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Long-term COVID symptoms, work ability and fitness to work in healthcare workers hospitalized for sars-CoV-2 infection

Marco Mendola[1]*, Marco Leoni[2], Ylenia Cozzi[2], Andrea Manzari[2], Fabio Tonelli[1], Francesca Metruccio[3], Luca Tosti[3], Vera Battini[5] Isabella Cucchi[1], Maria Cristina Costa[1], Paolo Carrer[1,4]

[1]Occupational Health Unit, Fatebenefratelli-Sacco University Hospital, Milan
[2]School of Occupational Medicine, University of Milan, Milan, Italy
[3]International Centre for Pesticides and Health Risk Prevention, Fatebenefratelli-Sacco University Hospital, Milan
[4]Department of Biomedical and Clinical Sciences "L. Sacco", University of Milan, Milan, Italy
[5]Unit of Clinical Pharmacology, Department of Biomedical and Clinical Sciences, University of Milan, Milan, Italy

KEYWORDS: Long-term, COVID-19, work ability; healthcare workforce; occupational medicine

Abstract

Background: *COVID-19 can affect the persistence of symptoms and work ability (WA), hence the fitness to work of healthcare workers (HCW). We describe the effects of COVID-19 in hospitalized HCWs of a large Hospital in Lombardy and their implications on WA and fitness to work.* **Methods:** *Fifty-six HCWs of Fatebenefratelli-Sacco Hospital have been hospitalized for COVID-19 since March 2020. Clinical and fitness-to-work data were acquired from Occupational Health Surveillance Program. A structured questionnaire was administered to 53/56 HCWs 18 months after infection to investigate Long-COVID symptoms and WA.* **Results:** *Symptoms most reported at recovery (rhino-pharyngeal swab-NPS-negative) were exertional dyspnea (86.8%), asthenia (86.8%), arthro-myalgia (71.7%), sleep disorders (64.2%), resting dyspnea (62.3%), cough (56.6%). 69.6% underwent evaluation at outpatient clinics experienced in long-COVID. Ten months after recovery, symptoms related to physical well-being decreased while memory and anxiety/depression were more persistent. At recovery, the WA score decreased from 10 to 8, and then an improvement from 8 to 9 was noted during the survey. At the return-to-work examination, fit-to-work judgements with restrictions increased from 31.4% to 58.7%; then, a slight decrease in the rate of judgements with restrictions was observed at the survey's time.* **Conclusion:** *Post-COVID-19 symptoms can persist for a long time and could impact WA and fitness-to-work of HCW. Adequate health surveillance protocols should guarantee the health protection of HCW with persistent disorders after COVID-19.*

1. Introduction

Coronaviruses are a family of viruses associated with a wide range of symptoms, such as common cold, pneumonia, and severe acute respiratory syndrome (SARS) and can also affect the gut [1]. A new strain of coronavirus – SARS-CoV-2 – was first reported in Wuhan, China, in December 2019. It has since spread to every country around the world [2]. The clinical syndrome associated with

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*Corresponding Author: Marco Mendola, Occupational Health Unit, Fatebenefratelli-Sacco University Hospital, via G.B. Grassi 74, 20159, Milan; E-mail: mendola.marco@asst-fbf-sacco.it; Tel.: +390239043229.

Sars-CoV-2 infection has been called COVID-19 (CoronaVirus Disease-19) [3].

Although many people remain asymptomatic, the most common symptoms appear approximately 4-10 days after exposure. The main symptoms of COVID-19 can be very mild to severe and include fever, cough, and shortness of breath. While most patients seem to have mild disease, about 15% progress to a more severe illness requiring hospitalization. Approximately 5% become critically ill, including pneumonia, respiratory failure and, in some cases, death [4]. Many people continue to describe ongoing symptoms long after the acute phase of COVID-19, often referred to as long-COVID. The World Health Organization (WHO) defines long-COVID syndrome as the persistence of signs and symptoms related to COVID-19 infection for more than twelve weeks and not explained by an alternative diagnosis. Weakness (41%, 95%CI 25.43 to 59.01), general malaise (33%, 95%CI 14.91 to 57.36), fatigue (31%, 95%CI 23.91 to 39.03), concentration impairment (26%, 95%CI 20.96 to 31.73) and dyspnea (25%, 95%CI 17.86 to 33.97) were the most described symptoms of the long-COVID syndrome. Patients also reported a large spectrum of less prevalent symptoms and signs, such as sweating, chest pain, sore throat, anxiety and headaches: the prevalence of these symptoms was usually less than 20% [5].

