharmacy and Geropsychiatric Assessment Scales in Geriatric Outpatients

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## Abstract

**Objective:** The aim of the study was to investigate the association between geropsychiatric assessment scales and polypharmacy.

**Materials and Methods:** A cross-sectional study was conducted that included patients ≥65 years, who applied to geriatric outpatients in a university hospital. Functionality was assessed by instrumental activities of daily living (IADL) and activities of daily living (ADL). The clinical frailty scale (CFS) was used for frailty screening. Multidimensional scale of perceived social support (MSPSS), mini-nutritional assessment-short form (MNA-SF), quality of life scale in older people (CASP-19), mini-mental state examination, loneliness scale for elderly, generalized anxiety disorder-7, geriatric depression scale (GDS), templer death anxiety scale, and cumulative illness rating scale for geriatrics (CIRS-G) were performed. Polypharmacy was defined as taking five or more medications.

**Results:** The study included 136 patients with a median (interlique range) age of 72.2 (68.1-76.3). The prevalence of polypharmacy was 52.2%. Age, IADL, GDS, CFS, MSPSS, CASP-19, and CIRS-G scores significantly differed between the polypharmacy and non-polypharmacy groups ($p<0.05$). There were inverse correlations between the number of medications and ADL, IADL, MNA-SF, MSPSS, and CASP-19. GDS had a weak and positive correlation ($p<0.001$, $r=0.322$) whereas, CFS ($p<0.001$, $r=0.463$) and CIRS-G ($p<0.001$, $r=0.530$) had moderate and positive correlations. In multivariable analysis, age [odds ratio (OR), 1.087; 95% confidence interval (CI), 1.005-1.176], CFS (OR, 1.602; 95% CI, 1.048-2.448), and CIRS-G (OR, 1.273; 95% CI, 1.090-1.486) were independent variables.

**Conclusion:** Age, CIRS-G, and frailty score by using CFS are independent variables of polypharmacy. The relationship between polypharmacy and functional dependency, depression, social support, and life quality should be supported by future large and comprehensive studies.

**Keywords:** Geriatric psychiatry, frailty, polypharmacy, geriatrics, geriatric psychology

## Introduction

Polypharmacy is described as the concurrent use of multiple medications. It is an important geriatric syndrome and a global health problem (1). Although there are so many definitions of it, polypharmacy is usually described as taking five or more medications, routinely (2). The prevalence of polypharmacy ranges between 10% and 90% (3). As the number of medications is higher, related problems emerge like adverse reactions, drug-drug interactions, and compliance with drugs (4). The clinical consequences of polypharmacy, reviewed mostly in the literature, are frailty, falls, cognitive dysfunction, physical impairment, hospitalization, and death (2). On the other hand, the occurrence of geriatric syndromes causes the increment of polypharmacy (5). Mainly, the bidirectional interaction between frailty and polypharmacy is a crucial concern. It is emphasized that reducing polypharmacy may reverse or delay frailty (6). There are emerging strategies for deprescribing strategies as a

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global health problem (1,7,8). It is recommended to screen and manage the medications of older patients, regularly. Besides, potentially inappropriate prescribing tools are present to help with this problem including TIME criteria, and Beers criteria (9,10). Comprehensive geriatric assessment is the cornerstone of polypharmacy management. Multidimensional studies are needed to find out the effects of possible other factors for medication care.

The aim of the study was to investigate the relationship between geropsychiatric assessment scales and polypharmacy. We evaluated the effect of functionality, frailty, cognitive function, nutritional status, depression, anxiety, fear of death, loneliness, social support, life quality and multimorbidity by using related, reliable and validated tools.

## Materials and Methods

### Study Design

A cross-sectional study was conducted in a university hospital. Patients, who were 65 years and older, and who applied to the geriatric outpatient clinic between October 2020 and October 2021 were included. Subjects with malignancy, acute infections, acute diseases, severe cognitive impairment, and psychiatric diseases that may cause communication problems were excluded. Baseline characteristics including age, sex, living conditions, educational status, and medications were recorded. Polypharmacy was defined as the daily taking of five or more medications (2). Comprehensive geriatric assessment and psychiatric scales were performed. The burden of chronic disease was assessed by the cumulative illness rating scale for geriatrics (CIRS-G) (11).

### Comprehensive Geriatric Assessment

The comprehensive geriatric assessment included standardized and validated tools. Functionality was assessed by using the Lawton-Brody instrumental activities of daily living (IADL), and Katz activities of daily living (ADL) scale (12,13). ADL was ranged between 0-6, and IADL was ranged between 0-8. The higher score indicated more independency. Mini nutritional assessment short-form (MNA-SF) was used for malnutrition screening. The score ranged from 1 to 14 (14). The mini-mental state examination (MMSE) was performed for cognitive status assessment. The score ranged between 0-30 (15). Frailty was measured by the clinical frailty scale (CFS). CFS was scored between 1 to 9 (16). A 15-item Yesevage geriatric depression scale (GDS) was measured to screen depression. Higher scores were about the severity of depression (17,18). Points 5-8, 9-11, and 12-15 showed mild, moderate, and severe depression respectively.

### Psychiatric Scales

Social support was measured by the multidimensional scale of perceived social support (MSPSS), which consists of questions about family, friends, and significant other (19). The total score is between 12-84. A higher score indicates higher social support. Life quality was examined by the quality of life scale (CASP-19). The scale includes 19 items and four factors (autonomy, self-realization, control, and pleasure). The higher score is related to higher life quality (20). Anxiety was assessed by 7-item generalized anxiety disorder (GAD-7) test. The score ranges between 0 and 21. It is categorized as follows; mild (0-4), moderate (5-9), high (10-14), and severe anxiety (15-21) (21). The level of loneliness was measured by the loneliness scale for the elderly (LSE) which consists of 11 items. The total score was between 0 and 22. Higher scores are associated with a higher level of loneliness (22). The Templer death anxiety scale including 15-item was used to define death anxiety. The total score ranged from 0 to 15. The higher scores were related to higher fear and death (23).

### Statistics

Statistical Package of Social Science 25.0 (SPSS) was used for statistical analysis. The normality of variables was examined by using visual and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk's test). Descriptive variables were presented as mean ± standard deviation or median ($25^{th}$-$75^{th}$ percentile) according to their distribution. Categorical variables were summarized in terms of counts and percentages. Patients were divided into two groups polypharmacy and non-polypharmacy groups. The comparison between groups was performed by using the Mann-Whitney U test, independent t-test, and the chi-squared test where appropriate. The Spearman rank correlation coefficient was used for correlation analyses. The association of variables with the existence of polypharmacy was investigated by using binary logistic regression analyses with odds ratio [odds ratio (OR), 95% confidence interval (CI)]. A Hosmer-Lemeshow test ($p>0.05$) was used for the model fit. The statistically different variables identified with univariate analyses were put into the multivariable logistic regression analysis. The significance level of p was set to 0.05.

### Ethical Approval

The study was approved by the Hacettepe University Department of Medicine Clinical Research Ethics Committee, and commissions with the Declaration of Helsinki (decision number: 2020/313, date: 15/12/2020). Written informed consent was present for all participants.

## Results

One-hundred and thirty-six patients who applied to the geriatric outpatient and who were eligible for the study were enrolled to the study. The median (IQR) age of 136 patients was 72.2 (68.1-76.3). The rates of robust, pre-frail and frail patients were 72.1% (n=98), 17.6% (n=24) and 10.3% (n=14) respectively. The 42.9% of robust, 70.8% of pre-frail, and 85.7% of frail patients had polypharmacy.

Patients were divided into two groups as polypharmacy and non-polypharmacy group. The polypharmacy rate was 52.2% (n=71). Baseline characteristic of two groups were given in Table 1 in comparison. The median age was 74 (65-89) in polypharmacy group and 70 (65-90) in non-polypharmacy group (p=0.015). IADL, GDS, CFS, MSPSS, CASP-19 and CIRS-G scores were significantly different between two groups (p<0.05).

Correlation analysis of variables with numbers of medications was given in Table 2. There were inverse correlations between the numbers of medications and ADL, IADL, MNA-SF, MSPSS, and CASP-19. GDS had weak and positive correlation (p<0.001, r=0.322) whereas, CFS (p<0.001, r=0.463) and CIRS-G (p<0.001, r=0.530) had moderate and positive correlations.

**Table 1. Comparison of polypharmacy and non-polypharmacy groups**

| | Non-polypharmacy n=65 (47.8) | Polypharmacy n=71 (52.2) | p |
|---|---|---|---|
| Age, years | 70 (65-90) | 74 (65-89) | **0.015** |
| Sex, female | 39 (60.0) | 45 (63.4) | 0.685 |
| Education, illiterate | 9 (13.8) | 16 (22.5) | 0.191 |
| Living alone | 14 (21.5) | 19 (26.8) | 0.478 |
| ADL | 6 (6-6) | 6 (6-6) | 0.246 |
| IADL | 8 (8-8) | 8 (7-8) | **0.003** |
| MMSE | 29 (26-30) | 28 (26-30) | 0.575 |
| MNA-SF | 13 (12-14) | 12 (11-14) | 0.061 |
| Geriatric depression scale | 2 (1-4) | 4 (2-7) | **<0.001** |
| Clinical frailty scale | 2.0 (1.5-3.0) | 3.0 (2.0-4.0) | **<0.001** |
| MSPSS | 76.0 (60.5-84.0) | 71.0 (57.0-82.0) | **0.032** |
| CASP-19 | 31.0 (24.5-35.0) | 24.0 (15.0-31.0) | **0.001** |
| Generalized anxiety disorder-7 | 2.0 (0-5.5) | 3.0 (0-7.0) | 0.329 |
| Loneliness scale for elderly | 6 (2-11) | 8 (2-14) | 0.160 |
| Death anxiety scale | 4 (1-8) | 4 (2-8) | 0.420 |
| CIRS-G | 4 (2-6) | 6 (5-9) | **<0.001** |

ADL: Activities of daily living, CASP-19: Quality of life scale in older people, CIRS-G: Cumulative illness rating scale for geriatrics, IADL: Instrumental activities of daily living, MMSE: Mini-mental state examination, MNA-SF: Mini-nutritional assessment-short form, MSPSS: Multidimensional scale of perceived social support, Variables were presented as median (25p-75p) or n (%)

Binary logistic regression analysis of variables associated with polypharmacy was given at Table 3. Age, IADL, CFS, GDS, MSPSS, CASP-19 and CIRS-G was significantly associated with polypharmacy in univariable analysis (p<0.05). In multivariable analysis only age (OR, 1.087; 95% CI, 1.005-1.176; p=0.038), CFS score (OR, 1.602; 95% CI, 1.048-2.448; p=0.030) and CIRS-G (OR, 1.273; 95% CI, 1.090-1.486; p=0.002) were independent variables.

## Discussion

This study assessed the polypharmacy with multidimensional approach including comprehensive geriatric assessment. Therefore, the effects of other important factors like loneliness, anxiety, fear of death, social support and life quality were investigated. Polypharmacy management in a holistic approach is a critical and trending issue worldwide. On the light of these issues, this study provided important data, and will set light to future studies.

The rate of polypharmacy was 52.2% in our study. We used the widely accepted definition of polypharmacy as the routine intake of five or more medications (2). The prevalence of polypharmacy range between 10% and 90% in the literature (3). DO-HEALTH study, included community-dwelling adults age 70 and older from seven European countries, reveled the rate of polypharmacy as 27.2% from 16.4% in Geneva to 60.8% in Coimbra (24). SHELTER study, including nursing home (NH) residents from 50 European and 7 Israeli NH facilities, reported the polypharmacy as 49.8% (25). These wide range of rates may be effected by the different definition of polypharmacy, used in the studies.

**Table 2. Correlation analysis of variables with numbers of medications**

| Number of medication | rho | |
|---|---|---|
| ADL | -0.204 | **0.017** |
| IADL | -0.295 | **<0.001** |
| MMSE | 0.015 | 0.866 |
| MNA-SF | -0.247 | **0.004** |
| Geriatric depression scale | 0.322 | **<0.001** |
| Clinical frailty scale | 0.463 | **<0.001** |
| MSPSS | -0.245 | **0.004** |
| CASP-19 | -0.321 | **<0.001** |
| Generalized anxiety disorder-7 | 0.070 | 0.420 |
| Loneliness scale for elderly | 0.153 | 0.076 |
| Death anxiety scale | 0.087 | 0.314 |
| CIRS-G | 0.530 | **<0.001** |

ADL: Activities of daily living, CASP-19: Quality of life scale in older people, CIRS-G: Cumulative illness rating scale for geriatrics, IADL: Instrumental activities of daily living, MMSE: Mini-mental state examination, MNA-SF: Mini-nutritional assessment-short form, MSPSS: Multidimensional scale of perceived social support

**Table 3. Binary logistic regression analysis of variables associated with polypharmacy**

| | Univariable | | Multivariable | |
|---|---|---|---|---|
| | OR (95% CI) | p | OR (95% CI) | p |
| Age* | 1.080 (1.012-1.152) | **0.020** | 1.087 (1.005-1.176) | **0.038** |
| Sex, female | 0.867 (0.434-1.732) | 0.685 | | |
| Education, illiterate | 0.552 (0.225-1.355) | 0.195 | | |
| Living alone | 1.331 (0.603-2.936) | 0.479 | | |
| ADL* | 0.613 (0.335-1.123) | 0.113 | | |
| IADL* | 0.654 (0.463-0.923) | **0.016** | 1.225 (0.798-1.881) | 0.353 |
| MNA-SF* | 0.882 (0.753-1.033) | 0.119 | | |
| MMSE* | 0.970 (0.878-1.071) | 0.544 | | |
| CFS* | 1.990 (1.444-2.742) | **<0.001** | 1.602 (1.048-2.448) | **0.030** |
| GDS* | 1.229 (1.091-1.385) | **0.001** | 1.114 (0.942-1.317) | 0.207 |
| MSPSS* | 0.978 (0.959-0.999) | **0.037** | 1.003 (0.954-1.076) | 0.851 |
| CASP-19* | 0.941 (0.906-0.977) | **0.002** | 1.013 (0.954-1.076) | 0.668 |
| LSE* | 1.047 (0.988-1.110) | 0.124 | | |
| GAD-7* | 1.047 (0.979-1.119) | 0.178 | | |
| DAS* | 1.026 (0.975-1.114) | 0.541 | | |
| CIRS-G* | 1.390 (1.202-1.607) | **<0.001** | 1.273 (1.090-1.486) | **0.002** |

ADL: Activities of daily living, CASP-19: Quality of life scale in older people, CFS: Clinical frailty scale, CIRS-G: Cumulative illness rating scale for geriatrics, DAS: Death anxiety scale, GAD-7: Generalized anxiety disorder-7, GDS: Geriatric depression scale, IADL: Instrumental activities of daily living, LSE: Loneliness scale for elderly, MMSE: Mini-mental state examination, MNA-SF: Mini-nutritional assessment-short form, MSPSS: Multidimensional scale of perceived social support, OR: Odds ratio, CI: Confidence interval, *included as continuous variables

In our study, the median age of polypharmacy group was higher than the non-polypharmacy group. In polypharmacy group IADL and CFS scores were worst. They were more dependent and frail. CIRS-G score and depression score were higher. On the other hand, we observed that MSPSS and CASP-19 scores were lower. That means that perceived social support and life quality of patients were worse in polypharmacy group. Correlation analysis revealed that, polypharmacy had positive moderate correlation with CFS and CIRS-G score, and low correlation with GDS score. Significant inverse correlations between polypharmacy and ADL, IADL, MNA-SF, MSPSS, CASP-19 were striking. Basically, we can say that frailty, multimorbidity, depression, functional dependency, social support and life quality seems to be related with polypharmacy. However, in multivariable analysis, we only found the independent effect of age, CFS and CIRS-G. However, only age, CIRS-G and CFS had independently associated with polypharmacy in multivariable analysis. A one-point increment of CFS score causes 1.6-fold, and one-point increment of CIRS-G score causes 1.27-fold risk of polypharmacy.

The relationship between age, multimorbidity and polypharmacy is a known fact. As we are getting aged, the rate of chronical diseases rises and the number of used medication get higher. Besides the changes on pharmacokinetics and pharmacodynamics of drugs; the risk of adverse drug reactions and drug-drug interactions rise. On the other hand, geriatrics syndromes, including falls, delirium, depression, cognitive impairment, malnutrition, orthostatic hypotension, incontinence, and chronic pain, may decrease the potential benefit of medications, increase the not only risk of adverse reactions, but also the rate of inappropriate prescriptions (5).

In DO-HEALTH study, polypharmacy was related to sex, age, number of comorbidities, and body mass index. This study was designed comprehensively and searched socio-demographic factors and health-related indicators with polypharmacy. They assessed frailty with Fried criteria and cognitive function with Montreal cognitive assessment (MOCA). However, frailty and cognitive functions were related to polypharmacy only in unadjusted model (24). Age and comorbidities are independent variables of polypharmacy in our study, too. We assessed frailty with CFS, and analyzed it as a continuous variable. We showed the effect of one-point increment in CFS on polypharmacy.

There are studies, investigating the mechanism and association between frailty and polypharmacy and supporting our study. In a systematic review and meta-analysis, polypharmacy was shown to be a major trigger of frailty, and future studies were called to confirm the effect of deprescribing in the development, reversion or delay of frailty (6). In another systematic review and meta-analysis concluded that, older adults living with frailty and polypharmacy were less likely to improve frailty states, and were prone to adverse hospital-related outcomes and mortality. They emphasized the requirement of further researches evaluating outcomes associated with polypharmacy in the frail population (26).

