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Assessment of Nutritional Status and Physical fitness among older adults: a pilot study

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Abstract

Introduction. With global aging trends, understanding the nutritional status and physical fitness of older adults is crucial for promoting healthy aging and independence. **Aim.** The aim of this study was to assess nutritional status, physical fitness, and demographic parameters among older adults. **Material and Methods.** Using reliable assessment tools, data were collected from 40 participants aged 60 years and above. Assessments included the Mini Nutritional Assessment (MNA), Timed Up & Go Test (TUG), and Handgrip Strength Test (HGS). Statistical analyses were conducted to explore correlations and differences. **Results.** Most participants exhibited normal nutritional status (n = 38; 95%) and generally normal mobility and handgrip strength. However, no significant correlations were found between nutritional status, physical fitness, and demographic factors. **Conclusions.** While the majority

demonstrated favorable health indicators, some individuals were at risk of malnutrition and functional limitations. Surprisingly, age did not correlate significantly with nutritional status or physical fitness. Further research with larger cohorts and sensitive assessment tools is needed to elucidate these relationships fully.

Keywords: nutritional status; physical fitness; Mini Nutritional Assessment (MNA); Timed Up & Go test (TUG); Handgrip Strength Test (HGS)

Introduction

Ongoing demographic changes lead to a significant rise in the population of elderly individuals and an increase in life expectancy. Aging is the inherent, time-dependent decline of physiological organ function which increases the risk for many medical disorders for older adults, reducing the quality of their life and even leading to death. Given that aging is linked to a higher risk of functional decline, the global goal is to maintain functional and cognitive abilities so that most older people can live independently, in their homes, for as long as possible [1], [2]. Decreased Physical fitness (PF) metrics like maximum aerobic power, vital capacity, and muscle strength and power are also associated with aging, leading to decreased: muscle mass and physical function, as well as cognitive impairment. Those declines have an adverse effect on one's capability to carry out daily tasks like cleaning, shopping and personal care [3] [4]. Physical Fitness is acknowledged as a health indicator and is thought to be an autonomous factor for all-cause diseases. Physical fitness is also impacted by several factors such as nutritional habits, smoking habits, genetics, and socioeconomic status [5]. Although diet has been proven to be crucial to an older person's health, it is frequently neglected hence leading to increased vitamin and mineral deficiencies. Poor nutrition in addition to prevalent age-related disorders has been linked to a higher risk of morbidity and mortality [4] . Numerous studies indicate the combination of a healthy diet and physical exercise seems to be the key to Healthy Ageing and should be the main focus of geriatric rehabilitation [2], [3], [5], [6], [7].

Aim

The aim of this study was to assess nutritional status, physical fitness and demographic parameters among older adults.

Materials and methods

The study was conducted on the premises of the Sports and Leisure Centre (OSiR) in Solec Kujawski, Recruitment of participants for the survey was achieved through media, lectures in clubs and senior citizens' homes, and the encouragement of OSIR guests. This research study obtained the approval of The Bioethics Committee of the Nicolaus Copernicus University functioning at Collegium Medicum in Bydgoszcz (KB 4/2024, 30.01.2024). Before conducting the survey, all participants received information explaining the entire survey process. After making sure all of them were familiar with the process, the potential participants were able to decide whether they agreed to participate in the research. Participants then signed a consent form to confirm their participation. The study included participants who provided written consent for participation, were aged 60 years or above, and demonstrated physical and mental capability to perform basic activities associated with daily

functioning. Exclusion criteria encompassed patients with residual paralysis or disabilities following stroke incidents, advanced Parkinson's disease, or severe physical or mental conditions hindering study participation. The interview questionnaire did not require disclosure of sensitive data. Participants retained the option to withdraw from the study at any stage without repercussions. With the main goal being to assess their nutritional status and physical fitness. Moving on to the actual part of the study, a self-authorized questionnaire in the form of a face-to-face interview was used to gather baseline data on sociodemographic information, physical fitness, and nutritional status of the participants. Then to evaluate the nutritional status of the patients The Mini Nutritional Assessment (MNA) was used as a reliable screening and assessment tool for identifying nutrition risk in elderly individuals (and hence to permit early nutritional intervention) [8] [9] . Next, to assess physical fitness the Timed Up & Go Test was used as a reliable and valid method for quantifying functional mobility and risk of fall in (frail) older individuals. Individuals are asked to stand up from a standard chair, walk straight for 3 m, turn around, walk back to the chair, and sit down again [10] [11] . Lastly, the Handgrip strength test was used to indicate an individual's overall strength and pieces of information regarding nutritional status and muscle mass, physical function, and health status. It is predictive of morality, hospital length of stay and physical function [12].

