Turkish Journal of Geriatrics
DOI: 10.29400/tjgeri.2024.397
2024; 27(3):239−247

Melike MERCAN BAŞPINAR[1]
Aysel GÜDEN[2]
Mustafa ÇALIK[3]
Osman MAVİŞ[2]
Sadettin KAMAT[4]
Hakan BAŞAR[5]

CORRESPONDANCE
[1]Melike MERCAN BAŞPINAR
Phone : +905433403942
e-mail : drmelikemercan@gmail.com

Received : Jun 04, 2024
Accepted : Jul 26, 2024

[1] University Health Sciences Gaziosmanpaşa Training and Research Hospital, Family Medicine, ISTANBUL, Turkey

[2] University Health Sciences Gaziosmanpaşa Training and Research Hospital, Internal Medicine, ISTANBUL, Turkey

[3] University Health Sciences Gaziosmanpaşa Training and Research Hospital, Emergency Medicine, ISTANBUL, Turkey

[4] University Health Sciences Gaziosmanpaşa Training and Research Hospital, Pulmonary Diseases, ISTANBUL, Turkey

[5] University Health Sciences Gaziosmanpaşa Training and Research Hospital, Orthopedics and Traumatology, ISTANBUL, Turkey

ORIGINAL ARTICLE

DETERMINATION OF MALNUTRITION, FRAILTY, POLYPHARMACY, MULTIMORBIDITY, AND MORTALITY RISK IN HOSPITALIZED ELDERLY COVID-19 PNEUMONIA CASES WITH AND WITHOUT POSSIBLE SARCOPENIA

Abstract

Introduction: To evaluate elderly COVID-19 pneumonia hospitalizations via the presence of possible sarcopenia, hand grip strength measurements, malnutrition, frailty, polypharmacy, multimorbidity, mortality risk and 30th-day mortality after discharge.

Materials and Method: This observational study included geriatric patients in the COVID ward of Gaziosmanpasa Training and Research Hospital between March 1, 2022, and April 30, 2022. SARC-F screening test, hand grip strength measurement, CALL score for mortality risk, KATZ Index of Independence in activities of daily living, Mini Nutritional Assessment-Short Form, BORG dyspnea scale, and Frail scale were administered. 30th-day mortality after discharge was recorded during follow-up using phone calls.

Results: Distribution of 75 cases aged 76.6±8.2 years was as follows: 65.3% (n =49) possible sarcopenia, 49.3% (n =37) malnutrition, 49.3% (n =37) polypharmacy,70.7% (n =53) multimorbidities. 30th-day after-discharge mortality was 24.0% (n =18). The length of hospital stay, activities of daily living, frailty, D-dimer level, albumin, and oxygen requirement were significant in the possible sarcopenia group compared to non-sarcopenia group (p =0.003, p = 0.012, p =0.012, p =0.007, p =0.004, and p =0.015, respectively). Impaired hand grip strength was related to a higher CALL risk score (r =-0.343; p =0.003), higher drug use and disease counts (r =-0.387, p =0.001 and r =-0.321; p =0.005), prolonged length of hospital stay (r=-0.315; p=0.006), and higher oxygen requirement (r =-0.240, p =0.038).

Conclusion: COVID-19 pneumonia hospitalizations of geriatric patients are significantly accompanied by possible sarcopenia. The measurement of hand grip strength was emphasized to determine associations with the length of hospital stay, malnutrition, and 30th-day discharge mortality of hospitalized COVID-19 pneumonia in the elderly.

Keywords: Pneumonia; COVID-19; Sarcopenia; Frail Elderly; Malnutrition; Mortality.

INTRODUCTION

Sarcopenia is characterized by the acute or chronic loss of muscle mass and function due to a primary cause (ageing) or secondary etiology (chronic diseases, low protein intake, immobilization, etc.) (1). Muscle strength is easy to measure, and it is recommended for routine use when measuring hand grip strength related to possible sarcopenia (PS) (2). The prevalence of sarcopenia varies with location and definition; however, it is estimated to be up to 29% of older persons in the setting of community healthcare and 14%–33% for those in long-term care (3).

