BALNEO RESEARCH Balneo and PRM Research Journal
English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

*Research article*

# Study on the assessment of cognitive and functional status for a segment of the population during the ageing process

**Elena Vizitiu [1], Andrei-Ioan Costea [2*], Sînziana-Călina Silişteanu [2*] and Mihai Constantinescu [3]**

1 Interdisciplinary Research Centre for Motricity Sciences and Human Health, Stefan cel Mare University of Suceava, Romania
2 Faculty of Medicine and Biological Sciences Stefan cel Mare University of Suceava, Romania
3 Faculty of Physical Education and Sport, Stefan cel Mare University of Suceava, Romania

* Correspondence: drandreicostea@gmail.com (CAI); sinziana.silisteanu@usm.ro (SSC)

**Citation:** Vizitiu E. , Costea A.I., Silişteanu S.C., Constantinescu M. - Study on the assessment of cognitive and functional status for a segment of the population during the ageing process
*Balneo and PRM Research Journal*
***2023**, 14(4): 624*

Academic Editor(s):
Constantin Munteanu

Reviewer Officer:
Viorela Bembea

Production Officer:
Camil Filimon

Received: 18.11.2023
Accepted: 04.12.2023
Published: 20.12.2023

**Reviewers:**
Gabriela Dogaru
Cristina Popescu

**Publisher's Note:** Balneo and PRM Research Journal stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Abstract:** Background: The aim of the paper is to assess the cognitive and functional status of a segment of the population for a senescent age group. These assessments can help develop intervention strategies to improve the cognitive and functional status of these individuals as well as promote a healthy and active lifestyle. The assessment of cognitive and functional status in a segment of the population during senescence can identify certain problems and deficiencies in cognitive and physical functioning and can help develop physical activities to optimize the cognitive and functional state of senescent people. Objectives: To identify the cognitive and functional profile of the studied age group; Pointing out risk factors for cognitive and functional deterioration; Suggesting physical activities to improve cognitive and functional status. Methods: The recorded data helps us develop personalized aquatic programs to improve health and physical performance, tailored to the individual needs of participants, to be used over 6 months in 2024. Results: The findings suggested by the collected data, recognises a significant link between subjects' body mass index and their physical test scores. Conclusions: Analysis of the data allows us to identify risk factors, including chronic conditions, adopted lifestyle, genetic influences or other environmental conditioning, that could contribute to cognitive and functional decline in the older population.

**Keywords:** estimation, cognitive, functional, population, aging process

## Introduction

The topic approached is extremely topical regarding the assessment of cognitive and functional status of people of senescent age. In this regard, current studies confirm that the global population is ageing, and this has a significant impact on society and health systems. Cellular senescence is a central component of the aging process. It has been found that this cellular response is induced by multiple forms of molecular lesions, and the number of senescent cells increases with age in all tissues examined to date [1]. Cellular senescence can compromise tissue repair and regeneration, thereby contributing to aging. Removing senescent cells can alleviate age-related tissue dysfunction and extend lifespan. Senescence may also act as a powerful anti-tumor mechanism by preventing the proliferation of potentially cancerous cells. It is a cellular program that acts as a double-edged sword, with both beneficial and harmful effects on the health of the body [2].

It is known that with age, inflammatory processes are triggered, and the level of IL-6 interleukins increases, being found in various pathologies associated with aging, such as Alzheimer's disease [3]. It is important to identify precise biomarkers that certify (or we can use, validate) the aging process, having utility in the development and successful application of therapies targeting age-related disorders [4].

Cellular senescence can be triggered by genome damage due to γ irradiation or metabolic imbalances that can be caused by a mitochondrial dysfunction [5]. In this context, we can say that evidence shows the role of senescent cells in the aging process, which includes the identification of senescent cells in aging tissues, such as skin, bones, cardiovascular system and brain [6]. Cellular senescence is a physiological mechanism by which a proliferative cell undergoes a stable cell cycle stop following damage or stress and causes a secretory phenotype. This highly dynamic and regulated cellular state plays beneficial roles in physiology, such as during embryonic development and wound healing, but may also have antagonistic effects in age-related pathologies, degenerative disorders, aging and cancer [7].

Cellular senescence is a common process in tissue remodelling, including wound repair and embryogenesis. However, prolonged senescence can be maladaptive, leading to cancer and age-related diseases. Cellular senescence involves cell cycle arrest and the release of inflammatory cytokines with autocrine, paracrine and endocrine activities. Senescent cells also show morphological changes: flattened cell bodies, vascularization and granularity in the cytoplasm and abnormal organelles [8].

Older adults were one of the populations that suffered most from the consequences of the COVID-19 pandemic. Social isolation, remoteness from relatives and friends, lack of social support, limited access to the health system had a negative impact on the health of older adults with comorbidities [9].

Functional status has a dramatic impact on life expectancy. For example, men and women aged 75 without limitations have a life expectancy of 5 years longer than those with ADL limitations and more than 1 year longer than those with mobility limitations [10]. The authors believe that older people want to live a active and independent life. Assessing cognitive and functional status can help identify factors that could disrupt this. Among these factors we find: natural aging, chronic diseases (cardiac, metabolic), sedentary lifestyle, addictive behaviors or addiction, depression and anxiety causing a decrease in quality of life [11]. It is important to identify these risk factors and take steps to reduce or eliminate them for healthy and independent ageing.