The following statistical methods were used for the analysis:

Descriptive statistical analysis - basic measures of descriptive statistics to characterize the distribution of quantitative variables.

Frequency analysis - percentage distributions of qualitative variables.

Shapiro-Wilk test - test of normality of the distribution of a quantitative variable.

Pearson's correlation coefficient (r-Pearson) - a coefficient allowing the assessment of the strength and direction of the linear relationship between two variables.

Levene's test - test of homogeneity of variance.

Mann-Whitney test - a non-parametric test for the significance of differences between two groups.

A significance level of $\alpha = 0.05$ was adopted (results with $p < 0.05$ are considered statistically significant). The analysis was conducted using the Excel program and the statistical package Jamovi.

Results

The study involved $N = 40$ participants. The basic demographic data are presented in Table I.

Table I. ***Characteristics of Study Participants***

	N	*n* (%)
Gender	40	
Female		31 (77.5%)
Male		9 (22.5%)
Educational background	40	
Primary education		5 (12.5%)
Secondary education		12 (30.0%)
Vocational education		14 (35.0%)
Higher education		9 (22.5%)
Occupation Past/Present	40	
Manual worker		21 (52.5%)
Knowledge worker		11 (27.5%)
Office worker		7 (17.5%)
Self-employment		1 (2.5%)
Place of residence	40	
Country		10 (25.0%)
City of up to 100, 000 inhabitants		29 (72.5%)
City of more than 100 000 inhabitants		1 (2.5%)

The results were sorted in descending order:

- Gender: 'Female' (*n* = 31; 77.5%), 'Male' (*n* = 9; 22.5%),
- Educational background: 'Vocational education' (*n* = 14; 35.0%), 'Secondary education' (*n* = 12; 30.0%), 'Higher education' (*n* = 9; 22.5%), 'Primary education' (*n* = 5; 12.5%),
- Occupation Past/Present: 'Manual worker' (*n* = 21; 52.5%), 'Knowledge worker' (*n* = 11; 27.5%), 'Office worker' (*n* = 7; 17.5%), 'Self-employment' (*n* = 1; 2.5%),
- Place of residence: 'City of up to 100, 000 inhabitants' (*n* = 29; 72.5%), 'Country' (*n* = 10; 25.0%), 'City of more than 100 000 inhabitants' (*n* = 1; 2.5%).

Basic descriptive statistics for selected variables are presented in Table 2.

Table II. ***Descriptive data of the sample***

Variable	*N*	*M*	*SD*	*Me*	Min.	Max.	Skewness	Kurtosis
Age	40	68.53	4.624	69.00	60.00	78.00	0.04	-0.66
Height cm	40	163.47	9.307	163.00	141.00	188.00	0.36	0.17
Weight kg	40	72.84	16.200	70.00	45.00	110.00	0.62	-0.22

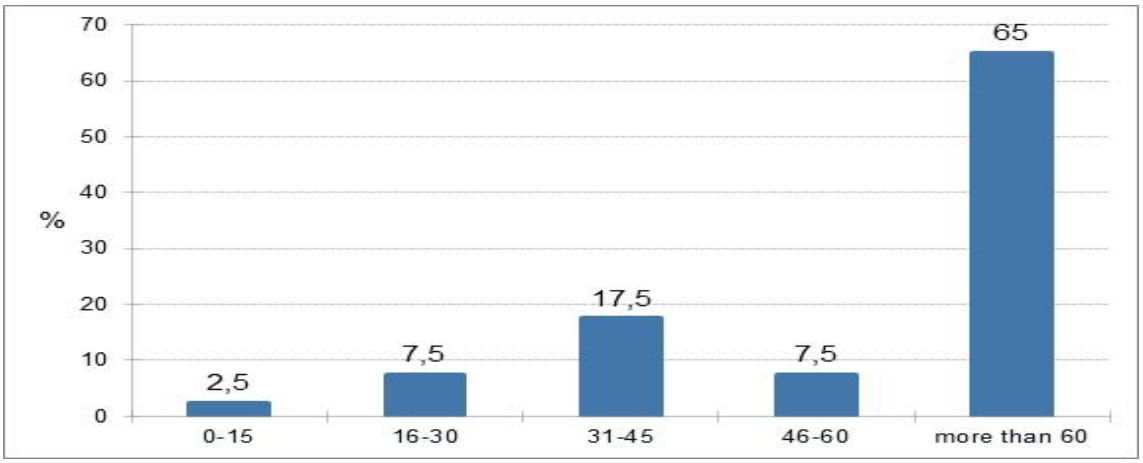
N - number of valid observations, *M* – mean, SD - standard deviation, *Me* – median, Min - minimum value, Max - maximum value.

