Clinical characteristics, management and health related quality of life in young to middle age adults with COVID-19

Chiara Temperoni¹, Stefania Grieco¹, Zeno Pasquini¹,², Benedetta Canovari¹, Antonio Polenta¹,², Umberto Gnudi³, Roberto Montalti⁴ and Francesco Barchiesi¹,²*

Abstract

Background: The outbreak of COVID-19 has rapidly spread to Italy, including Pesaro-Urbino province. Data on young to middle age adults with COVID-19 are lacking. We report the characteristics, management and health-related quality of life (HRQoL) in patients with COVID-19 aging ≤ 50 years.

Methods: A retrospective analysis was performed in all patients ≤50 years with a confirmed diagnosis of COVID-19 admitted to Emergency department (ED) of San Salvatore Hospital in Pesaro from February 28th to April 8th, 2020. Data were collected from electronic medical records. HRQoL was investigated after 1 month from hospital discharge using the SF-36 questionnaire. Outcomes were evaluated between hospitalized and not hospitalized patients.

Results: Among 673 patients admitted to the ED and diagnosed with COVID-19, 104 (15%) were ≤ 50 years old: 74% were discharged at home within 48 h, 26% were hospitalized. Fever occurred in 90% of the cases followed by cough (56%) and dyspnoea (34%). The most frequent coexisting conditions were hypertension (11%), thyroid dysfunction (8%) and neurological and/or mental disorders [NMDs] (6%). Mean BMI was 27. Hypokalaemia and NMDs were significantly more common in patients who underwent mechanical ventilation. Regardless of hospitalization, there was an impairment in both the physical and mental functioning.

Conclusions: Overweight and hypertension are frequent conditions in young to middle age adults with COVID-19. Hypokalaemia and NMDs are commonly associated with progressive disease. A significant impact on HRQoL in the early stage of post-discharge is common in this population.

Keywords: COVID-19, Young to middle age adults, SARS-Cov-2, Respiratory distress, Health related quality of life
**Background**

In early December 2019, 41 cases of coronavirus disease 2019 (COVID-19) were described in Wuhan in Hubei Province [1]. The outbreak of the new pandemic coronavirus pneumonia has rapidly spread all over the world, included Europe and Italy, with an increasing number of cases. People have been facing this new virus changing their habits and their behaviours with a huge impact on mental and physical health [2].

The first two cases in Italy were reported on the 23rd of January 2020 coming from Wuhan [3]. Since then, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has overwhelmed Italy with approximately 215,000 infected subjects. Among the most affected areas in Italy (Fig. 1), Marche region counted almost 6,400 cases [4]. The median age of the Italian patients was 62 years old; patients between 19 and 50 years old represented the 28% of the infected population, while patients older than 50 were the 70% [4].

---

**Fig. 1** Distribution of Patients with Covid-19 from the seven Italian regions mainly involved in the pandemic (a) and across Marche region (b). Laboratory-confirmed cases of Covid-19 throughout Northern and Center Italy according to the Italian Civil Protection as of May 8, 2020 (a) and across Marche region according to the GORES (Operative Regional Group for Sanitary Emergencies) as of May 8, 2020. Map produced by the Authors.
Data on adults younger than 50 years old with COVID-19 are lacking. Although one study from China reported a median age of 41 years, the overall population ranged from 41 to 65 years and it included even older patients [5]. Data from European countries describe patients who are generally older than those reported from Asiatic countries [6, 7]. Actually a remarkable interest of COVID-19 has been focused on older people who represent the main population at risk to develop SARS-CoV-2 related pneumonia [8–10]. Since little clinical information is available in patients with COVID-19 aging ≤50 years, the aim of this study was to illustrate the epidemiological, demographic, clinical, laboratory, radiological characteristics and clinical outcomes of laboratory-confirmed young to middle age patients with COVID-19.

All over the world measures, such as quarantine, containment and school and business closures, have been enforced to slow down virus spreading [11], this resulting in worsening of the quality of life, with an increasing of stress level and sedentary lifestyle [12] and lasting physical and psychological consequences [13]. Therefore, we also investigated the impact of COVID-19 in the quality of life of this population. To this aim we used the short form survey (SF-36) which includes 36 questions analysing eight health domains including physical functioning, role physical and bodily pain which evaluates physical sphere, mental health, role emotional, and social functioning items analysing mental component [14].

Methods

Patients
A retrospective analysis was performed on the confirmed cases of COVID-19, who were admitted to Emergency department (ED) of San Salvatore Hospital in Pesaro from February 28th to April 8th, 2020. All adults patients with age ranging from 18 to 50 years were considered in this study. A confirmed case of infection with SARS Cov-2 was defined by RT-PCR assay on nasopharyngeal swab.

Data collection and definitions
Data were extracted from electronic medical records including patient demographic information, tobacco smoke addiction, underlying comorbidities, triage vital signs, referred symptoms on admission and the interval time lapse between illness onset and ED access. Fever was defined as axillary temperature of at least 37.5 °C. Respiratory distress syndrome was defined as PaO2/FiO2 ratio ≤ 300 according to the Berlin Definition [15]. Laboratory tests and radiological data on admission were also collected.