Some hereditary and acquired factors can affect both host sensitivity and disease severity. Older age, male gender, diabetes, cardiovascular diseases, malignancy and immunodeficiency conditions are the most critical hosting factors for COVID-19. Other pathologies recognized as risk factors for COVID-19 infection and morbidity are pulmonary disease (such as COPD and asthma), cerebrovascular diseases, chronic renal disease, chronic liver disease, severe autoimmune diseases and malnutrition [6]. Italian Ministry of Health [7] provided specific instructions on the management of workers who qualify at a high risk of COVID-19 and related adverse events (called "fragile") due to health conditions: in particular, these conditions included immunodeficiency, cancer, severe disability or serious chronic diseases in poor clinical control. In these cases, workers were asked to stay at home carrying out their job remote (so-called "smart working" or "work from home"), also via assignment to different tasks belonging to the same employment level. If it was impossible to activate "work from home", the period of absence from work was treated as hospitalization from an insurance point of view. Workers with chronic diseases in poor control are not included in the list provided by the Ministry of Health. However, they could require appropriate evaluation by the Occupational Physician (as part of the so-called "exceptional" health surveillance program) because of their job [7]. Indeed, some environmental and occupational factors can play a role in Sars-CoV-2 transmission and COVID-19 development, and HCW can be considered at high risk of infection [8]. COVID-19 can have significant repercussions in terms of both persistence of clinical symptoms for a long time and work ability (WA) [9], which could affect the HCW's fitness at return-to-work time.

This study aimed to describe the main long-term effects of COVID-19 infection among HCWs of a large University Hospital in Lombardy requiring hospitalization and the subsequent implications regarding perceived WA and fitness to work.

2. Methods

Fatebenefratelli-Sacco University Hospital is part of the Italian public healthcare system. It comprises four Hospital Centers (Sacco, Fatebenefratelli, Macedonio Melloni, Buzzi) and several Territorial Outpatient Units in Milan and employs 5,605 workers.

Our study included all workers of Fatebenefratelli-Sacco University Hospital who required hospitalization for COVID-19 disease. As required by the regulations issued by the Italian Ministry of Health [9], all hospitalized workers affected by COVID-19 underwent a clinical evaluation at the Occupational Health Unit at the time of return to work with the expression of a fitness to work judgment. Four Occupational Physicians were involved in the medical surveillance of hospitalized HCWs. Periodic meetings to discuss the most complex cases and the presence of an Occupational Medical Coordinator allowed a homogeneity in the criteria

used for cases' managing and issuing the fitness to work judgements. Each HCW was visited at the time of return to work and underwent further medical examinations by the same Occupational Physician from his return to work until today. Data were collected from the beginning of the pandemic until 15th March 2022. Data related to demographic characteristics, remote pathological diagnosis and fitness to work were acquired from the occupational health unit's caring for the health surveillance program. A structured questionnaire was developed and administered to all participants to investigate the presence of symptoms related to long-COVID syndrome and their impact on perceived WA. The questionnaire was divided into three main sections (as shown in the Supplementary file): (i) The first one was composed of 30 items related to the presence of symptoms at the time of the recovery from the infection and their duration if eventually resolved. (ii) In the second section, 30 questions investigated the persistence of symptoms at the time of the questionnaire administration and their clinical course. (iii) The third section included three items related to perceived WA. All participants were asked to score their WA from 0 to 10, considering that before infection as 10, both at the time of recovery and at the time of questionnaire administration; the third item investigated (c) the time required to reach the current level of perceived WA. A trained physician administered the questionnaire in February and March 2022, about 18 months (95%CI 17.3-19.3) after the diagnosis of infection. All participants were informed about the purpose of the questionnaire and declared their consent to participate in the study. All data have been collected and analyzed anonymously in compliance with current privacy regulations.

Descriptive analysis was performed in terms of age, sex, type of job, fitness to work and clinical history of the subjects. Frequencies and percentages are provided for nominal data. Due to the small sample size and the normality check, the median (25th-75th percentiles) for continuous data and non-parametric tests were preferred. Due to the different temporal lag between the infection and the time of administration of the questionnaire among cases, we scheduled a follow-up cut-off at ten months from the infection onset to study the persistence of symptoms related to the long-COVID syndrome by using a mid-p McNemar test. The threshold of a significant p-value was set to 0.003 after Bonferroni's correction for multiple comparisons. The Kaplan-Meier method was then used for survival analyses of patients still having specific mild symptoms during recovery. The log-rank test was used to detect significant differences between age groups, sexes, presence of chronic diseases, and hospitalization days.

Statistical analysis was performed with R-Studio (R Core Team-2019. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL: https://www.R-project.org/).

3. Results

3.1 Characteristics of study's population and prevalence of post-COVID symptoms

Since the beginning of the COVID-19 pandemic, among the Fatebenefratelli-Sacco University Hospital workers, 56 HCWs affected by COVID-19 required hospitalization care. As shown in Table 1, hospitalized cases were equally divided into males and females with a median age of 55. 33.9% were physicians, 41.1% were nurses, 17.9% were nursing assistants, and 3.6% were other HCWs (radiology technicians, laboratory technicians, biologists, and other health professionals not included in the main groups reported).