In the study group, the mean values for the respective variables were:
'Age' *M* = 68.53 (*SD* = 4.52), 'Height cm' *M* = 163.48 (*SD* = 9.307), 'Weight kg' *M* = 72.84 (*SD* = 16.200).

Survey Results

Results obtained for the question: 'Everyday physical activity minutes' are presented in Figure 1.

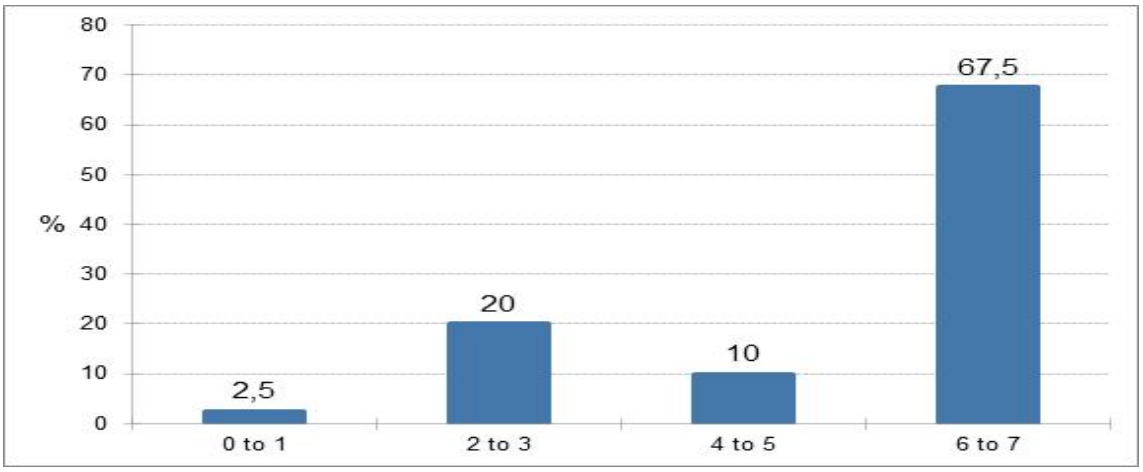
Figure 1. ***Percentage distribution of responses to the question: 'Everyday physical activity minutes', (n = 40).***



Participants in the study mostly (n = 26; 65%) declared that their daily physical activity exceeds 60 minutes. The remaining participants indicated their physical activity as follows: '31-45' (n = 7; 17.5%), '16-30' (n = 3; 7.5%), '46-60' (n = 3; 7.5%), or '0-15' minutes (n = 1; 2.5%).

Results obtained for the question: 'Physical activity days per week' are presented in Figure 2.

Figure 2. ***Percentage distribution of responses to the question: 'Physical activity days per week', (n = 40)***



The majority of study participants (n = 27; 67.5%) reported engaging in physical activity for 6 to 7 days per week. The remaining respondents reported engaging in such activity for '2 to 3' days (n = 8; 20%), '4 to 5' days (n = 4; 10%), or '0 to 1' day (n = 1; 2.5%).

Basic descriptive statistics for the variable 'Prescription drugs per day' are presented in Table III.

Tabela III. ***Basic Descriptive Statistics for the variable 'Prescription drugs per day'***

