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High Platelet-to-Lymphocyte Ratio is Associated with Dynapenia in COVID-19 Inpatients: a Case-Control Study

Elevada Relação Plaqueta-Linfócito Está Associada com a Dinapenia em Pacientes Hospitalizados com COVID-19: um Estudo Caso-Controle

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Abstract

SARS-CoV-2 virus infection can cause a cytokine storm leading to symptoms like fever, fatigue, anorexia, and myalgia, which are associated with impaired nutritional status including dynapenia. However, few studies have examined the relationship between dynapenia and prognostic markers in COVID-19 patients. This study aimed to evaluate the occurrence of dynapenia in hospitalized COVID-19 patients and investigate its association with prognostic markers. This study was a case-control design, including inpatients with and without a COVID-19 diagnosis. The occurrence of dynapenia was evaluated according to the European Working Group on Sarcopenia 2 criteria. Additionally, inflammatory markers and 4C Mortality Score were assessed. The study sample consisted of 96 patients, and there were no differences between groups regarding age (p=0.656), sex (p=0.777), presence of comorbidities such as type 2 diabetes (p=0.659) and systemic arterial hypertension (p=0.427), and Body Mass Index (p=0.657). Dynapenia was observed in 53.1% of patients with COVID-19. Dynapenic COVID-19 patients had a lower mean Phase Angle (p=0.029), hematocrit (p=0.046), and hemoglobin (p=0.045) and higher Platelet-to-Lymphocyte Ratio (p=0.089). The occurrence of dynapenia in patients with COVID-19 was associated with Phase Angle <5º (p = 0.013) and high PLR >180 (p = 0.019) (markers of worse inflammatory prognosis). Dynapenia was associated with high PLR and PA, but did not relate to other prognostic variables. These findings emphasize the importance of evaluating muscle strength and quality to prevent and/or treat dynapenia.

Keywords: COVID-19. Muscle Strength. Biomarkers. Prognosis. Nutrition Assessment. Mortality.

Resumo

A infecção pelo vírus SARS-CoV-2 pode causar uma tempestade de citocinas levando a sintomas como febre, fadiga, anorexia e mialgia, que estão associados a um estado nutricional comprometido, incluindo a dinapenia. No entanto, poucos estudos examinaram a relação entre dinapenia e marcadores prognósticos em pacientes com COVID-19. Este estudo teve como objetivo avaliar a ocorrência de dinapenia em pacientes hospitalizados com COVID-19 e investigar sua associação com marcadores prognósticos. Este é um estudo caso-controle, incluindo pacientes internados com e sem diagnóstico de COVID-19. A dinapenia foi avaliada de acordo com os critérios do Grupo de Trabalho Europeu sobre Sarcopenia 2. Marcadores inflamatórios e o Escore de Mortalidade 4C também foram avaliados. 96 pacientes foram avaliados, e não houve diferenças entre os grupos em relação à idade (p=0,656), sexo (p=0,777), presença de comorbidades como diabetes tipo 2 (p=0,659) e hipertensão arterial sistêmica (p=0,427) e Índice de Massa Corporal (p=0,657). A dinapenia foi observada em 53,1% dos pacientes com COVID-19. Pacientes com COVID-19 e dinapenia apresentaram uma média menor de Ângulo de Fase (p=0,029), hematócrito (p=0,046) e hemoglobina (p=0,045), e uma maior relação plaquetas/linfócitos (RPL) (p=0,089). A ocorrência de dinapenia em pacientes com COVID-19 foi associada a um Ângulo de Fase <5º (p=0,013) e uma RPL alta >180 (p=0,019) (marcadores de pior prognóstico inflamatório). A dinapenia foi associada a RPL alta e Ângulo de Fase, mas não se relacionou com outras variáveis prognósticas. Esses achados enfatizam a importância de avaliar a força muscular e a qualidade para prevenir e/ou tratar a dinapenia.