Short form health survey (SF-36)
After 1 month from hospital discharge patients were interviewed and requested to answer to the short form health survey (SF-36). The SF-36 is an internationally instrument to measure Health-Related Quality of Life (HRQoL) [14]. It includes 36 questions analysing eight health domains including physical functioning, role physical and bodily pain which evaluates physical sphere, mental health, role emotional, and social functioning items analysing mental component. Scores for each domain can range from 0 (worst) to 100 (best), higher scores indicate better HRQoL. The SF-36 has been used in many different diseases to evaluate the quality of life for patients with other respiratory infections such as Middle East Respiratory Syndrome (MERS) [16] and SARS-CoV-1 [17].

Statistical analysis
Continuous variables were expressed as median (IQR) and compared with the Mann-Whitney U test or independent group t tests, when data were normally distributed; categorical variables were expressed as number (%) and compared by χ² test or Fisher’s exact test. Comparison analysis was carried out between hospitalized and not hospitalized patients (i.e.: discharged at home within 48 h upon ED arrival). A two-sided α of less than 0.05 was considered statistically significant. All the statistical analyses were supported by SPSS (Statistical Package for the Social Sciences) version 25.0 software (SPSS Inc).

Results
Among 673 patients admitted to the ED and diagnosed with COVID-19 from February 28th to April 8th, 2020, 104 (15%) were ≤50 years old. Demographic, clinical, laboratory and radiological characteristics of the patients are shown in Table 1. Age ranged from 22 to 50 years with a mean of 41 years, the majority were men and the mean of BMI was 27. Hypertension was the most frequent coexisting condition being observed in 11% of the patients, followed by thyroid dysfunction (8%), and neurological and/or mental disorders (6%). Mean days from illness onset to first hospital access was 8.8. Common symptoms at the onset were fever (90%), cough (56%) and dyspnoea (34%), less common symptoms were fatigue (17%), anosmia (16%), diarrhoea (15%) and chest pain (14%). Respiratory distress was present in 13% of the patients. Chest X-ray and/or CT scan revealed ground glass opacity, bilateral patch shadow or focal lesions in 27, 37 and 10% of the patients, respectively. In 26% of the cases, chest X-ray was negative.