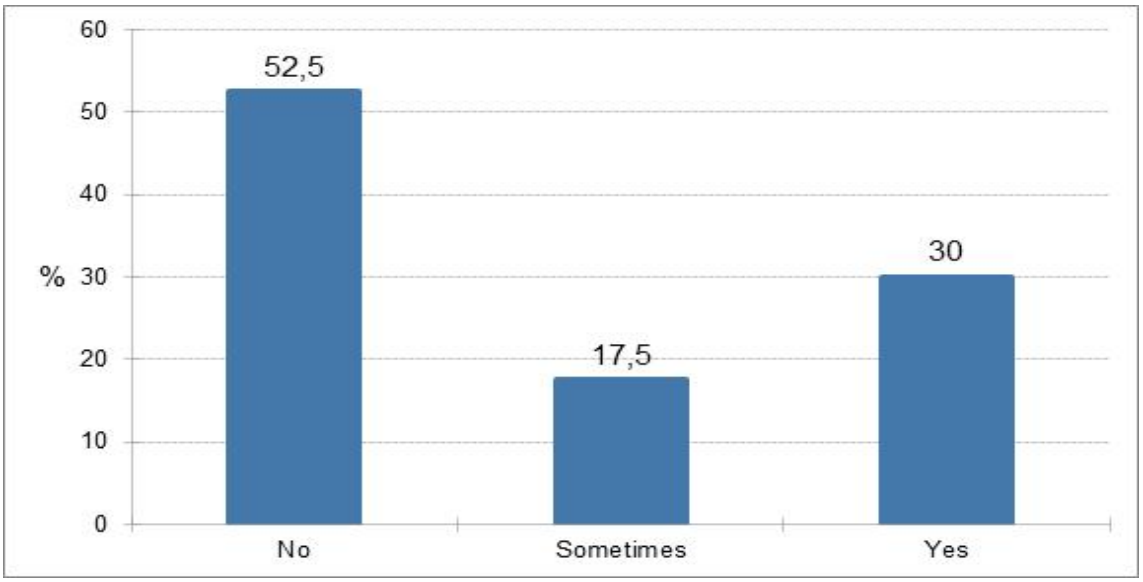
Variable	*N*	*M*	*SD*	*Me*	Min.	Maks.	Skewness	Kurtosis
Prescription drugs per day	40	2.95	2.810	2.00	0.00	12.00	1.27	1.17

N - number of valid observations, *M* – mean, SD - standard deviation, *Me* – median, Min - minimum value, Max - maximum value.

In the examined group, the mean value for the variable 'Prescription drugs per day' was M = 2.95 (SD = 2.810).

Results obtained for the question: ‘Discomfort or pain during everyday activities’ are presented in Figure 3.

Figure 3. ***Percentage Distribution of Responses to the Question: 'Discomfort or pain during everyday activities', (n = 40)***



The majority of respondents (n = 21; 52.5%) denied experiencing discomfort or pain during daily activities. 30% of the respondents (n = 12) answered affirmatively, while the remaining respondents occasionally experienced such discomfort (n = 7; 17.5%).

Basic descriptive statistics for the variable 'Physical ability self-rating 1-10 (where 1 is very bad and 10 is excellent)' are presented in Table IV

Table IV. ***Basic Descriptive Statistics***

Variable	*N*	*M*	*SD*	*Me*	Min.	Max.	Skewness	Kurtosis
Physical ability self-rating 1-10 (where 1 is very bad and 10 is excellent)	40	7.80	1.114	8.00	5.00	9.00	-0.92	0.08

N - number of valid observations, *M* – mean, SD - standard deviation, *Me* – median, Min - minimum value, Max - maximum value.

In the study group, the mean value for the variable 'Physical ability self-rating 1-10 where 1 is very bad and 10 is excellent' was M = 7.80 (SD = 1.114).

Basic descriptive statistics for the Hand Grip Strength Test variables are presented in Table V.

Table V. ***Basic Descriptive Statistics***

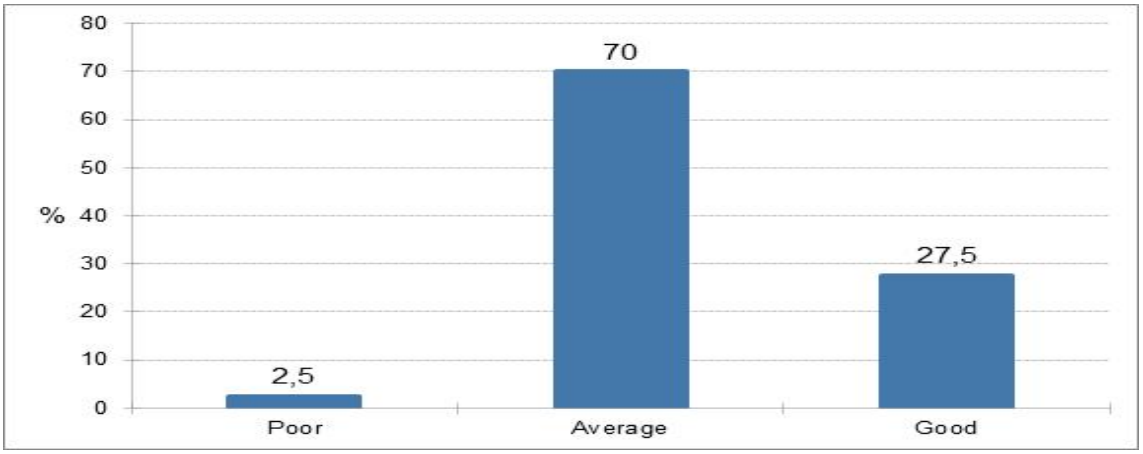
Variable	*N*	*M*	*SD*	*Me*	Min.	Max.	Skewness	Kurtosis
HGS - Dominant	40	25.68	6.770	25.00	15.00	40.00	0.34	-0.97
HGS - Right	40	25.45	6.638	25.00	15.00	38.00	0.28	-1.16
HGS - Left	40	25.02	7.407	25.00	13.00	41.00	0.43	-0.77