Social isolation and curfew restrictions during the COVID-19 pandemic in older adults led to decreased daily physical activity, accelerating the loss of muscle strength and function (4). In addition, because of the pandemic lockdown, it was difficult to evaluate sarcopenia as a significant risk factor for pneumonia in older adults. Decreased grip strength indicates a general loss of muscle mass and strength, including the respiratory and oropharyngeal muscles. Furthermore, cases of aspiration pneumonia linked to low muscle mass are associated with notably high rates of mortality (5). Respiratory muscle strength regulates the effectiveness of coughing to clear the airways, thereby preventing pneumonia (6). The CALL score has been observed to be strongly related to in-hospital mortality as a complementary diagnostic measure for treatment planning for COVID-19 pneumonia in a study by Akıllı et al. (7). Therefore, we preferred to use the CALL score to determine mortality risk during hospital stay.

The focus on older adults in this study stems from their heightened risk for both pneumonia and sarcopenia. The COVID-19 pandemic has exacerbated health challenges for this vulnerable group, with COVID-19 pneumonia presenting significant risks. Hand grip strength is a crucial measure of muscle strength and serves as a valuable tool for understanding and managing these health issues. This analysis explores the relationship between PS, COVID-19 pneumonia, and the utilization of hand grip strength as a predictive and diagnostic tool in the elderly. While previous studies have shown that sarcopenia is linked to prolonged hospital stays, increased mortality, and a higher need for ICU admission in COVID-19 patients, there is a lack of publications on PS. This study aims to identify PS, which is assessed quickly through hand grip strength in hospital wards. Secondly, it was aimed to assess malnutrition, frailty, polypharmacy, multimorbidity, mortality risk and 30th-day mortality after discharge in hospitalized elderly COVID-19 pneumonia cases with and without PS.

MATERIALS AND METHOD

Study design

This study was conducted as an observational study.

Sample and setting

The study population included patients older than 65 years old who were hospitalized in the COVID-19 ward of Gaziosmanpasa Training and Research Hospital. Two months after the study started recruiting patients, the pandemic ward of hospital was closed and new cases were redirected to other designated pandemic centers. As a result, the study included hospitalized patients from the final two months before the ward closure, specifically from March 1 to April 30, 2022. Consequently, the optimal sample size was not calculated, and all patients who met the inclusion criteria were enrolled.

The inclusion criteria for the study were as follows: hospitalization with COVID-19 infection, age over 65 years, and ability to cooperate with tests and computerized tomography. Patients were excluded if they had pretibial edema, amputation, severe dehydration, dialysis, uncontrolled thyroid function test results, rheumatic disease, nervous system diseases related to atrophies or demyelinating diseases, history of stroke, history

of chronic steroid use (≥ 5 mg/day for >3 months), diagnosis of chronic heart failure, diagnosis of severe chronic obstructive pulmonary disease which corresponds to clinical features of GOLD Stage 3 and GOLD Stage 4 or severe chronic asthma requiring systemic corticosteroid related to high frequency of exacerbations, or who were followed up with cancer or cancer treatment.

All measurements and laboratory tests were performed on the first day of hospitalization. During hospitalization, laboratory findings such as C-reactive protein (CRP), procalcitonin, leukocyte count, lymphocyte count, fibrinogen, lactate dehydrogenase, D-dimer, ferritin, albumin, and hemoglobin were analyzed. Patients were contacted by phone on the 30th day of hospital discharge during post-COVID follow-up. The total length of hospital stay and mortality were recorded.

Instruments

The researchers prepared a questionnaire consisting of sociodemographic data, SARC-F test, Mini Nutritional Assessment Short Form (MNA-SF), KATZ Index of Independence in Activities of Daily Living (ADL), Frail Scale (FS), and Modified BORG Scala. A face-to-face questionnaire was administered to older adults via face-to-face under mask protection. Dominant hand grip strength was measured three times with a calibrated digital hand dynamometer (CAMRY EH101 dynamometer 90 KG / 200 LBS, Certificate Standard: ISO 9001:2008, Issued By: SGS United Kingdom LTD) while the arms of the patients were parallel to the floor. The highest strength value among the three measurements was noted. The mortality risk was assessed using the CALL score.