Seventy-one patients (74%) were managed in ED and discharged at home within 48 h, 33 patients (26%) were hospitalized. Compared with patients who did not require hospitalization, in-patients were significantly older
| Characteristics                                      | All patients (n = 104) | Outpatients (n = 71) | Inpatients (n = 33) | p value   |
|------------------------------------------------------|------------------------|----------------------|---------------------|-----------|
| Mean age ± SD – years                                 | 41.1 ± 7.4             | 39.5 ± 7.5           | 44.8 ± 5.8          | < 0.001   |
| Male gender – no. (%)                                 | 56 (53.8%)             | 37 (52.1%)           | 19 (57.6%)          | 0.757     |
| Healthcare worker – no. (%)                          | 13 (12.5%)             | 11 (15.5%)           | 2 (6.1%)            | 0.218     |
| Mean BMI (Body mass index) ± SD                      | 27.1 ± 5.01            | 26.37 ± 5.12         | 28.6 ± 4.46         | 0.029     |
| Smoking habit – no. (%)                              | 11 (10.6%)             | 9 (13.8%)            | 2 (7.1%)            | 0.495     |
| Coexisting conditions                                |                        |                      |                     |           |
| Hypertension                                         | 11 (10.6%)             | 8 (11.3%)            | 3 (9.1%)            | > 0.999   |
| Diabetes                                             | 4 (3.8%)               | 2 (2.8%)             | 2 (6.1%)            | 0.590     |
| Chronic obstructive pulmonary disease                | 2 (1.9%)               | 2 (2.8%)             | 0                   | > 0.999   |
| Cerebrovascular disease                              | 1 (1%)                 | 1 (1.4%)             | 0                   | > 0.999   |
| Chronic liver disease                                | 3 (2.9%)               | 2 (2.8%)             | 1 (3%)              | > 0.999   |
| Neurological disease and mental disorder             | 6 (5.8%)               | 2 (2.8%)             | 4 (12.1%)           | 0.079     |
| Malignancy                                           | 3 (2.9%)               | 3 (4.2%)             | 0                   | 0.550     |
| Thyroid diseases                                     | 8 (7.7%)               | 7 (9.9%)             | 1 (3%)              | 0.431     |
| Days from illness onset to visit hospital            | 8.8 ± 6.05             | 8.5 ± 6.49           | 8.5 ± 6.07          | 0.996     |
| Signs and symptoms at the onset                      |                        |                      |                     |           |
| Fever                                                | 94 (90.4%)             | 61 (85.9%)           | 33 (100%)           | 0.028     |
| Cough                                                | 58 (55.8%)             | 35 (49.3%)           | 23 (69.7%)          | 0.082     |
| Dyspnoea                                             | 35 (33.7%)             | 18 (25.4%)           | 17 (51.5%)          | 0.016     |
| Chest pain                                           | 15 (14.4%)             | 9 (12.7%)            | 6 (18.2%)           | 0.551     |
| Fatigue                                              | 18 (17.3%)             | 13 (18.3%)           | 5 (15.2%)           | 0.906     |
| Sore throat                                          | 9 (8.7%)               | 9 (12.7%)            | 0                   | 0.054     |
| Anosmia                                              | 17 (16.3%)             | 14 (19.7%)           | 3 (9.1%)            | 0.280     |
| Diarrhoea                                            | 16 (15.4%)             | 9 (12.7%)            | 7 (21.2%)           | 0.406     |
| Vomiting                                             | 5 (4.8%)               | 4 (5.6%)             | 1 (3%)              | > 0.999   |
| Headache                                             | 8 (7.7%)               | 6 (8.5%)             | 2 (6.1%)            | > 0.999   |
| Myalgia                                              | 11 (10.6%)             | 7 (9.9%)             | 4 (12.1%)           | 0.740     |
| Syncope                                              | 6 (5.8%)               | 4 (5.6%)             | 2 (6.1%)            | > 0.999   |
| Respiratory distress syndrome                        | 14 (13.95%)            | 2 (2.8%)             | 12 (36.4%)          | < 0.001   |
| Vital signs                                           |                        |                      |                     |           |
| Systolic blood pressure, mm Hg                       | 96 ± 15.51             | 128 ± 14             | 132 ± 18.1          | 0.289     |
| Heart rate                                           | 91.7 ± 17.45           | 90.3 ± 18.3          | 94.6 ± 15.6         | 0.329     |
| Respiratory rate                                     | 18 (17–24)             | 17 (16–18)           | 18 (17–24)          | 0.171     |
| Laboratory findings                                  |                        |                      |                     |           |
| White blood cell count, × 109/L (normal range 4–11)  | 5.820 ± 2.489          | 5.614 ± 2.259        | 6.264 ± 2.913       | 0.224     |
| Lymphocyte count, ×109/L (normal range 1–4)          | 1.318 ± 0.609          | 1.415 ± 0.597        | 1.109 ± 0.592       | 0.018     |
| Platelet count, ×109/L (normal range 150–400)        | 186 (152–248)          | 183 (161–246)        | 190.5 (142–250)     | 0.693     |
| Alanine aminotransferase, U/L (normal range 0–35)    | 28 (18–40)             | 21 (15–33)           | 36.2 (26.7–50)      | 0.001     |
| Aspartate aminotransferase, U/L (normal range 0–35)  | 24 (42–20.5)           | 24 (19–30)           | 42 (29.7–51)        | < 0.001   |
| Creatinine, mg/dl (normal range 0.67–1.17)           | 0.844 ± 0.21           | 0.823 ± 0.19         | 0.890 ± 0.24        | 0.128     |
| Potassium, mEq/L (normal range 3.5–5.1)              | 3.99 ± 0.36            | 3.96 ± 0.348         | 4.05 ± 0.38         | 0.248     |
| Lactate dehydrogenase, U/L (normal range 0–247)      | 250.5 (176.5–326.5)    | 179 (150–221)        | 317 (259–448)       | < 0.001   |
| Creatine kinase, U/L (normal range 0–195)            | 73 (49.25–124.5)       | 67.5 (49–90.7)       | 116 (59–270)        | 0.034     |
In brackets are expressed percentages and IQR are frequent conditions in young to middle age adults. Overall, we showed that overweight and hypertension were more likely to be overweight. Fever and dyspnoea were significantly more common in hospitalized patients. As expected, a significantly higher proportion of hospitalized patients had respiratory distress. Additionally, this group was more likely to have lymphocytopenia, hepatic disfunction, higher inflammation biomarkers (i.e.: PCT, CRP and D-dimer [p ranging from < 0.001 to 0.034]), and more extensive lung involvement (p < 0.001).

Six out of 33 hospitalized patients (18%) required mechanical ventilation (Table 2). Respiratory distress syndrome and hypokalaemia at the infection onset were significantly more common in patients requiring mechanical ventilation (p 0.001 and 0.028, respectively). No difference was noticed in other laboratory findings between patients who required and did not require ICU care. Among coexisting conditions, only neurological and/or mental disorders were significantly more common in patients requiring ICU care (p = 0.014). Table 3 details clinical features of six patients who required ICU care. Except for patient n. 5, who did not suffer from any underlying disease, the remaining five patients died from one to 39 days upon the admission in ICU.

Among 104 patients, 85 were contacted 1 month from hospital discharge and requested to answer to SF-36 questionnaire. A total of 64 subjects (75%) answered the SF-36 questionnaire. The results of the survey are reported in Table 4. HRQoL revealed that physical functioning, general health and mental health reached the highest scores (74, 63, and 59, respectively) while physical role, vitality, social functioning and emotional role reached the lowest scores (30, 48, 45 and 46, respectively). Additionally, there were no significant differences between hospitalized and not hospitalized patients in physical component or mental component scores.