N - number of valid observations, *M* – mean, SD - standard deviation, *Me* – median, Min - minimum value, Max - maximum value.

In the study group, the mean values for the respective variables were: 'HGS - Dominant' M = 25.68 (SD = 6.770), 'HGS - Right' M = 25.45 (SD = 6.638), 'HGS - Left' M = 25.02 (SD = 7.407).

Results obtained for the 'Handgrip strength test evaluation for the dominant hand' are presented in Figure 4.

Figure 4. ***Percentage Distribution for the: 'Handgrip strength test evaluation dominant', (n = 40)***



The majority of study participants (n = 28; 70%) achieved average grip strength in their dominant hand. 27.5% of the participants achieved good grip strength (n = 11; 27.5%). Only 1 person (2.5%) had weak grip strength in the tested hand.

Basic descriptive statistics for ‘Timed Up & Go (sec) and MNA (scores)’ are presented in Table VI.

Table VI. ***Basic Descriptive Statistics***

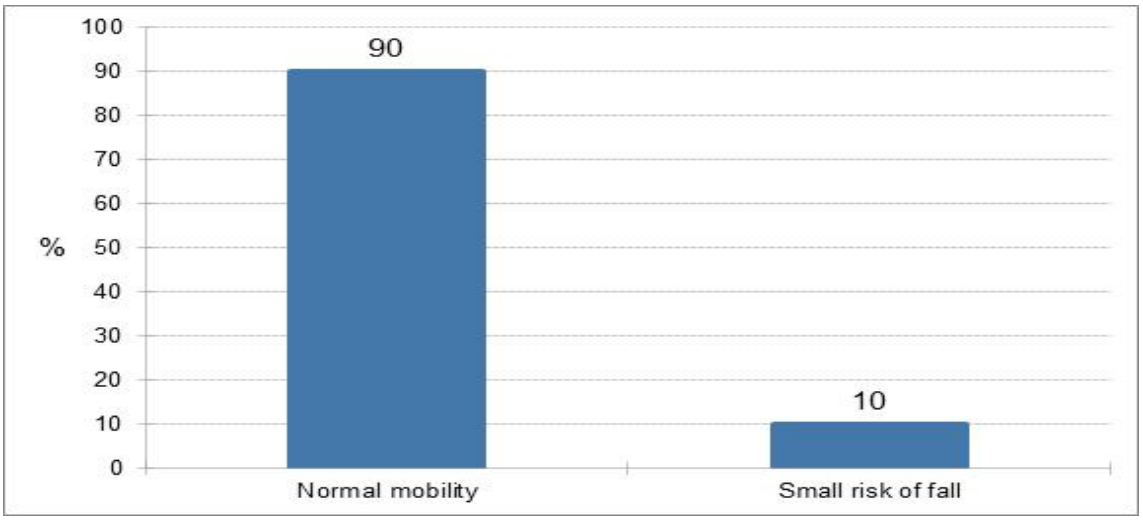
Variable	*N*	*M*	*SD*	*Me*	Min.	Max.	Skewness	Kurtosis
TUG- Timed Up & Go (sec)	40	7.41	2.320	6.80	4.80	17.90	2.54	8.22
MNA scores	40	26.86	2.075	27.25	20.50	30.00	-1.17	1.53

N - number of valid observations, *M* – mean, SD - standard deviation, *Me* – median, Min - minimum value, Max - maximum value.

In the study group, the mean values for the respective variables were: 'TUG- Timed Up & Go (sec)' M = 7.41 (SD = 2.320), 'MNA scores' M = 26.86 (SD = 2.075).

Percentage Distribution of the 'Timed Up & Go Test (evaluation)' results are presented in Figure 5.