Sarcopenia detection: PS was diagnosed with a SARC-F screening test score of over 4 points and confirmed with low hand grip strength. Muscle grip strength cut-offs were 16 kg for females and 27 kg for males, and those lower than these values were accepted. According to the criteria revised and published by the European Working Group on Sarcopenia in the Elderly (EWGSOP) in 2018, sarcopenia was diagnosed by evaluating muscle strength, muscle quantity or quality, and physical performance. When low muscle strength is detected using the SARC-F test and hand grip strength, it is evaluated as possible sarcopenia and low physical performance is considered severe sarcopenia (8). Since muscle mass measurement and sarcopenia severity evaluation, which are the third step according to EWGSOP criteria, could not be performed due to the isolation conditions, only the diagnosis of PS could be determined.

Mini Nutritional Assessment Short Form (MNA-SF): The risk of malnutrition was assessed using the MNA-SF, which consists of six items: involuntary weight loss, loss of appetite, mobility, psychological stress, neuropsychological problems (i.e., dementia), and low BMI. Based on the total score, individuals were identified as well-nourished (≥ 12 points), at risk of malnutrition (8–11 points), or malnourished (< 8 points) (9).

KATZ Index of Independence in Activities of Daily Living (ADL): KATZ ADL is a widely used tool to assess the level of independence in older adults by scoring 0 or 1 point on bathing, dressing, toileting, transferring, continence, and feeding questions (10).

Frail Scale: The Frail Scale was developed in 2004 by Morley et al.(11). A Turkish validity and reliability study was conducted by Hymabaccus et al. in 2017.The scale examines the variables of fatigue, resistance (inability to climb one floor of stairs), ambulation (difficulty in walking more than one block), illness (≥ five comorbid diseases), and weight loss (loss of ≥5% of actual weight). Scores ≥3 are accepted as frail, and scores 1-2 mean prefrail (12).

Modified BORG Scala (0-10 points): Modified BORG Scala describes dyspnea between 0-10 points to predict respiratory muscle weakness (13). While not specifically designed for infections like COVID-19, the Modified Borg Scale can still be a

useful tool in evaluating perceived breathlessness and exertion in COVID-19 patients. Since respiratory function tests could not be performed on hospitalized patients in this study, this test was preferred due to its simple applicability.

CALL Score: Scoring systems have been developed for COVID-19 disease progression, one of which is the CALL score by Ji et al., which was derived based on patient comorbidities (C), age (A), lymphocyte count (L), and serum lactate dehydrogenase (LDH) levels (L) at admission (7,14). Advanced age (>60 years), high LDH levels, and low lymphocyte counts are high-risk factors for the progression of COVID-19, and the CALL score contributes to its prediction (14).

Statistical Analysis

The data obtained from the study were analyzed in the SPSS 24 package program (IBM SPSS, New York, USA). Descriptive data are presented as means, medians, standard deviation values, frequencies, and interquartile range tables according to normality results via the Kolmogorov-Smirnov test and histograms. For statistical analysis of the data, the Chi-square test was used to compare groups, and F or T-tests were used to compare numeric data. Logistic regression analysis was performed to control for confounding variables that were found to be significant in the univariate analyses.