Wastesson et al. (27) reported the factors associated with chronic polypharmacy as higher age, female sex, multimorbidity, multidose dispensing, and living in an institution. We presented the independent effect of age, multimorbidity and frailty. On the other hand, we highlighted the perceived social support, life quality, depression, frailty, functional dependency and disease burden on geriatric outpatients. Wastesson et al. (27) found living in an institution as a factor. We may anticipate that patients living in an institution can have less social support, depression, functional dependency, and they can perceive their life quality as low. This issue varies from an institution to institution. These associations should be investigated in future studies.

Makovski et al. (28) conducted an interesting study, evaluating the role of functional, clinical and social factors in multimorbidity and quality of life. They showed symptoms, polypharmacy, loneliness and ADL/IADL to be significant, after all factors of interest were introduced in the base model (adjusted for age, sex, employment, household income, living alone, and education) separately. They suggested to consider these factors to estimate the impact of multimorbidity and life quality for improving patient care (28). This study is important as it highlighted the relationship between polypharmacy and loneliness, functionality, multimorbidity and life quality.

### Study Limitations

This is the first study investigating the factors related to polypharmacy by using validated and reliable tools. Besides socio-demographic factors, we evaluated functionality, nutritional status, cognitive function, frailty, anxiety, depression, loneliness, social support, and life quality. Polypharmacy management requires multi-dimensional approaches, and all factors influencing it should be clarified and confirmed with future, longitudinal and comprehensive studies. Our study highlights to this issue (4). On the other hand, performing all screening tests were long lasting and needed great effort.

The cross-sectional design of our study is a weak limitation. Firstly, we could not assess the chronic polypharmacy and its long-term effects. However, our primary aim was to draw attention to social, cognitive, functional and psychiatric factors. Because not only for health professionals but also health care systems have been trying to prevent polypharmacy and related outcomes. Secondly, it was a single center experience.

## Conclusion

Age, CIRS-G and frailty score by using CFS are independent variables of polypharmacy. The relationship between polypharmacy and functional dependency, depression, social support, life quality should be supported by future large and comprehensive studies.

### Ethics

**Ethics Committee Approval:** The study was approved by the Hacettepe University Department of Medicine Clinical Research Ethics Committee, and commissions with the Declaration of Helsinki (decision number: 2020/313, date: 15/12/2020).

**Informed Consent:** Written informed consent was present for all participants.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Concept: E.O.C., Z.K., Ç.Ç., B.B.D., Ö.E.A., M.C., Design: E.O.C., Z.K., Ç.Ç., B.B.D., Ö.E.A., M.C., Data Collection or Processing: Y.Ö., E.O.C., M.H., Z.K., Ç.Ç., B.B.D., Ö.E.A., M.C., Analysis or Interpretation: Y.Ö., M.H., C.B., B.B.D., M.H., Ö.E.A., M.C., Literature Search: Y.Ö., M.H., C.B., B.B.D., M.H., M.C., Writing: Y.Ö., C.B., B.B.D., M.H., M.C.

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ORIGINAL RESEARCH

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# The Effect of the Use of Frailty Scores and Hospital Score on 30-Day Hospital Readmissions in Geriatric Patients Admitted to the Emergency Department

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## Abstract

**Objective:** Assessing the efficiency of healthcare systems is commonly done by analyzing the 30-day readmission rates. However, research on the effectiveness of readmission models, particularly in predicting 30-day unplanned readmissions in the older adult population with frailty, is insufficient.

**Materials and Methods:** This study analyzed 423 older patients who were admitted to the emergency department observation ward and evaluated their frailty scores and HOSPITAL scores. The HOSPITAL score's index admission criteria were modified to suit hospitalization. To assess the overall performance of each prediction model, the scaled Brier score was computed for the HOSPITAL score with and without the frailty scores.

**Results:** The analysis was performed on 320 of the patients, consisting of 188 (58.8%) females and 132 (41.3%) males, with ages ranging from 65 to 99 years, and a mean age of 79.05 years (standard deviation =10.76). The readmission rate was observed to be 43.17%. The models evaluated were (1) hospital only, (2) hospital + clinical frailty score (CFS), and (3) hospital + CFS + PRISMA-7. The scaled Brier scores for all models were computed, and it was found that the score was the same for all models, with a value of 0.02. This value indicates that the overall accuracy of the prediction of 30-day readmission is good.

**Conclusion:** While hospital readmissions can be prevented, relying solely on scoring systems may not be effective. Instead, case-based approaches using patient admissions may provide more meaningful results. Although the HOSPITAL score can predict 30-day readmissions, the frailty test may not to be a predictor.

**Keywords:** 30-day readmission, frailty, geriatrics, emergency department, HOSPITAL score

## Introduction

In 2009, a significant number of emergency department (ED) visits in the United States, totaling over 19.8 million, were attributed to individuals aged 65 and above. Furthermore, this age group accounted for approximately 36% of all hospitalizations during that period. The healthcare requirements of this demographic group pose a significant burden on EDs, which are already grappling with high patient volumes. As such, effectively managing and meeting the healthcare demands of older adults within the ED setting necessitates careful planning, resource allocation, and strategic interventions (1).

The efficiency of healthcare systems is commonly assessed using 30-day readmission rates as a metric to direct budget allocation. They also act as the main indicator in research projects aiming at raising the standard of care. The majority of studies on 30-day readmission rates have been on patients who are referred from the community to the hospital and then discharged back to the community. Users of home care and long-term residential care, particularly frail older persons, who pose one of the biggest

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difficulties to the current healthcare system, are not taken into consideration by this restricted focus (2).

Hospital readmissions have been associated with a range of factors, including socio-demographic factors, individual characteristics, multiple health conditions, and medical events. Elderly patients who receive treatment for various illnesses and undergo surgical procedures such as hip fracture, cancer, bypass, acute cardiovascular events, or complex surgery are particularly susceptible to being readmitted within 30-days. Although readmissions after surgery may not be directly linked to the surgical procedure, they can be influenced by underlying chronic health conditions. Therefore, chronic diseases can significantly increase the likelihood of readmission, regardless of the initial reason for hospitalization. Chronic diseases among older adults are interrelated, and treating one disease may negatively affect another, making patterns of 30-day hospital readmissions highly complex (3).

The HOSPITAL score is one of many readmission prediction models that have been created. Seven easily accessible clinical markers are included in the HOSPITAL score: serum sodium, hemoglobin, length of stay, procedure while hospitalized, prior admission numbers, index admission type, and discharge from oncology service. The utilization of these models in diverse clinical contexts worldwide has been driven by their user-friendly nature and consistent reproducibility. However, assessing the performance of these models has proven to be a challenging task due to the wide range of populations studied. Particularly, evaluating the accuracy of HOSPITAL ratings in predicting unplanned readmission within a 30-day period among older adults with compromised physical function and malnutrition has emerged as a crucial area of concern. This holds significant importance within the context of older individuals, who often present with interconnected and complex health conditions, as observed in acute geriatric units (4).

Frail older adults are susceptible to physiological changes that hasten physical deterioration and functional decline, thereby raising the risk of unfavorable health outcomes. Frailty becomes more common as people age and is linked to greater mortality, morbidity, disability, health care utilization and costs. It is also a predictor of unfavorable outcomes from surgeries and interventions. In addition, frailty independently predicts hospital readmissions, including those occurring in less than 30-days after complex cardiovascular surgery and general admission to a medical ward (5).

In our study, we aimed to demonstrate the effectiveness of the Program of Research to Integrate the Services for the Maintenance of Autonomy-7 (PRISMA-7) and clinical frailty score (CFS) scores, which have been validated in Turkey, in conjunction with the hospital score, in predicting 30-day hospital readmission.

## Materials and Methods

### Study Setting

In the context of ED triage, the Manchester triage scale (MTS) utilizes a five-level system to prioritize patients, with level one indicating immediate attention and level five indicating non-urgent cases (6). Those deemed to be unstable, i.e., requiring management in the ED resuscitation, cardiac care or intensive care units with MTS score of one or two and who are deemed as non-urgent (T5), were excluded from the study as they are not subject to frailty assessments in our hospital. The study included 320 patients who were 65 years of age or older, had a T3-T4 triage score, and were under observation in our hospital's ED from January 1, 2022, to March 1, 2022, in weekdays morning shift was assessed retrospectively. Our ED covers an area with 460,000 inhabitants and has ~310,000 visits annually, Annually, there are ~10 ED geriatric observational unit patient presentations per weekday morning shift. Ethical approval was obtained from Ethics Committee of İstanbul Medeniyet University (21.12.2022).

The reason for choosing weekday working hours in our study is that 30-day readmission may also occur in outpatient clinic appointments during these time periods and patients have the ability to apply to outpatient hospital outpatient clinics.

### Assessment Tools

Patient files, and retrospective hospital automation system scans, were used to assess the parameters of the HOSPITAL score, including the patient's hemoglobin level at discharge, diagnosis of cancer or discharge from the oncology department, sodium level at discharge, interventions with ICD 9 or ICD 10 codes, number of hospital admissions and length of stay in the last 12 months, emergency or outpatient visits in the first month after discharge, chronic illnesses, readmissions and length of stay in the first month, and the impact of HOSPITAL score, frailty score, and both on readmissions were analyzed. As our study involves only patients from ED we have modified the index admission criteria of HOSPITAL score with hospitalization from ED and scoring was performed according to original study by Donzé et al. (7). The Table 1 gives the information about the hospital score parameters and scoring system. A post hoc power analysis was conducted though G*Power 3 (8) to test the difference between two independent group means of modified HOSPITAL, scores by using a two-tailed test, alpha of 0.05. The results showed that the achieved power is 0.67 in mean differences of two groups observed readmission (n=132) and non-observed readmission (n=177). Thirty-day readmission data was obtained from hospital administration system. If the patient was hospitalized, 30-day readmission was assessed after the discharge date.

The PRISMA-7 assessment comprises seven questions with binary responses of "yes" or "no". It assesses a range of factors such as

age, gender, the existence of health issues that impede activities or require home care, need for assistance while walking, and the requirement for regular support. One point is assigned for each affirmative answer, and a score of three or higher is indicative of elevated frailty. In the study, the patient was considered frail if the patient scored 3 or more points on the PRISMA-7 score (9,10).

CFS is a useful tool with various domains that include Very Fit, well, Managing Well, Vulnerable, Mildly Frail, Moderately Frail, Severely Frail, Very Severely Frail, and Terminally Ill. It has demonstrated strong criterion validity through its ability to predict 5-year mortality and institutionalization and has displayed robust construct validity by accurately identifying poor health outcomes and validated in Turkish population (11). In our study, patients with a score of 5 or more points were considered frail.

### Statistics

All statistical analyses were performed with SPSS Statistics Version 25.0 software (IBM, Chicago, IL). Descriptive statistics, were presented as proportions, means with standard deviation (SD), and as medians with interquartile ranges (IQR) as appropriate.

The score comparison between two independent groups (with and without readmission) was analyzed conducting independent sample t-test for continuous variables and chi-square test for categorical variables. Binary logistic regression was used to calculate predicted outcomes for readmission. In order to test the overall performances of each predicted models, the scaled Brier score was computed and compared within the models. Also, error bar charts were used to visualize the mean difference between predicted outcomes of different models. ROC curve analysis was conducted for predicted models. The statistical significance level was determined as $p<0.05$.

**Table 1. HOSPITAL score for readmission**

| Attributes | Points if positive |
|---|---|
| Low hemoglobin at discharge (<12 g/dL) | 1 |
| Discharge from an oncology service | 2 |
| Low sodium level at discharge (<135 mEq/L) | 1 |
| Procedure during hospital stay (ICD10 coded) | 1 |
| Emergency hospitalisation | 1 |
| Number of hospital admissions during the previous year | |
| 0-1 | 0 |
| 2-5 | 2 |
| >5 | 5 |
| Length of stay ≥5 days | 2 |

## Results

At our hospital, a total of 423 geriatric patients were admitted to the observation unit on the given dates. Out of these patients, 80 were initially evaluated in the T5 area and admitted to the observation unit without assessing their frailty score. None of the patients included in the study were transferred to other hospitals. Additionally, data was missing for 23 of these patients. As a result, analysis was performed on 320 of these patients. One hundred eighty eight (58.8%) female and 132 (41.3%) male patients ages from 65 to 99 (mean =79.05, SD =10.76) were screened. The readmission rate was observed as 43.17%.

The baseline characteristics of patients according to 30-day readmission were presented in Table 2. Table 3 demonstrates the details the prediction of HOSPITAL scores parameters and frailty scores on 30-day readmission.

### Hospital Score * Readmission

The independent sample t-test was conducted to examine the difference between patients observed readmission and patient not observed readmission in the HOSPITAL score. The results show that there is a statistically significant difference between observed readmission, mean (SD) =3.70 (2.5) and median (IQR) =3.00 (3.00), not observed readmission groups, mean (SD) =3.02 (2.4) and median (IQR) =3.00 (3.00), according to HOSPITAL scores, $t(307)=2.40$, $p<0.05$, Cohen's $d=0.28$.

**Table 2. The baseline characteristics of patients according to 30-day readmission with HOSPITAL and frailty scores**

| Characteristics | Patients' 30-day readmission rate frequency (%) | | p |
|---|---|---|---|
| | No (n=184) | Yes (n=136) | |
| **Sex** | | | |
| Male | 76 (41.3%) | 56 (41.1%) | 0.98 |
| Female | 108 (58.6%) | 80 (58.8%) | |
| **Age groups** | | | |
| 65-74 | 53 (28.8%) | 47 (34.5%) | 0.52 |
| 75-84 | 69 (37.5%) | 45 (33%) | |
| ≥85 | 62 (33.6%) | 44 (23.3%) | |
| **Comorbidities** | | | |
| Diabetes mellitus | 65 (36.3) | 56 (41.2) | 0.38 |
| Hypertension | 125 (69.8) | 106 (77.9) | 0.11 |
| **Coronary artery disease*** | **30 (16.8)** | **40 (29.4)** | **<0.01** |
| Congestive heart failure | 40 (22.3) | 37 (27.2) | 0.32 |
| Dementia | 16 (8.9) | 9 (6.6) | 0.45 |
| Chronic kidney disease | 15 (8.4) | 14 (10.3) | 0.57 |
| Chronic obstructive pulmonary disease | 15 (8.4) | 16 (11.8) | 0.32 |

*p<0.05

The independent sample t-test was conducted to examine the difference between patients observed readmission and patient not observed readmission in the CFS score. The results show that there is no statistically significant difference between observed readmission, mean (SD) =4.80 (1.75) and median (IQR) =5.00 (2.00), not observed readmission groups, mean (SD) =4.82 (1.95) and median (IQR) =5.00 (3.00), according to CFS scores, t (312) =0.10, p=0.92.

The chi-square test for independence was conducted to examine the association between patients observed readmission and patient not observed readmission with the PRISMA-7 score. The results show that there is no statistically significant association, $\chi^2$ =0.001, p=0.97.

The aim of the study is to compare the models that predict patients' readmissions to hospital according to HOSPITAL, frailty, and PRISMA-7 scores. The models are (1) HOSPITAL only, (2) HOSPITAL + CFS and (3) HOSPITAL + CFS + PRISMA-7. The scaled Brier scores of models were computed. For all models the scaled Brier score is the same and 0.02 and this value shows that the overall accuracy for the prediction of 30-day readmission is good. There is no statistically significant association between HOSPITAL score groups (low, intermediate & high) and PRISMA-7 score and frailty score. There is a very weak positive correlation between hospital score and frailty score (r=0.12, p<0.05). There is a strong positive association between PRISMA and frailty scores (r=0.79, p<0.001). There is no statistically significant difference in frailty scores & PRISMA-7 scores between patients who readmitted to hospital and who not. Figure 1 demonstrates the prediction models of the study.

## Discussion

In our research findings indicate that the HOSPITAL score is a reliable predictor of hospital admissions within a 30-day timeframe for elderly patients. However, when considering frailty scores such as CFS and PRISMA-7, whether used independently or in conjunction with the HOSPITAL score, they do not exhibit dependable predictive capabilities in this context.

