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Original article

## Prevalence of nutritional risk and malnutrition during and after hospitalization for COVID-19 infection: Preliminary results of a single-centre experience



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### SUMMARY

**Background & aims:** The effect of the COVID-19 infection on nutritional status is not well established. Worldwide epidemiological studies have begun to investigate the incidence of malnutrition during hospitalization for COVID-19. The prevalence of malnutrition during follow-up after COVID-19 infection has not been investigated yet. The primary objective of the present study was to estimate the prevalence of the risk of malnutrition in hospitalized adult patients with COVID-19, re-evaluating their nutritional status during follow-up after discharge. The secondary objective was to identify factors that may contribute to the onset of malnutrition during hospitalization and after discharge.

**Methods:** We enrolled 142 COVID-19 patients admitted to Careggi University Hospital. Nutritional parameters were measured at three different timepoints for each patient: upon admission to hospital, at discharge from hospital and 3 months after discharge during follow-up. The prevalence of both the nutritional risk and malnutrition was assessed. During the follow-up, the presence of nutritional impact symptoms (NIS) was also investigated. An analysis of the association between demographic and clinical features and nutritional status was conducted.

**Results:** The mean unintended weight loss during hospitalization was 7.6% ( $p < 0.001$ ). A positive correlation between age and weight loss during hospitalization was observed ( $r = 0.146$ ,  $p = 0.08$ ). Moreover, for elderly patients ( $>61$  years old), a statistically significant correlation between age and weight loss was found ( $r = 0.288$ ,  $p = 0.05$ ). Patients admitted to an Intensive Care Unit (ICU) or Intermediate Care Unit (IMCU) had a greater unintended weight loss than patients who stayed in a standard care ward (5.46% vs 1.19%;  $p < 0.001$ ). At discharge 12 patients were malnourished (8.4%) according to the ESPEN definition. On average, patients gained 4.36 kg ( $p < 0.001$ ) three months after discharge. Overall, we observed a weight reduction of 2.2% ( $p < 0.001$ ) from the habitual weight measured upon admission. Patients admitted to an ICU/IMCU showed a higher MUST score three months after discharge (Cramer's V 0.218,  $p = 0.035$ ). With regard to the NIS score, only 7 patients (4.9%) reported one or more nutritional problems during follow-up.

**Conclusions:** The identification of groups of patients at a higher nutritional risk could be useful with a view to adopting measures to prevent worsening of nutritional status during hospitalization. Admission to an ICU/IMCU, age and length of the hospital stay seem to have a major impact on nutritional status.

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Nutritional follow-up should be guaranteed for patients who lose more than 10% of their habitual weight during their stay in hospital, especially after admission to an ICU/IMCU.

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## 1. Introduction

In March 2020 COVID-19 was declared a pandemic by the World Health Organization (WHO). COVID-19 infection may occur in asymptomatic or pauci-symptomatic forms or, in severe cases, in pneumonia with an acute respiratory distress syndrome. Initially, the effect of the COVID-19 infection on nutritional status was not well established; subsequently, a few epidemiological studies were conducted to investigate the incidence of malnutrition during hospitalization for COVID-19. The main cause leading to a poor nutritional status seems to be an inadequate nutrient intake due to the presence of clinical symptoms (fatigue, dyspnoea, fever, confusion, headache, sore throat, chest pain, pneumonia, diarrhoea, nausea and vomiting, and loss of taste and smell) [1,2]. It is well established that malnutrition alters immune function and is associated with poor health outcomes (e.g. increased infection rates and pressure ulcers, increased length of hospital stay, increased duration of convalescence after acute illness), as well as increased mortality [3,4], especially during an Intensive Care Unit (ICU) stay [5]. Risk factors for the worst clinical outcomes related to COVID-19 are male gender, old age and comorbidities, such as chronic lung diseases, hypertension, diabetes and obesity [6–8]. It is reported that screening of nutritional risk should be systematically and routinely conducted for all patients upon admission to hospital and thereafter at regular intervals especially in case of older adults suffering from chronic or acute comorbidities [9,10], but at present, changes in nutritional status during hospitalization or after discharge are not well known. In fact, the prevalence of malnutrition during follow-up after COVID-19 infection has not been investigated yet. The purpose of the present study was to estimate the prevalence of both nutritional risk and malnutrition in hospitalized adult COVID-19 patients, upon admission to either a non-intensive, intermediate intensive (IMCU) or an ICU, at discharge and after three months of follow-up.