**Discussion**

Overall, we showed that overweight and hypertension are frequent conditions in young to middle age adults with COVID-19, hypokalaemia and NMDs are instead commonly associated with progressive disease. A significant impact on HRQoL in the early stage of post-discharge is common in this population.

This study focused on clinical characteristics, management and health related quality of life in young to middle age adults with COVID-19 admitted to the ED of Pesaro Hospital. During the pandemic, Marche, and particularly the Province of Pesaro-Urbino, was one of the most affected regions in Italy. Overall, our data highlight distinctive features of COVID-19 in this population.

First, as many as 26% of the patients was hospitalized upon arrival to the ED. This is a remarkable percentage considering the age. Even if there is a lack of data describing the management of patients after ED access, it is reasonable to think, looking at the regional prevalence of SARS-CoV-2, that many patients with mild symptoms were managed at home according to WHO indications [18]. Second, in contrast to many reports in which SARS-CoV-2 seems to affect more males then females, our population included approximately an equal number of men and women. Conversely, we observed a slightly higher number of men (57%) requiring hospitalization after ED access. It has been demonstrated that for SARS-CoV-2, as for other similar infections (i.e.: MERS and SARS-CoV-1), the male gender is more affected than female thereby reflecting sex predisposition associated with genetic factors [19]. Third, several coexisting conditions were quite frequent in this population. In concert with other studies focused on patients with COVID-19 without age selection, an increase of BMI even in young to middle age adults has been observed (mean BMI SD 27.1 ± 5.01 kg/m²). As it has been already demonstrated in Influenza A virus [20], obesity may worsen the severity of respiratory diseases. One study showed that SARS-CoV-2 patients having BMI ≥35 are at higher risk of mechanical ventilation, compared to

**Table 1** Demographic, clinical, laboratory and radiological characteristics of 104 young adults with COVID-19 considered in this study (Continued)

| Characteristics                        | All patients (n = 104) | Outpatients (n = 71) | Inpatients (n = 33) | p value |
|----------------------------------------|------------------------|----------------------|---------------------|---------|
| Procalcitonin ng/mL (normal range 0.38) | 0.03 (0.02–0.08)       | 0.02 (0.02–0.04)     | 0.07 (0.02–0.132)   | 0.018   |
| C-reactive protein mg/mL (normal range 0–0.49) | 1.74 (0.49–5.72)       | 0.89 (0.195–2.44)    | 7.63 (2.66–11.72)   | <0.001  |
| D-dimer, ng/L (normal range 0–500)     | 587 (298–920)          | 406 (263–494)        | 861 (591–1165)      | 0.001   |

Data are expressed as mean ± SD, median (IQR) or n (%)

*p* values indicate differences between out and in-patients. P < .05 was considered statistically significant

In brackets are expressed percentages and IQR
**Table 2** Demographic, clinical, laboratory and radiological characteristics of 33 hospitalized young adults with COVID-19 considered in this study