Palavras-chave: *COVID-19. Força Muscular. Biomarcadores. Prognóstico. Avaliação Nutricional. Mortalidade.*

1 Introduction

SARS-CoV-2 virus (Family *Coronaviridae*, Subfamily *Orthocoronavirinae*, Genus *Betacoronavirus*, Species *Severe acute respiratory syndrome-related coronavirus*) infection causes an immune response, which includes a large-scale inflammatory reaction, currently described as a cytokine storm[1]. Symptoms such as fever, fatigue, anorexia, and myalgia are common in this infectious condition and can lead to impaired nutritional status[2-4]. Evidence showed a high prevalence of nutritional impairment in patients hospitalized with COVID-19[4-6]. Among the examples that describe the impairment of nutritional status, dynapenia stands out as one possible consequence.

Dynapenia is characterized by reduced muscle strength and is one of the components that define sarcopenia. It is strongly associated with age progression[7,8]. Important scientific institutions recommend measuring Handgrip Strength (HS) to diagnose dynapenia[7,9]. Low HS values have been shown to be associated with functional impairment, reduced bone mineral density and fractures, cognitive impairment, depression, longer hospital stays, and all-cause mortality[9].

Although dynapenia is often associated with sarcopenia, it can occur through other mechanisms that are independent of the impairment of skeletal muscle mass. Therefore, it is necessary to assess both conditions. Evidence suggests the involvement of neural and acute factors, such as inflammatory cascades, although the mechanisms that lead to dynapenia are still poorly understood[8]. Muscle weakness and fatigue in patients with COVID-19 appear to be related to lower HS (dynapenia) and poor muscle quality[10]. Furthermore, low HS has been identified as an independent risk factor for longer hospital stay, higher disease severity, and higher mortality in patients with COVID-19[11-14].

Despite scientific advances, there is still limited knowledge about the influence of dynapenia on the evolution and risks associated with COVID-19[15]. Therefore, this study aimed to evaluate the occurrence of dynapenia in middle-aged and older adult patients hospitalized with COVID-19, compare it with a control group, and investigate its relationship with prognostic markers.

2 Material and Methods

2.1 Study design and sample size

This is a case-control study involving middle-aged and older patients hospitalized with COVID-19 treated at two university hospitals, located in the Northeast of Brazil. The data were collected between August 2021 and August 2022.

The COVID-19 group was composed by patients who aged ≥40 years, of both sexes, hospitalized with a diagnosis of COVID-19, confirmed by RT-PCR molecular test or SARS-CoV-2 Rapid Antigen Test, through swab of naso-oropharyngeal secretion. The control group consisted of patients who aged ≥40 years, of both sexes, hospitalized for other causes and with a negative diagnosis for COVID-19.

Patients previously diagnosed with consumptive diseases (such as cancer, HIV infection, chronic heart failure, chronic obstructive pulmonary disease, chronic kidney disease on renal replacement therapy) or with some physical limitations were excluded from both groups.

The pairing of 1 case to 2 controls (1:2) was considered. Each case was paired by age (±3 years), sex, nutritional status according to BMI and presence of comorbidities [systemic arterial hypertension (SAH) and type 2 diabetes mellitus (DM2)].

Recruitment tracked the following order: after a patient diagnosed with COVID-19 was entered into the research, two controls were selected.

The Epi-Info software® version 6.04 was used to calculate the sample size and the following parameters were considered: the lowest prevalence outcome (sarcopenia), a significance level of 95%, a test power (1 – β) of 80%, a ratio of two controls for each case and a cross-product ratio (Odds Ratio – OR) of 3.8, for an estimated prevalence of 22% for exposure to sarcopenia among cases[13] and of 7% among controls[16]. The minimum required sample was 32 cases and 64 controls.

2.2 Dynapenia evaluation

The dynapenia diagnosis was made based on the measurement of muscle strength using a JAMAR® digital dynamometer and following the techniques established by the American Society of Hand Therapists. HS was measured in triplicate by a trained and calibrated evaluator for accuracy and analysis purposes, and the average value was recorded. Individuals with HGS <27 kg/f for men and <16 kg/f for women were considered to have dynapenia[9].