The study proposed by the authors is important and timely due to the increase in the number of people of young senescent age living with cognitive conditions such as Alzheimer's disease, dementia and other cognitive disorders. The incidence of cognitive impairment in elderly patients with multiple diseases is much higher compared to the elderly in general [12,13].

Study of Peng [14] points out that cognitive impairment can be reversible and based on assessments, as shown by Ruan's research [15], the risk of affecting elderly patients can be predicted. Because of this, assessing cognitive functions is crucial in diagnosing, monitoring and recovering them. Addressing functional status in older people is important and current due to the increasing number of people living with chronic or acute conditions that affect daily activities.

Deconditioning of the musculoskeletal, neuro-endocrine, cardiovascular, renal and digestive apparatus can negatively influence the functional status by limiting the effort capacity specific to senescent age. Understanding the relationship between impaired functional status and impaired cognitive function can help identify and develop specific interventions to prevent and manage cognitive deterioration at the same time. There are studies [16-18] that demonstrate that impaired physical function is associated with reduced cognitive performance.

Functionally impaired senescent people tend to avoid participating in social activities, creating interpersonal contacts, both activities having a role in mental and cognitive stimulation [19]. Authors (John, Shimada) [20,21] have suggested that functional status impairment caused by stress, other chronic or acute conditions, is a state of vulnerability plus possible cognitive impairment, representing an additional risk for senescent people. Thus, Marlon [22] believes that in the evaluation of elderly patients, in

addition to functional assessment elements, tests to assess a possible cognitive risk should be included.

Many neurodegenerative disorders increase in prevalence with age.

Therefore, the need for rehabilitation treatment in this segment of the population is very high, with functional loss being the most prominent condition for admission of elderly people to rehabilitation centers. Rehabilitation in the elderly is an important tool in regaining autonomy, associated with substantially reducing the burden of social and health costs [23].

Sarcopenia, the reduction in muscle mass and strength that occurs with aging, is considered one of the major causes of disability in older people. Surprisingly, criteria that could help a clinician identify people with impaired muscle function are still missing. Using data from a large representative sample of the general population, we examined how calf muscle function and surface area change with aging and affect mobility in men and women without neurological conditions [24].

In another study the authors reported that repeated physical activity can reduce the inflammatory process and oxidative stress, helping to maintain a normal weight and diminish visceral fat. WHO has developed a physical activity plan for 2018-2030 and has shown that physical activity is necessary to achieve prophylaxis of noncommunicable diseases associated with a reduced risk of cardiovascular disease. For an adult, 150 minutes/week of moderate-intensity physical activity or 75 minutes/week of high-intensity aerobic physical activity is recommended [25].

Multicomponent exercise programmes adapted to people's functional capacity are fundamental for maintaining mobility, musculoskeletal function and optimal function of other body systems (neurological, cardiovascular, respiratory, endocrine) [26]. In short, physical exercise throughout life can help mitigate the loss of many properties affected by aging, especially when the latter is accompanied by an inactive lifestyle and the benefits can also be obtained in fragile people who start exercising in old age. Multicomponent programmes combining mainly aerobic and resistance training should be included in older elderly [27]. Making individuals maintain adequate levels of physical activity throughout their lives could prevent declines in physical function, which would be of major importance for public health [28].

The findings of this systematic review and meta-analysis of randomized controlled trials show that exercise interventions improve physical function in older adults in residential care, regardless of their functional or cognitive status, including by improving functional independence for activities of daily living (e.g., higher scores in the Barthel index), as well as in various measures of muscle strength, physical performance, balance and flexibility [29].

Older people face various problems and require a multisectoral approach involving contributions from diverse disciplines in health, psychology, nutrition, sociology and social sciences [30]. In this context, applying weight loss programs used to improve disability and reduce pain can help reduce the values of inflammatory biomarkers [31]. In older age, the passage of time is linked to a large number of specific physical changes, such as gray hair, wrinkling of the skin, and changes in reproductive capacity, immune system response, and cardiovascular functioning. An interesting question about these physical changes is whether they are inevitable, natural consequences of aging.

In fact, research shows that some of the changes we consider normal aspects of aging are modifiable, preventable, and linked to lifestyle choices and cultural practices [32]. Life expectancy is accompanied by a higher incidence of multiple chronic conditions, despite unprecedented advances in prevention, diagnosis and treatment. Aging is the biggest risk factor for many life-threatening conditions, including cardiovascular disease, neurodegeneration and cancer [33].

## 1. Materials and Methods

The aim of the paper is to assess the cognitive and functional status of a segment of the population for a senescent age group. These assessments can help develop intervention strategies to improve the cognitive and functional status of these individuals as well as promote a healthy and active lifestyle. Hypothesis of the work: The assessment of cognitive and functional status in a segment of the population during senescence can identify certain problems and deficiencies in cognitive and physical functioning and can help develop physical activities to optimize the cognitive and functional state of senescent people

Objectives of the work: Identification of the cognitive and functional profile of the studied age group; Identifying risk factors for cognitive and functional deterioration; Proposing physical activities to improve cognitive and functional status.

Organization and conduct of the experiment: In order to assess cognitive and functional assessment that took place within the C. F. Suceava Ambulatory and Interdisciplinary Research Centre for Motricity Sciences and Human Health from Faculty of Physical Education and Sport, a sample of 30 people aged between 63 and 84 years was established. Height and weight data were collected to calculate their Body Mass Index (BMI) and to assess their physical performance.