**Table 3. m-HOSPITAL score and frailty scores**

| **m-HOSPITAL score** | | | |
|---|---|---|---|
| **Low hemoglobin at discharge (<12 g/dL)*** | **126 (71.2)** | **77 (57.5)** | **<0.05** |
| Discharge from an oncology service | 5 (2.8) | 5 (3.7) | 0.66 |
| Low sodium level at discharge (<135 mEq/L) | 43 (24.3) | 35 (26.3) | 0.69 |
| Procedure during hospital stay (ICD10 coded) | 28 (15.6) | 15 (11.0) | 0.24 |
| **Hospitalization urgent or emergent *** | **23 (12.8)** | **57 (41.9)** | **<0.01** |
| Number of hospital admissions during the previous year* | | | <0.05 |
| 0-1 | 92 (51.4) | 50 (36.8) | |
| 2-5 | 56 (31.3) | 51 (37.5) | |
| >5 | 31 (17.3) | 35 (25.7) | |
| Length of stay ≥5 days | 35 (19.6) | 16 (11.8) | 0.06 |
| **m-HOSPITAL TOTAL* (n=177/132)** | **3.02 (2.44)** | **3.70 (2.50)** | **<0.05** |
| PRISMA-7 | | | 0.97 |
| No risk | 74 (56.9) | 56 (43.1) | |
| At risk | 105 (56.8) | 80 (43.2) | |
| CFS | 4.82 (1.95) | 4.80 (1.75) | 0.92 |

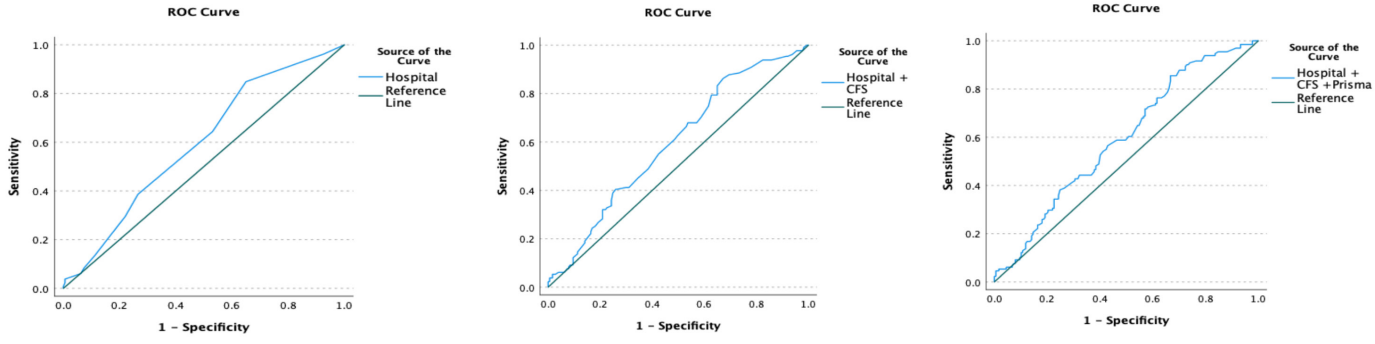


**Figure 1.** Prediction models of the frailty and hospital score

Older age, male gender, non-white race, medicaid eligibility, recent physician interactions, prior ED visits, and prior hospitalizations are just a few of the patient characteristics that have been connected to greater return rates to an ED or hospital. The fact that these results diverge from those of other worldwide studies could be attributed to differences in patient populations and healthcare infrastructure. These findings emphasize the significance of strengthening care transitions for patients at high risk and adjusting solutions to the particular requirements of each patient population (1).

Frailty is a recognized geriatric syndrome that is marked by comorbidity, diminished muscle strength, and malnutrition in addition to the loss of function and physiologic reserve. Frail persons had more than 40 times the likelihood of having four or more comorbid conditions compared to robust ones, according to nationwide longitudinal research in the United States. In frail older persons, asthenia and cognitive impairment frequently coexist, which may help to explain why fragile patients are more likely to suffer negative health consequences (12). As it objectively represents their chronic health issues and medical requirements, frailty in older people is a substantial risk factor for adverse clinical events (13). Furthermore, academics and policymakers are becoming more interested in determining how vulnerable older people are to negative health outcomes as a result of the demographic trend in many industrialized countries towards an aging population. Such measurement and its association with adverse health outcomes are essential for healthcare planning and resource allocation (14).

In studies conducted at a university hospital in Ireland has demonstrated the efficacy of various screening measures in identifying frailty among patients in the ED. Notably, CFS and the PRISMA-7 screening instrument exhibited higher levels of accuracy, suggesting their preferential consideration for identifying frailty in ED settings (15,16). Therefore, we chose these two frailty instruments in our study. In addition, we preferred to use the PRISMA-7 score parameters for functional assessment and the CFS score parameters for clinical evaluation, which allowed us to compare two different frailty assessments. Our study revealed that the two scores were strongly correlated, indicating that frailty is a significant issue for patients in both clinical and functional contexts. There are also studies in the literature that have been conducted with a variety of different frailty assessment tools, for example a study confirms the ability of hospital frailty risk score (HFRS) to identify older, frail people at higher risk of prolonged hospital length of stay and increased mortality risk. However, in that study it was not observed a significant association between HFRS and 28-day unplanned readmission or repeated hospital admission (17). In other study with HFRS form shows that frailty was a powerful predictor of long length of stay and in-hospital mortality, but less so of emergency readmissions (18). The Identifying seniors at risk (ISAR) tool can be used to identify people who are more likely to need readmission through risk stratification. It is appropriate for rapid patient screening to determine who needs to be reviewed by a clinical geriatric team due to its high sensitivity and negative predictive value at a cut-point of 2+. The clinical geriatric team can then determine whether patients have geriatric conditions that necessitate further attention, instruction, and supervision in order to lower the risk of readmission (19).

In a study that utilized the PRISMA-7 and ER2 frailty assessment tools, their association with short-term adverse outcomes such as increased hospitalization and prolonged ED stay was established. However, conflicting results exist regarding the evaluation of frailty in the ED and its association with long-term outcomes (20). In a study conducted by Shang et al. (21) to compare the predictive abilities of the FRAIL scale (FS), frailty screening questionnaire (FSQ), and CFS for adverse outcomes in older adults in the ED, the three tools were found to have a low predictive ability for readmission. In another study comparing CFS, ISAR, and PRISMA-7 scores, it was found that the PRISMA-7 score was able to predict the 30-day admission (22).

Given the prevalence of numerous other conditions that necessitate ongoing outpatient appointments and are associated with negative consequences in fragile patients, we investigated the impacts of the HOSPITAL score, the PRISMA-7 score, and the CFS score on 30-day hospital admission in our study. Additionally, we expected that combining frailty scores with the HOSPITAL score would produce a better prediction of 30-day hospital admission because the HOSPITAL score does not offer a separate evaluation for individuals over the age of 65. Surprisingly, we discovered that frailty ratings had no bearing on this result. The contradictions in predicting 30-day readmissions with frailty scores can be explained in the following ways:

Frailty is not a static condition and patients may become frailer during the 30-day follow-up period. To prevent frailty from progressing, follow-up policies in the ED, involvement of departments in discharge recommendations, and widespread implementation of home healthcare services may be necessary.

Frail patients tend to be more dependent on others in their daily activities due to disabilities, dementia, CKD, CVD, and COPD. Additionally, in countries like Turkey where appointment systems are web-based, these patients may be less familiar with new technologies (23), potentially leading to a reduction in hospital admissions. Moreover, in our country, the emergency system may only bring patients to hospital EDs, and they may not be able to attend outpatient clinic appointments. Another factor could be the widespread family medicine system, which may allow patients to benefit from home healthcare services instead of hospitals.

The PRISMA-7 score includes parameters such as social support and advanced age. In a previous study, the relationship between patients' socio-demographic characteristics and 30-day readmissions was compared (24). The addition of social determinants of health variables did not improve the performance of the hospital readmission risk score as frailty markers in our study. In our study The HOSPITAL score had good overall performance in this setting with a Brier score of 0.02. However, when we also included frailty scores in the HOSPITAL score, the Brier score did not change (25). In our study, no relationship was found between the HOSPITAL score and frailty scores, and this is likely due to the fact that the parameters of the HOSPITAL score are generally derived from hospital data, which may not capture the difficulties that frail patients face in accessing hospital care.

### Study Limitations

Although it is one of the forerunner studies on frailty and hospital score assessment in older patients admitting to Turkish emergency medicine departments, the study has some limitations. First as all the patients have index emergency admission, we had to modify the hospital score to emergency hospitalizations as our intervention should decrease the HOSPITAL score, but HOSPITAL score still predicts 30-day readmission, we believe this has minimum effect on analysis and interpretation of results. Second as our hospital is a tertiary hospital the healthcare standards might be high and may lead to decreased number of readmissions. Third it is a single-center study and standards of care might change in the other institutions and multicentered studies should be performed in the future to replicate and validate our results.

## Conclusion

Our research findings demonstrate that the HOSPITAL score successfully predicts hospital admissions within a 30-day period for older patients. However, the frailty scores, either alone or in conjunction with the HOSPITAL score, fail to provide reliable prediction in this regard. Hospital readmissions can be prevented, but rather than relying solely on scoring systems, case-based approaches using patient admissions may be more meaningful. Another point of discussion is that patients may be frailer, resulting in decreased hospital readmissions.

### Ethics

**Ethics Committee Approval:** Ethical approval was obtained from Ethics Committee of İstanbul Medeniyet University (21.12.2022).

**Informed Consent:** Retrospective study.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: G.A.S., Concept: G.A.S., Design: G.A.S., Data Collection or Processing: G.A.S., Analysis or Interpretation: G.A.S., B.B.K., Literature Search: G.A.S., B.B.K., Writing: G.A.S., B.B.K.

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ORIGINAL RESEARCH

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# Correlation Between Different Dietary Indexes, and Their Association with An Anti-inflammatory Biomarker in Older Adults: An Exploratory Study

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## Abstract

**Objective:** Aging is associated with low-grade systemic inflammation (LGSI), and nutrition has been recognized as a crucial modifiable factor concerning LGSI. The aims of this study are to (i) identify the dietary quality of community-dwelling older adults using three approaches; two conventional *a priori* indexes and a ratio between minimally processed and ultra-processed foods (UPR; based on the NOVA classification); (ii) explore some differences and similarities among the approaches; (iii) investigate the association of DII and MDS with a biomarker of systemic inflammation, and investigate if UPR could be used in a complementary way to these associations.

**Materials and Methods:** We studied independent (non-frail) older adults, both genders, without any inflammatory disease. Variables investigated: - The anti-inflammatory index (AII = IL-10/IL-6 ratio); - Two 24h-food recall, from which we calculated: The dietary inflammatory index (DII); the Mediterranean Diet Scale (MDS); and the ratio between unprocessed or minimally processed/ultra-processed food (UPR). Single and multiples linear regression models, crude or adjusted by age and sex, were adopted to test the associations between the approaches and the anti-inflammatory biomarker. The differences and similarities between the approaches were explored using correlation analyses and the regression models.

**Results:** The MDS and DII showed the same trend to indicate the inflammatory potential; the UPR presented a non-significant correlation with the others. Only the MDS positively and significantly explained the AII values; the combination between MDS or DII with UPR did not change the association level with the anti-inflammatory index.

**Conclusion:** The only significant correlation was found between MDS and DII, however in different directions; only the MDS showed a significant association with our anti-inflammatory marker and the inclusion of UPR in our regression models did not add any improvement to the models. More studies are necessary with more robust and representative samples.

**Keywords:** Aging, dietary inflammatory index, low-grade systemic inflammation, Mediterranean diet, NOVA classification

## Introduction

Aging is generally associated with low-grade systemic inflammation (LGSI), which has been pointed out to be responsible for several aging-related adverse outcomes (1). Diet quality has been recognized as an essential modifiable factor concerning LGSI, contributing to health (2); however, most studies have investigated specific nutrients or foods instead of considering broader diet features.

A comprehensive investigation of diet quality may be performed from two different approaches: *a posteriori* analysis consists of data reduction through other statical models, for instance, cluster analysis, factor analysis, or principal component analysis (3); *a*

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*priori* analysis takes into account different indexes previously developed based on previous hypotheses (4,5). As such, *a priori* analyses consider different concepts, enabling the population's diet to be compared with healthy eating recommendations (4,6-8). The indexes consider nutrients, food groups, and dietary patterns (9,10). For instance, the Mediterranean dietary pattern (MDP) considers adherence to different food groups, which is widely recognized models of healthy eating. Many studies have associated MDP indexes with benefits in chronic diseases and pro-inflammatory markers (11,12). Another frequently *a priori* index used is the dietary inflammatory index (DII) (13). This tool has been proposed as applicable to verify the inflammatory potential of the diet. It is calculated from a list of 45 food, nutrients, and food components considered pro- or anti-inflammatory and have also demonstrated a good association with health outcomes and inflammatory biomarkers (14,15).

The Dietary Guidelines for the Brazilian Population (DGBP) introduced a new approach to dietary recommendations, which has been associated with the assessment of diet quality. Instead of using the "conventional" food groups based on nutrients, DGBI explores the extent of food processing (16). As such, four groups are proposed by this guide: Unprocessed or minimally processed, culinary ingredients, processed, and ultra-processed food. Studies have demonstrated the association between high consumption of ultra-processed foods and chronic diseases (17-19).

Exploring the association between different dietary indexes with LGSI can contribute to planning healthy aging strategies (20). In this regard, some important points must be highlighted: (i) different indexes are used to discuss the quality and adequacy of dietary intake; however, few publications have compared these indexes regarding their correlation and their association with inflammatory biomarkers; (ii) The NOVA classification is innovative and incorporates one of the critical points of the nutritional transition - the damage to health caused by the excessive intake of ultra-processed foods (21); we consider relevant to investigate some possibilities to use this classification as a complement to the dietary indexes. We hypothesize that NOVA classification could be used together with the other indexes.

As such, in this exploratory study, we aimed to: (i) identify the dietary quality of community-dwelling older adults using three approaches, that is, two conventional *a priori* indexes and a ratio between minimally processed and ultra-processed foods (UPR; based on the NOVA classification); (ii) explore correlations among the approaches; (iii) investigate the association of DII and MDS with a biomarker of systemic inflammation, and investigate if the UPR could be used in a complementary way to these associations.

## Materials and Methods

### Sample

This study was conducted with secondary baseline data from an already finished clinical study (22). The original study (ReBec Clinical register RBR-6qr9xx) investigated the effects of a symbiotic supplementation in community-dwelling older adults, both genders, independent (non-frail), without reference to inflammatory disease (i.e., bowel disease or joint diseases) and not taking any antibiotics, or laxative substances, or food supplements. Regarding chronic diseases, considering the most common ones (hypertension, type 2 diabetes, and dyslipidemias), we only included those who controlled these diseases with appropriate medicines. In the present exploratory study, we had that previous project's baseline (n=73) data. We, therefore, define the current sample as a convenience and secondary sample.

### Blood Collection and Analyses

The participant's blood was collected after 8-12 h fasting. After the collection, the blood was centrifuged and stored at -80 °C; from these samples, we analyzed the interleukin-6 (IL-6) and interleukin-10 (IL-10) by Multiple Analyte Profiling method (HCYTMAG-60K-03; Millipore®). These variables were treated as an anti-inflammatory index (AII) from the IL-10/IL-6 ratio (23).

### Dietary Analyses

Two 24-hour dietary recalls (24HR) assessed the diet, applied in non-consecutive days, with a minimum of two week-interval. The information was first converted from home to standard measures (grams and milliliters) following specific technical publications. Other corrections and adjustments to the 24HR were conducted according to a particular manual developed by the Research Group of Food Intake, University of São Paulo (GAC-USP). After the adjustments needed, the 24HR were calculated for energy, macronutrients, micronutrients, and bioactive compounds, using the Nutrition Data System for Research (NDSR) software. Some flavonoid compounds not present in the NDSR database were calculated using data from the USDA Food Composition Databases as the first option and Brazilian Table of Food Composition as the second option. Afterward, each dietary variable was organized in statistical software (STATA®14) to gather each component's total consumption in each 24HR. The habitual intake was obtained using the multiple source method (MSM) software; this stage was mandatory to correct intraindividual variability.

The DII was developed by Cavicchia et al. (24) and Shivappa et al. (13). This index investigates the intake of 45 dietary components (which includes food, nutrients, and other compounds) derived from a previous systematic review and adjusted for population's data from eleven countries worldwide, which the authors

considered as global intake. The DII can be calculated from different tools of dietary investigation, and here we used the 24HR. The dietary data were organized in a pre-developed Excel file, following the information given by Shivappa et al. (13). First, we calculated each dietary component individually; then, we used the global daily mean intake and its standard deviation and overall inflammatory effect to perform this calculation. To do so, we took the following steps:

(i) Z-score calculation: Subtraction of the global mean intake of the component from the individual's usual intake divided by the global standard deviation of the same component.

Z-score= [(usual intake of the component - global daily mean intake of the component)/global standard deviation of the component]

(ii) Percentile: Conversion of Z-score in percentile.

Percentile (in excel command) = DIST.NORMP.N (Z-score;TRUE)

(iii) Transformation of the percentile in a centralized percentile.

Centralized Percentile =(Percentile*2)-1

(iv) Effect score: Multiplication of centralized percentile by the inflammatory score of each component (also described in Shivappa's publication)

Effect score=Centralized percentile*(inflammatory factor of the component)

(v) The overall DII is obtained from summating all the components included.

When considering all the 45 food parameters, DII scores can range from -8.87 (a more anti-inflammatory diet) to +7.98 (a more pro-inflammatory diet).

The MDS was assessed according to the proposal by Trichopoulou et al. (12). The consumption of fish, vegetables, legumes, fruits and nuts, cereals, and the monounsaturated: saturated fat ratio, situated below or above the median (adjusted for energy intake by both sexes) of the own group, received scores zero and one, respectively. An inverse assignment was attributed to meat and dairy products, above or below the median. Alcohol intake of 10 to 50 g/day and 5 to 25 g/day, respectively, for men and women, were considered moderate and received the value of one; the consumption below or above these intervals received zero value. Thus, the total MDS ranged from 0 to 9, with higher scores indicating greater adherence to the MDP. As recommended by the author (12,25), for the construction of the MDS, we included only the authentic foods of the Mediterranean diet (maintaining as much as possible the statement of being fresh, locally produced, and not modified or with minimal modifications from their natural state).

The NOVA classification was performed according to Monteiro et al. (16) and supported by the second edition of DGBP, 2014. The individuals' food constituted four groups: Group 1 - unprocessed or minimally processed foods; Group 2 - processed culinary ingredients; Group 3 - processed foods and Group 4 - ultra-processed foods. Based on the "golden rule" of the DGBP ("always prefer natural or minimally processed foods and freshly made dishes and meals to ultra-processed foods"), we calculated the ratio between the diet energy density of the two main groups, unprocessed and minimally processed foods (UMF) and ultra-processed foods (UPF). We provisionally named this calculation "ultra-processed ratio" (UPR), and it is detailed below:

UPR= (energy density (g/kcal) of UMF /energy density (g/kcal) of UPF)

Higher ratio values represent a higher intake of UMF (healthy diet) than UPF, while lower values represent a higher consumption of UPF (unhealthy diet).