## 2. Materials and methods

### 2.1. Patient selection and data collection

We enrolled 142 COVID-19 patients admitted to Careggi University Hospital between March and April 2020. The inclusion criteria were having a SARS-CoV-2 infection confirmed by real-time Polymerase Chain Reaction (PCR) and age >18 years. Demographic and clinical characteristics of patients (age, gender, smoker, comorbidities), were taken from the electronic medical record. Comorbidities were categorized into cardiovascular disease, hypertension, diabetes, dyslipidaemia, chronic kidney disease and chronic lung disease. Weight and Body mass index (BMI) were measured and calculated at three different timepoints for each patient: upon hospital admission (HA), at hospital discharge (HD) and after 3 months of follow-up (FU). A trained operator recorded the patient's weight, measured with calibrated weighing scales, and height, measured with a stand-alone stadiometer (measured only at HA). Habitual weight was self-reported by each patient at HA. Nutritional risk was evaluated using the malnutrition universal screening tool (MUST) in accordance with the ESPEN guidelines

[11]. The unintended weight loss (UWL), expressed as percentage weight loss/percentage weight change =  $[(\text{usual or previous weight (kg)} - \text{actual weight (kg)})/\text{usual or previous weight (kg)}] * 100$ , was then calculated for each patient. UWL >10% of the habitual weight over any time period or >5% over three months was considered a risk factor for the onset of malnutrition [12]. Malnutrition was diagnosed according to the ESPEN definition [12]. During the follow-up, 3 months after discharge, we collected information about the presence of nutritional impact symptoms (NIS) by face-to-face interviews performed by trained staff, in order to evaluate the possible causes of the insufficient nutrient intake.

A further subanalysis was conducted to evaluate differences in terms of nutritional risk, comorbidities and length of hospital stay between patients admitted to ICU, IMCU or standard care wards.

This study was conducted in accordance with the World Medical Association Declaration of Helsinki after approval by the local Ethics Committee and having obtained informed consent from all subjects.

### 2.2. Statistical analysis

Continuous variables are presented as mean and standard deviation or median and interquartile ranges according to their distribution. Categorical variables are presented as numbers and percentages. The appropriate statistical test was selected according to the type of data and number of observations in each comparison. Shapiro–Wilk and Levene's tests were used to assess normality and homogeneity, respectively. Continuous variables were analysed using a two-tailed, unpaired t-test; categorical variables were analysed using the chi-squared test or Fisher's exact test. To measure the strength of association the coefficient Cramer's V was calculated. Pearson's correlation coefficient was used to investigate the correlation between continuous variables. A two-sided p value < 0.05 was defined as a threshold for statistical significance. All analyses were performed in IBM SPSS (version 25).

## 3. Results

Eighty-three (58.5%) of the 142 COVID-19 patients were men. The majority of patients were in the sixth decade of life (27.5%), with a median age of 61 years. 134 patients (94.4%) had never smoked or had given up smoking at least five years before. Concomitant diseases were present in 79 patients (55.6%) and 25 patients (17.6%) had two or more comorbidities. Hypertension was the most frequent (40.8%) followed by type 2 diabetes (14.8%), chronic lung diseases (14.1%), dyslipidaemia (12.0%), cardiovascular diseases (8.5%) and chronic kidney diseases (2.1%). The mean duration of the hospital stay was 14.1 days ( $\pm 15.5$ ).

The anthropometric parameters of patients are reported in Table 1. The mean BMI at HA was 28.0 kg/m<sup>2</sup>, 47 patients (33.1%) were in the normal weight class and 95 patients (66.9%) were overweight or obese, while no underweight patients were found. At HD the mean BMI was 25.8 kg/m<sup>2</sup> while the mean BMI at FU was 27.26 kg/m<sup>2</sup>. In particular, 3 months after discharge, 52 patients (36.6%) were in the normal weight class and 90 (63.4%) were overweight or obese (no underweight patients). The differences in

**Table 1**  
Anthropometric parameters of patients at hospital admission, hospital discharge and follow-up.

	Hospital admission (HA)	Hospital discharge (HD)	Follow-up (FU)
<b>Weight (kg), mean (SD)</b>	81.31 (17.45)	74.81 (15.43)	79.17 (16.48)
<b>BMI (kg/m<sup>2</sup>), mean (SD)</b>	28.0 (5.35)	25.80 (4.75)	27.26 (4.89)
<b>BMI class, n<sup>o</sup> (%)</b>			
Underweight	0 (0)	2 (1.4)	0 (0)
Normal weight	47 (33.1)	70 (49.3)	52 (36.6)
Overweight	51 (35.9)	43 (30.3)	50 (35.2)
Obesity class I <sup>o</sup>	32 (22.5)	21 (14.8)	31 (21.8)
Obesity class II <sup>o</sup>	7 (4.9)	4 (2.8)	5 (3.5)
Obesity class III <sup>o</sup>	4 (2.8)	2 (1.4)	4 (2.8)

Hospital admission (HA), Hospital discharge (HD), Follow-up (FU), Standard deviation (SD), Body mass index (BMI).

terms of BMI between HA and HD, HD and FU and HA and FU were all statistically significant ( $p < 0.001$ ).