Subjects underwent physical tests that included the standup test, the 6-minute walk test, and the 1kg weight lifting test. These tests were conducted to assess the subjects' muscular strength and endurance, as well as the test of cognitive abilities or mental functioning. The duration of the testing period was one week during September 2023. We suggest that this data can help us develop personalized health and physical performance improvement programmes, tailored to the individual needs of participants, to be used over 6 months in 2024.

The criteria for the proposed sample are as follows:

- Inclusion criteria: Age 60 to 85 years; Good health status; Adequate cognitive ability; Ability to exercise; Willingness and signed informed consent.
- Exclusion criteria: Age under 60 or over 85; Presence of a pathology or medical condition; Absence of signed informed consent.

In the study "Regular Aerobic Exercise Prevents and Restores Age-Related Declines in Endothelium-Dependent Vasodilatation in Healthy Men", [34] results indicate that regular aerobic exercise can prevent declines in endothelium-dependent vasodilation and restore levels in healthy middle-aged men and older, previously sedentary men. This may represent an important mechanism by which regular aerobic exercise reduces the risk of cardiovascular disease in this population [34]. Specific exercises can be proposed to improve the cognitive and functional state of study participants. These activities may include exercise programs, occupational therapy, social work, etc. In this regard, we propose a Model Intervention Program for improving cognitive and functional status through Aquagym recovery.

The rehabilitative aquarobics (aquagym) is a form of activity performed in water, offering numerous benefits and satisfactions regarding physical and mental health during senescence," water will be used at a temperature of between $32^0$ -$35^0$ C so as not to change the body's thermal balance. After the pre-warm-up that takes place at the edge of the pool through isometric exercises / stretching, we will continue with exercises in shallow water. In the first week, the exercises will take place face to face with the specialist guide and depending on the patient's tolerance, following the same principle of gradual increase of physical effort based of the complexity of aquatic activity" [35].

General objectives of the program: Increasing and maintaining joint mobility and flexibility; Optimizing cognitive abilities by stimulating blood flow to the brain, improving memory, concentration, etc.; Optimizing the emotional state by performing physical exercises releasing endorphins, hormones of happiness, which can reduce stress, anxiety

and depression; Cognitive stimulation through socialization and interaction with other participants.

Content: Walking through water: standing still, walking back and forth or walking in circles to improve blood circulation and work lower muscles; Buoyancy exercises for arms and legs; Stretching and flexibility exercises; Resistance and toning exercises; Balance exercises; Breathing and relaxation exercises. It is important to take into account and focus on the safety and adaptability of the exercises according to the individual needs and capabilities of each participant.

## 2. Results

For the interpretation and analysis of the data we used the mathematical-statistical method based on the following statistical indicators:

- Mean (X)- This measure is useful to understand the central level of the data and to make comparisons between different groups or datasets.
- Standard deviation (σ)-This indicator measures how much individual values differ from the mean of the data set. The higher the standard deviation, the more varied and dispersed the data.
- Coefficient of variation (CV%)- This represents the relative variability of the data and is useful in comparing the relative dispersion of different data sets. It allows comparison of variability between data sets that have different means, expressing variability as a percentage of the data set mean.
- The statistical calculation was carried out using Excel, which is a useful tool for performing statistical calculations and analysis in an efficient and accurate way.

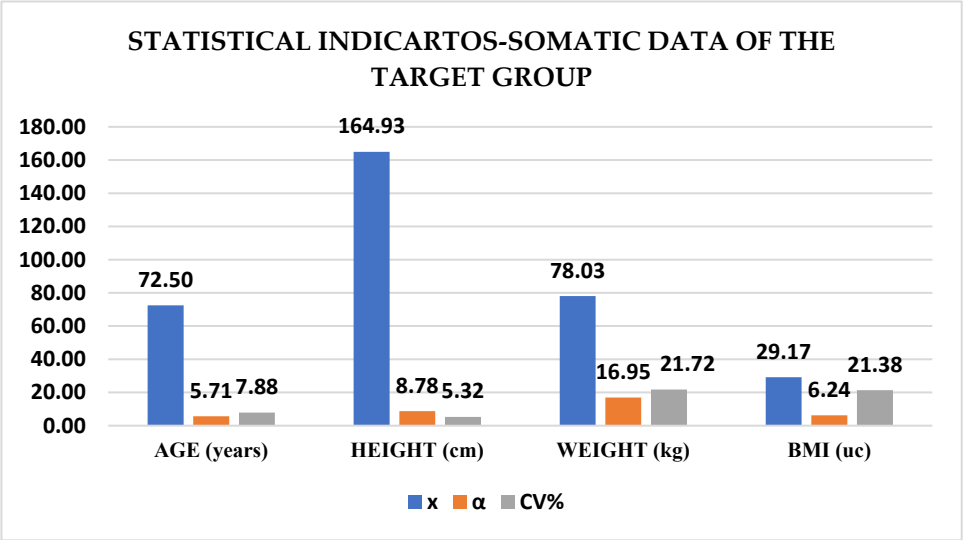


**Figure 1.** Calculation of statistical indicators concerning the average (X), standard deviation (α)and coefficient of variability (CV%)- Somatic data of the target group

The age range of the subjects is between 63 and 84 years, height ranges from 152 to 196 centimeters, weight is between 50 and 115 kilograms, and Body Mass Index (BMI) ranges from 19.53 to 40.75.