The participants had their weight and height evaluated, following standard recommendations. These values were used to calculate the body mass index (BMI) (weight/height$^2$) and were classified according to the proposal of the Pan American Health Organization (2002) for older adults (BMI <23 kg/m$^2$, low body weight; 23≤ BMI ≤28 kg/m$^2$, within the normality range; 28< BMI ≤30 kg/m$^2$, overweight and BMI >30 kg/m$^2$, obesity).

Age, gender, years of formal schooling, and individual monthly income were obtained, in the original study, by applying a structured questionnaire with the participants' information.

### Statistics

Continuous variables were presented as median and range intervals, while categorical ones were presented as absolute and relative frequency. The normality of the continuous variables was investigated using the Kolmogorov-Smirnov test. We performed correlation analysis (Pearson correlation) to compare the three dietary indexes' directions. To test the association between the dietary indexes and the plasma AII, we run three single linear regression models between each dietary index and the AII. To investigate the complementarity potential of UPR to the two indexes, we run multiple linear regression models, including UPR + DII (Multiple Model 1) and UPR + MDS (Multiple Model 2). The multiple models were run as unadjusted and adjusted (by sex and age) fashion. To meet the assumptions of regression models, the variables that did not present normal distribution were Box-cox normalized. To investigate the models' quality and adequacy, we investigated the existence of multicollinearity (from tolerance and inflation factor analyses) and the independence from the residues (from Durbin-Watson test and ANOVA test). To explore the importance of adding the

UPR in multiple models, we investigated the difference between the $R^2$ from single and the $R^2$ from multiple models, observing the significance of these differences (ANOVA test). The analyses were performed with TIBCO Statistica software (version 13) and IBM SPSS statistics software (version 22); the significance of the analyses was established in p-value <0.05.

## Results

The baseline characteristics of participants are described in Table 1. Seventy-three older adults were studied, with a mean age of 76 (63.0-89.0) years old and females' predominance (76.7%). Although most were classified as within the normality range (45.2%), a high prevalence of overweight (34.2%) and one-fifth of low body weight was observed. Formal schooling was highly heterogeneous between participants, while almost half of the sample reported monthly income between six and ten minimum wages. The UPR showed a mean ratio of 0.29 (0.0-1.3), demonstrating a predominant intake of unprocessed or minimally processed foods. The DII had a median of 0.51 [(-2.99) - (+3.14)], indicating a slight trend to be more pro-inflammatory. The MDS showed a median range of 4.0 (1.0-7.0), indicating a moderate adherence to this dietary pattern. In turn, the AII showed a mean value of 2.50 (0.35-14.88), indicating, in general terms, a sample with an anti-inflammatory profile.

Table 2 depicts the Pearson correlation analyses between the indexes. The only correlation that showed a significant result was MDS vs. DII, with a negative correlation (r=-0.40; p=0.003), indicating that both showed a similar trend to predict the diet quality. It is relevant to consider the direction of the different indexes' scores; lower values of DII indicate more anti-inflammatory diets; in contrast, the higher scores of MDS indicate a more anti-inflammatory profile.

Table 3 depicts the regression models investigated, taking the AII as the dependent variable. All models met the assumptions of collinearity and independence of residuals. The single models showed only the MDS as significantly associated with the AII. On average, each one-unit increase in the MDS was associated with a 0.25 unit increase in the AII. The MDS maintained the significance when added to the multiple models, both unadjusted and adjusted. However, the UPR did not add any significant increase in the Beta values, in none of the models.

## Discussion

This exploratory study investigated correlations and complementarities between two a priori dietary indexes, named MDS, DII, and an indicator of ultra-processed foods intake (UPR); we investigated the association of these dietary indexes with plasma AII in a convenience sample of community-

**Table 1. General description of the study's participants (n=73)**

| Variable | Categories | Median (range) or number (%) |
|---|---|---|
| **Age (years)** | - | 76.0 (63.0-89.0) |
| **Sex** | Male | 17 (23.3) |
| | Female | 56 (76.7) |
| **BMI[a]** | Low body weight | 15 (20.5) |
| | Normality range | 33 (45.2) |
| | Overweight | 25 (34.2) |
| **Years of formal schooling** | None | 1 (1.4) |
| | 1 to 4 | 12 (16.4) |
| | 5 to 8 | 13 (17.8) |
| | 9 to 11 | 18 (24.6) |
| | 12 or more | 29 (39.7) |
| **Monthly income[b]** | ≤1 | 5 (6.8) |
| | >1 - ≤5 | 16 (21.9) |
| | ≥6 - ≤10 | 35 (47.9) |
| | >10 | 17 (23.4) |
| **UPR** | - | 0.29 (0.0-1.3) |
| **DII** | - | 0.51 [(-2.99) - 3.14] |
| **MDS** | - | 4.0 (1.0-7.0) |
| **AII (IL-10/IL-6)** | - | 2.50 (0.35-14.88) |

AII: Anti-inflammatory index, BMI: Body mass index, DII: Dietary inflammatory index, MDS: Mediterranean diet scale, UPR: Ultra-processed ratio, [a]classification according to PAHO, 2002, [b]number of minimal wages

**Table 2. Correlation matrix between the indexes**

| Dietary indexes (a) | MDS | DII | NOVA |
|---|---|---|---|
| | r- values (p-value) | | |
| **MDS** | 1.0 | **-0.40 (0.003)** | -0.04 (0.74) |
| **DII** | | 1.0 | 0.16 (0.89) |
| **NOVA** | | | 1.0 |

(a) Scores normalized. Values in bold mean p<0.05. DII: Dietary inflammatory index, MDS: Mediterranean diet scale, UPR: Ultra-processed ratio

**Table 3. Regression analysis between the inflammatory outcome (AII) and the dietary indexes investigated (a)**

| Models | Predictors | Single models | | | Multiple models | | | Adjusted multiple models (b) | | | Models quality (c) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | β | 95% CI | p-value | Adj. β | 95% CI | p-value | Adj. β | 95% CI | p-value | |
| Single model 1 | UPR | -0.066 | -0.085 to 1.426 | 0.93 | | | | | | | $R^2$=0.00; 0.93 DW=1.9 |
| Single model 2 | DII | -0.046 | -0.051 to 1.632 | 0.18 | | | | | | | $R^2$=0.025; 0.18 DW=1.9 |
| Single model 3 | MDS | 0.086 | **0.090 to 0.164** | **0.03** | | | | | | | $R^2$=0.252;0.03 DW=2.0 |
| Multiple model 1 (DII + UPR) | DII | | | | -0.186 | -0.124 to 3.612 | 0.13 | -0.176 | -0.122 to 3.599 | 0.15 | |
| | UPR | | | | -0.009 | -1.541 to 1.424 | 0.94 | -0.12 | -1.565 to 1.416 | 0.92 | $R^2$ adjusted model= [-0.008] $R^2$ change=0.003 (0.95) DW=1.9 |
| Multiple Model 2 (MDS+ UPR) | MDS | | | | 0.247 | **0.005 to 0.163** | **0.04** | 0.247 | **0.005 to 0.163** | **0.04** | |
| | UPR | | | | -0.003 | -1.479 to 1.444 | 0.99 | -0.006 | -1.503 to 1.430 | 0.96 | $R^2$ adjusted model=0.219 $R^2$ change=0.000 (0.99) DW=2.0 |

(a)Dietary indexes Box-Cox transformed; (b) Models adjusted by age and sex; (c) $R^2$= relative to the single or multiple adjusted model; $R^2$ change= difference between $R^2$ from single model and $R^2$ from adjusted multiple model and significance of this difference (ANOVA), AII- plasma anti-inflammatory index (IL-10/IL-6), DII: Dietary inflammatory index, MDS: Mediterranean diet scale, UPR: Ultra-processed ratio, DW: Durbin-Watson test. Negative values are [in brackets]. Values in bold mean p<0.05

dwelling older adults. As the main results, the MDS and DII indexes showed the same trend to indicate healthy (or anti-inflammatory) and unhealthy (or pro-inflammatory) diets; the UPR presented a non-significant inverse direction when tested against the other two (MDS and DII). Finally, only the MDS positively and significantly explained the AII values in single, and in unadjusted and adjusted multiple models. The inclusion of UPR in the multiple models did not significantly change the $R^2$ values, therefore, not confirming our hypothesis of using UPR as a complementary index to be associated with our plasma inflammatory indicator.

It is important to highlight some conceptual differences between the indexes and the ratio adopted in our work. The DII and the MDS include potentially inflammatory and anti-inflammatory foods in their construction; the DII considers nutrients, foods, and bioactive compounds singly, while the MDS considers food groups and nutrients ratio. Additionally, they also differ regarding the scoring system. While the DII works with the intakes standardization and includes energy as a component, the MDS is constructed based on the habitual intake and uses the median adjusted for energy intake. Nevertheless, the negative correlation between DII and MDS was coherent, with the lowest

scores for DII and higher scores for MDS, meaning both an anti-inflammatory potential. On the other hand, the NOVA classification characterizes food by the extent of processing, being a broader approach to identifying possible inflammatory food components.

Our MDS results agree with other studies. A recent cross-sectional descriptive study compared different dietary indexes as predictors of inflammatory biomarkers (26). This study included 73 subjects aged >50 years without diseases; only the MDS indexes were inversely associated with serum IL-8 concentrations [β= (-0.251); p=0.018 and β= (-0.221); p=0.017]; the two dietary inflammatory indexes explained only the marker of oxidative stress (malondialdehyde). The authors hypothesized an explanation of MDP's anti-inflammatory role in intestinal microbiota change. The study used indexes of adherence to the MDP, which were derived from the one adopted in the present study (25). Our MDS results agree with other studies. A recent cross-sectional descriptive study compared different dietary indexes as predictors of inflammatory biomarkers (26). This study included 73 subjects aged >50 years without diseases; only the MDS indexes were inversely associated with serum IL-8 concentrations [β= (-0.251); p=0.018 and β= (-0.221); p=0.017]; the two dietary inflammatory indexes explained only the marker of oxidative stress (malondialdehyde). The authors hypothesized an explanation of MDP's anti-inflammatory role in intestinal microbiota change. The study used indexes of adherence to the MDP, which were derived from the one adopted in the present study (25).

Our sample, composed of older adults, did not present high values of UPR, which align with the last Brazilian family budgets survey (POF - 2017-2018) (27); older adults consume more energy from the unprocessed and minimally processed groups than ultra-processed ones. This can be one of the reasons for our non-significant results related to this ratio.

A Brazilian study with a robust sample derived from the ELSA-Brazil cohort found a significant association between higher consumption of ultra-processed products (caloric percentage) and C-reactive protein levels in women without adjusting BMI (28). We hypothesized that the NOVA index could be used as a complementary analysis of the other indexes since it classifies the diet according to the degree of processing without considering the intake of traditional food groups. We included MDS, or DII, to test this hypothesis in combined models with UPR. However, the combination of the MDS and the UPR in these models did not increase the degree of the association. The single model with MDS explained 6% ($R^2$=0.06) of the association, while including the UPR in the model explained 4% (adjusted $R^2$=0.04). Therefore, our hypothesis was not confirmed; an explanation for this non-significance may be that the MDS does not consider, in its calculation, the consumption of foods other than fresh, minimally processed, and Mediterranean foods (therefore, unprocessed, or minimally processed).

Concerning DII, da Silva et al. (29), different from our results, found a significant and inverse association between this index and the consumption of ultra-processed food and culinary ingredients in a cross-sectional study with 2.359 patients with cardiovascular diseases, mostly older adults (64.2%) and overweight (68.8%). Patients in the third tertile of DII (DII >0.91) were more likely to have two or more cardiovascular events and more likely to consume a higher percentage of processed ultra-processed, and culinary ingredients compared with the patients in the first DII tertile (DII ≤0.91). Also, UPF consumption higher than three servings/day was associated with higher odds for short telomeres in a Spanish sample of 645 men and 241 women with a mean age of 67.7±6.1 years. Besides not being a direct marker of inflammation, telomeres are markers of the aging process. The shortening of the telomeres is known to be associated with inflammation and oxidative stress (30).

### Study Limitations

It is essential to highlight some limitations in discussing our results. Our sample consisting by older adults showed a non-expressive intake of ultra-processed food, which in combination with our small sample size, could not be enough to give statistical power to our analysis.

The sample's inflammatory profile indicated a sample with a more anti-inflammatory profile, possibly healthy. Also, it is known that many other covariates not considered in our study, could interfere with inflammatory profile, such as chronic diseases, medicaments, or even genetic aspects.

Additionally, in older adults, the characteristic of a monotonous diet may have influenced the minor changes in all indexes' scores, particularly DII. On the other hand, as far as we know, our study is the first exploratory attempt to develop an index that uses the NOVA classification and verifies the agreement between dietary indexes in a sample of older adults. The search for an appropriate index from the DGBP can contribute to expanding the possibilities of its use.

## Conclusion

The three indicators of healthy/anti-inflammatory potential tested in our study led to the following conclusions. The only significant correlation was found between MDS and DII, however in different directions; only the MDS showed a significant association with our anti-inflammatory marker and the inclusion of UPR in our regression models did not add any improvement to the models. More studies are necessary with more robust and representative samples.

### Ethics

**Ethics Committee Approval:** The original was approved by the Research Ethics Committee of the School of Arts, Sciences and Humanities, University of São Paulo (process 200.870/2013).

**Informed Consent:** The participants signed a consent form, and the procedures used in this study adhere to the tenets of the Declaration of Helsinki.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Concept and Design: B.M.V., S.M.L.R., Analysis or Interpretation: B.M.V., A.A.B, C.M.M., S.M.L.R., Writing: B.M.V., A.A.B, C.M.M., R.C.A., S.M.L.R., Supervision: S.M.L.R.

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ORIGINAL RESEARCH

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# Cognitive Functions in Obstructive Sleep Apnea: Observing the Effects of Continuous Positive Airway Pressure Treatment in Aging Patients

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## Abstract

**Objective:** Obstructive sleep apnea (OSA) is known to have disruptive effects on cognitive functions (CFs) in advanced ages. The aim of this study was to reveal the effect(s) of continuous positive airway pressure (CPAP) treatment on CFs in older patients with OSA.

**Materials and Methods:** Follow-up comparisons were conducted after 6 months of CPAP treatment in pulmonary medicine departments outpatient clinic of a reference university hospital. Patients were included to study after one-night hospitalization for polysomnographic assessments. All participants underwent a comprehensive neuropsychological evaluation which was repeated after an average of 6 months of regular CPAP treatment. Moderate to severe OSA patients with mean age of 64.9 (n=30; female 56.7%) and control group (CG) with mean age of 67.13 (n=30; female 50%) were included.

**Results:** OSA patients displayed poorer performance in executive functions and memory as compared to the CG. After the CPAP treatment an improvement was observed on memory; significantly on immediate recall (p=0.044), learning (p=0.017) and recognition (p=0.033) scores of older OSA patients. Also, the clock drawing test scores ameliorated after treatment (p=0.046).

**Conclusion:** Examining memory functions to its processes showed that OSA may impair learning and free recalling of the recently encoded memory inputs. Follow-up results suggested that the disruption of CFs that may be due to the sleep breathing disorder itself, significantly benefited from 6 months of regular CPAP treatment in older patients with moderate to severe OSA.

**Keywords:** Sleep breathing disorder, cognition, continuous positive airway pressure, geriatrics, neuropsychological functioning

## Introduction

Obstructive sleep apnea (OSA) is a sleep-related breathing disorder manifesting with complete or partial upper airway obstruction during sleep (1). This would lead to sleep fragmentations due to apneas, hypopneas (2), and frequent arousals (3). Besides causing various pathophysiological changes (4) OSA is also known to cause deterioration in cognitive functions (5) and pose a risk for progressive cognitive impairment (6).

The prevalence of sleep-related breathing disorders increases with age (7) while age itself is already a confounder for cognitive functioning. Moreover, older adults are reported to be more prone to cognitive decline associated with OSA as compared to their younger (8). Among the reasons for progressive cognitive decline in elderly, OSA is one of the few reversible causes for cognitive impairment (9) but if left untreated, OSA may cause permanent damage on cognition and psychological well-being (10). Despite these versatile impact notifications, OSA studies investigating the effectiveness of CPAP treatment on cognitive

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functions are usually carried out with screening tools (11,12), and follow-up intervals may be relatively short to evaluate the treatment results (13,14). However, the number of studies on the cognitive profiles and treatment responses of patients over 60 years of age with OSA is fewer than with younger participants.

There are increasing number of studies about the relationship between OSA and cognitive impairment (7,8,15). As the previous studies presented, patients with OSA experience difficulties in cognitive functions such as learning new information, using cues that will facilitate retrieval, and making memory-based behaviors such as following an instruction (7,16). The most effective, safe and gold standard treatment for OSA is the practice of "continuous positive airway pressure" (CPAP). As a result of the positive airway pressure, an increase in functional residual capacity is achieved and oxygen saturation during apnea/hypopnea periods is improved. CPAP therapy is expected to result with an improvement at patient's cognitive skills. A meta-analysis of studies, in which treatment efficacy was assessed with neuropsychological tests, reported that the most consistent improvement after CPAP therapy was in the area of attention; i.e., processing speed, memory, working memory, verbal fluency, and visuo-spatial structuring skills (17). A few detailed cognitive evaluations indicating the effectiveness of CPAP therapy also revealed improvement in memory (18,19); sustained attention (20) and executive functions (5,19).