2.3 Nutritional assessment and body composition data

Body Mass Index (BMI), calf circumference (CC), mid arm circumference (MAC), and body fat mass (FM) measured using bioelectrical impedance analysis (BIA) were considered. The results related to BMI, MAC, CC, and FM were analyzed according to previously proposed cutoff points[17-19].

2.4 Prognostic markers

The following prognostic markers were considered: 4C (Coronavirus Clinical Characterization Consortium) Mortality Score, number of vaccine doses, Total Lymphocyte Count (TLC), leukocytosis (>11,000), Respiratory Rate (RR) >20, Neutrophil-Lymphocyte Ratio (NLR), Platelet-Lymphocyte Ratio (PLR), and Phase Angle (PA).

The 4C Mortality Score uses patient demographic data such as age in years and biological sex, clinical observations such as number of comorbidities, oxygen saturation, Glasgow scale, and blood parameters such as serum urea and C-reactive protein (CRP), which are usually available at the time of hospital admission. Four risk groups were defined with corresponding mortality rates determined: low risk (score 0-3, mortality rate 1.2%), intermediate risk (score 4-8, mortality rate 9.9%), high risk (score 9-14, mortality rate 31.4%), and very high risk (≥15 points, mortality rate 61.5%)[20].

Total Lymphocyte Count (TLC) was defined using the equation: percentage of lymphocytes x total leukocytes/100. A low TLC, values below 1500 mm³/dl, was adopted. NLR > 4.27[21] and PLR > 180[22] were adopted as indicators of worse outcomes in patients with COVID-19. PA values (<5º), measured by a predictive formula after evaluation by BIA, were associated with poor nutritional status and worse prognosis[23].

2.5 Sociodemographic, biomarkers and clinical data

The following variables were considered: sex, age, presence of comorbidities such as systemic arterial hypertension (SAH) and diabetes mellitus (DM), renal, thyroid and psychiatric disorders, cognitive dysfunction and physical dependence. In addition, signs and symptoms related to COVID-19 reported by the patient at the time of collection, such as dyspnea, hyposmia, hypogeusia, fever, dysphagia, anorexia, and diarrhea were recorded.

Respiratory rate (RR) and oxygen saturation (SpO2) were measured, and patients were asked about their COVID-19 vaccination status, with the number of doses taken at the time of collection being recorded. Biochemical parameters obtained from tests collected from medical records up to 72 hours after the patient's admission to the ward were considered, including hemogram, leukogram, platelet count, and albumin.

2.6 Ethical aspects

All the procedures performed in our study (involving human participants) were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the Human Research Ethics Committee of the Health Sciences Center of the Federal University of Pernambuco (CEP/HC/UFPE) and the HUOC/PROCAPE Hospital Complex, in accordance with Resolution 466/2012 of the National Health Council, registered under CAE 50518521.1.0000.5208 and 45469721.0.0000.8807, respectively. All the participants provided informed consent to participate in the study and to have their data published.

2.7 Data-analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) software – version 28. Data descriptive statistical analysis was performed by calculating relative and absolute frequencies, mean and standard deviation or median and interquartile range, according to the normality pattern of the variable, evaluated by the Kolmogorov-Smirnov test.

The Chi-square test was used to compare differences and distribution between proportions, while the Student's "t" test or Mann-Whitney U test were used to verify differences between means or medians, respectively. The association between categorical variables was analyzed using the Pearson's chi-square test or Fisher's Exact test. In all the analyses, a significance level of $p < 0.05$ was considered, and a borderline significance for p values between 0.05 and 0.10[24,25].

3 Results and Discussion

96 patients were included in our study, with 64 in the control group (without COVID-19) and 32 patients in the case group (with COVID-19). We did not find any differences in the mean age between the case and control groups (p = 0.656). The mean age of the case group was 63.3±11.8 years, while the mean age of the control group was 64.3±5.5 years. Table 1 summarizes the demographic, clinical, behavioral, nutritional, and anthropometric data evaluated in our study.