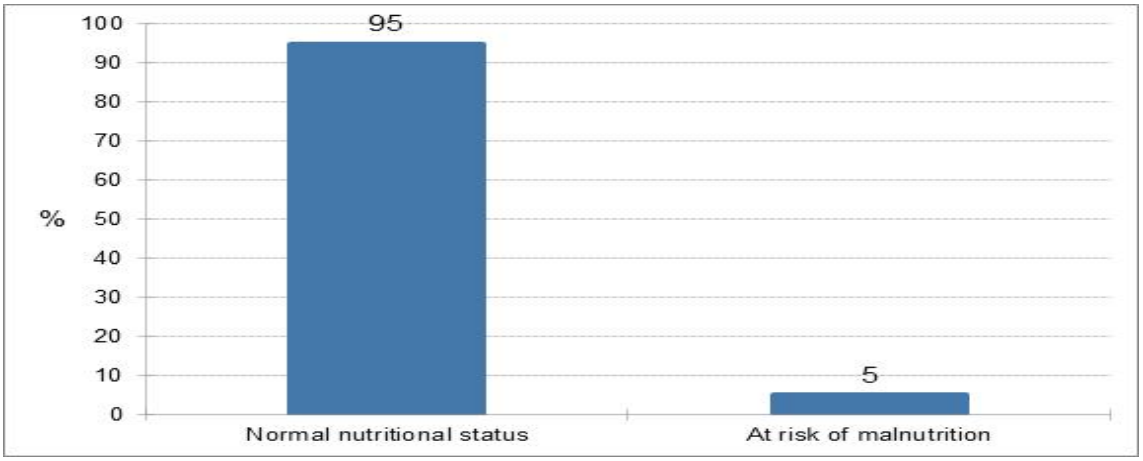
Figure 5. ***Percentage Distribution of Responses to the Question: 'TUG norm', (n = 40)***



The vast majority of participants (n = 36; 90%) obtained TUG test results indicating normal mobility. The remaining study participants (n = 4; 10%) obtained results suggesting a low risk of falls.

Percentage Distribution of the 'Malnutrition Indicator Score' according to the results of the MNA are presented in Figure 6.

Figure 6. ***Percentage Distribution of the: 'Malnutrition Indicator Score', (n = 40)***



The vast majority of study participants (n = 38; 95%) obtained results indicating normal nutritional status. The remaining participants obtained results suggesting a risk of malnutrition (n = 2; 5%).

Results of statistical tests

Hypothesis 1: There is a statistically significant correlation between age and nutritional status as assessed by the MNA among individuals over 60 years old -The obtained results indicate the rejection of the hypothesis, as there is no significant correlation between MNA and age.

Results of Pearson's r Correlation Analysis (MNA & Age)

To determine the strength and direction of the relationship between the variable 'Age' and the variable 'MNA-Malnutrition Indicator Score', Pearson's linear correlation coefficient (r-Pearson) was used. The results are presented in Table VII.

Table VII. ***Results of Pearson's r Correlation Analysis***

				95% CI		
Variable 1	Variable 2	*n*	*r*	Lower	Upper	*p*
Age	MNA scores	40	-0.04	-0.35	0.27	0.789

The results of Pearson's r Correlation Analysis do not indicate a significant relationship between age and MNA scores.

Hypothesis 2: There is a statistically significant difference in the results of the "Timed Up & Go" test depending on the nutritional status assessed by MNA in individuals over 60 years of age.

Unfortunately, there are only two results different from the norm. Therefore, it is difficult to conduct a meaningful comparison. Under the test results, correlation results are also included.

Comparison of Two Groups (Independent Variable: 'MNA norm')

Descriptive Statistics

Basic descriptive statistics regarding the variable 'HGS Dominant', divided according to the variable 'MNA-Malnutrition Indicator Score ', are presented in Table VIII.

Table VIII. ***Descriptive Statistics - Division by 'MNA norm'***

	MNA	*N*	*M*	*SD*	*Me*	Min.	Maks.	*IQR*
HGS Dominant	Normal nutritional status	38	25.72	6.566	25.00	15.00	40.00	9.50
	At risk of malnutrition	2	24.75	13.789	24.75	15.00	34.50	9.75

N - number of valid observations, *M* – mean, SD - standard deviation, *Me* – median, Min - minimum value, Max - maximum value, *IQR* - interquartile range

Table IX. To assess the normality of the distribution of the variable 'HGS Dominant', the Shapiro-Wilk test was used. The obtained results are presented in Table IX.

Shapiro-Wilk Test Results for Normality of Distribution

Variable	*W*	*p*
HGS Dominant	0.96	0.121

The Shapiro-Wilk test result indicates the normality of the distribution of the variable 'HGT Dominant'.