Ethical Considerations

This study was approved by the Ethics Committee of the University of Health Science Gaziosmanpasa Training and Research Hospital (decision no:16.02.2022-29) and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

RESULTS

This study included 75 hospitalized elderly participants with COVID-19 pneumonia, consisting of 29 females (38.7%) and 46 males (62.3%). The average age of the participants was 76.6±8.2 years, ranging from 65 to 91 years. Comorbidity distribution was as follows: 53 participants (42.4%) had hypertension, 32 participants (25.6%) had diabetes mellitus, and 14 participants (11.2%) had asthma or chronic obstructive pulmonary disease (COPD) except cases with severe degree asthma/COPD before admission. The health status of the patients showed that 37 (49.3%) had malnutrition, 49 (65.3%) had PS, 37 (49.3%) had polypharmacy, 53 (70.7%) had multimorbidity, and 18 (24.0%) had a mortality rate within 30 days after discharge. Detailed sociodemographic data, initial laboratory test results, and comparisons between groups with and without PS are presented in Table 1. Relationships between hand grip strength and various study characteristics are shown in Table 2. Factors affecting 30-day post-discharge mortality were analyzed using logistic regression, as displayed in Table 3.

As shown in Table 1, the mean age, distribution of sex, education, income level, average COVID vaccine dose counts, and previous COVID disease history were statistically similar between groups with and without PS ($p = 0.299$, $p = 0.306$, $p = 0.094$, $p = 0.221$, $p = 0.735$, $p = 0.443$, respectively). During hospitalization, 79.6% of the PS group and 21.8% of the non-sarcopenia group received steroid treatment; however, there was no significant difference in steroid use between the groups ($p = 0.903$). In addition, 30th day mortality was similar in group with and without steroid use ($p = 0.787$) as similar results between CALL risk score with comparison of with and without steroid use ($p = 0.451$)

18.4% of PS group and 3.8% of non-sarcopenia group were admitted to the intensive care unit (ICU) ($p=0.078$). The average CALL mortality risk score was 9.65±1.82, with the PS group having a significantly higher score than the non-sarcopenia group (9.98±1.63 vs 9.04±2.03; $p=0.006$). Two

Table 1. The sociodemographic data, initial laboratory test results of the study participants and comparison of groups with and without probable sarcopenia

Characteristics	Total (n=75) (n,%)	Probable Sarcopenia (n=49, 65.3%) (n,%)	Non-Sarcopenia (n=26, 34.7%) (n,%)	P value
Age (years) (mean ± SD)	76.6±8.2	77.4±7.9	75.2±8.8	0.299
Sex (female)	29 (38.7%)	21 (42.9%)	8 (30.8%)	0.306
Education (illiterate)	17(22.7%)	14 (28.6%)	3 (11.5%)	0.094
Income (low)	39 (52.0%)	28 (57.1%)	11 (42.3%)	0.221
COVID vaccine dose (mean ± SD)	2.16±1.31	2.12±1.32	2.23±1.31	0.735
Previous COVID disease history	12 (16%)	9 (18.4%)	3 (11.5%)	0.443
30th-day discharge mortality	18 (24.0%)	16 (32.7%)	2 (7.7%)	**0.015***
CALL score (mean ± SD)	9.65±1.82	9.98±1.63	9.04±2.03	**0.006***
Multimorbidity	53 (70.7%)	37 (75.5%)	16 (61.5%)	0.190
Drug count (median, IQR)	4 (11)	4 (5)	5 (7)	0.541
Polypharmacy (≥5 drugs)	37 (49.3%)	23 (46.9%)	14 (53.8%)	0.569
Steroid use for COVID treatment	60 (80.0%)	39 (79.6%)	21 (21.8%)	0.903
Length of hospital stay (median, IQR)	8 (9)	10 (12)	6 (4)	**0.003***
Intensive care unit (ICU) admission during hospital stay	10 (13.3%)	9 (18.4%)	1 (3.8%)	0.078
KATZ ADL (median, IQR)	14 (6)	14 (6.5)	18 (12)	**0.012***
MNA-SF (median, IQR)	8 (5)	7 (5.5)	8 (4)	0.108
MNA-SF (≤7 points)	37 (49.3%)	27 (55.1%)	10 (38.5%)	0.170
FS (median, IQR)	3 (4)	4 (1)	3 (3)	**0.012***
Frailty (3-5 points)	60 (80.0%)	43 (87.8%)	17 (65.4%)	**0.021***
Hemoglobin (g/dL) (mean ±SD)	12.21±7.87	10.88±2.01	14.72±12.87	**0.044***
Leukocyte ($\times10^3$ / µL) (mean ± SD)	10.84±4.65	10.66±5.40	11.18±2.79	0.584
Lymphocytes, ($\times10^9$ /) (mean ± SD)	1.32±1.17	1.26±1.34	1.42±0.76	0.520
Fibrinogen (mg/dL) (median, IQR)	492 (246)	496 (268)	487 (220)	0.867
INR (mean ± SD)	1.22±0.48	1.28±0.58	1.10±0.17	0.134
Lactate dehydrogenase (U/L) (median, IQR)	284 (167)	320 (153)	275 (166)	0.570
D-dimer (mcg FEU/Ml) (median, IQR)	1260 (1210)	1500 (1434)	925 (1035)	**0.007***
Ferritin (mcg/L) (median, IQR)	297 (354)	267 (441)	300 (218)	0.929
Albumine (g/dL) (mean ± SD)	32.72±4.88	31.66±5.16	34.73±3.58	**0.004***
C-reactive protein (mg/dL) (median, IQR)	79 (121)	79 (105)	74.5 (136.5)	0.911
Procalcitonin (ng/mL) (median, IQR)	0.22 (0.57)	0.22 (0.93)	0.21 (0.52)	0.197
Borg scale (median, IQR)	4 (5)	4 (5)	2.5 (5.5)	0.646
SpO2 on admission (median, IQR)	89 (31)	89 (7)	91.5 (11)	0.141
O2 requirement, L/per min (median, IQR)	3 (15)	4 (6)	1 (4)	**0.015***