| Characteristics                                  | No ICU care (n = 27) | ICU care (n = 6) | p value |
|--------------------------------------------------|----------------------|-----------------|---------|
| Mean age ± SD – years                            | 45.48 ± 5.09         | 42.5 ± 8.26     | 0.257   |
| Male gender – no. (%)                            | 16 (59.3%)           | 3 (50%)         | > 0.999 |
| Healthcare worker – no. (%)                     | 2 (7.4%)             | 0               | > 0.999 |
| Mean BMI ± SD                                    | 28.7 ± 4.8           | 28.6 ± 2.84     | 0.989   |
| Smoking habit – no. (%)                          | 1 (4%)               | 1 (33.3%)       | 0.206   |
| Coexisting conditions                           |                      |                 |         |
| Hypertension                                     | 3 (11%)              | 0               | > 0.999 |
| Diabetes                                         | 2 (7.4%)             | 0               | > 0.999 |
| Chronic liver disease                            | 1 (3.7%)             | 0               | > 0.999 |
| Neurological disease and mental disorder         | 1 (3.7%)             | 3 (50%)         | 0.014   |
| Thyroid diseases                                 | 0                    | 1 (16.7%)       | 0.182   |
| Signs and symptoms at the onset                  |                      |                 |         |
| Fever                                            | 100%                 | 100%            | –       |
| Cough                                            | 21 (77.8%)           | 2 (33.3%)       | 0.053   |
| Dyspnoea                                         | 13 (48.1%)           | 4 (66.7%)       | 0.656   |
| Chest pain                                       | 6 (22.2%)            | 0               | 0.563   |
| Fatigue                                          | 5 (18.5%)            | 0               | 0.556   |
| Anosmia                                          | 3 (11.1%)            | 0               | > 0.999 |
| Diarrhoea                                        | 6 (22.2%)            | 1 (16.7%)       | > 0.999 |
| Vomiting                                         | 1 (3.7%)             | 0               | > 0.999 |
| Headache                                         | 1 (3.7%)             | 1 (16.7%)       | 0.335   |
| Myalgia                                          | 4 (14.8%)            | 0               | > 0.999 |
| Syncope                                          | 6 (22.2%)            | 1 (16.7%)       | 0.335   |
| Respiratory distress syndrome                    | 6 (22.2%)            | 6 (100%)        | 0.001   |
| Vital signs                                      |                      |                 |         |
| Systolic blood pressure. mm Hg                   | 132 ± 18.1           | 131 ± 20        | 0.895   |
| Heart rate                                       | 93.3 ± 16.3          | 103 ± 3.51      | 0.291   |
| Laboratory findings                              |                      |                 |         |
| White blood cell count, ×10^9/L (normal range 4–11) | 6.437 ± 2.981        | 5.511 ± 2.714   | 0.492   |
| Lymphocyte count, ×10^9/L (normal range 1–4)    | 1.091 ± 0.460        | 1.183 ± 1.051   | 0.739   |
| Platelet count, ×10^9/L (normal range 150–400)  | 199(144.750–260.500) | 156.5 (138.750–181.750) | 0.308   |
| Alanine aminotransferase, U/L (normal range 0–35)| 39 (30.2–52)         | 25 (17.5–28.7)  | 0.055   |
| Aspartate aminotransferase, U/L (normal range 0–35)| 43 (28.5–49.7)      | 35 (30.7–67)    | 0.906   |
| Creatinine, mg/dl (normal range 0.67–1.17)      | 0.86 ± 0.218         | 1 ± 0.294       | 0.093   |
| Potassium, mEq/L (normal range 3.5–5.1)         | 4.1 ± 0.332          | 3.7 ± 0.460     | 0.028   |
| Lactate dehydrogenase, U/L (normal range 0–247) | 297 (235–365)        | 483 (362–729)   | 0.141   |
| C-reactive protein mg/mL (normal range 0–0.49)  | 6.5 (2.55–11.25)     | 11.7 (11.1–14.1) | 0.097   |
| Involvement on chest radiographs                 |                      |                 |         |
| No involvement                                   | 1 (3.7%)             | 0 (0%)          | 0.865   |
| Ground-glass opacity                             | 4 (14.8%)            | 1 (16.7%)       |         |
| Bilateral lung patch shadow                      | 20 (74.1%)           | 5 (83.3%)       |         |
| Focal lesions                                    | 2 (7.4%)             | 0 (0%)          |         |

Data are expressed as mean ± SD, median (IQR) or n (%)

p values indicate differences between out and in-patients. P < .05 was considered statistically significant

In brackets are expressed percentages and IQR
those with BMI < 25 [21]. This could be due to multiple factors. Accumulation of adipose tissue in the mediastinum and in the abdominal cavities seen in obese subjects determines lung mechanical dysfunction [22, 23]. Additionally, fat causes an abnormal cytokine production and an increasing inflammatory pathway activation thereby favouring the infection per se and worsening its clinical course.

Hypertension is one of the most frequent underlying diseases in patients with COVID-19 [24]. In our study, 11% of the patients suffered from this clinical condition. Although hypertension has been commonly described to increase the severity illness in patients with COVID-19 [25], it is still unclear whether hypertensive subjects are more likely to be infected by coronavirus. It is reasonable to think that angiotensin-converting enzyme 2 expression, frequently increased in these patients, and the activation of the renin-angiotensin system can be involved either in the entrance of the virus into the cell or in the inflammatory response [26]. Further studies are warranted to elucidate this issue.

Thyroid dysfunction was seen in 8% of our patients. Little is known about the correlation between COVID-19 and thyroid dysfunction. Thyroid hormones play an important role in regulating the immune response and in modulating pulmonary system and alveolar ventilation. Hypothyroid patients can have a decreased lung function [27] but there is no evidence that those who have a thyroid disorder, unless they are under immunosuppressive treatment, are at higher risk to be infected by coronavirus [28].

Fourth, we identified several features more frequently associated with young to middle age patients requiring ICU admission, namely the respiratory distress syndrome, the hypokalaemia and neurological diseases and mental disorders. While the more severe respiratory syndrome the greater risk of mechanical ventilation is easily explained, the relationship between the other two parameters and ICU admission is less clear.

Hypokalaemia has been already reported among patients with COVID-19 with progressive disease [29]. It can occur first through virus action on angiotensin-converting enzyme 2 with an increased potassium excretion by the kidneys and secondly through loss, with vomiting or diarrhoea, in patients with gastrointestinal symptoms [30]. Hypokalaemia might worsen acute respiratory distress syndrome and acute cardiac injury, which are common complications in COVID-19 [29, 30].

It has already demonstrated that people with severe mental illness have a higher risk to develop pneumonia [31]. Lee et al., underline as patients with underlying mental health disease have higher risk for severe clinical outcomes of COVID-19 [32]. Poor information on the effect of chronic benzodiazepines use in patients with COVID-19 infection is available. It is interesting to note how four out of six patients, who underwent mechanical ventilation, were taking benzodiazepines. The mechanism of action of these drugs is enhancing the effect of γ-amino-butyric acid type A (GABA_A) at the GABA_A receptors. Chronic benzodiazepine exposure could be associated with an increased risk of developing pneumonia [33] as GABA can play an important role in regulating the secretion of a great number of cytokines [34, 35].