Tabel X. To test the equality of variances between the compared groups, the Levene test was used. The obtained results are presented in Table X.

Levene Test Results for Equality of Variances

Zmienna/ Variable	*F*	*df1*	*df2*	*p*
HGS Dominant	2.65	1	38	0.112

The Levene test result indicates equality of variances between the compared groups in terms of the variable 'HGT Dominant'.

Mann-Whitney U Test Results

To determine the significance of differences between the two groups ('HGS Dominant' - dependent variable; 'MNA norm' - independent variable), the Mann-Whitney U test was used. The obtained results are presented in Table XI.

Table XI. ***Mann-Whitney U Test Results - Significance of Differences Between Two Groups (Independent Variable: 'MNA norm')***

				95% CI	
Zmienna/ Variable	*U*	*p*	r_{rb}	Lower	Upper
HGS Dominant	42.50	0.804	0.12	-0.61	0.74

The Mann-Whitney U test results do not indicate a significant difference between the compared groups in terms of the variable 'HGS Dominant'.

MNA Correlation with Dominant Hand - No Significant Correlation

Results of Pearson's r Correlation Analysis (MNA & HGS)

To determine the strength and direction of the relationship between the variable 'MNA scores' and the variable 'HGS Dominant', Pearson's linear correlation coefficient (r-Pearson) was used. The obtained results are presented in Table XII.

Table XII. ***Results of Pearson's r Correlation Analysis***

				95% CI		
Variable 1	Variable 2	*n*	*r*	Lower	Upper	*p*
MNA scores	HGS Dominant	40	0.12	-0.2	0.41	0.468

The results of Pearson's r Correlation Analysis do not indicate a significant relationship between MNA scores and HGS Dominant.

Hypothesis 3: There is a statistically significant difference in the results of the Handgrip Strength Test depending on the nutritional status assessed by MNA in individuals over 60 years of age.

Similarly as above, there are only two results different from normal nutritional status, which makes it difficult to conduct a meaningful analysis. Below this analysis, correlation results are also included.

Comparison of two groups (independent variable: 'MNA norm')

Descriptive statistics

Basic descriptive statistics for the variable 'TUG- Timed Up & Go (sec)', divided by the variable 'MNA norm', are presented in TableXIII.

Table XIII. ***Basic Descriptive Statistics - Division by the variable 'MNA norm'***

	MNA	*N*	*M*	*SD*	*Me*	Min.	Maks.	*IQR*
TUG Timed Up & Go (sec)	Normal nutritional status	38	7.14	1.619	6.77	4.80	11.86	1.92
	At risk of malnutrition	2	12.50	7.637	12.50	7.10	17.90	5.40

N - number of valid observations, *M* – mean, SD - standard deviation, *Me* – median, Min - minimum value, Max - maximum value, *IQR* - interquartile range

Table XIV. To assess the normality of the distribution of the variable 'TUG- Timed Up & Go (sec)', the Shapiro-Wilk test was used. The obtained results are presented in Table XIV.

Results of the Shapiro-Wilk normality test distribution

Variable	*W*		*p*
TUG Timed Up & Go (sec)	0.91	**	0.004

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The Shapiro-Wilk test result indicates a lack of normality in the distribution of the variable 'TUG Timed Up & Go (sec)'.

Table XV. To test the equality of variances of the compared groups, the Levene's test was used. The obtained results are presented in Table XV.

Results of the Levene's test for equality of variances

Variable	*F*		*df1*	*df2*	*p*
TUG - Timed Up & Go (sec)	25.93	** *	1	38	<0.001

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The Levene's test result indicates a lack of equality of variances between the compared groups in the variable 'TUG- Timed Up & Go sec'.

Mann-Whitney test results

To determine the significance of differences between the two groups ('TUG -Timed Up & Go (sec)' - dependent variable; 'MNA norm' - independent variable), the Mann-Whitney test was used. The obtained results are presented in Table XVI.

Table XVI. ***Results of the Mann-Whitney test - the significance of differences between two groups (independent variable: 'MNA norm')***

				95% CI	
Variable	*U*	*p*	r_{rb}	Lower	Upper
TUG - Timed Up & Go (sec)	15.00	0.163	-0.61	-0.91	0.13

The Mann-Whitney test results do not indicate a significant difference between the compared groups in terms of the variable 'TUG -Timed Up & Go (sec)'.

MNA and TUG correlation - lack of significant correlation.