DL, activities of daily living; FS, Frailty Scale; IQR, interquartile range; MNA-SF, mininutritional assessment-short form; n, number; SD, Standard deviation., *p<0.05 significant

Table 2. Correlation between Hand Grip Strength and other characteristics of the study

Characteristics	Hand Grip Strength	
	Correlation Coefficient (r)	P value
Age	-0.371	**0.001***
Drug count	-0.387	**0.001***
Additional disease count	-0.321	**0.005***
COVID-19 CALL score	-0.343	**0.003***
SARC-F score	-0.552	**<0.001***
BORG score	-0.082	0.485
FS score	-0.361	**0.001***
KATZ ADL score	0.578	**<0.001***
MNA-SF score	0.388	**0.001***
Length of hospital stay (day)	-0.315	**0.006***
Albumine (g/dL)	0.100	0.392
D-dimer (mcg FEU/Ml)	-0.234	**0.043***
Hemoglobin (g/dL)	0.205	0.077
Steroid dose	-0.027	0.816
O2 requirement, L/per	-0.240	**0.038***

FS, Frailty Scale; ADL, activities of daily living; MNA-SF, mininutritional assessment-short form, *p<0.05 significant

Table 3. Regression analysis of risk factors on 30th-day mortality after discharge (Nonsurvivor)

Characteristics	OR	95% CI	P value
Hand Grip Strength	0.990	0.888-1.103	0.856
Probable Sarcopenia	2.997	0.383-23.439	0.296
COVID-19 CALL score	1.300	0.783-2.158	0.310
FS score	0.945	0.400-2.234	0.898
KATZ ADL score	1.136	0.936-1.379	0.197
MNA-SF score	1.107	0.823-1.490	0.502
Length of hospital stay	0.948	0.875-1.027	0.190
Intensive care unit (ICU) admission (+) during hospitalization	57.496	4.488-736.645	**0.002***

Model: Hand Grip Strength, Probable Sarcopenia, COVID-19 CALL score, FS (Frailty Scale) score, KATZ ADL (Activities of daily living) score, MNA-SF (Mini nutritional assessment-short form) score, Length of hospital stay, Intensive care unit (ICU) admission (+); OR, odds ratio ; CI,Confidence Interval , *p<0.05 significant

patients (one with PS and one without PS) died during their hospital stay.