Table 1 - Demographic, clinical, behavioral, nutritional, and anthropometric characteristics of hospitalized patients with COVID-19 compared to a control group in two reference hospitals in the city of Recife/2022

Variables	**Control (n = 64) (%)**	**Cases (COVID-19) (n = 32) (%)**	**p-value***
Sex (%)			
Men	38 (59.4)	18 (56.3)	0.777
Women	26 (40.6)	14 (43.8)	
Age (in years old) (%)			
40-49	0 (0.0)	5 (15.6)	0.656
50-59	6 (9.4)	5 (15.6)	
60-69	47 (73.4)	14 (43.8)	
70-79	10 (15.6)	6 (18.8)	
≥ 80	1 (1.6)	2 (6.2)	
Comorbidities and lifestyle (%)			
SAH	56 (69.1)	13 (68.4)	0.952
DM 2	32 (39.5)	5 (26.3)	0.211
Depression	3 (4.7)	7 (21.9)	**0.031**
Smoking	19 (29.7)	6 (18.8)	0.326
Alcoholism	21 (32.8)	4 (12.5)	**0.026**
Sedentarism	50 (78.1)	29 (90.6)	0.163
Nutritional and anthropometric characteristics			
BMI (kg/m²) (Mean)	26.3±5.2	26.8±5.6	0.657
BMI (%)			
Malnutrition	16 (25.0)	9 (28.1)	0.801
Eutrophy	25 (39.1)	11 (34.4)	0.823
Excessive weight	23 (35.9)	12 (37.5)	1.000
MAC (cm)	28.9±3.9	31.1±5.7	0.053
MAC adequacy (%)			
Malnutrition	30 (46.9)	10 (31.3)	0.189
Eutrophy	29 (45.3)	14 (43.7)	1.000
Excessive weight	5 (7.8)	8 (25.0)	**0.028**
CC (cm)	34.2±3.7	34.7±5.0	0.618
CC (%)			
Adequate	31 (48.4)	18 (56.2)	0.521
Non-adequate	33 (51.6)	14 (43.8)	
Phase Angle (º)	5.0 [4.0 – 6.1]	5.1 [4.0 – 6.5]	0.368
Dynapenia components			
HS (mean) (kg/f)	22.3±10.2	24.2±12.9	0.465
Dynapenia (Low HS)	39 (60.9)	17 (53.1)	0.514

*Pearson's Chi-square or Fisher's Exact test for frequency comparisons, Student's t-test for mean comparisons, and Mann Whitney's U test for median comparisons. SAH: Systemic Arterial Hypertension; DM: Type 2 Diabetes Mellitus; BMI: Body Mass Index; MAC: Mid-Arm Circumference; CC: Calf Circumference; HS: Hand Grip Strength.
Source: resource data.

Patients with COVID-19 had a higher frequency of self-reported depression (p=0.031) and a higher frequency of overweight, according to the MAC adequacy parameter (p=0.028). Dynapenia was observed in 53.1% of patients with COVID-19, while in the control group it occurred in 60.9% of individuals. When comparing the groups, considering only patients with dynapenia, we found a higher proportion of women (p=0.046), patients with anorexia (p=0.002), and overweight patients (p<0.001) among those with COVID-19. COVID dynapenic patients had a lower mean % of body fat (p=0.011) and a lower median CTL (p<0.001) (Table 2).

Table 2 - Demographic, clinical, behavioral, nutritional, and anthropometric characteristics of patients with dynapenia hospitalized with COVID-19 compared to the control group in two reference hospitals in the city of Recife/2022