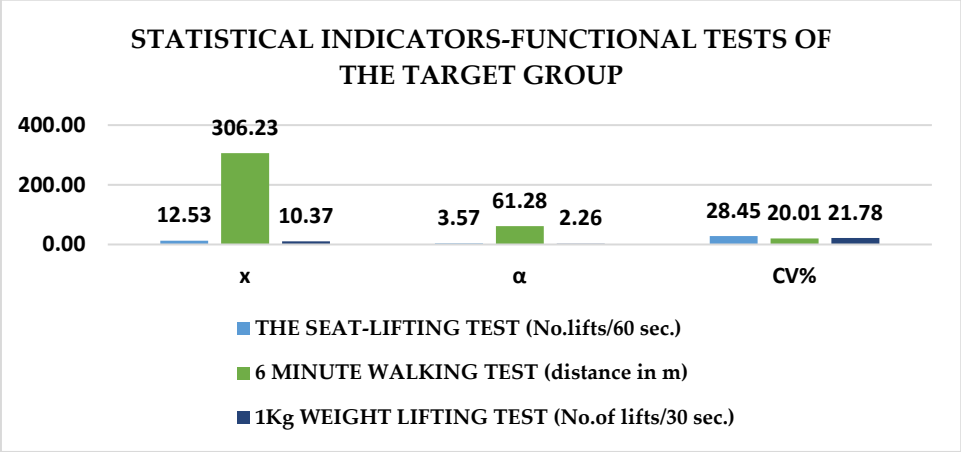


**Figure 2.** Calculation of statistical indicators concerning the average (X), standard deviation (α)and coefficient of variability (CV%)-Functional tests of the target group

Lifting test (no, Lifts/60 sec): Number of lifts performed in 60 seconds, with values between 7 and 22. 6-minute walking test (distance in m): Walking distance in 6 minutes, ranging from 220 to 480 meters. 1 kg weight lifting test (number of lifts/30 sec): Number of lifts performed in 30 seconds, with values between 7 and 15.

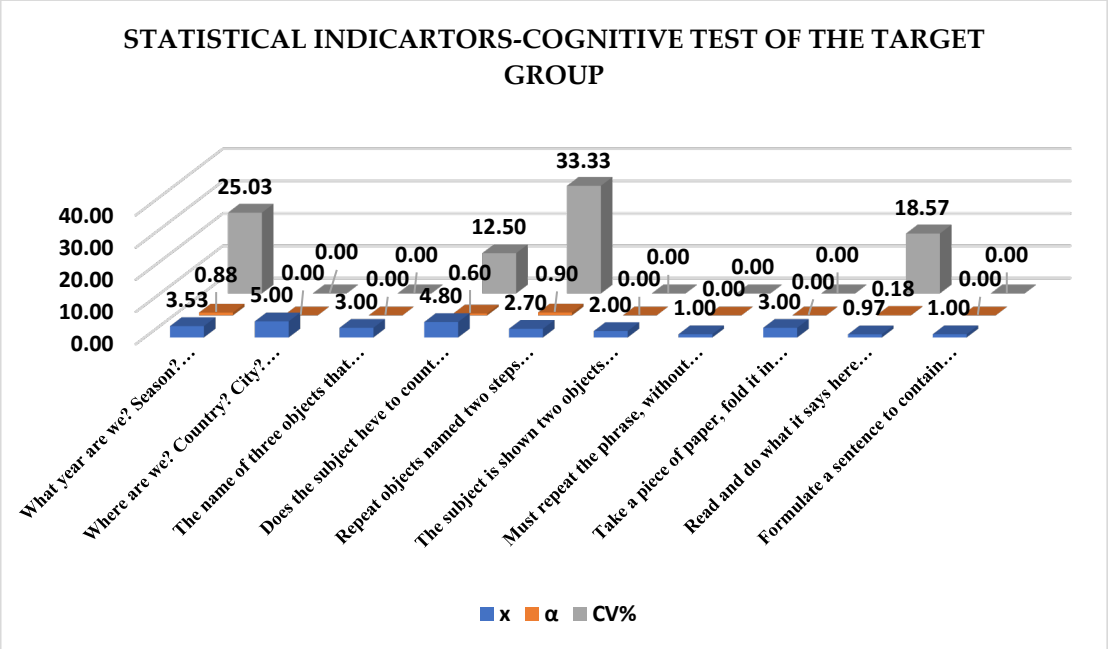


**Figure 3.** Calculation of statistical indicators concerning the average (X), standard deviation (α)and coefficient of variability (Cv%)- Cognitive test of the target group

These scores represent the subjects' performance on the test at the initial stage, and the value of each score may have specific significance in the context of the associated questions or tasks. There is a high consistency in the responses or performance of the subjects, since the values are almost identical for each subject (from 1 to 30). There was uniformity in the responses of the data, having almost all values identical for each subject.