Pearson's r correlation analysis results (MNA & TUG)

To determine the strength and direction of the relationship between the variable 'MNA scores' and the variable 'TUG Timed Up & Go sec', Pearson's linear correlation coefficient r was used. The obtained results are presented in Table XVII.

Table XVII. ***Results of Pearson's r correlation analysis***

				95% CI		
Variable 1	Variable 2	*n*	*r*	Lower	Upper	*p*
MNA (scores)	TUG - Timed Up & Go (sec)	40	-0.23	-0.5	0.09	0.155

Pearson's r correlation analysis results do not indicate a significant relationship between MNA scores and the time to perform the TUG test.

Discussion

The goal of this study was to assess the nutritional status and physical fitness of older adults, with an additional focus on understanding the relationships between these variables and demographic parameters such as age.

The study opts for the Mini Nutritional Assessment (MNA) due to its widely recognized effectiveness in identifying malnutrition risk in older populations [13], [14] . With high sensitivity (≥ 80%) and good specificity (≥ 60%), as validated in various settings, including community dwellings, the MNA offers a reliable means to evaluate nutritional status [13], [14], [15], [16], [17] . Additional advantages are that it demonstrates reproducibility, simplicity, user-friendliness, and affordability [18], [19].

In terms of nutritional assessment, this study revealed that the majority of participants (n = 38; 95%) exhibited normal nutritional levels according to MNA scores, indicating overall favorable nutritional status. However, a small percentage of participants (n = 2; 5%) were identified as being at risk of malnutrition, highlighting the importance of vigilant monitoring and intervention in older populations. While this study did not find a significant correlation between MNA scores and age among older adults, other studies have reported varying findings indicating a decline in nutritional status with advancing age [20], [21], [22]. However, according to the systematic review for risk factors in malnutrition based on longitudinal data by (Moreira et al, 2016), there are studies that indicate that age as an isolated factor is not always confirmed as a risk factor for malnutrition [23], [24], [25] . Rather than age, frailty which is defined as a clinically recognizable state of increased vulnerability resulting from aging-associated decline in reserve and function across multiple physiologic systems [26], is suggested as a significant factor contributing to malnutrition in older individuals. [23], [27], [28]

Moving on to physical fitness, our results from the Timed Up & Go Test and Hand Grip Strength Test indicated generally normal mobility levels and handgrip strength among participants. While studies by Ramsey K et al, Woods J et al and Fatyga-Katoula et al have reported significant correlations between TUG and malnutrition, in this study did not find such a correlation [29], [30], [31] . The case was similar regarding the relationship between MNA and HGT, whilst no significant correlation was confirmed in this study, we know from previous studies that lower HGS values tend to be associated with malnourished patients [32],

[33]. Overall, the combination of limited variation in nutritional status, a relatively lower age bracket within the elderly population (M = 68.53), and an active lifestyle among participants likely contributed to the absence of significant correlations observed in this study [34]. Further research with more diverse samples and consideration of additional factors influencing nutritional status and physical fitness may provide deeper insights into these complex relationships.

Conclusions

In summary, the study's primary goal to assess nutritional status and physical fitness revealed promising overall health indicators among participants, but there were still some individuals at risk of malnutrition and experiencing discomfort during daily activities. These findings emphasize the critical role of ongoing assessment and regulation of nutritional status and physical fitness in geriatric rehabilitation and the enhancement of overall well-being among older adults.

The study did not firmly establish expected relationships between these variables and demographic factors in older adults. [35]. These results underscore the need for further research with larger and more diverse cohorts to gain deeper insights into the multifaceted dynamics between nutritional status, physical fitness, and demographic parameters. Additionally, employing more sensitive assessment tools and considering additional variables may offer a more nuanced understanding of these complex associations.

Disclosures

Author's contribution:

Conceptualization**:** Konstantinos Kyriakos, Radosław Perkowski.

Methodology: Konstantinos Kyriakos, Radosław Perkowski.

Software: Konstantinos Kyriakos.

Check: Konstantinos Kyriakos, Radosław Perkowski.

Formal analysis: Radosław Perkowski.

Investigation: Konstantinos Kyriakos, Radosław Perkowski.

Resources: Konstantinos Kyriakos, Radosław Perkowski.

Data curation: Konstantinos Kyriakos, Radosław Perkowski.

Writing - rough preparation: Konstantinos Kyriakos, Radosław Perkowski.

Writing - review and editing: Konstantinos Kyriakos, Radosław Perkowski.

Visualization: Konstantinos Kyriakos, Radosław Perkowski.

Supervision: Radosław Perkowski.

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