The aim of our study was to reveal the possible effects of OSA on cognition in a sample of patients with moderate to severe OSA and the impact of CPAP treatment with 6 months of follow-up. Since the number of studies with detailed cognitive test battery was limited, we used a comprehensive neuropsychological evaluation for this follow-up study. The significant contribution of this study would indicate that adverse effects of OSA on cognition can be ameliorated with CPAP treatment even in patients above 60 years of age.

## Materials and Methods

### Participants

We recruited patients among those admitted to pulmonary medicine department's outpatient clinic of Istanbul University Istanbul Faculty of Medicine. Patients, who were diagnosed with moderate to severe OSA via full-night polysomnography (PSG) and subsequently prescribed CPAP treatment, were invited to participate. Thirty-three patients diagnosed with OSA participated in the study (Figure 1). One of the patients was excluded, because the low educational level caused a missing value above 5% in cognitive tests. Although recommended, two of the patients refused to use CPAP device, thus their data were also excluded from to the analysis. Consequently, 30 patients (n=30, f/m =17/13, mean age =65.56± 4.87) diagnosed with moderate to severe OSA with full-night polysomnography were included. Considering the International Classification of Sleep Disorders (2014) inclusion criteria for patient group were having a clinical OSA profile, an apnea-hypopnea index (AHI) ≥5/h and the presence of clinical symptoms or AHI ≥15/h without any symptoms. We excluded patients who were already under positive airway pressure treatment and/or oxygenation therapy, using drugs affecting central nervous system (e.g., anticonvulsants, antipsychotics, benzodiazepines), having any malignancy and history of unstable severe cardiopulmonary disease (e.g., acute myocardial infarction, heart failure), having any kind of developmental disability, neurodegenerative, and neuromuscular diseases. Baseline cognitive and psychological assessments of the OSA patient group were done 2 to 3 days after PSG. Sixteen of the patients with OSA attended the cognitive assessment after treatment and comprised our follow-up group.

Healthy control participants were recruited among patient relatives by using call-boards of the clinics in our hospital (Figure 1). Control group (CG) consisted of volunteered participants who did not report sleep-breathing disorder after a semi-structured medical interview including the Epworth Sleepiness Scale (ESS) (21). Age and education matched participants with Mini Mental State Examination (MMSE) (22) ≥24, Geriatric Depression Scale (GDS) (23) ≤14 and ESS ≤10 was included. We excluded volunteered participants from CG who had sleep complaints, chronic sleep deprivation, chronic use of sedative drugs or alcohol, any malignancy and history of unstable severe cardiopulmonary disease, and any kind of neurological diseases. Participants of CG underwent comprehensive neuropsychological assessment.

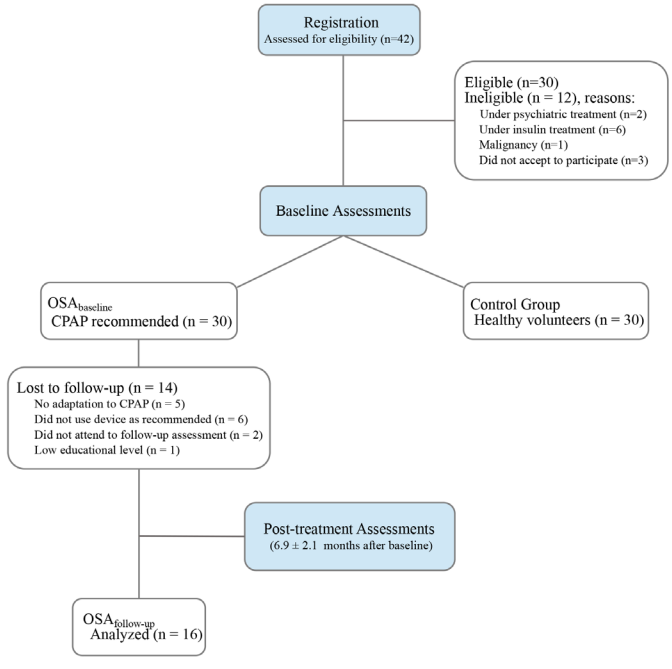


**Figure 1.** Flow diagram of subjects participating through each stage of the study

Usage of CPAP at least 5 days a week, at least 4 hours a day was accepted as device adaptation (regular CPAP use) (24). Patients using CPAP device minimum of 3 months per 6 months follow-up comprised our follow-up sample. The participants were questioned monthly about the use of CPAP by phone calls. Patients were invited for post-treatment evaluation at 6 months and the data of participants who used CPAP for at least 3 months (within the effective and sufficient time previously reported in this paper) were included. All procedures performed in this study involving human participants were in accordance with the ethical standards of İstanbul University, İstanbul Faculty of Medicine Ethics Committee for Clinical Research and with the Helsinki Declaration (no: 2023-1782132).

### Measurements

### Polysomnography and Sleep Assessments

OSA diagnoses of the patients were determined after full-night polysomnography (PSG) using the Compumedics E device in Sleep Laboratory of İstanbul University, İstanbul Faculty of Medicine. Sleep stages and respiratory events were scored according to the American Association of Sleep Medicine 2012 guidelines (25). Apnea was defined as a cessation of airflow ≥90% compared with baseline for ≥10 seconds while there was evidence of persistent respiratory effort. Hypopnea was defined as an amplitude reduction of ≥30% in airflow lasting for ≥10 seconds that was associated with an oxygen desaturation of ≥3% or with arousal. Polysomnography records were scored by a trained technician. OSA was diagnosed if the apnea-hypopnea index (AHI) was ≥5/h and the presence of clinical symptoms or AHI ≥15/h without any symptoms. The OSA severity was graded as mild (AHI 5-14/h), moderate (AHI 15-29/h), or severe (AHI ≥30/h). Oxygen saturation level was also recorded. The oxygen desaturation index (ODI) indicates the count of decline of the blood oxygen level below baseline per one hour. Measurements were taken during polysomnography by using a finger oximeter. The CPAP titration study was performed in the sleep laboratory. The pressure correcting apneas and hypopneas was determined to the appropriate pressure for each patient.

The body mass index (BMI) was calculated using Khosla and Lowe's formula [weight (kg)/height$^2$(m$^2$)] (26). ESS was filled by the participants and the ESS score of >10 was used as a cut-off value for excessive daytime sleepiness (27).

### Neuropsychological Evaluation

Cognitive functions refer to mental processes such as attention, language, memory, visuo-spatial abilities and executive functions. In this study; digit span (forward) (28) was used to evaluate attention and Trail Making Test form A (TMT-A) (29) was used to asses psychomotor speed. Word fluency test, Stroop test (30), Trail Making Test form B (TMT-B) (29), digit span (backwards) (28) and Clock Drawing Test (CDT) were applied to evaluate executive functions. CDT was scored based on the 5-point Shulman scoring system (31). In order to make sure that the scorings of CDT between the pre- and post-treatment measurements was not rater-biased, the drawings were re-scored by a geriatric psychiatrist who was blinded to the study. Word fluency test was both applied with semantic (naming animals) and phonemic categories (words starting with letters K, A, S) for one minute, each. Logical memory subtest of Wechsler Memory Scale-Revised (WMS-R), and California Verbal Learning Test (CVLT) (32) were applied to evaluate memory functions. Baseline cognitive and psychological assessments of the OSA patients were performed 2 to 3 days after PSG.

### Statistics

Statistical analyses were performed using IBM SPSS Statistics 21. After assessing distribution characteristics of data with Shapiro-Wilk test, non-parametric statistical analyses were carried out. Mann-Whitney U test was used to evaluate differences between groups' socio-demographic variables, cognitive tests, and psychological scales. For the follow-up comparisons, Wilcoxon Signed-rank test was used. All analyses were run with raw scores; the only exception was the Logical Memory subtest of WMS-R. This test has two alternative forms that include different number of items. Thus, in order to compare results transformed Z-scores of the logical memory subtest were used. Severity effect of OSA on cognitive tests was examined with one-way analysis of variance on ranks (Kruskal-Wallis H test). To study possible associations between sleep assessments and cognitive tests, we used correlation analysis and the results will be given in Spearman's rank correlation coefficients ($r_s$). Two tailed significance level was accepted as $p<0.05$ for all analyses. To eliminate the possibility of biased evaluation on CDT scoring in pre and post-treatment comparisons; intraclass correlation coefficient (ICC) analysis was used. The agreement level between the principal and blinded raters' scorings of CDT was assessed.

Associations between severity of OSA and cognitive test scores were examined with One-Way Analysis of Variance on ranks (Kruskal-Wallis H test). To study possible associations between sleep assessments and cognitive tests, we used correlation analysis and the results will be given in Spearman's rank correlation coefficients ($r_s$).

## Results

### Characteristics of the Overall Sample

Thirty-three patients diagnosed with OSA participated in the study (Figure 1). Data of one participant were removed because the low educational level caused missing value above 5% in cognitive tests. Although recommended, two of the patients refused to use CPAP device, thus their data were also not included to the analysis. Consequently, 30 patients with OSA included

to the baseline analysis, whose cognitive and psychological test results were compared with 30 healthy controls. Control group comprised of age and education matched volunteered participants who did not report sleep-breathing disorder. The minimum age for participation was set at 60. The age of the participants were 60 years and above for both groups.

Polysomnographic assessment results of $OSA_{baseline}$ patients (n=30; female 56.7%) are given in Table 1. Among these, 21 patients (70%) had diagnosis of hypertension and 5 (30%) had diabetes mellitus type II; 4 had no medical history. None of our patients had diagnosis of any type of dementia. Eleven patients (36.7%) had moderate and 19 patients (63.3%) had severe OSA. None of them were under insulin treatment or had no past cerebrovascular incident. All patients reported OSA related symptoms such as snoring (n=30, 100%), witnessed apnea (n=23, 76.7%), and daytime sleepiness (n=20, 66.7%). Mean ESS scores were in a range between 1-18 (median =5), and 24 of these patients had ESS ≤10.

Thirty patients who were recommended CPAP treatment and had informed consent were called for follow-up examinations after 6 months; 14 patients dropped out due to device adaptation problems and/or not showing up at control assessments. Sixteen of the patients with OSA attended the cognitive assessment after treatment and comprised our follow-up group. The follow-up comparisons were run with 16 patients (8 women, 8 men) that will be mentioned as $OSA_{follow-up}$. Average duration of CPAP usage was 6.9±2.1 months (median =6; range =5-9 months).

Volunteered participants (n=30; 50%) with MMSE scores >24 (M =29.28; SD =0.75) comprised our cognitively normal comparison group which was recruited as CG. Mean ESS score of the CG was 1.0 (SD =1.15) within the range of 0-3 (median =1). Among CG, 10 (33.4%) had diagnosis of hypertension and 4 (13.4%) had diabetes mellitus type II; 16 (53.4%) had no medical history. None of them were under insulin treatment or had any past cerebrovascular incident.

**Table 1. Polysomnographic measurement results of $OSA_{baseline}$ patients**

| | $OSA_{baseline}$ (n=30) |
|---|---|
| | n (%) |
| **Severity** | |
| Moderate | 11 (36.7) |
| Severe | 19 (63.3) |
| | **Mean ± SD** |
| **Polysomnographic measurements** | |
| Apnea-hypopnea index | 38.89±16.53 |
| Oxygen desaturation index | 35.79±17.92 |
| Minimum oxygen saturation (%) | 77.27±8.41 |
| Mean oxygen saturation (%) | 93.24±1.82 |
| $SpO_2$<90% (sc) | 9.5±14.31 |

SD: Standard deviation, $SpO_2$: Pulse oxygen saturation

### Baseline Comparisons of OSA Group and Control Group

Socio-demographic features of $OSA_{baseline}$ and CG revealed no significant differences in terms of age (p=0.104), education year (p=0.414), and gender (p=0.409). But, two subgroups had differed at ESS (p=0.001) and BMI (p=0.002) showing that CG had lower sleepiness scores and lower BMI than $OSA_{baseline}$ patient group (Table 2).

The comparisons between the patient group and the healthy controls showed that, $OSA_{baseline}$ patients performed almost the same level as CG on attention and psychomotor speed test (Table 3). However, CDT (p=0.040) and phonemic fluency (p=0.049) performances of patients with OSA were significantly worse as compared to CG. In the Logical Memory subtest of WMS-R, immediate recall performances also showed difference at the lower significance (p=0.048). The difference of two groups' stroop test performance remained at significancy limit (p=0.050).

At the baseline evaluation, assessment of memory revealed significant differences both at CVLT learning (p=0.018) and delayed free recall (p=0.024) scores between $OSA_{baseline}$ and control group. Learning and delayed recall performances of $OSA_{baseline}$ were lower than CG (Table 3).

$OSA_{baseline}$ group showed no significant difference on digit span (both forward and backwards), TMT (both A and B), semantic

**Table 2. Demographic variables and clinical screening results of study sample**

| | $OSA_{baseline}$ (n=30) (17 female; 56.7%) | | CG (n=30) (15 female; 50%) | | |
|---|---|---|---|---|---|
| | **Median** | **IQR (25-75%)** | **Median** | **IQR (25-75%)** | **p** |
| **Age**, years | 64 | 6 (62-68) | 66 | 8 (61-69) | 0.104 |
| **Education**, years | 5 | 5.25 (5-10.25) | 9.5 | 6 (5-11) | 0.414 |
| **ESS** | 5 | 6.5 (2-8.5) | 1 | 2 (0-2) | 0.001* |
| **BMI** | 32 | 7.5 (30-37) | 27.3 | 4.5 (25.4-28.3) | 0.002* |
| **GDS** | 3 | 6 (1-7) | 5 | 5.5 (3.3-9) | 0.202 |

*Significant difference, p<0.05, OSA: Obstructive sleep apnea, CG: Control group, IQR: Interquartile range, ESS: Epworth sleepiness scale, BMI: Body mass index, GDS: Geriatric depression scale

fluency, stroop test, logical memory delayed recall, and CVLT immediate free recall and recognition scores as compared to CG.

### Associations Between OSA Severity on Cognition

Analysis of variance showed that the OSA severity had significant effect [$\chi^2(1) = 5.292$, p=0.021] on CVLT delayed recall. Patients with moderate OSA had higher delayed recall scores (mean rank =11.90) than patients with severe OSA (mean rank =6.95), in which the higher scores indicating better performance.

### Relation Between Sleep Measurements and Cognitive Tests

Correlation analysis was run between sleep measurements (ESS, AHI, ODI) and all neuropsychological test scores of $OSA_{baseline}$ patient group. Correlations were controlled for BMI, as covariant. As a result, CDT baseline scores showed significant correlation with AHI (n=28, $r_s$=-0.528, p=0.004) and ODI (n=28, $r_s$=-0.500, p=0.007). However, the correlation between ESS and baseline CVLT learning scores (n=29, $r_s$=0.347, p=0.047) lost its significance after controlling for BMI (n=29, $r_s$=0.201, p=0.746).

### Cognitive Changes After CPAP Treatment

The effect of CPAP treatment was analyzed with repeated measures tests. Analysis results showed that CDT performances of older patients with OSA improved significantly after the CPAP treatment (p=0.046). The inter-rater reliability at the baseline evaluation revealed that 85.6% of the variance was real [ICC (2, 1) =0.856; p<0.001]. For the post-treatment, ICC was 0.636 (p=0.040). The significant difference between CDT scores of $OSA_{baseline}$ and $OSA_{follow-up}$ maintained even calculated with the scorings of the other rater (p=0.008).