A severe respiratory infection generally affects HRQoL. This has been demonstrated in subjects recovering from MERS [16], SARS-CoV-1 [17] and H1N1 [36]. Batawi et al. [16] demonstrated that subjects with MERS experiencing ICU admission scored low values for physical function, general health, vitality, emotional role and physical components. To our knowledge, there are only few reports considering the impact of COVID-19 on mental health and quality of life among these patients. Hu et al., evaluated the mental health status of 85 hospitalized patients (mean age 49 years) with COVID-19 [37]. They found that female sex, disease duration, levels of inflammatory markers and self-perceived illness severity were factors significantly related with mental disturbances. Liu et al., investigated the distress levels within young adults (18–30 years) during the COVID-19 pandemic [38]. They reported significant depression, anxiety and post-traumatic stress disorder during the first few weeks of the pandemic. In particular, a pre-existing
mental health diagnosis makes this population more vulnerable to poorer quality of life. Despite a quite young age population analysed in this study and the majority of patients who were discharged early after ED arrival, we observed lowest rating scores in items regarding physical role, vitality, social functioning and emotional role. It is interesting to note how the quality of life reported by hospitalized patients did not differ from non-hospitalized ones, as shown by similar physical and mental component summary scores (around 50 in both groups). This can be due by the fact that patients discharged early from ED experienced the lockdown period, so their psychological and physical spheres were possibly affected as the ones hospitalized. One study [37] found a significant correlation between levels of inflammatory markers and physical and mental quality of life; although we also tried to investigate a possible correlation between laboratory markers, pre-existing pathologies and HRQoL scores, we did not find any significant relationship in our population (data not shown).

The present study has some limitations. First, being a single-centre study, the number of patients considered is low. The suspected but undiagnosed cases were ruled out in the analyses. This feature has certainly weakened the statistical power of the study. Nevertheless, we considered all patients admitted to the ED of Pesaro Hospital in a very limited time which represented the period with highest COVID-19 incidence in our country. Second, this was a retrospective analysis. Although we tried to collect a possible correlation between laboratory markers, pre-existing pathologies and HRQoL scores, we did not find any significant relationship in our population (data not shown).

The present study has some limitations. First, being a single-centre study, the number of patients considered is low. The suspected but undiagnosed cases were ruled out in the analyses. This feature has certainly weakened the statistical power of the study. Nevertheless, we considered all patients admitted to the ED of Pesaro Hospital in a very limited time which represented the period with highest COVID-19 incidence in our country. Second, this was a retrospective analysis. Although we tried to collect a possible correlation between laboratory markers, pre-existing pathologies and HRQoL scores, we did not find any significant relationship in our population (data not shown).

The SF-36 is an internationally instrument to measure Health-Related Quality of Life (HRQoL). It includes 36 questions analysing eight health domains including physical functioning, role physical and bodily pain which evaluates physical sphere, mental health, role emotional, and social functioning items analysing mental component. Scores for each domain can range from 0 (worst) to 100 (best), higher scores indicate better HRQoL.

### Table 4 Average score of SF36* components reported by 64 COVID-19 patients

|                                | All patients (n = 64) | Outpatients (n = 49) | Inpatients (n = 15) | p value |
|--------------------------------|-----------------------|----------------------|---------------------|---------|
| Physical functioning            | 74.3 ± 25.48          | 76.22 ± 25.34        | 68 ± 25.76          | 0.277   |
| Physical role                   | 30.47 ± 42.13         | 31.12 ± 42.86        | 28.33 ± 41.04       | 0.825   |
| Bodily pain                     | 54.34 ± 30.39         | 51.88 ± 28.50        | 62.40 ± 35.80       | 0.244   |
| General health                  | 63.06 ± 17.91         | 62.10 ± 19.37        | 66.27 ± 12.19       | 0.436   |
| Vitality                        | 48.44 ± 23.20         | 47.65 ± 21.22        | 51 ± 29.47          | 0.629   |
| Social functioning              | 45.12 ± 29.52         | 43.62 ± 27.85        | 50 ± 35.04          | 0.468   |
| Emotional role                  | 46.87 ± 45.50         | 45.57 ± 45.99        | 51.11 ± 45.19       | 0.684   |
| Mental health                   | 59.06 ± 20.35         | 58.04 ± 20.38        | 62.40 ± 20.61       | 0.472   |
| Physical component summary      | 49.87 ± 24.25         | 55.32 ± 23.48        | 56.25 ± 23.15       | 0.894   |
| Mental component summary        | 55.54 ± 23.22         | 48.72 ± 23.14        | 53.63 ± 28.11       | 0.498   |

The SF-36 is an internationally instrument to measure Health-Related Quality of Life (HRQoL). It includes 36 questions analysing eight health domains including physical functioning, role physical and bodily pain which evaluates physical sphere, mental health, role emotional, and social functioning items analysing mental component. Scores for each domain can range from 0 (worst) to 100 (best), higher scores indicate better HRQoL.