The 30-day post-discharge mortality rate was 32.7% in the PS group and 7.7% in the non-sarcopenia group (p=0.015). Malnutrition was detected in 55.1% of the PS group compared to 38.5% in the non-sarcopenia group (p=0.170). The PS group also had significantly lower KATZ ADL scores and a higher frequency of frailty (p=0.012 and p=0.021, respectively).

Laboratory test results indicated that lower hemoglobin (Hg) and albumin levels, as well as higher D-dimer levels, were significantly associated with PS (p=0.044, p=0.004, and p=0.007, respectively). Additionally, the O2 requirement in the PS group was significantly higher (p=0.015). As shown in Table 2, stronger hand grip strength was correlated with KATZ ADL and MNA-SF scores (r =0.578; p <0.001 and r =0.388; p =0.001). However, lower hand grip strength was associated with a higher CALL mortality risk score (r =-0.343; p =0.003), higher drug and disease counts (r = -0.387; p =0.001 and r =-0.321; p =0.005), longer length of stay (r =-0.315; p =0.006), and higher amount of O2 requirement (r =-0.240; p =0.038).

In Table 3, the presence of ICU requirement showed a 57.5-fold higher risk of 30th-day mortality after discharge (Odds ratio =57.496; 95% Confidence Interval= 4.488-736.645; p =0.002).

DISCUSSION

The goals of this study were to investigate the presence of PS, emphasizing the importance of hand grip strength as a valuable tool, and to assess malnutrition, frailty, polypharmacy, multimorbidity, mortality risk scores, and laboratory test results in elderly patients hospitalized with COVID-19 pneumonia. The prevalence of PS was 65.3% and was associated with a higher mortality risk score. Impaired hand grip strength was related to a higher mortality risk score, increased drug use and disease counts, prolonged length of stay, and higher O2 requirements. Additionally, ICU admission during the hospital stay was identified as a significant risk factor for predicting 30-day mortality after discharge.

The prevalence of sarcopenia in patients with COVID-19 studies varies from 0.8 to 90.2%, and the pooled prevalence is 48.0% (15). Akıllı and Bilge reported that the CALL score was strongly related to in-hospital mortality due to COVID-19 (7). The CALL score was used to assess the predicted 30th day mortality of hospital discharge between the groups with and without PS in our study. Both CALL scores and frequency of 30th-day mortality after discharge in the present study were higher in the presence of PS.

The oxygen therapy requirement of patients with COVID-19 has shown different amounts of need during activities of daily living rehabilitation according to Tham et al. (16). Showering activity, which requires higher muscle strength and the longest duration of supplemental oxygen weaning, proved to be the rate-limiting ADL for discharge home (16). In our study, activities of daily living based on the KATZ score were impaired, and the frequency of frailty was higher in the PS group than in the non-sarcopenia group. Low ADL was related to lower hand grip strength, higher need for O2 support, and prolonged hospital stay.

Pucci et al. demonstrated that hand grip strength was a predictor of the risk of future adverse outcomes in patients hospitalized for COVID-19, independent of the etiology of muscular impairment (17). Low grip strength is also associated with impaired nutrition (18). Grip strength, including swallowing and chewing abilities, is essential for maintaining a balanced oral nutrient intake (18). Although no significantly increased risk of COVID-19 was observed in patients with malnutrition and sarcopenia in the study by Lengele et al. (19), COVID-19 in medical units dedicated to non-intensive care is associated with a high prevalence of malnutrition, especially for patients transferred from the ICU (20). Low grip strength in detecting sarcopenia may be both a cause and outcome of malnutrition. Uemura et al. showed that the low serum albumin alone, sarcopenia alone, and sarcopenia/low serum albumin groups had a higher risk of disability than the non-sarcopenia/normal serum albumin group (21). In our study, the frequency of malnutrition by MNA-SF scores was 49.3% and was higher in the PS group, based on the

distribution of 55.1% in the PS group versus 38.5% in the non-sarcopenia. There was a relationship between nutrition scores and handgrip strength values although no relationship was found between albumin level and handgrip strength. Therefore, we thought that MNA might be a better marker than albumin level for determining hand grip strength.