Another significant difference was found in CVLT immediate recall (p=0.044), learning (p=0.017), recognition (p=0.033), and also false positive recognition (p=0.046) scores between baseline and post-treatment assessments. While significant difference indicates an improvement in CVLT immediate recall and learning scores; CVLT false positive recognition score

**Table 3. Comparison of neuropsychological test scores between $OSA_{baseline}$ and CG before CPAP treatment**

| | CG (n=30) | | $OSA_{baseline}$ (n=30) | | | | |
|---|---|---|---|---|---|---|---|
| | Median | IQR (25-75%) | Median | IQR (25-75%) | U | p | r |
| **Attention** | | | | | | | |
| Digit Span Forward | 5 | 0.75 (5-5.75) | 5 | 1 (4-5) | 173.0 | 0.068 | 0.236 |
| **Psychomotor Speed** | | | | | | | |
| TMT-A | 50 | 51 (32-83) | 70.5 | 26.75 (59.75-86.5) | 116.0 | 0.070 | 0.238 |
| Executive Functions | | | | | | | |
| Digit Span Backward | 4 | 0.75 (3.25-4) | 3.5 | 1 (3-4) | 174.0 | 0.086 | 0.210 |
| Semantic fluency | 18 | 5.5 (15.25-20.75) | 17 | 9.25 (14-20.75) | 178.0 | 0.260 | 0.145 |
| Phonemic fluency | 27.5 | 16.5 (23-40.5) | 22.5 | 26.75 (59.75-86.5) | 132.0 | 0.049* | 0.173 |
| TMT-B | 154 | 113 (110-223) | 188 | 136.25 (157-293.25) | 122.5 | 0.097 | 0.214 |
| **Stroop Test**<br>Time difference<br>False response | <br>41<br>1 | <br>34 (35.5-69.5)<br>2 (0-2) | <br>61.5<br>1 | <br>38.25 (45.75-84)<br>3 (0-3) | <br>103.5<br>193.5 | <br>0.050<br>0.805 | <br>0.252<br>0.032 |
| Clock Drawing Test | 5 | 0 (5-5) | 5 | 1 (4-5) | 160.0 | 0.040* | 0.265 |
| WMS-R Logical Memory Immediate recall (Z-scores) | 58.4 | 18.75 (45.85-64.6) | 45.8 | 12.48 (39.6-52.08) | 137.5 | 0.048* | 0.255 |
| WMS-R Logical Memory Delayed recall (Z-scores) | 56.3 | 16.7 (41.7-58.4) | 45.8 | 8.3 (41.7-50.0) | 120.5 | 0.069 | 0.237 |
| **Memory (CVLT)** | | | | | | | |
| Immediate free recall | 6 | 2 (6-8) | 6 | 3 (5-8) | 183.0 | 0.490 | 0.089 |
| Learning score | 54 | 10 (49-59) | 45.5 | 15 (40-55) | 116.5 | 0.018* | 0.304 |
| Perseveration | 1 | 4 (1-5) | 6 | 6 (2-8) | 146.0 | 0.138 | 0.191 |
| Delayed free recall | 12 | 3 (11-14) | 10 | 4 (8-12) | 121.5 | 0.024* | 0.290 |
| Recognition<br>False positive | 16<br>1 | 1 (15-16)<br>2 (0-2) | 15<br>1 | 1 (15-16)<br>2 (0-2) | 175.5<br>155.5 | 0.351<br>0.716 | 0.120<br>0.049 |

*Significant difference between control group and $OSA_{baseline}$ patient group, p<0.05, IQR: Interquartile range, U: Mann-Whitney U test, r: Effect size, TMT-A: Trail making test form A, TMT-B: Trail making test form B, WMS-R: Wechsler memory scale-revised, CVLT: California verbal learning test

**Table 4. Neuropsychological test scores of patients with OSA after CPAP treatment**

| | $OSA_{baseline}$ (n=16) | | $OSA_{follow-up}$ (n=16) | | | | |
|---|---|---|---|---|---|---|---|
| | Median | IQR (25-75%) | Median | IQR (25-75%) | Z | p | r |
| **Attention** | | | | | | | |
| Digit Span Forward | 5 | 0 (5-5) | 5 | 1 (4-5) | -1.414 | 0.157 | 0.250 |
| **Psychomotor Speed** | | | | | | | |
| TMT-A | 78.5 | 65.5 (48-104) | 66 | 33 (53.5-83.5) | -1.521 | 0.128 | 0.266 |
| **Executive Functions** | | | | | | | |
| Digit Span Backwards | 3.5 | 1 (3-4) | 3.5 | 1 (3-4) | -0.447 | 0.655 | 0.078 |
| Semantic fluency | 17 | 8 (13.5-20.5) | 17 | 10 (13-22.5) | -0.912 | 0.362 | 0.161 |
| Phonemic fluency | 22 | 13 (19-29) | 21 | 19 (18-34) | -0.492 | 0.622 | 0.087 |
| TMT-B | 201 | 96.5 (176.5-290) | 172.5 | 121.75 (131-200) | -1.786 | 0.070 | 0.316 |
| **Stroop Test**<br>Interference time<br>False response | <br>46<br>0 | <br>31.5 (42-66)<br>2 (0-2) | <br>42<br>0 | <br>49 (31-71)<br>0 (0-0) | <br>-1.201<br>-1.450 | <br>0.230<br>0.147 | <br>0.212<br>0.256 |
| Clock Drawing Test | 5 | 1 (4.5-5) | 5 | 0 (5-5) | -2.000 | 0.046* | 0.354 |
| WMS-R Logical Memory Immediate recall (Z-scores) | 41.7 | 14.75 (41.7-50) | 45.4 | 10.40 (40.9-55.6) | -0.210 | 0.834 | 0.037 |
| WMS-R Logical Memory Delayed recall (Z-scores) | 45.8 | 18.18 (36.36-54.5) | 50 | 12.47 (41.7-52.08) | -1.481 | 0.140 | 0.262 |
| **Memory (CVLT)** | | | | | | | |
| Immediate free recall | 7 | 4 (5-9) | 8.5 | 3 (7-10) | -2.010 | 0.044* | 0.177 |
| Learning score | 49 | 17 (42-58) | 57 | 13.5 (47.5-60.5) | -2.387 | 0.017* | 0.422 |
| Perseveration | 6 | 6 (2.5-8) | 7.5 | 4 (5-9) | -1.134 | 0.257 | 0.201 |
| Delayed free recall | 10 | 4 (8-12) | 11 | 3 (9.5-12) | -0.602 | 0.547 | 0.106 |
| Recognition<br>False positive | 15<br>2 | 1 (15-16)<br>3 (0-3) | 16<br>1 | 1 (15-16)<br>1 (1-1.5) | -2.126<br>-1.987 | 0.033*<br>0.046* | 0.376<br>0.353 |

*Significant difference between $OSA_{baseline}$ and $OSA_{follow-up}$ patient group, p<0.05, IQR: Interquartile range, Z: Wilcoxon Signed-rank test, r: Effect size, TMT-A: Trail making test form A, TMT-B: Trail making test form B, WMS-R: Wechsler memory scale-revised, CVLT: California verbal learning test

was declined after CPAP treatment. However, no significant difference was observed at CVLT delayed recall scores after CPAP treatment (Table 4).

$OSA_{follow-up}$ group showed no significant difference on digit span (both forward and backwards), TMT (both A and B), semantic and phonemic fluency, Stroop Test, logical memory (both immediate and delayed recall), and CVLT delayed free recall scores as compared to $OSA_{baseline}$.

## Discussion

In this study we aimed to contribute to the accumulating knowledge about the neurocognitive deficits in patients with OSA and the probable benefit of CPAP treatment with a prospective aspect. The prominent result of our study showed the positive effect of CPAP on memory functions in patients with OSA older than 60 years of age after 6-months of treatment.

At the baseline evaluation, OSA patients performed similarly with the controls on attentional test and psychomotor speed test. Yet, they performed significantly worse in clock drawing and phonemic fluency. The difference between CG and OSAS patient's Stroop Test performance was at the level of statistical significance. With regard to memory, there were significant differences both at CVLT learning and delayed free recall performances, and immediate recall of the logical memory subtest of WMS-R on the favor of worse performance in the patient group. Moreover, OSA severity was positively related with the decline in CVLT delayed recall.

In the follow-up, we observed that clock drawing performance, CVLT immediate recall, learning, recognition, and false positive recognition scores of the OSAS patients were improved significantly.

Considering previous studies on cognition in older OSA patients, we are presenting almost similar results in the patients with OSA over 60 years of age and additionally presenting the examination of memory through its phases. Most of the sleep-memory studies were designed under experimental conditions to apply memory tasks before and after sleep in a laboratory environment (33). However, learning and retrieval phases of

memory tests may be very informative at the clinical setting whether OSA has an impact on cognitive functioning of aging patients.

Memory has three information processing phases; i.e., encoding, consolidation and retrieval. In the verbal memory tests, total learning scores are being calculated from the sum of free recalled items of word list's each learning trial; which can be referred to encoding phase. We evaluated verbal memory with a word list (CVLT) and a story that has emotional and spatiotemporal context (WMS-R logical memory subtest) in this study. In the memory tests of moderate to severe OSA patients over 60 years of age, we observed a decrease in learning scores and delayed free recall scores compared to the matched control group. After 6 months of regular CPAP treatment, the disruptive effect of OSA on learning eliminated at the follow-up examination: As the immediate recall increased and learning ability improved then the need of recognition cues was observed to decline. Thus, the increase at the learning score in favor of the post-treatment examination indicates an improvement in the encoding phase of the memory. These findings of ours are in line with the studies reporting that OSA impairs memory (5,34) and those memory functions benefit from CPAP treatment (18,35). Retrieval phase, recalling of memory, refers to accessing the information which have already been encoded, and can be assessed with the "delayed recall" performance in memory tests. Consistently with the number of previous studies reporting that patients with OSA experience difficulties in memory phases such as free recall (36) while recognition was intact (7,8). Also, retrieval phase is the phase of the memory on which we observed the severity effect: Severe OSA group had worse delayed recall scores than moderate OSA group before treatment. In addition to the difficulties in learning and recalling the word list, the immediate recall of the logical memory task was also found to be affected in older OSA patients as compared to CG. Nonetheless, in the immediate recall of WMS-R logical memory subtest, which is primarily a working memory task, we did not observe the expected significant positive effect of treatment, even though an improvement was apparent.

Among the executive functions i.e., working memory, phonemic fluency, cognitive flexibility, set shifting and planning are other cognitive domains that have been repeatedly reported to be impaired in adults with OSA (37). Our results revealed that response inhibition which requires cognitive flexibility and set shifting, is impaired in older patients with OSA in comparison to CG. However, the difference was manifested at the significance level. This result may be limited by the small sample size. Another prominent finding of our study revealed that patients with OSA perform worse on planning and visuoconstruction task in comparison to CG which is consistent with the studies listed in the review presented by Saunamäki and Jehkonen (37). The decline in planning and praxis ability of the patients with OSA aged over 60 years significantly benefited from 6-months of CPAP treatment. CDT, measures visual and spatial skills with symbolic representations that evaluate executive and praxis functions (38). Since the instruction of the CDT contains two-stepped instruction, it is also an executive operation that requires holding the information online for goal-directed behavior. CDT showed negative correlation with sleep measurements (AHI and ODI) of $OSA_{baseline}$ group, leading us to accept this test as a representative assessment of executive function affected by desaturation. We believe, this simply administered but informative test should be included in the cognitive evaluations of patients with OSA.

The task of finding words with a phonemic cue requires scanning widespread the association cortices, whereas semantic fluency task is limited to the temporal brain areas (39). In studies evaluating cognition in patients with OSA, phonemic fluency was reported to be negatively affected by this sleep breathing disorder (40). Here we also observed a decline in phonemic fluency in older patients with OSA. However, patient and control groups performed close to each other on the semantic fluency task. Thus, we can formulate that the attentional system is relatively more affected, while OSA has no obvious effect on semantic storage. Probably devalued by the small sample size, the improvement we observed at phonemic fluency after CPAP treatment couldn't reached the significance level.

In terms of the other cognitive tests, our research results were in line with CPAP treatment efficiency studies of TMT-A (17,18) and digit span (36) that did not reveal any significant change. However, TMT-B has been repeatedly reported to be affected from OSA (12,41) and improved after CPAP treatment (41). Although we expected an improvement in set shifting ability within sustained attention, our results revealed no significant difference.

### Study Limitations

This study has some limitations and strengths. Small sample size was one of the limitations. On the other hand, as the number of participants increase it becomes difficult to control confounding factors that may affect cognitive functions in the older individuals. Another limitation was the missing data of untreated older patients with OSA. The comparison of cognitive test results of CPAP treated patients with OSA and who refused to use CPAP treatment were considered to be valuable. However, the number of OSA patients who did not agree to use CPAP therapy could not reach the level for statistical analysis, within the planned duration of the study. For this very valuable piece of information our further motivation is to add a CPAP-free control group. Examining the memory functions to its processes enabled us to conclude that the OSA may impair learning and

free recalling of the recently encoded memory inputs, which cannot be achieved with screening tests. The significant difference between CDT scores of $OSA_{baseline}$ and $OSA_{follow-up}$ maintained even calculated with the scorings of the other rater (Interrater reliability was met both at the baseline and follow-up evaluations of clock drawing).

## Conclusion

We reported the data on the cognitive functionality in OSA patients over 60 years of age by comparing with matched CG, and cognitive change in the treated group. The absence of psychiatric or malign medical conditions presented relatively pure results about cognitive functions. A number of executive functions and memory functions were found to be affected in our sample. Detailed assessment of cognitive abilities showed that learning and free recall phases of memory were disrupted while recognition was intact. The cognitive impairment that may be related to OSA found to be benefited from a sufficient period of treatment, i.e., average of 6 months of effective CPAP use, even in individuals over 60 years of age. There are few studies revealing the effect of OSA on memory processing phases, while this provides very important information for discriminative diagnosis among neurodegenerative disorders. Thus, we believe that the study required to be replicated with a larger number of participants. For the further researches we are motivated to combine the results with structural and functional neuroimaging at resting state is believed to be more informative.

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### Ethics

**Ethics Committee Approval:** All procedures performed in this study involving human participants were in accordance with the ethical standards of İstanbul University, İstanbul Faculty of Medicine Ethics Committee for Clinical Research and with the Helsinki declaration (no: 2023-1782132).

**Informed Consent:** All participants provided written informed consent.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: E.K., Z.B., Concept: G.B., M.A.K., A.T.Ç., Design: G.B., Data Collection or Processing: E.K., Z.B., D.B., Analysis or Interpretation: Z.B., D.B., Literature Search: A.T.Ç., D.B., Writing: G.B., Z.B., D.B.

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ORIGINAL RESEARCH

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# Validity and Reliability of Study of Osteoporotic Fractures Index in the Diagnosis of Sarcopenia in Turkish Geriatric Patients

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## Abstract

**Objective:** The objective of this study was to evaluate the reliability and validity of the Turkish version of the study of osteoporotic fractures (SOF) index, and to investigate the prognostic power of the SOF index in predicting the risk for sarcopenia in the geriatric population.

**Materials and Methods:** The sample of this cross-sectional study consisted of 144 geriatric patients who applied to the outpatient clinic where this study was conducted between July 2017 to July 2018. The frailty status of patients was evaluated using the SOF index. The European Working Group on Sarcopenia in Older People diagnostic criteria were used in the diagnosis of sarcopenia. Accordingly, patients were divided into two groups as the sarcopenia and non-sarcopenia groups. Patients' measurement results were recorded and comparatively analyzed between the groups.

**Results:** The rate of sarcopenia was significantly higher in patients who were determined to be frail based on SOF index than the remaining patients (93.2% vs. 61.5%, respectively; $p<0.001$). The kappa value was determined as 0.608 based on the qualitative data, in substantial agreement with Cohen's Kappa coefficient, indicating reliability. The ROC analysis revealed that the sensitivity and specificity of SOF index cut-off value of 1 in determining sarcopenia were 76.4% and 55.6%, respectively. The validity of the SOF index with a cut-off value of 1 was found as 0.659 (validity values of >0.5 indicate statistical significance).

**Conclusion:** The study findings indicate that the SOF index is a feasible, valid and reliable tool, and it has a high positive prognostic value in predicting sarcopenia.

**Keywords:** Frailty, reliability, sarcopenia, SOF index, validity

## Introduction

The incidence of frailty and sarcopenia, both of which limit mobility, increases with age. The coexistence of frailty and sarcopenia in older patients is correlated with a higher incidence of recurrent hospitalizations, multiple drug therapies, and hospital admissions, increasing the risk for morbidity and mortality. Considering the rates of sarcopenia in the Middle East and European countries, frailty and sarcopenia rates were reported as 28.3% and 31.7%, respectively, in a study conducted with a large patient cohort in Turkey (1), and as 51.7% and 34.4%, respectively, in a study conducted in Israel (2,3). Similarly, the frailty rate of geriatric patients in Saudi Arabia was reported as 29.2% (4), whereas the prevalence of sarcopenia was found to be 32.5% in a population-based multi-center study conducted in Iran (5). These rates were found to be lower in European countries. In a study evaluating frailty in 10 European countries and another study evaluating sarcopenia in 28 European countries, frailty, and sarcopenia rates were found as 5.8-27.3% and 11.2-20.2%, respectively (6,7).

Sarcopenia is a condition associated with aging resulting in an involuntary loss of skeletal muscle mass, reducing skeletal muscle function and strength (8). In parallel, Rogers and Evans (9)

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reported that total muscle strength decreases by 30% and muscle mass decreases by 40% over the period between the second and seventh decades of life. Sarcopenia is considered one of the geriatric syndromes in addition to falls, delirium, and incontinence, which all negatively affect the quality of life (10,11).

Frailty is a multifaceted syndrome characterized by clinical deficiencies such as mobility, strength, endurance, nutrition, physical activity, physiological reserve, cognitive impairment, and depression (12,13). Early diagnosis of frailty in older patients is important in terms of taking the necessary preventive measures and determining the appropriate treatment approaches. To this end, various simple screening tools have been developed. One of these tools, the study of osteoporotic fractures (SOF) index, was developed by the SOF research group in 2008 as a feasible, rapid diagnostic test for frailty (14).

In this context, this study was conducted to assess the reliability and validity of the Turkish version of the SOF index in older patients (≥65 years) and to investigate the prognostic power of the SOF index in predicting the risk for sarcopenia in the geriatric population.

## Materials and Methods

### Population and Sample

The population of this cross-sectional study consisted of 845 patients aged 65 or above who applied to the geriatric outpatient clinic where this study was conducted between July 2017 to July 2018. In the G*Power program, we chose the test family as the chi-square test and the type of power analysis a priori, and when we took the effect size value as 0.3, the alpha margin of error as 0.05, the power of the study as 80%, and the Df value as 2, the minimum number of samples required for our study was 108. Patients with prosthesis or pacemaker that falsified bioelectrical impedance analysis (BIA), and those with advanced dementia, Parkinson's disease, congestive heart failure, malignancy, rheumatologic disease, inflammatory bowel disease, and neuromuscular disease who could not perform the tests were excluded from the study. In the end, the study sample consisted of 144 patients. Patients were divided into two groups as the sarcopenia and non-sarcopenia groups. Each group consisted of 38 males and 34 females. Patients' demographic and laboratory characteristics and anthropometric measurement results in addition to walking speed, hand grip strength, and fat-free mass index (FFMI) and SOF index scores were recorded and comparatively analyzed between the groups.