### Conclusions

Overweight and hypertension are frequent coexisting conditions in young to middles age adults with COVID-19. Respiratory distress and hypokalaemia at the infection onset such as neurological and/or mental disorders are commonly associated with progressive disease. Regardless of hospitalization, either physical or mental status are deeply affected in the early stage of post-discharge.

### Abbreviations

COVID-19: New coronavirus disease 2019; HRQoL: Health related quality of life; ED: Emergency department; SF-36: Short form health survey; NMDs: Neurological and/or mental disorders; BMI: Body mass index; SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2; RT-PCR: Reverse transcriptase-polymerase chain reaction; MERS: Middle east respiratory syndrome; SARS-Cov1: Severe acute respiratory syndrome coronavirus 1; IQR: Interquartile range; WHO: World Health Organization

### Acknowledgements

Not applicable.

### Authors’ contributions

CT, SG, and RB designed this study and wrote the manuscript. CT, SG, ZP, BC, AP, and UG conducted data collection and analysis, and interpretation of results. RM performed statistical analysis. All authors agree to publish the article. All authors read and approved the final manuscript.
Funding
The study was in part supported by Fondi Ricerca Scientifica di Ateneo to FB, project n 243 and 394. Funder had no role in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript.

Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on request.

Ethics approval and consent to participate
The ethics committee of the Azienda Ospedaliera Ospedali Riuniti Marche Nord approved verbal consent because of the urgency of the situation at the time of the COVID-19 pandemic and the fact that the data used in this study were collected during routine medical procedures, which did not pose any additional risk to the patients. All participants provided fully informed verbal consent before being enrolled in this study. The data used in this study were anonymized prior to use.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Author details
1Malattie Infettive, Azienda Ospedaliera Ospedali Riuniti Marche Nord, Pesaro, Italy. 2Dipartimento di Scienze Biommediche e Santità Pubblica, Università Politecnica delle Marche, Ancona, Italy. 3Pronto Soccorso e Medicina d’Urgenza, Azienda Ospedaliera Ospedali Riuniti Marche Nord, Pesaro, Italy. 4Dipartimento di Sanità Pubblica, Unità di Chirurgia Epato-bilio-pancreatica, Mininvasiva e Robotica, Università Federico II, Naples, Italy.