Dynapenic Patients' Characteristics	**Control (n = 39) (%)**	**Cases (COVID-19) (n = 17) (%)**	**p-value***
Sex (%)			
Men	25 (64.1)	6 (35.3)	**0.046**
Women	14 (35.9)	11 (64.7)	
Age (years old)	63 [61.3 – 66]	63.5 [52.3 – 70.5]	0.221
Comorbidities and lifestyle (%)			
SAH	30 (76.9)	11 (64.7)	0.349
DM 2	20 (51.3)	7 (41.2)	0.568
Depression	2 (5.1)	3 (17.6)	0.313
Anorexia	3 (7.9)	8 (47.1)	**0.002**
Fatigue	10 (25.6)	5 (33.3)	0.736
Smoking	8 (20.5)	5 (29.4)	0.504
Alcoholism	12 (33.3)	4 (23.5)	0.538
Sedentarism	31 (79.5)	16 (94.1)	0.250
BMI (kg/m²) (mean)	25.4±4.6	25.6±6.0	0.786
BMI (%)			
Malnutrition	11 (28.2)	7 (41.2)	0.366
Eutrophy	17 (43.6)	5 (29.4)	0.383
Excessive weight	11 (28.2)	5 (29.4)	0.750
MAC (cm)	28.0±3.8	30.5±6.2	0.136
MAC adequacy (%)			
Malnutrition	23 (59.0)	6 (35.3)	0.148
Eutrophy	14 (35.9)	6 (35.3)	1.000
Excessive weight	2 (5.1)	8 (47.1)	**<0.001**
CC (cm)	33.8±3.8	33.8±5.9	0.998
CC (%)			
Adequate	18 (46.1)	9 (52.9)	0.773
Non-adequate	21 (53.9)	8 (47.1)	
Body fat (kg)	30.4±11.2	21.0±12.2	**0.011**
Phase Angle (º)	4.05 [4.0 – 5.1]	4.05 [3.0 – 5.8]	0.901
HS (kg/F)	17.9±7.8	14.3±6.6	0.086
Biochemical parameters			
Hemoglobin (g/dl)	11.5 [9.5 – 12.4]	10.9 [9.1 – 12.3]	0.668
Leukocytes (mm³)	9078±4229	7255±3150	0.083
TLC (mm³)	1047 [830 – 2363]	1334 [529 – 2065]	**<0.001**
Albumin (g/dl)	3.2±0.7	3.1±0.8	0.714

*Pearson's Chi-square or Fisher's Exact test for frequency comparisons, Student's t-test for mean comparisons, and Mann Whitney's U test for median comparisons. SAH: Systemic Arterial Hypertension; DM: Type 2 Diabetes Mellitus; BMI: Body Mass Index; MAC: Mid-Arm Circumference; CC: Calf Circumference; HS: Hand Grip Strength; TLC: Total Lymphocyte Count.
Source: resource data.

Analyzing dynapenia only in the group of patients with COVID-19 (cases), it was observed that dynapenia was more frequent in females (p=0.016) and in individuals with higher age (p=0.009). Dynapenic COVID-19 patients had a lower mean PA (p=0.029), hematocrit (p=0.046), and hemoglobin (p=0.045) and higher RPL (p=0.089), with statistical significance threshold, when compared to COVID-19 patients without dynapenia (Table 3).

Table 3 - Comparison of demographic, nutritional, clinical, and prognostic variables regarding the presence or absence of dynapenia in middle-aged and older patients hospitalized with COVID-19

Characteristics	**Dynapenia (n = 17)**	**Without dynapenia (n = 15)**	**p-value***
Sex			
Men	6 (35.3)	12 (80.0)	**0.016**
Women	11 (64.7)	3 (20.0)	
Age (Years old)	68.4±11.2	57.5±10.4	**0.009**
SAH			
Yes	11 (64.7)	10 (66.7)	1.000
No	6 (35.3)	5 (33.3)	
DM 2			
Yes	7 (41.2)	5 (33.3)	0.726
No	10 (58.8)	10 (66.7)	
Symptoms			
<3	14 (82.3)	8 (53.3)	0.128
≥3	3 (17.7)	7 (46.7)	
RR	21.3±5.1	21.3±5.3	0.972
SpO_2 (%)	97 [96 – 98]	97 [95 – 98]	0.797
BMI (kg/m²)	25.9±5.9	27.9±5.1	0.301
MAC (cm)	30.5±6.2	31.8±5.2	0.534
CC (cm)	33.8±5.9	35.8±3.7	0.276
Body fat (kg)	21.0±12.2	25.1±7.9	0.267
Phase Angle (º)	4.0 [3.0 – 5.7]	6.1 [5.0 – 7.1]	**0.029**
Hemoglobin (g/dl)	10.8±2.2	12.4±2.1	**0.045**
Hematocrit (g/dl)	32.0±6.1	36.6±6.3	**0.046**
Leukocytes (mm³)	7255±3150	8451±4444	0.394
TLC (mm³)	1311±835	1697±709	0.168
Albumin (g/dl)	3.0±0.8	3.6±0.7	0.310
NLR	4.0 [1.5 – 9.1]	2.1 [1.5 – 5.1]	0.473
PLR	207.0 [115 – 411]	111.6 [83.7 – 172.2]	**0.089**
4C *Mortality score*	8.6±2.5	7.5±2.1	0.183
Number of vaccine doses	2.0 [1.7 – 2.0]	2.0 [2.0 – 3.0]	0.140