### Diagnosis of Sarcopenia

The European Working Group on Sarcopenia in Older People diagnostic criteria were used in the diagnosis of sarcopenia. Accordingly, 72 (8.5%) of the 845 patients who were determined to have low muscle mass, along with low physical performance or low muscle strength, were diagnosed with sarcopenia (10).

### Muscle Mass

BIA was used to determine patients' muscle mass (10). BIA was conducted using the Bodystat Quadscan 4000 brand bioimpedance device (Bodystat Ltd., Isle of Man, UK), while the patients were in the fasting state and their bladders were empty. They were in supine position, provided that their extremities were not in contact with their body, and after the metal accessories were removed from their bodies. To this end, a total of four electrodes, two at the level of the wrist and metacarpophalangeal joint in the upper extremity and two at the level of the ankle and metatarsophalangeal joint in the lower extremity, were connected to the patients. Subsequently, patients' age, gender, height, weight, waist and hip circumference data and activity levels were entered into the bioimpedance device in a certain order. The device calculated the FFMI based on these data. The study conducted to determine the optimal FFMI cut-off value included 30 healthy males and 30 healthy females between 20-40 years of age with normal body mass index (BMI) values. Consequently, the optimal FFMI cut-off value was determined as 13.4 kg/m$^2$ for females and 17.1 kg/m$^2$ for males, taking standard deviation of the mean FFMI value as "-2". Similar to the literature, patients with less FFMI values were considered to have low muscle mass (15-17).

### Muscle Strength

Hand grip test was performed using a Jamar branded (Model SH500L, Four D Rubber Company Ltd., Derbyshire, UK) hand dynamometer in order to assess muscle strength. To this end, the patients were placed in a flexion position with their elbows on the table and their arms parallel to the floor. Measurements were made three times on both right and left arms with 1-minute rest periods in between. Patients with the highest of the three measurements below 30 kg in males and 20 kg in females were considered to have "low muscle strength".

### Muscle Performance

Patients' physical performance was assessed based on the walking speed test. To this end, the time that took the patients to walk for 6 meters in standing position was recorded in terms of seconds. A walking speed of 0.8 m/s was considered as the cut-off value and patients of both genders with a walking speed below this value were considered to be at risk for sarcopenia.

### Diagnosis of Frailty

### SOF Index

The SOF index is a questionnaire that consists of three parameters for frailty diagnosis;

1. Involuntary weight loss of 5% or more within three years (<%5 =1 point; ≥5% =0 point).

2. Inability to rise from a chair five consecutive times without using the arms (<5 times =1 point; 5 times =0 point).

3. Having low energy as identified by a negative answer to the question "do you feel full of energy?" ("no"=1 point; "yes"=0 point.

Accordingly, the older adults who scored 0 point, 1 point and 2-3 points are considered robust older patients, prefrail older patients, and frail older patients, respectively (18).

### Validity Studies

The validity of the SOF index was determined by receiver operating characteristic (ROC) curve analysis. For this reason, non-sarcopenic patients with an SOF index value below the optimal cut-off value and sarcopenic patients with an SOF index value above the optimal cut-off value were added and then divided by the total number of patients included in the study. The result obtained was considered significant in terms of validity if above 0.5 (19).

### Reliability Studies

The SOF index was administered to 144 patients at baseline, and then to 72 of these 144 patients for a second time within two weeks to measure the test-retest reliability (Cronbach's alpha). The resulting kappa coefficients between 0.81 and 1.00, 0.61 and 0.80, 0.41 and 0.60, 0.21 and 0.40, 0.01 and 0.2, and below 0 were considered to indicate almost perfect, substantial, moderate, fair, none to slight agreement, and no agreement, respectively (20).

### Statistics

Statistical analyses were carried out with SPSS 20.0 (Statistical Package for Social Sciences for Windows, version 20.0, IBM Corp., Armonk, NY, U.S., 2011) software package. Sarcopenia and non-sarcopenia groups were compared using the Pearson's chi-squared test based on the robust, prefrail and frail classifications made according to the SOF index scores. Pearson's correlation analysis test was used to examine the relationship between patients' anthropometric measurement values and SOF index scores. The sensitivity and specificity values of certain SOF index cut-off scores were examined with ROC curve analysis. Probability (p) values of <0.05 were deemed to indicate statistical significance.

## Results

The study sample consisted of 144 geriatric patients. Both the sarcopenia and non-sarcopenia groups consisted of 72 patients. Each group consisted of 38 males and 34 females. Distribution of patients' demographic and laboratory characteristics and anthropometric measurement results in addition to walking speed, hand grip strength, and FFMI and SOF index scores by genders and sarcopenia groups is demonstrated in Table 1.

Sarcopenic and non-sarcopenic patients were compared based on the robust, prefrail, and frail classifications made according to their SOF index scores. Accordingly, there was a significant difference between robust and frail patients (p<0.001), but not between prefrail and frail patients or robust and prefrail patients (p>0.05), in terms of presence of sarcopenia. The comparison of the groups created based on SOF index scores in terms of presence of sarcopenia is shown in Table 2.

**Table 1. Distribution of patients' demographic and laboratory characteristics and anthropometric measurement results, and FFMI and SOF index scores by genders and sarcopenia groups**

| | Sarcopenia group (n=72) | | | Non-sarcopenia group (n=72) | | |
|---|---|---|---|---|---|---|
| | Male (n=38) (mean ± SD) | Female (n=34) (mean ± SD) | p-value | Male (n=38) (mean ± SD) | Female (n=34) (mean ± SD) | p-value |
| **Age (years)[a1]** | 80.39±6.89 | 82.03±7.27 | 0.334 | 76.84±6.99 | 81.41±6.62 | **0.006** |
| **Height (cm)[b1]** | 165±9 | 147±6 | **<0.001** | 167±9 | 151±7 | **<0.001** |
| **Weight (kg)[a3;b3]** | 60±8 | 50±7 | **<0.001** | 79±10 | 69±12 | **0.001** |
| **BMI (kg/m²)[a3;b3]** | 21.83±2.62 | 23.01±3.26 | 0.093 | 28.44±3.43 | 30.57±5.08 | **0.026** |
| **Waist circumference (cm)[a3;b3]** | 81±8 | 80±11 | 0.782 | 99±8 | 96±12 | 0.185 |
| **Hip circumference (cm)[a3;b3]** | 88±7 | 89±9 | 0.655 | 99±8 | 104±12 | 0.081 |
| **Walking speed (m/sec)[a3]** | 0.74±0.51 | 0.52±0.3 | 0.334 | 1.22±0.52 | 0.67±0.39 | **0.006** |
| **Hand grip strength (kg)[a3;b1]** | 21±8 | 13±5 | **<0.001** | 30±8 | 16±6 | **<0.001** |
| **FFMI (kg/m²)[a3;b3]** | 14.56±2.02 | 11.8±1.6 | **<0.001** | 19.49±1.81 | 15.76±1.63 | **<0.001** |
| **SOF score[a3;b1]** | 2.03±0.97 | 2.21±0.81 | 0.505 | 1.05±0.98 | 1.62±1.04 | **0.024** |

SD: Standard deviation, BMI: Body mass index, FFMI: Fat-free mass index, SOF: Study of osteoporotic fractures
[a1]p<0.05, [a2]p<0.01, [a3]p<0.001
[b1]p<0.05, [b2]p<0.01, [b3]p<0.001
[a]Data pertaining to male patients in both sarcopenia and non-sarcopenia groups
[b]Data pertaining to female patients in both sarcopenia and non-sarcopenia groups

The ROC analysis revealed that the sensitivity and specificity of SOF index cut-off value of 1 in determining sarcopenia were 76.4% and 55.6%, respectively.

Additionally, the positive and negative predictive values of SOF index cut-off value of 1 were determined as 63.2% and 70.2%, respectively, indicating that 1 can be used as an optimal cut-off value. The ROC curve analysis of the prognostic power of SOF index in predicting the diagnosis of sarcopenia is shown in Figure 1.

There was a significant negative correlation between the SOF index scores and walking speed, BMI values, right calf, waist, and hip circumferences, FFMI scores, and right hand grip strength.

The SOF index score of 72 patients was measured for a second time within 2 weeks for assessing the reliability of the index, and the kappa coefficient was found as 0.608. The intergroup comparison and ROC analysis revealed that the validity of the SOF index cut-off value of 1 was 0.659 (validity values of >0.5 indicate statistical significance). The details of the reliability and validity studies of the SOF index are shown in Table 3.

## Discussion

This study featured the assessment of the validity and reliability of the SOF index for Turkish geriatric population and the prognostic power of the SOF index in predicting the risk for sarcopenia in the geriatric population.

The findings of this study revealed that female patients diagnosed with sarcopenia had lower weight, BMI values, waist and hip circumferences, hand grip strength, and FFMI values, whereas higher SOF index scores, compared to female patients without sarcopenia. On the other hand, male patients diagnosed with sarcopenia were older and had a lower walking speed compared to male patients without sarcopenia.

In a cross-sectional study conducted with 771 geriatric patients, 359 females and 412 males, in Taiwan, 119 patients were diagnosed with sarcopenia. The distribution of the patients with sarcopenia by the BMI values revealed that sarcopenia was most common in the group with high BMI values (16 of the 31 patients with BMI values >30 kg/cm$^2$ were diagnosed with sarcopenia), followed by the group with low BMI values (14 of the 29 patients with BMI values <18.5 kg/cm$^2$ were diagnosed with sarcopenia) (21). In contrast, none of the patients with a high BMI value had sarcopenia (none of the 26 patients with BMI values >30 kg/cm$^2$ was diagnosed with sarcopenia). Sarcopenia was most common in the group with low BMI values regardless of gender (8 of the 9 patients with BMI values <18.5 kg/cm$^2$ were diagnosed with sarcopenia). The findings of this study suggest that weight, waist and hip circumferences in patients with sarcopenia are correlated with low BMI values. The said discrepancy between the study conducted in Taiwan and this study may be due to the differences in the ethnic structure of the respective societies, lifestyles, and geographical differences (22,23).

In a cohort study conducted by De Buyser et al. (14) with 191 Belgian older male adults with a mean age of 78, SOF index was used to assess frailty and hand grip strength, and dual-energy X-ray absorptiometry (DEXA) were used to diagnose sarcopenia, and frailty and sarcopenia were each detected in 7% of the cohort. The rate of sarcopenia patients with frailty was found as 23%. Unlike the said study, female patients were also included in this study and BIA was used instead of DEXA to measure muscle mass, given that BIA is performed at the bedside, is a noninvasive and inexpensive method, and gives results comparable to DEXA (24,25). In addition, walking speed of patients was also measured in the diagnosis of sarcopenia

**Table 2. The comparison of the SOF index groups according to sarcopenia**

| SOF groups | Sarcopenia group (n=72) | Non-sarcopenia group (n=72) | p-value |
|---|---|---|---|
| Prefrail **(n=33)** | 38.5% (20) | 19.1% (13) | 0.19 |
| Frail **(n=87)** | 61.5% (32) | 80.9% (55) | |
| Robust **(n=24)** | 38.5% (20) | 6.8% (4) | **<0.001** |
| Frail **(n=87)** | 61.5% (32) | 93.2% (55) | |
| Robust **(n=24)** | 50% (20) | 23.5% (4) | 0.064 |
| Prefrail **(n=33)** | 50% (20) | 76.5% (13) | |

SOF: Study of osteoporotic fractures

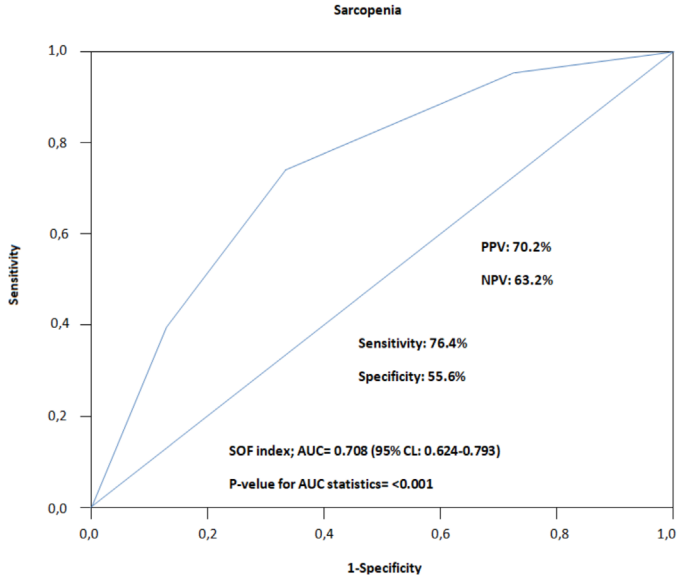


**Figure 1.** ROC curve for the sarcopenia of the SOF index

*SOF: Study of osteoporotic fractures, ROC: Receiver operating characteristic, AUC: Area under the curve, NPV: Negative predictive value, PPV: Positive predictive value*

**Table 3. The reliability and validity assessment of the SOF index**

| **The reliability assessment of the SOF index** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Retest of the SOF index** | | | | **Total** | **Kappa coefficient** |
| | | 0 | 1 | 2 | 3 | | |
| **SOF score** | 0 | 9 | 0 | 0 | 0 | 9 | **0.608*** |
| | 1 | 6 | 8 | 0 | 0 | 14 | |
| | 2 | 0 | 11 | 16 | 2 | 29 | |
| | 3 | 0 | 0 | 2 | 18 | 20 | |
| Total | | 15 | 19 | 18 | 20 | 72 | |

| **The validity assessment of the SOF index** | | | | |
|---|---|---|---|---|
| | **Sarcopenia** | | **Total** | **Validity value NO** |
| | **NO** | **YES** | | |
| **Those with SOF score of 0 and 1** | 40 | 17 | 57 | **0.659**** |
| | 55.6% | 23.6% | 39.6% | |
| **Those with SOF score of 2 and 3** | 32 | 55 | 87 | |
| | 44.4% | 76.4% | 60.4% | |
| **Total** | 72 | 72 | 144 | |
| | 100% | 100% | 100% | |

SOF: Study of osteoporotic fractures, *: Reliability (Kappa number), **: Validity value

in this study in addition to muscle mass and muscle strength measurements. Consequently, the rates of male and female patients who were found to be both frail and sarcopenic were 71.0% and 82.3%, respectively. In comparison, the rate of patients with both frailty and sarcopenia was lower in De Buyser et al.'s (14) study. In another study conducted with 70 geriatric patients in India with a design comparable to this study, the patients were divided into two groups as the sarcopenia (n=42) and non-sarcopenia (n=28) groups, and the rate of frail patients in the sarcopenia group was found as 66.7% (26). The discrepancies between the findings of the relevant studies available in the literature might be attributed to the differences between the methodologies of these studies and the socio-demographic structures of the geriatric populations of the countries where these studies were conducted.

In a study conducted by Yürüyen et al. with 112 geriatric patients, walking speed and right hand grip strength measurements were performed in addition to muscle mass measurements with BIA to establish the diagnosis of sarcopenia. ROC analysis revealed that walking speed and right hand grip strength predicted the diagnosis of sarcopenia with a sensitivity and specificity of 71% and 47% [area under the curve (AUC)=0.642, p<0.001], and 65% and 50% (AUC=-0.594, p<0.001), respectively (27). Similarly, in this study, the ROC analysis revealed that walking speed and right hand grip strength predicted the diagnosis of sarcopenia with a sensitivity and specificity of 65.8% and 67.6% (AUC=0.688, p<0.001), and 61.1% and 63.9% (AUC=0.687, p<0.001). However, the prognostic power of the SOF index with a cut-off value of 1 (AUC=0.708, p<0.001; 76.4%, 55.6%) in predicting the diagnosis of sarcopenia was higher than those of walking speed and right hand grip strength.

As in many other studies that used indexes as data collection tools, first, intergroup comparison and ROC analysis were performed to assess the discriminant validity of the SOF index in this study (28,29). As a result, the validity of the SOF index with a cut-off value of 1 was found as 0.659 (validity values of >0.5 indicate statistical significance), and the kappa value was determined as 0.608 based on the qualitative data, in substantial agreement with Cohen's Kappa coefficient, indicating reliability (30).

### Study Limitations

Firstly, in this study, there is a small population, which may make the result inaccurate. Secondly, this study was conducted in a single-center, its results may not be widely generalized. However, this study has important contributions to the literature. Firstly, this is the first study that demonstrated that the SOF index can be used for the diagnosis of sarcopenia. Secondly, the SOF index was found to have high sensitivity and specificity in the diagnosis of sarcopenia in the Turkish population.

## Conclusion

The rate of patients with both sarcopenia and frailty (measured with the SOF index) was higher in the Turkish geriatric population compared to the literature data. In addition, it was determined that the SOF index can be used with high validity

and reliability in the Turkish population, and that it was superior to walking speed, and right hand grip strength in the diagnosis of sarcopenia. Considering that BIA, walking speed and right hand grip strength is relatively more time consuming and difficult to apply for both the physician and the patient in outpatient settings, the SOF index is a promising assessment and screening tool in the diagnosis of sarcopenia.

### Ethics

**Ethics Committee Approval:** Analyses of the clinical data were approved by the Ethics Committee of İstanbul University-Cerrahpaşa, Cerrahpaşa Faculty of Medicine (no: 2017/259929).