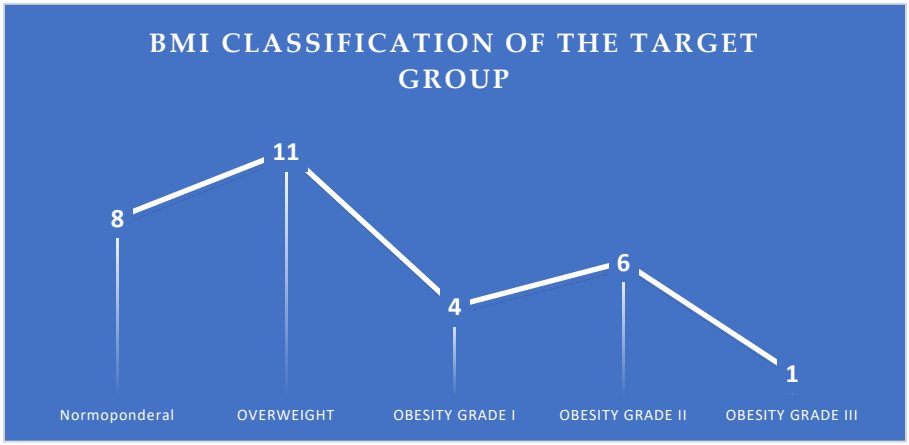


**Figure 4.** BMI classification of the target group

The data in Figure 4 show us how many people in the sample proposed for the study are in each weight category. Data shows that most people tested have tendencies towards overweight or obesity

**Table 1**. Correlation between physical tests and BMI

| Fitness Variable | Correlation with BMI |
|---|---|
| r- Lifting test (60 sec) and BMI | 0,21 |
| r- Distance (test de 6 min) and BMI | 0,11 |
| r- Weight lifting 1kg (30 sec) and BMI | -0,08 |

r- Lifting test (60 sec) and BMI(0.21)- correlation coefficient of 0.21 indicates a weak positive correlation between lifting test and BMI. This could mean that, in general, people with a higher BMI tend to score higher on the chair lift test, but the relationship is a weak one.
r- Distance (6 min test) and BMI (0.11)- the correlation coefficient of 0.11 indicates a positive and weaker correlation between the 6 min walk test and BMI. This may suggest that people with a higher BMI may tend to have slightly poorer results on the 6-minute walk test, but the relationship is very weak.
r- 1 kg weight lifting (30 sec) and BMI (-0.08)- the correlation coefficient is negative and very weak (-0.08).

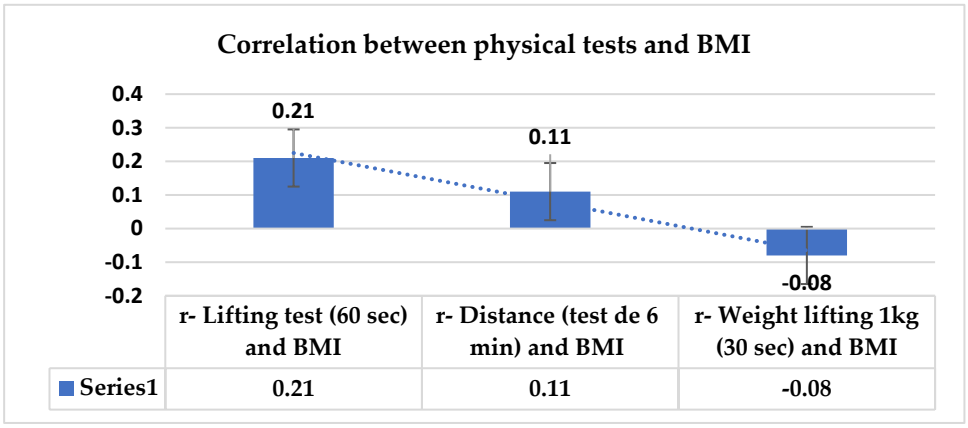


**Figure 5.** Correlation (r) between physical tests and BMI

This indicates a very weak and negative correlation between the 1 kg weight lifting test and BMI. There may be a very slight tendency for people with a higher BMI to perform slightly worse on this test, but the association is almost non-existent.

**Table 2.** Correlation between physical tests and cognitive test

| Fitness Variable | Correlation with cognitive test |
|---|---|
| r- Lifting test (60 sec) and cognitive test | 0,20 |
| r- Distance (6 min test) and cognitive test | 0,26 |
| r- Weight lifting 1kg (30 sec) and cognitive test | 0,23 |

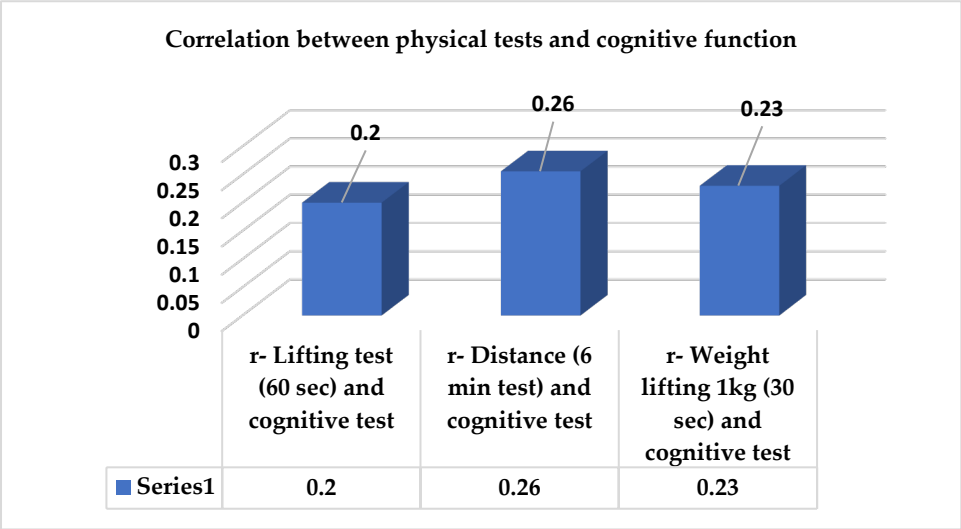


**Figure 6.** Correlation (r) between physical tests and cognitive function

These correlations indicate the degree of association between physical and cognitive performance on these tests. The values of the correlation coefficients are quite small, ranging from 0.20 to 0.26. This indicates a weak to moderate correlation between physical test scores and cognitive performance. Thus, there is an association, but it is not very strong between physical and cognitive test scores. It should be noted that the correlation does not always indicate a direct causal relationship between the two variables, but only a statistical association between them.