Gulec-Balbay et al. predicted mortality risk in hospitalized elderly patients with COVID-19 pneumonia related to corticosteroid use, especially pulse corticosteroid therapy (22). In our study, frequency of corticosteroid use was 79.6% in PS group and 21.8% in the non-sarcopenia groups and 30th day mortality rate and CALL risk scores were similar between groups with and without steroid use.

Galindo-Oseguera found that providing aggressive oxygen therapy during hospital admission decreased the mortality risk (23). In our study, the O2 requirement was higher in the PS group than in the other groups and had a negative relationship with hand grip strength. This result has been interpreted as sarcopenia also affecting the respiratory muscles and negatively affecting the disease prognosis.

Limitations

This study provides information on the factors associated with hospitalized COVID-19 pneumonia in elderly individuals with PS. Secondly, outpatients were not monitored for PS. Therefore, this small sample results of the study evaluated PS status only in hospitalized elderly and are not generalizable to all elderly COVID-19 pneumonia cases.

CONCLUSION

Detecting PS by hand grip strength as an easy tool may be helpful in the hospitalization of older patients with COVID-19 pneumonia caused by the associations of PS, frailty, daily living activity, length of hospital stay, malnutrition, multimorbidity, polypharmacy, steroid use, O2 need, and 30th-day discharge mortality. In addition, it was also highlighted that this research might be helpful in terms of revealing that there are simple tests that can be used to diagnose sarcopenia in primary health care and all specialities that accept geriatric patients.

Funding: This manuscript did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sectors.

Informed Consent Statement: Written informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors have no conflict of interest to declare in connection with this article.

Acknowledgement: The authors thank all participants who contributed to the study.

REFERENCES

1. Muscaritoli M, Anker SD, Argilés J, et al. Consensus definition of sarcopenia, cachexia and pre-cachexia: joint document elaborated by Special Interest Groups (SIG)"cachexia-anorexia in chronic wasting diseases" and "nutrition in geriatrics". Clin Nutr. 2010;29(2):154-9. (DOI:10.1016/j.clnu.2009.12.004)
2. Ibrahim K, May C, Patel HP, Baxter M, Sayer AA, Roberts H.A feasibility study of implementing grip strength measurement into routine hospital practice (GRImP): study protocol. Pilot Feasibility Stud. 2016;6(2):27. (DOI:10.1186/s40814-016-0067-x)
3. Cao L, Morley JE. Sarcopenia is recognized as an independent condition by an international classification of disease, tenth revision, clinical modification (ICD-10-CM) code. J Am Med Dir Assoc. 2016;17(8):675-7. (DOI:10.1016/j.jamda.2016.06.001
4. Morley JE, Vellas B. Editorial: COVID-19 and Older Adults. J Nutr Health Aging. 2020;24(4):364-365. (DOI:10.1007/s12603-020-1349-9)

5. Okazaki T, Ebihara S, Mori T, Izumi S, Ebihara T. Association between sarcopenia and pneumonia in older people. Geriatr Gerontol Int. 2020;20(1):7-13. (DOI:10.1111/ggi.13839)

6. American Thoracic Society/European Respiratory Society. ATS/ERS Statement on respiratory muscle testing. Am J Respir Crit Care Med. 2002;166(4):518-624. (DOI:10.1164/rccm.166.4.518)

7. Akıllı IK, Bilge M. Prognostic Performance of the CALL Score in Hospitalized Patients with COVID-19 Pneumonia. Med J Bakirkoy 2021;17(4):359-66. (DOI:10.4274/BMJ.galenos.2021.59354)

8. Cruz-Jentoft AJ, Bahat G, Bauer J, et al. Writing Group for the European Working Group on Sarcopenia in Older People 2 (EWGSOP2), and the Extended Group for EWGSOP2. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing. 2019 ;48(4):601. (DOI:10.1093/ageing/afz046)

9. Kaiser MJ, Bauer JM, Ramsch C, et al. MNA-International Group. Validation of the Mini Nutritional Assessment short-form (MNA-SF): a practical tool for identification of nutritional status. J Nutr Health Aging. 2009 Nov;13(9):782-8. (DOI:10.1007/s12603-009-0214-7)