*Pearson's Chi-square or Fisher's Exact test for frequency comparisons, Student's t-test for mean comparisons, and Mann Whitney's U test for median comparisons. SAH: Systemic Arterial Hypertension; DM: Type 2 Diabetes Mellitus; RR: Respiratory Rate in breaths per minute; SpO2: Oxygen Saturation; BMI: Body Mass Index; MAC: Mid-Arm Circumference; CC: Calf Circumference; HS: Hand Grip Strength; TLC: Total Lymphocyte Count; NLR: Neutrophil-to-Lymphocyte Ratio; PLR: Platelet-to-Lymphocyte Ratio.
Source: resource data.

The frequency of dynapenia in patients with COVID-19 was associated with PA <5º (p = 0.013), high RPL >180 (p = 0.019), and higher risk of mortality (4C Mortality Score >8;

p = 0.082), with a threshold of statistical significance. There were no associations with other prognostic variables (p > 0.05). (Table 4).

Table 4 - Chi-Square association of prognostic variables with the occurrence of dynapenia in hospitalized patients with COVID-19

Prognostic Markers	Dynapenia (n = 17) (%)	Without dynapenia (n = 15) (%)	p-value
4C Mortality Score (>8)			
Yes	12 (70.6)	6 (40.0)	**0.082**
No	5 (29.4)	9 (60.0)	
Phase Angle (<5º)			
Yes	10 (58.8)	3 (20.0)	**0.013**
No	7 (41.2)	12 (80.0)	
TLC (<1500)			
Yes	10 (58.8)	6 (40.0)	0.288
No	7 (41.2)	9 (60.0)	
Leukocytosis (>11000)			
Yes	3 (17.6)	2 (13.3)	0.737
No	14 (82.4)	13 (86.7)	
NLR (>4.27)			
Yes	7 (41.2)	4 (26.7)	0.388
No	10 (58.8)	11 (73.3)	
PLR (<180)			
Yes	8 (47.1)	13 (86.7)	**0.019**
No	9 (52.9)	2 (13.3)	
RR* (>20 bpm)			
Yes	7 (41.2)	8 (53.3)	0.715
No	8 (47.1)	7 (46.7)	
Number of vaccine doses (>2)			
Yes	5 (29.4)	3 (20.0)	0.387
No	12 (70.6)	12 (80.0)	

PLR: Platelet-to-Lymphocyte Ratio; TLC: Total Lymphocyte Count; NLR: Neutrophil-to-Lymphocyte Ratio; RR: Respiratory Rate in breaths per minute. *Data is missing for 2 patients regarding RR, as measurement was not possible. Source: data obtained and analyzed by the authors.
Source: resource data.

As far as we know, this is the first case-control study to explore the relationship between the occurrence of dynapenia and prognostic indicators in middle-aged and older patients hospitalized with COVID-19.

The frequency of dynapenia in COVID-19 patients (53.1%) found in our study contrasts with the study by Piotrowiczk et al.[26], which reported a frequency of 40.3%. However, these differences may be a product of sampling bias. It should be noted that the frequency of dynapenia was similar between groups (case-control), demonstrating that SARS-CoV-2 infection did not increase the risk of this condition in our population. However, this fact does not necessarily exclude the possibility that SARS-CoV-2 infection may promote greater impairment of muscle quality and strength[10-14].