Received: 24 September 2020 Accepted: 25 January 2021

Published online: 01 February 2021

References
1. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet. 2020;395(10223):497–506.
2. Dubey S, Biohas P, Ghori R, Chatterjee S, Dubey MJ, Chatterjee S, Lahiri D, Lavie CJ. Psychosocial impact of COVID-19. Diabetes Metab Syndr. 2020;14(5):779–88.
3. Giovanetti M, Benvenuto D, Angeletti S, Ciccozzi M. The first two cases of 2019-nCoV in Italy: where they come from? J Med Virol. 2020;92(5):751–6.
4. https://www.epicentro.iss.it/coronavirus/bollettino/Infografica_8maggio2020ITA.pdf. [En ligne]. Accessed 8 May 2020.
5. Xu WW, Wu XX, Jiang XG, et al. Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARS-CoV-2) outside of Wuhan, China: retrospective case series. BMJ. 2020;368:m6380.
6. Docherty AB, Harrison EM, Green CA, et al. Features of 20 133 UK patients in hospital with covid-19 using the ISARIC WHO clinical characterisation protocol: prospective observational cohort study. BMJ. 2020;369:m1985.
7. Grasselli G, Zangrillo A, Zanella A, et al. Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy region, Italy. JAMA. 2020;323(16):1574–81.
8. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. JAMA. 2020;323(11):1061–9.
9. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet. 2020;395(10223):507–13.
10. Liu Y, Sun W, Li J, Chen L, Wang Y, Zhang L, et al. Clinical features and progression of acute respiratory distress syndrome in coronavirus disease 2019. MedRxiv. 2020.
11. Elbrahim SH, Ahmed QA, Gozzer E, Schlagenhauf P, Merrish ZA. COVID-19 and community mitigation strategies in a pandemic. BMJ. 2020;368:m1066.
12. Qi M, Li P, Moyle W, Weeks B, Jones C. Physical activity, health-related quality of life, and stress among the Chinese adult population during the COVID-19 pandemic. Int J Environ Res Public Health. 2020;17(18):6494.
13. Bryson WJ. Long-term health-related quality of life concerns related to the COVID-19 pandemic: a call to action. Qual Life Res. 2020;18:1–3.
14. Ware JE Jr. SF-36 health survey update. Spine (Phila Pa 1976). 2000;25(24):3130–9.
15. Ranieri V, Rubenfeld GD, Thompson B, Ferguson ND, Caldwell E, Fan E, Camporota L, Slutsky AS, Antonelli M, Anzueto A, Beale R, Brochard L, Brower R, Esteban A,Gattinoni L, Rhodes A, Vincent JL, Benten A, Needham D, Pesenti A. The ARDS Definition Task Force. Acute respiratory distress syndrome: the Berlin definition. JAMA. 2012;307(23):2526–33.
16. Batavia S, Tarazan N, Al-Raddadi R, et al. Quality of life reported by survivors after hospitalization for Middle East respiratory syndrome (MERS). Health Qual Life Outcomes. 2019;17(1):101.
17. Ng J, Ko FW, Ng SS, To RW, Wong M, Hui DS. The long-term impact of severe acute respiratory syndrome on pulmonary function, exercise capacity and health status. Respir Physiol. 2010;173(3):543–50.
18. Home care for patients with COVID-19 presenting with mild symptoms and management of their contacts. https://www.who.int/publicationsuminium/home-care-for-patients-with-suspected-novel-coronavirus-(ncov)-infection-presenting-with-mild-symptoms-and-management-of-contacts. [En ligne]. Accessed 15 May 2020.
19. Sharma G, Volgyas AS, Michos ED. Sex differences in mortality from COVID-19 pandemic: are men vulnerable and women protected? JACC Case Rep. 2020;2(9):1407–10.
20. Honce R, Schultz-Cherry S. Impact of obesity on influenza a virus pathogenesis, immune response, and evolution. Front Immunol. 2019;10: 1071.
21. Simonnet A, Chetboun M, Poissy J, et al. High prevalence of obesity in severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) requiring invasive mechanical ventilation. Obesity (Silver Spring). 2020;28(7):1195–9.
22. Dixon AE, Peters U. The effect of obesity on lung function. Expert Rev Respir Med. 2018;12(9):555–67.
23. Sattar N, McNees IB, McMurray JJV. Obesity a risk factor for severe COVID-19 infection: multiple potential mechanisms. Circulation. 2020;142(1):1–6.
24. Richardson S, Hirsch JS, Narasimhan M, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. JAMA. 2020;323(20):2052–9.
25. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020;395(10229):1054–62.
26. Panata R, Lim MA, Huang I, Raharjo SB, Lukito AA. Hypertension is associated with increased mortality and severity of disease in COVID-19 pneumonia: A systematic review, meta-analysis and meta-regression. J Renin Angiotensin Aldosterone Syst. 2020;21(2):1470320320926899, pp. 1–11.
27. Sadek SH, Khalfia WA, Azzaz AM. Pulmonary consequences of hypothyroidism. Ann Thorac Med. 2017;12(3):204–8.
28. Boelaert K, Visser WE, Taylor PN, Moran C, Leger J, Persani L. Endocrinology on occurrence of pneumonia and mortality from pneumonia: a nested case-control and survival analysis in a population-based cohort. Thorax. 2020;75(12):1025–31.
29. Chen, D, Li, X, Song, Q, et al. Hypokalemia and clinical implications in patients with coronavirus disease 2019 (COVID-19). medRxiv. Epub ahead of print 29 February 2020.
30. Lippi G, South AM, Green KM. Electrolyte imbalances in patients with severe coronavirus disease 2019 (COVID-19). Ann Clin Biochem. 2020;57(3):262–5.
31. Seminog OQ, Goldacre MJ. Risk of pneumonia and pneumococcal disease in people with severe mental illness: English record linkage studies. Thorax. 2013;68(2):171–6.
32. Lee SW, Yang JM, Moon SY, et al. Association between mental illness and COVID-19 susceptibility and clinical outcomes in South Korea: a nationwide cohort study. Lancet Psychiatry. 2020;7(12):1025–31.
33. Obora E, Hubbard R, Sanders RO, Myles PR. The impact of benzodiazepines on occurrence of pneumonia and mortality from pneumonia: a nested case-control and survival analysis in a population-based cohort. Thorax. 2013;68(2):163–70.
34. Bhandage AK, Jin Z, Korol SV, et al. GABA Regulates Release of Inflammatory Cytokines From Peripheral Blood Mononuclear Cells and CD4+ T Cells and Is Immunosuppressive in Type 1 Diabetes. EBioMedicine. 2018;30:283–94.
35. Sanders RD, Godlee A, Fujimori T, et al. Benzodiazepine augmented γ-aminobutyric acid signaling increases mortality from pneumonia in mice. Crit Care Med. 2013;41(7):1627–36.
36. van Hoek AJ, Underwood A, Jit M, Miller E, Edmunds WJ. The impact of pandemic influenza H1N1 on health-related quality of life: a prospective population-based study. PLoS One. 2011;6(3):e17030.
37. Hu Y, Chen Y, Zheng Y, You C, Tan J, Hu L, Zhang Z, Ding L. Factors related to mental health of inpatients with COVID-19 in Wuhan, China. Brain Behav Immun. 2020;89:587–93.

38. Liu CH, Stevens C, Conrad RC, Hahm HC. Evidence for elevated psychiatric distress, poor sleep, and quality of life concerns during the COVID-19 pandemic among U.S. young adults with suspected and reported psychiatric diagnoses. Psychiatry Res. 2020;292:113345.

Publisher's Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.