Regarding weight change, the mean reduction of weight during hospitalization was 6.49 kg ( $p < 0.001$ ) and the UWL was 7.6% ( $p < 0.001$ ). A positive correlation between age and weight loss during hospitalization, though not statistically significant ( $r = 0.146$ ,  $p = 0.08$ ), was observed. Moreover, for elderly patients (>61 years old) a statistically significant correlation between age and weight loss was found ( $r = 0.288$ ,  $p = 0.05$ ).

On average, patients gained 4.36 kg ( $p < 0.001$ ) three months after discharge from hospital. Overall, we observed a weight reduction of 2.2% ( $p < 0.001$ ) from the habitual weight reported by patients upon admission to hospital (Table 2).

A statistically significant positive correlation between the length of the hospital stay and the weight loss between HA and HD and between HA and FU was observed ( $r = 0.536$ ,  $p < 0.001$  and  $r = 0.388$ ,  $p < 0.001$ , respectively).

At HD 12 patients were malnourished (8.4%) according to the ESPEN definition [12]. During FU, nutritional risk according to MUST was determined to establish how many patients were at a high risk of malnutrition three months after discharge from hospital. Ninety-eight patients (74.2%) were in the low, 20 (15.1%) in the medium and 14 (10.6%) in the high-risk class. No patients were malnourished at FU according to the ESPEN definition.

A further sub-analysis was conducted to evaluate differences in terms of UWL at BMI, MUST [11], comorbidities and days of hospitalization between patients admitted to the ICU or IMCU and patients admitted to standard care wards (Table 3). No differences in terms of comorbidities were found. Patients admitted to an ICU/IMCU lost more weight during hospitalization and the stay was significantly longer for patients admitted to an ICU/IMCU than patients admitted to standard care wards (32.4 vs 8.16 days;  $p < 0.001$ ). Patients admitted to an ICU and IMCU lost on average 5.23 kg, vs 1.13 kg ( $p = 0.003$ ) lost by those not admitted to an ICU/IMCU. As for UWL, a greater reduction was observed in the ICU/IMCU group than in the non-ICU/IMCU group (5.5% vs 1.2%;  $p < 0.001$ ). A weak association between the MUST score and admission to an ICU/IMCU was also observed (Cramer's V 0.218,  $p = 0.035$ ). In particular, patients admitted to an ICU/IMCU showed a higher MUST score at FU. After

HD, 18 (12.7%) patients were admitted to COVID-safe houses while the others returned to their homes.

As regards dietary habit changes and the presence of NIS compromising oral intake at FU: twenty-two patients (15.5%) changed their eating habits while 21.2% reduced their habitual oral intake. In particular, 22 patients (15.5%) reduced their cereal consumption, 17 (12%) their fat consumption, 11 (7.7%) their milk and dairy product consumption, 10 (7%) their meat, fish, egg and pulse consumption and 3 (2.1%) reduced their vegetable and fruit consumption. The average number of meals of each patient was 3.45/day. Regarding NIS, 7 patients (4.9%) reported one or more problems. Dysgeusia and xerostomia were the most frequent associated symptoms (2.1%) followed by lack of appetite, dysphagia for solids, dysosmia (1.4%) and dysphagia for liquids (0.7%).

#### 4. Discussion

Eighty-three male patients were enrolled on the present study (58.5% of total): this data is consistent with the higher rates of hospitalization for COVID-19 infection in men than in women [13,14]. Most of them were overweight or obese. A high frequency of obesity in COVID-19 inpatients was reported, highlighting the fact that obesity may aggravate COVID-19 [15]. In fact, a recent meta-analysis showed that COVID-19 severity is associated with higher BMI values [16]. In our cohort, the patients admitted to an ICU and IMCU had a higher mean BMI than patients admitted to standard care wards (28.8 kg/m<sup>2</sup> vs 27.8 kg/m<sup>2</sup>,  $p = 0.33$ ). Old age is considered a risk factor for nutritional status [9]. The median age of our sample was 61 years and we found a statistically significant correlation between age and weight loss ( $r = 0.288$ ,  $p = 0.05$ ). Our data confirm the concept that the prevalence of malnutrition in elderly patients with COVID-19 is high [17].