## 3. Discussion

Various research emphasise the importance of studying and understanding adults for developing a complete perspective on contemporary society. The objective [36] was assessing the impact of self-assessment of general, physical and mental health on functional decline and mortality in older adults. The findings indicate that self-assessment of overall health and specific dimensions of health are significant and independent predictors of functioning and mortality in this age group. In study [37] the author confirms that the methodical approach, based on objective measurements, address essential aspects of functionality, such as assessment of daily activities, cognitive status, mental health, social networks, mobility and risk of falls, nutrition, sensory impairments, etc. as well as "ensuring primary and secondary prevention is also increasingly important for older people". Authors [38] state that „ Static and dinamic balance are factors of major importance in the manifestation of human motor skills at a higher level". Exercise prevents

physical disability of elderly patients diagnosed with musculoskeletal disorders by retaining functional independence [39].

Elderly patients with functional impairment and requiring medical rehabilitation have altered nutritional, physical and psychological markers. If they also have cognitive impairment associated with anxiety, physical function is greatly influenced, which requires prompt management [40].

A study found an association between measures of physical function and cognitive performance among older South African adults, even among those with high levels of functioning. The authors believe that further investigation is needed to assess the extent to which exercise can improve functional capacity and its impact on cognitive performance [41].

According to another study, cognitive ability is found to predict not only physical function, but also how it changes in older people. Cognitive status appears to provide valuable information for assessing changes associated with the disability process - both in terms of functional limitations and disability. Findings about the increased interdependence between cognitive status and physical function over time also support the idea that cognitive function may play a more significant role in the disability process as we age [42].

Other studies have investigated the economic impact on cognitive function in adults. According to the authors' research there is an independent association between current economic status and cognitive function in adults over 60 [43].

Other authors longitudinally investigated the link between catastrophic cognitive decline and various aspects of functional status, including functional limitations that are rarely explored in recently published studies [44].

Through statistical analysis, a group of six clinical measures was identified that had the ability to predict cognitive function after one year among older adults. Other clinical measures that have been identified include 1) assessment of fall risk, 2) measurement of muscle strength, 3) analysis of cardiovascular function, and 4) assessment of physical activity level [45].

The findings of the studies underline the importance of regular cognitive and functional assessments of elderly population. The assessments can serve as crucial tools for risk evaluation and the development of appropriate care interventions. Also assessments bring a important contribution to maintaining and improving quality of life as people age.

## 4. Conclusions:

The data collected suggest that there is a significant association between subjects' BMI and their

performance in physical tests. More specifically, higher BMI is associated with an increased number of lifts and less exercise in the 6-minute test, compared to subjects who have a lower BMI.

The study points out risk factors that may contribute to cognitive and functional deterioration in

the older population. These factors may include chronic diseases, lifestyle, genetic or other environmental factors.

Based on the results obtained, physical activities can be proposed to improve the cognitive and

functional status of the subjects studied. Exercise programs will be carried out from the Aquagym recovery programme.

The study can identify risk factors that may contribute to cognitive and functional deterioration

among the senescent population. These factors may include chronic diseases, lifestyle, genetic or other environmental factors, „The adult woman has a complex of endocrine metabolic changes that can influence and cause various disorders in the body regarding

the decrease of functional and regulatory capacities. The involuntary changes in a woman's aging highlight both the appearance and the functionality" [46].

**Author Contributions:** "Conceptualization, V.E.; methodology, V.E.; software,V.E.; validation, V.E.; formal analysis, V.E.; investigation, C.M.; resources, C.A.I.; data curation, C.M.; writing—original draft preparation, C.A.I.; writing—review and editing, S.S.C.; visualization, V.E.; supervision, S.S.C; project administration, V.E.; funding acquisition, C.A.I.

The author have read and agreed to the published version of the manuscript."

**Institutional Review Board Statement**: "The study was conducted according to the guidelines of the Declaration of Helsinki, and ap-proved by the Institutional Review Board (or Ethics Committee) of „Stefan cel mare" University of Suceava (148/27.07.2023).".

**Informed Consent Statement:** All investigated peoples agreed to participate in the study.

**Acknowledgments:** The author of this work thanks the students of the Faculty of Physical Education and Sports from Suceava, for their involvement in the research carried out.