In our study, we found that the frequency of self-reported depressive symptoms was higher in hospitalized patients with COVID-19 (21.9%) compared to the control group. Similar results were found by Kong et al.[27], who reported a depression prevalence of 28.47% among hospitalized COVID-19 patients. These results may be explained by the clinical circumstances imposed by the diagnosis itself, which requires patient isolation and may contribute to the development of depression and anxiety symptoms.

This is important to investigate because some evidences suggest that patients with depressive symptoms may have difficulty controlling symptoms of the diseases for which they were hospitalized[28,29]. It is important to highlight that depressive syndromes can lead to pathological anorexia[30], resulting in a significant reduction in food intake. This, in turn, can worsen nutritional disorders, with consequent muscular impairment and functional repercussions.

Corroborating these results, we can suggest a feedback loop that affects muscle strength and quality, as we also found that inpatients with COVID-19 and dynapenia had a higher frequency of anorexia compared to their control group (inpatients with dynapenia, but without COVID-19). Consistent with these results, evidence has suggested that anorexia is one important symptom related to SARS-CoV-2 infection[2-4].

We also found in our study that COVID-19 patients with dynapenia had lower serum levels of hematocrit and hemoglobin compared to the control group. Similar results were observed in a study carried out by Jang et al.[31], who reported a higher prevalence of anemia in individuals with dynapenia compared to the control group. It is believed that these findings may be explained by the possible reduction of oxygenation in muscle tissues due to anemia, leading to hypoxia in skeletal muscle and consequently to impairment of muscle strength and functional capacity[32].

Regarding prognostic indicators, our results showed that patients with dynapenia had lower grip strength. Some evidences suggest that grip strength is associated with muscle strength, functional capacity, and can be a predictor of unfavorable outcomes[33,34]. However, this result should be interpreted with caution, as among the dynapenic patients, we had a higher proportion of women and individuals of advanced age, and the observed differences may be related to differences in characteristics between the groups rather than dynapenia itself. These findings are consistent with studies reporting variation in grip strength values between sexes, with lower values for women[35,36].

In our study, we also observed that the presence of dynapenia in COVID-19 patients was associated with a higher risk of mortality (mortality score 4C > 8), although with borderline statistical significance. However, it is possible that this result is influenced by a sampling bias. In line with our findings, Kara et al.[37] found that low HS independently increased the risk of severe COVID-19 by up to three times, as well as the risk of mortality.

We also observed that the occurrence of dynapenia in patients with COVID-19 was associated with a high PLR (>180). PLR is a new inflammatory index that is currently considered capable of reflecting the presence of systemic inflammation, especially in patients with COVID-19, and is associated with greater disease severity and prolonged hospitalization time[38]. To date, no study has evaluated the association between dynapenia and PLR. However, based on our results, we can suggest that the muscle strength impairment (dynapenia) in hospitalized patients with COVID-19 is related to a worse inflammatory prognosis.

In a study conducted by Chan and Rout[39], higher PLR values were observed in patients with severe COVID-19. The authors also suggested the use of PLR as an independent prognostic marker for disease severity. In addition, a study by Ortega-Rojas[40] found that PLR has significant prognostic value, capable of predicting the high risk of mortality in patients with COVID-19, reinforcing its use in clinical practice.

Given the above, we emphasize that our results demonstrated an important association between the occurrence of dynapenia and elevated PLR values in patients with COVID-19. These findings highlight the importance of carefully evaluating nutritional status and diagnosing dynapenia.

Some limitations should be considered in our study, such as the relatively small sample size, which limits the extrapolation of results to other populations. Additionally, the evaluation of HS within 72 hours of hospital admission prevents observation of the effects of COVID-19 evolution on nutritional status and the prevalence of dynapenia. Despite these limitations, it is important to highlight as a strong point of this research the use of a control group for comparison.

4 Conclusion

Dynapenia was frequent in middle-aged and older inpatients with COVID-19, with more than half of the patients affected, but there was no difference compared to the control group. Dynapenia was associated with high PLR (a marker of worse inflammatory prognosis) and PA, but did not relate to other prognostic variables. These results highlight the need to evaluate muscle strength and quality to prevent and/or treat dynapenia and minimize adverse effects related to this condition.

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