Furthermore, our results show that COVID-19 has a negative effect on nutritional status. In fact, many patients lost weight during hospitalization (mean UWL of 7.6%) and UWL prevalently occurred during the ICU/IMCU stay (13.6% vs 5.6%;  $p < 0.001$ ). At HD 12 patients were malnourished (8.45%). A recent study reports a high prevalence of malnutrition, especially for patients transferred

**Table 2**  
Weight change during hospitalization and follow-up.

	From HA to HD	p	From HD to FU	p	From HA to FU	p
<b>Weight change (kg), mean (SD)</b>	-6.49 (6.37)	<0.001	4.36 (4.43)	<0.001	-2.14 (5.84)	<0.001
<b>UWL (%), mean (SD)</b>	-7.62 (6.62)	<0.001	5.97 (6.07)	<0.001	-2.24 (6.37)	<0.001

Hospital admission (HA), Hospital discharge (HD), Follow-up (FU), Unintended weight loss (UWL), Standard deviation (SD).

**Table 3**  
Comparison between ICU/IMCU and Non ICU/IMCU populations.

		ICU/IMCU group	Non ICU/IMCU group	p
<b>Hospital Admission (HA)</b>	Weight (kg)	85.56 (19.34)	79.92 (16.64)	0.09
	BMI (kg/m <sup>2</sup> )	28.78 (6.64)	27.76 (4.87)	0.33
<b>Hospital Discharge (HD)</b>	Weight (kg)	73.59 (16.12)	75.22 (15.25)	0.59
	BMI (kg/m <sup>2</sup> )	24.79 (5.57)	26.13 (4.43)	0.15
<b>Follow-up (FU)</b>	Weight (kg)	80.33 (16.66)	78.79 (16.48)	0.63
	BMI (kg/m <sup>2</sup> )	27.01 (5.66)	27.34 (4.65)	0.73
<b>UWL (%)</b>	<b>From HA to HD</b>	−13.63 (7.1)	−5.65 (5.13)	<0.001
	<b>From HD to FU</b>	+9.6 (6.77)	+4.78 (5.34)	<0.001
	<b>From HA to FU</b>	−5.46 (6.88)	−1.19 (5.85)	<0.001

Data are expressed as mean (SD). Unintended weight loss (UWL), Intensive care unit (ICU), Intermediate care unit (IMCU).

from an ICU, which confirms our data [18]. A factor that contributes to UWL is the length of the hospital stay ( $r = 0.536$   $p < 0.001$ ). Length of hospital stay and ICU/IMCU are closely linked to one another and to COVID-19 severity.

It is well known that the most frequent NIS related to COVID-19 are anosmia and dysgeusia [19] but whether these symptoms persist after the infection is cured remains unclear. Three months after discharge from hospital, we observed that only 7 patients (4.9%) reported symptoms that may have a negative influence on their nutrient intake. In fact, patients were able to reach an adequate nutritional level and to regain weight during the follow-up period. This aspect could indicate that in-hospital malnutrition during a COVID-19 infection is multifactorial, but after discharge the nutritional status rapidly returns normal when a nutritional follow-up is scheduled, indicating that COVID-19 patients requiring hospitalization do not suffer any permanent nutritional dysfunction. However, according to MUST, 26.6% of patients remained at a high nutritional risk due to their UWL during their hospital stay. In particular, patients admitted to an ICU/IMCU showed a higher MUST score three months after hospital discharge. This data confirms the influence of post-intensive care syndrome on nutritional recovery after discharge [20]. In fact, several studies have reported that the catabolic/hypermetabolic condition associated with critical illness may last up to two years after discharge from hospital, negatively affecting the recovery of muscle mass and function [21].

## 5. Conclusion

In conclusion, our study shows that COVID-19 is associated with nutritional risk and malnutrition, proportionally to the severity of the disease, indirectly inferable from an evaluation of the length of stay and need for admission to ICU/IMCU. Old age is an additional factor that contributes to UWL. Malnutrition starts during the initial phases of disease that take place at home, as upon admission, patients declared significant UWL when compared to their habitual weight. The early identification of patients at a higher nutritional risk could be useful with a view to adopting measures to prevent worsening of their nutritional status during hospitalization.

Patients at a high nutritional risk during follow-up are those who lose more than 10% of their habitual weight during their hospital stay or are admitted to an ICU and IMCU. Nutritional follow-up should be guaranteed especially for these categories of patients.

## Authors' contribution

C.F.,F.C.,L.R.,L.L.,L.G.,A.N. collected the data; C.F.,F.C.,C.C.,L.R. analysed data; C.F.,F.C.,C.C.,A.N wrote the manuscript; and C.F.,F.C.,I.O.,A.C.,F.G.,F.L.,A.B.,A.N. supervised all the manuscript.

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## Declaration of competing interest

No Conflicts of Interest were present and Ethical Adherence was applied. On behalf of all authors, the corresponding author states that there is no conflict of interest. The authors declare that the manuscript has not been submitted to any other journal.

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