10. Wallace M, Shelkey M. Katz index of independence in activities of daily living (ADL). Urol Nurs 2007;27(1):93-4.

11. Morley JE, Malmstrom TK, Miller DK. A simple frailty questionnaire (FRAIL) predicts outcomes in middle aged African Americans. J Nutr Health Aging. 2012;16(7):601-8 (DOI:10.1007/s12603-012-0084-2)

12. Hymabaccus BAB, Dogrul RT, Balcı C et al. An effective and practical tool to assess physical frailty in older adults: Turkish validation of the FRAIL Scale. Marmara Med J 2023;36(2):149–156. (DOI:10.5472/marumj.1297696)

13. Just N, Bautin N, Danel-Brunaud V, Debroucker V, Matran R, Perez T. The Borg dyspnoea score: a relevant clinical marker of inspiratory muscle weakness in amyotrophic lateral sclerosis. Eur Respir J. 2010;35(2):353-60. (DOI:10.1183/09031936.00184908)

14. Ji D, Zhang D, Xu J, et al. Prediction for Progression Risk in Patients With COVID-19 Pneumonia: The CALL Score. Clin Infect Dis. 2020 Sep 12;71(6):1393-9. (DOI:10.1093/cid/ciaa414)

15. Xu Y, Xu J-w, You P, et al. Prevalence of Sarcopenia in Patients With COVID-19: A Systematic Review and Meta-Analysis. Front Nutr. 2022 Jul 4;9:925606. (DOI:10.3389/fnut.2022.925606)

16. Tham SL, Tan KKC, Lin NL, Seng AWP. Oxygen Therapy During Activities of Daily Living Rehabilitation and Outcome in Patients With Severe-to-critical COVID-19. Arch Rehabil Res Clin Transl. 2023;5(4):100304. (DOI:10.1016/j.arrct.2023.100304)

17. Pucci G, D'Abbondanza M, Curcio R, et al. Handgrip strength is associated with adverse outcomes in patients hospitalized for COVID-19-associated pneumonia. Intern Emerg Med. 2022;17(7):1997-2004. (DOI:10.1007/s11739-022-03060-3)

18. Özsürekci C, Kara M, Güngör AE, et al. Relationship between chewing ability and malnutrition, sarcopenia, and frailty in older adults. Nutr Clin Pract. 2022;37(6): 1409-17. (DOI:10.1002/ncp.10877)

19. Lengelé L, Locquet M, Moutschen M, et al. Frailty but not sarcopenia nor malnutrition increases the risk of developing COVID-19 in older community-dwelling adults. Aging Clin Exp Res. 2022;34(1):223-24. (DOI:10.1007/s40520-021-01991-z)

20. Bedock D, Lassen PB, Mathian A, et al. Prevalence and severity of malnutrition in hospitalized COVID-19 patients. Clin Nutr ESPEN. 2020;40:214-9. (DOI:10.1016/j.clnesp.2020.09.018)

21. Uemura K, Doi T, Lee S, Shimada H. Sarcopenia and Low Serum Albumin Level Synergistically Increase the Risk of Incident Disability in Older Adults. J Am Med Dir Assoc. 2019;20(1):90-93. (DOI:10.1016/j.jamda.2018.06.011)

22. Lidou-Renault V, Baudouin E, Courtois-Amiot P, et al. Corticosteroid therapy in COVID-19 associated with in-hospital mortality in geriatric patients: a propensity matched cohort study. J Gerontol A Biol Sci Med Sci. 2022;77(7):1352-60. (DOI:10.1093/gerona/glac084)

23. Galindo-Oseguera E, Pinto-Almazán R, Arellano-Ramírez A, et al. Mortality and Survival Factors in Patients with Moderate and Severe Pneumonia Due to COVID-19. Healthcare (Basel). 2023 Mar 23;11(7):932.. (DOI:10.3390/healthcare11070932)