**Conflicts of Interest:** "The author declares no conflict of interest."

## References

1. Lawrence, I.; Bene, M.; Nacarelli, T.; Azar, A.; Cohen, Z. J.; Torres, C.; Johannes, G., Sell, C. Correlations between age, functional status, and the senescence-associated proteins HMGB2 and p16INK4a. Geroscience 2018, 40(2), 193-199.
2. Kumari, R; Jat, P. Mechanisms of Cellular Senescence: Cell Cycle Arrest and Senescence Associated Secretory Phenotype. Front Cell Dev Biol 2021, 9,645593
3. He, S; Sharpless, N.E. Senescence in health and disease. Cell 2017, 169(6),1000–1011.
4. Niedernhofer, L.J.; Kirkland, J.L.; Ladiges, W. Molecular pathology endpoints useful for aging studies. Ageing Res Rev 2017, 35, 241–249
5. Nacarelli, T.; Sell, C. Targeting metabolism in cellular senescence, a role for intervention. Mol Cell Endocrinol 2017, 5, 455:83– 92
6. Zhu, Y.; Armstrong, J.L.; Tchkonia, T.; Kirkland, J.L. Cellular senescence and the senescent secretory phenotype in agerelated chronic diseases. Curr Opin Clin Nutr Metab Care 2017 17(4), 324–328
7. González-Gualda, E.; Baker, A.G.; Fruk, L.; Muñoz-Espín, D. (2021), A guide to assessing cellular senescence in vitro and in vivo. FEBS J 2021, 288 (1),56-80.
8. Huang, W.; Hickson, L.J.; Eirin, A.; Kirkland, J. L.; Lerman, L.O. (2022). Cellular senescence: The good, the bad and the unknown. Nat Rev Nephrol. 2022, 18(10), 611–627.
9. Sardella, A.; Chiara, E.; Alibrandi, A.; Bellone, F.; Catalano, A.; Lenzo, V.; Quattropani, M.C.; Basile,B. Changes in Cognitive and Functional Status and in Quality of Life of Older Outpatients during the COVID-19 Pandemic. Gerontology 2022, 68 (11), 1285–1290.
10. Keeler, E.; Guralnik, J.M.; Tian, H.; Wallace, R.B.; Reuben, D.B. The impact of functional status on life expectancy in older persons. J Gerontol A Biol Med Sci 2010, 65(7), 727–733
11. Duica, L.; Szakács, J.; Silisteanu, S.C. Study on the correlation between knee osteoarthritis and anxiety in patients aged over 55. Balneo Research Journal 2020, 11(1), 95–104
12. Menzies, V.; Kelly, D.L.; Yang, G.S.; Starkweather, A.; Lyon, D.E. A systematic review of the association between fatigue and cognition in chronic noncommunicable diseases. Chronic Illn. 2021, 17(2),129–50.
13. Allan, C.L.; Behrman, S.; Ebmeier, K.P.; Valkanova, V. Diagnosing early cognitive frailty-When, how and for whom? Maturitas 2017, 96, 103–8
14. Peng, S.; Zhou, J.; Xiong, S.; Liu, X.; Pei, M.; Wang, Y.; Wang, X.; Zhang, P. Construction and validation of cognitive frailty risk prediction model for elderly patients with multimorbidity in Chinese community based on non-traditional factors. BMC Psychiatry 2023, 23, 266
15. Ruan, Q.; Yu, Z.; Chen, M.; Bao, Z.; Li, J.; He, W. Cognitive frailty, a novel target for the prevention of elderly dependency. Ageing Res Rev. 2015, 20, 1–10.
16. Ma, L.; Zhang, L.; Sun, F.; Li, Y.; Tang, Z. Cognitive function in prefrail and frail community-dwelling older adults in China. BMC Geriatrics 2019, 19(1)
17. Robertson, D.A.; Savv,a G.M.; Kenny, R.A. Frailty and cognitive impairment-a review of the evidence and causal mechanisms. Ageing Research Reviews 2013, 12(4),840–851