**Informed Consent:** The ethical committee agreed to the analysis of routinely collected clinical data provided that informed consent is obtained from the patients in advance. Accordingly, all patients were fully informed of the study procedures before they gave their consent.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: T.K., H.Y., D.S.E., Concept: T.K., H.Y., F.F., D.S.E., A.E.C., Design: T.K., H.Y., F.F., D.S.E., A.E.C., Data Collection or Processing: T.K., H.Y., A.E.C., Analysis or Interpretation: T.K., H.Y., F.F., D.S.E., A.E.C., Literature Search: T.K., H.Y., F.F., A.E.C., Writing: T.K., H.Y., F.F., D.S.E.

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CASE REPORT

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# Delirium Caused by Hypercalcemia in Older Adults

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## Abstract

Delirium; can be described as a temporary and reversible brain dysfunction syndrome, which manifests itself primarily with physical, physiopathological and psychological disorders. The leading causes of delirium are pneumonia, cancer, urinary infection, electrolyte imbalance (hypo-hypernatremia, hypo-hypercalcemia, hypo-hypermagnesemia), dehydration, congestive heart failure, uremia and stroke. We present a 68-year-old male patient was admitted to the geriatric outpatient clinic with complaints of fatigue, abdominal pain, loss of appetite and weight loss that started about 4 weeks previously. His physical examination was conscious, awake, co-operative but time orientation was not complete. The delirium assessment scale (DAS) was used for delirium evaluation and MDAS 13/30 (delirium >11/30) was detected. At the end of the evaluation the patient was careless and deterioration was detected in the recall test of three items. During the first 48 hours of the treatment, the patient's serum calcium level regressed and the symptoms were controlled. Hyperparathyroidism, malignancy and long-lasting immobilization are the most common causes of hypercalcemia in the elderly. Neuropsychiatric symptoms due to hypercalcemia may occur initially with concentration and increase in sleep time. As the degree of hypercalcemia increases, depression, delirium, confusion and afterwards coma may develop. As described in our patient, acute onset of attention reduction and cognitive or sensory disturbances in the course of delirium are the main features of the fluctuating course. The cause of delirium in elderly patients is multifactorial, so pathologies that may cause delirium should be excluded individually. Delirium is multifactorial, causing serious problems for affected patients, family members, caregivers and healthcare providers. The general purpose of delirium treatment is therefore early diagnosis and treatment with a multidisciplinary approach, which are of great importance in appropriate cases with delirium.

**Keywords:** Aging, delirium, elderly, hypercalcemia, parathyroid adenoma

## Introduction

Delirium can be described as a temporary and reversible brain dysfunction syndrome, which manifests itself primarily with physical, physiopathological and psychological disorders (1). In addition to cholinergic and dopaminergic system disorders, impaired serotonergic system, increased glutamine and glutamate, beta-endorphin reduction, and histaminergic system disruption are thought to be effective in the pathogenesis of delirium (2). Depending on the changes in the concentration of these neurotransmitters in the brain, disturbances of consciousness ranging from mild consciousness to coma may occur. The leading causes of delirium are pneumonia, cancer, urinary infection, electrolyte imbalance (hypo-hypernatremia, hypo-hypercalcemia, hypo-hypermagnesemia), dehydration, congestive heart failure, uremia and stroke. We present a patient with primary hyperparathyroidism who developed hypercalcemic delirium.

## Case Report

A 68-year-old male patient was admitted to the geriatric outpatient clinic with complaints of fatigue, abdominal pain, loss of appetite and weight loss that started about 4 weeks ago. According to the history taken from the relatives of the patient, common pain, delusional thoughts, visual hallucinations, intermittent confusion and agitation attacks were also described. The patient's medical history included hypertension and hyperlipidemia. He had no family history of hypercalcemia or metabolic disease.

In the physical examination, it was observed that he was conscious, awake, cooperative, but not fully oriented in time.

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The total score of the memorial delirium assessment scale (MDAS) used for delirium diagnosis was 13 (>11/30 compatible with delirium) (3). At the end of the evaluation the patient was careless and deterioration was detected in the recall test of three items. His pulse was 96 beats/min and rhythmic, blood pressure was 100/60 mmHg, while respiratory system and abdominal examination were unremarkable. The patient had mild weakness and decreased reflexes in all four extremities, and there was no focal neurologic deficit. The laboratory results of the patient are shown in Table 1.

In order to control the agitation and hallucinations occurring in the patient, after admission to the hospital, haloperidol was given intravenously (iv), 1 mg every 6 hours. In the treatment of hypercalcemia, saline (200 mL/hr iv), zoledronic acid (4 mg iv, once) and dexamethasone (60 mg/day iv) were used. During the first 48 hours of the treatment, the patient's serum calcium level decreased and the symptoms were controlled. MDAS score decreased to 0/30 and hallucinations and agitation findings disappeared. In the following seven days, the patient's mental state continued to improve. Visual hallucinations or agitation were not observed again after the serum calcium level was controlled.

Tests for the etiology of hypercalcemia were performed. No pathological lesion compatible with parathyroid adenoma was observed in the neck ultrasonography. Mediastinal SPECT showed focally increased MIBI involvement in the left upper paratracheal area, which was thought to be an ectopic parathyroid adenoma. Thoracic computed tomography revealed an ectopic parathyroid adenoma.

## Discussion

Hypercalcemia is defined as a level of plasma calcium more than 1 mg/dL above the laboratory reference range (4). According to serum calcium levels, 10.5-12 mg/dL is defined as mild, 12-15 mg/dL as moderate, and >15 mg/dL as severe hypercalcemia (hypercalcemic crisis). The most common cause of hypercalcemia is primary hyperparathyroidism and its prevalence in adults ranges from 1-7/1.000 (5). Hyperparathyroidism, malignancy and long- lasting immobilization are the most common causes of hypercalcemia in the elderly (6). When plasma calcium levels are between 10.5-12.0 mg/dL, more than half of the cases are asymptomatic. When calcium levels exceed 13 mg/dL, symptoms and findings that negatively affect many systems are seen (7). Neuropsychiatric symptoms such as impaired concentration and increased sleep duration may occur initially due to hypercalcemia. As the calcium level increases, depression, delirium, confusion, and then coma may develop. As described in our patient, acute onset of attention deficit and cognitive or sensory impairments are the main features of the fluctuating course of delirium. The cause of delirium in elderly patients is multifactorial, so pathologies that may cause delirium should be excluded individually. In our patient, we think that delirium development was caused by hypercalcemia and dehydration. Delirium disappeared after hydration and serum calcium levels were restored to within normal limits. Although hypercalcemia due to overproduction of PTH has been reported with published cases that cause delirium, the pathology of hypercalcemia and delirium has not been clearly established (8). However, calcium is bound to negatively charged membrane proteins, stimulating voltage-dependent sodium channels and decreasing intracellular sodium input. Delirium is multifactorial, and causes serious problems for affected patients, family members, caregivers and healthcare providers. The general purpose of delirium treatment is therefore early diagnosis and treatment with a multidisciplinary approach, which are of great importance in appropriate cases with delirium.

**Table 1. Laboratory results of the patient**

| | Pre-op | Post-op |
|---|---|---|
| Creatinine (0.57-1.25 mg/dL) | 1.4 | 1.1 |
| Sodium (136-145 mmol/L) | 131 | 141 |
| Potassium (3.5-5.1 mmol/L) | 3.1 | 4.2 |
| Magnesium (1.6-2.6 mg/dL) | 1.53 | 1.9 |
| Phosphorus (2.7-4.3 mg/dL) | 2.5 | 3.1 |
| Albumin (3.5-5.0 g/dL) | 3.9 | 4.1 |
| Calcium (8.4-10.2 mg/dL) | 15.9 | 9.8 |
| PTH (10-55 pg/mL) | 278 | 50 |
| 25-hydroxyvitamin D (20-70 ng/mL) | 30.38 | 37.5 |
| WBC (4.3-10.3/uL) | 10.8 | 9.7 |

PTH: Parathyroid hormone, WBC: White blood cell

### Ethics

**Informed Consent:** Informed consent was obtained.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: F.D.Y., Z.A.Ö., Concept: F.D.Y., Z.A.Ö., Design: Z.A.Ö., Data Collection or Processing: F.D.Y., Analysis or Interpretation: F.D.Y., Literature Search: F.D.Y., Z.A.Ö., Writing: F.D.Y., Z.A.Ö.

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CASE REPORT

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# Idiopathic Hypertrophic Pyloric Stenosis - A Rare Condition Mimicking Gastric Cancer in An Older Adult

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## Abstract

Idiopathic hypertrophic pyloric stenosis is a very rare entity in older adults, unlike in childhood. Although the etiology of idiopathic hypertrophic pyloric stenosis is not clear, secondary causes such as excessive healing of gastric or duodenal ulcers, malignancies postoperative intraabdominal adhesions should be excluded. In this case presentation, we present an older adult admitted with symptoms mimicking gastric cancer and diagnosed with idiopathic hypertrophic pyloric stenosis.

**Keywords:** Geriatrics, hypertrophic, idiopathic, pyloric, stenosis

## Introduction

Idiopathic hypertrophic pyloric stenosis (IHPS) is a predominantly infantile disease characterized by idiopathic thickening of gastric pyloric musculature. Infantile IHPS incidence is between 0.1% and 0.8% (1). and it is usually diagnosed during the first 2 months of life. Adult idiopathic hypertrophic pyloric stenosis (AIHPS) is a rare condition with very few cases reported in the literature (2). Secondary causes for pyloric obstruction appear to be far more common in middle-aged males (3,4) but still, AIHPS should be kept in mind. Although the etiology remains unclear, theories have been proposed regarding the persistence of the juvenile form into adulthood. In this report, we present a case of AIHPS, to remind physicians of this benign entity that rarely comes to mind in the differential diagnosis of an older adult presenting symptoms mimicking gastric cancer.

## Case Report

A 66-year-old male patient was admitted to the geriatric outpatient clinic with complaints of abdominal pain, weight loss, nausea, postprandial vomiting, and early satiety. He had been experiencing these symptoms for two years. He had lost twenty kilos in a year. His symptoms worsened progressively over the previous three months. The patient's complaints of nausea and vomiting began after meals. The vomit content consisted mostly of undigested food and there was no bile. He had a medical history of diabetes mellitus and benign prostatic hypertrophy. He had no specific surgical history. His diabetes mellitus disease was under control, there was no gastrointestinal involvement. A physical exam revealed a soft, mildly distended abdomen. No mass or tenderness was detected. The rest of the examination was normal. He had iron deficiency anemia, hemoglobin level was 8.4 gr/dL, ferritin level was 59 nq/mL, and transferrin saturation was 5%. He had no vitamin B12 or folate deficiency. Hba1c was 6.3% and the fasting blood glucose level was 116 mg/dL. The potassium level (3.24 mmol/L) was detected as low due to vomiting. Chest X-ray demonstrated the "Kirklin's sign" defined as the deformity of the normal gastric bubble (Figure 1).

Due to the persistent symptoms and iron deficiency anemia, abdominal computed tomography (CT) and upper gastrointestinal endoscopy were performed to exclude gastric malignancy or peptic ulcer. CT's abdomen demonstrated a wide stomach with thickening of the wall in the antrum and a stenotic pylorus (Figure 2). Upper gastrointestinal endoscopy showed a distended stomach with a large volume collection of partly digested food. Due to this much collection, the distal stomach could not be seen clearly by endoscopic examination. After non-oral feeding and

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nasogastric decompression, upper endoscopy was performed again. The patient's stomach was still filled with food content and the endoscope couldn't pass the pyloric channel which was interpreted as pyloric stenosis. His symptoms did not improve, he underwent laparotomy for diagnostic and therapeutic purposes. A palliative gastrojejunostomy was performed and pathologic samples were taken from the paraesophageal lymph node. Pathology was reported as a benign reactive lymph node. In the postoperative period, the patient's recovery was slow, and symptoms completely improved at the 1-month follow-up visit. Upper gastrointestinal endoscopy was reperformed after 1 month of surgery. It showed an intact stomach and pylorus with a "cervix sign" (Figure 3). Endoscopic pathology was significant for foveolar epithelial hyperplasia of the stomach. There was no evidence of gastric cancer, ulcer, metaplasia, or helicobacter pylori infection. According to the results of these clinical and radiological findings, the patient was diagnosed with AIHPS.

## Discussion

AIHPS is a rare disease and more common in middle-aged men (3,4). Hypertrophic pyloric stenosis (HPS) has been divided into several types by different authors. The most widely accepted etiologic classification includes the primary type with no obvious underlying disease and the secondary type caused by an underlying disorder such as overhealing of gastric or duodenal ulcers, malignancy, gastrointestinal stromal tumors (GISTs), postoperative intra-abdominal adhesions (5-7). In the secondary type, the muscle fibers are usually replaced by fibrous tissues, and there is little or no smooth muscle hypertrophy, as compared to the primary type. The etiology of AIHPS is unclear. Most researchers believe that AIHPS is the persistent form of mild juvenile HPS (6). Infantile and adult forms of IHPS have anatomical and histologically similar changes (8). However, it still seems unclear why most of the patients stay asymptomatic until middle age.


**Figure 1.** Deformity of the normal gastric bubble on an upright chest X-ray: "Kirklin's sign"

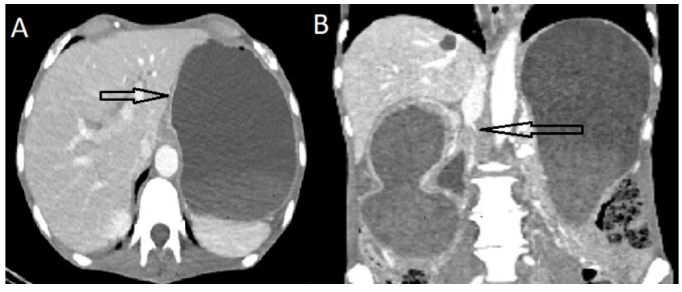


**Figure 2.** A. Wide stomach, B. Thickening of the wall in antrum, stenotic pylorus

The clinical features of adult IHPS are similar to other conditions that cause gastric outlet obstruction. As in our case, postprandial nausea, vomiting, and early satiety are the most common symptoms of AIHPS. Unlike infantile IHPS, an abdominal mass is rarely felt (9).

In the differential diagnosis, more common malignancies and diabetic gastropathy should be considered. Adult IHPS is not easy to diagnose without surgery. The image of the protrusion of the pylorus into the duodenal valve is called Kirklin's (10) sign or "fungus sign" in radiological examination. Kirklin (10) were the first investigators to describe this finding radiologically in 1993. This sign is common in 50% of pediatric patients (11). Its frequency in AIHPS is uncertain, as it is also can find in the normal population. Abdominal CT helps to exclude secondary causes of HPS such as malignancy, and distal gastric wall thickening can be detected as a unique nonspecific sign of İHPS as in our case. Upper gastrointestinal endoscopy is used to diagnose HPS. The endoscopic sign, which is called the "cervix sign" indicating the narrowing of the pylorus, was first described by Schuster and Smith (12). The "cervix sign", which was also found in our patient, was one of the clues that helped us to diagnose IHPS.

Multiple treatments have been suggested for AIHPS, such as endoscopic dilatation, pyloromyotomy, or gastrectomy with Billroth I gastroduodenostomy. The treatment of choice is usually

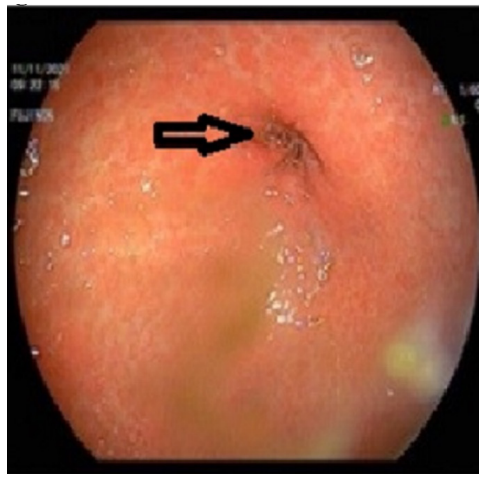

**Figure 3.** Pylorus demonstrating "cervix sign"

surgery with gastric resection and Billroth I anastomosis (3). Although pyloroplasty and vagotomy also showed successful results (6). Currently, there is no evidence of which surgical technique is superior, but some authors recommend partial gastrectomy as long-standing pyloric hypertrophy may increase the risk of gastric carcinoma (9,13,14). A definitive diagnosis of IHPS is made by demonstrating smooth muscle hypertrophy in the histopathology of the pylorus. In our patient, pyloric histopathology was not available because a palliative gastrojejunostomy was performed by preserving the pylorus due to the patient's advanced age and frail nature. However, our patient has not had a history of peptic ulcer, surgery, and previous malignancy. In addition, preoperative and postoperative endoscopy and computed tomography have not revealed any secondary causes. After 1 month of surgical treatment symptoms were completely improved.

## Conclusion

Adult IHPS is a long-standing disease of uncertain etiology. AIHPS is very rarely reported in older adults so this report can remind clinicians this benign entity should be kept in mind in an older patient presenting with persistent vomiting and weight loss. Partial gastrectomy with Billroth I reconstruction is the preferred treatment method by most physicians but in older frail adults gastrojejunostomy could be an alternative surgical option due to the low risk of complications and faster recovery time, as in our case.

### Ethics

**Informed Consent:** Informed consent was obtained.

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### Authorship Contributions

Surgical and Medical Practices: E.Ç., E.Çe., F.G., H.D.V., Concept: E.Ç., H.D.V., Design: H.D.V., Data Collection or Processing: E.Ç., E.Çe., Analysis or Interpretation: E.Ç., E.Çe., Literature Search: E.Ç., H.D.V., Writing: E.Ç., H.D.V.

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