18. Yuan, Y.; Lapane, K.L.; Tjia, J.; Baek, J.; Liu, S.H.; Ulbricht, C.M. Physical frailty and cognitive impairment in older nursing home residents: a latent class analysis. BMC Geriatrics 2021, 21(1)
19. Peng, C.; Burr, J.A.; Yuan, Y.; Lapane, K.L. Physical Frailty and Cognitive Function among Older Chinese Adults: The Mediating Roles of Activities of Daily Living Limitations and Depression. J Frailty Aging 2023, 12(3), 156–165
20. St John, P.D.; Tyas, S.L.; Griffith, L.E.; Menec. V. The cumulative effect of frailty and cognition on mortality - results of a prospective cohort study. Int Psychogeriatr 2017, 29(4), 535–543
21. Shimada, H.; Makizako, H.; Lee, S.; et al. Impact of Cognitive Frailty on Daily Activities in Older Persons. J Nutr Health Aging 2016, 20(7), 729–735
22. Aliberti, M.J.R.; Cenzer, I.S.; Smith, A.K.; Lee, S.J.; Yaffe,K.; Covinsky, K.E. Risk Assessment of Adverse Outcomes for Older Adults: The Need to Include Both Physical and Cognitive Elements. J Am Geriatr Soc. 2019, 67(3), 477–483
23. Mureșan, D.A.; Stănescu, I.; Bulboacă, A.E.; Fodor, D.M.; Bulboacă, A.I. Perspectives of inpatient neurological rehabilitation in elderly patients. Balneo Research Journal 2019, 10(4), 495–501
24. Lauretani, F.; Russo,C.R.; Bandinelli,S.; Bartali, B.; Cavazzini, C.; Di Iorio, A.; Corsi, A.M.; Rantanen, T.; Guralnik, J.M.; Ferrucci, L. Age-associated changes in skeletal muscles and their effect on mobility: an operational diagnosis of sarcopenia. J Appl Physiol 2003, 95(5), 1851-60
25. Silisteanu, S.C. Impact of the COVID-19 pandemic on the physical and mental health of the elderly. Biomedical Engineering Applications for People with Disabilities and the Elderly in the COVID-19 Pandemic and Beyond. Elesevier 2022, 29, 335-345
26. Merchant, R.A.; Morley, J.E.; Izquierdo, M. Exercise, Aging and Frailty: Guidelines for Increasing Function. J Nutr Health Aging 2021, 25(4), 405–409
27. Valenzuela, P.L.; Castillo-García, A.; Morales, J.S.;Mikel Izquierdo,M.; Serra-Rexach, J.A.; Santos-Lozano, A.; Alejandro Lucia, A. Physical Exercise in the Oldest Old. Comprehensive Physiology 2019, 9(4), 1281-1304, 2019
28. Brach, J.S.; FitzGerald, S.; Newman, A.B.; et al. Physical Activity and Functional Status in Community-Dwelling Older Women: A 14-Year Prospective Study. Arch Intern Med. 2003, 163(21), 2565–2571
29. Valenzuela, P.L.; Saco-Ledo, G.; Morales, J.S.; Gallardo-Gómez, D.; Morales-Palomo, F.; López-Ortiz, S.; Rivas-Baeza, B.; Castillo-García, A.; Jiménez-Pavón, D.; Santos-Lozano, A.; del Pozo Cruz, B.; Lucia, A. Effects of physical exercise on physical function in older adults in residential care: a systematic review and network meta-analysis of randomised controlled trials. The Lancet Healthy Longevity 2023, 4(6), 247-256
30. Amarya, S.; Singh, K.; Sabharwal, M. (2018). Ageing Process and Physiological Changes. InTechOpen, Gerontology 2018, 1, 3-24
31. Silisteanu, S.C.; Silisteanu, A.E. The importance of physical exercise-bone mass density correlation in reducing the risk of vertebral and nonvertebral fracture in patients with osteoporosis. Balneo Research Journal 2018, 9(2), 64-68.
32. Morgan, L.A.; Kunkel, S.R.; Roy, S.; Bennett, C.R. Aging and Society. In Aging, Society, and the Life Course 2015, (pp. 1–22). Springer Publishing Company.
33. Ellison-Hughes, G.M. First evidence that senolytics are effective at decreasing senescent cells in humans. EbioMedicine 2020, 56, 102473
34. DeSouza, C.A.; Shapiro, L.F.; Clevenger, C.M; Dinenno, F.A.; Monahan, K.D.; Tanaka, H.; Seals, D.R. Regular aerobic exercise prevents and restores age-related declines in endothelium-dependent vasodilation in healthy men. Circulation 2000, 102(12):1351-7
35. Vizitiu, E.; Constantinescu, M.; Poraicu, C. Aquatic therapy in neuromotor recovery - case study. Balneo and PRM Research Journal 2022, 13(3), 516
36. Lee, Y. 2000, The predictive value of self assessed general, physical, and mental health on functional decline and mortality in older adults. Journal of Epidemiology and Community Health 2000, 54(2)
37. Devons, C.A.J. Comprehensive geriatric assessment: making the most of the aging years. Current Opinion in Clinical Nutrition and Metabolic Care 2002, 5 (1),19-24
38. Mocanu, G.D.; Onu, I. Differences in the manifestation of balance according to BMI levels for women students of the Faculty of Physical Education and Sports. Balneo and PRM Research Journal 2022, 13(3), 513
39. Stanton, T.R.; Karran, E.L.; Butler, D.S.; Hull, M.J.; Schwetlik, S.N. et al. A pain science education and walking program to increase physical activity in people with symptomatic knee osteoarthritis: a feasibility study. Pain Rep 2020, 5(5), 830.

40. Tolley, A.P.L.; Reijnierse, E.M.; Maier, A.B. Characteristics of geriatric rehabilitation inpatients based on their frailty severity and change in frailty severity during admission: RESORT. Mech Ageing Dev. 2022, 207, 111712
41. Ramnath, U.; Rauch, L.; Lambert, E.V.; Kolbe-Alexander, T.L. The relationship between functional status, physical fitness and cognitive performance in physically active older adults: A pilot study. PLoS ONE 2018, 13(4): e0194918.
42. Lee, Y.; Kim, J.H.; Lee, k.j.; Han, G.; Kim, J.L. Association of cognitive status with functional limitation and disability in older adult. Aging Clin Exp Res 2005, 17(1):20-8.
43. Zhang, M.; Gale, S.D.; Erickson, L.D.; Brown, B.L.; Woody, P.; Hedges, D.W. Cognitive function in older adults according to current socioeconomic status. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn 2015, 22(5):534-43
44. Nicolova, R.; Demers, L.; Béland, F. Trajectories of cognitive decline and functional status in the frail older adults. Archives of Gerontology and Geriatrics 2009, 48(1):28-34
45. Bolandzadeh, N.; Kording, K.; Salowitz, N.; Davis, J.C.; Hsu, L.; Chan, A.; Sharma, D.; Blohm, G.; Liu-Ambrose, T. Predicting Cognitive Function from Clinical Measures of Physical Function and Health Status in Older Adults. PLoS One 2015, 10(3) :e0119075
46. Vizitiu, E.; Constantinescu, M. Study on the impact of the therapeutic swimming on elderly women diagnosed with osteoporosis. Balneo and PRM Research Journal 2022, 13 (1), 495