At the time of the positive rhino-pharyngeal swab (NPS), 40% of the hospitalized HCWs worked in a COVID-19 area. Clinical history of hospitalized HCWs most showed overweight/obesity (57.1% of cases), hypertension (25% of cases) and respiratory disorders (particularly asthma, 16.1% of cases). 7.5% of hospitalized HCWs were active smokers. All hospitalized HCWs involved in our study were not yet vaccinated against Sars-CoV-2 at the time of infection, and 23.5% of conditions that required hospital care occurred in unvaccinated HCWs between December 2020 and April 2021, after the beginning of the vaccination campaign. Hospitalization lasted more than 21 days in 32.1% of cases, between 10 and

Table 1. Socio-demographic and clinical characteristics of the studied population.

	n.	%
Total hospitalized HCWs	56	100
Age, median (25th-75th Percentiles)	55 (50-61.2)	-
Females	28	50
Job category		
Physicians	19	33.9
Nurses	23	41.1
Nursing assistant	10	17.9
Other sanitary workers	2	3.6
Non-sanitary workers	2	3.6
Working area		
COVID-19 hospital area	23	41.1
Non-COVID-19 hospital area	31	55.4
Non-sanitary area	2	3.6
Duration of hospitalization (days)		
4-9	16	28.6
10-21	22	39.3
22-118	18	32.1
Clinical history		
Overweight/obesity	32	57.1
Hypertension	14	25
Respiratory disorders	9	16.1
Neurological disorders	3	5.4
Endocrinological disorders	4	7.1
Hematological disorders	4	7.1
Psychiatric disorders	2	3.8
Cardiovascular disorders	2	3.8
Diabetes	1	1.8
Sars-CoV-2 vaccination status at the time of infection		
Not vaccinated	56	100
Fully vaccinated	0	0.0
Partially vaccinated	0	0.0

21 days in 39.3% and less than ten days in 28.6% of hospitalized HCWs.

Fifty-three HCWs (94.6%) agreed to participate in the survey by answering the questionnaire administered at a mean time of 18 months after the diagnosis of infection. As shown in Table 2, the most reported symptoms after COVID-19 recovery (negative NPS) were resting and exertional dyspnea. Generalized asthenia (86.8% of hospitalized HCWs) followed, in order, by arthromyalgia (71.7%), sleep disorders (64.2%), resting dyspnea (62.3%) and cough (56.6%). Anosmia and ageusia were reported respectively from 47.2% and 43.4% of interviewed HCWs.

No differences were found in symptoms prevalence at the time of COVID-19 recovery comparing HCWs subgroups sorted by age (under 55 y.o vs over 55 y.o.), gender (male/female) and clinical history (cases with no chronic illness vs those with known chronic diseases). Due to these symptoms, 69.6% of hospitalized HCWs underwent examination and clinical management at outpatient clinics with expertise in long-COVID syndrome. Ten months after COVID-19, a sharp decrease in many long-COVID symptoms' prevalence was found. A significant reduction in physical symptoms was found as compared to the time of recovery: in particular, cough, resting dyspnea, asthenia, ageusia, exertional dyspnea, anosmia, chest pain and arthromyalgia. Conversely, symptoms related to mental and psychological well-being, such as loss of memory, anxiety and depression, resulted in prolonged persistence at the time of the questionnaire administration with a non-significant decrease compared with data at the time of negative NPS. Anosmia, cough and cephalgia, when resolved at the questionnaire administration, were the symptoms with the referred most rapid resolution time (approximately 15 days). At the same time, loss of memory, sleep disorders, anxiety/depression and asthenia required a longer resolution time (about 135 days, 120 days, 75 days, and 90 days). We compared HCWs subgroups sorted by age (under 55 y.o vs over 55 y.o.), gender (male/female) and clinical history (cases with no chronic illness vs those with known chronic diseases) at the time of ten months after COVID-19 resolution. A higher prevalence of anosmia was found in cases without chronic illness versus those with one or more chronic diseases (p=0.02) (Figure 1A), and a higher prevalence of arthro-myalgia was found in subjects over 55 as compared to younger people (p=0.03).

Table 2. Post-COVID-19 symptoms among Hospitalized HCWs (n=53).

Symptom	N. of patients with symptoms at negative NPS test n. (%)	N. of patients recovering from symptoms ten months after infection n. (%)	Duration of symptoms (d) Median (25th-75th percentiles)
Cough	30 (57)	23 (77)*	15 (15-30)
Resting dyspnea	33 (62)	28 (84)*	15 (15-38)
Exertional dyspnea	46 (87)	19 (41)*	30 (15-90)
Arthromyalgia	38 (72)	16 (42)*	30 (15-68)
Chest pain	17 (32)	14 (82)*	38 (15-90)
Tachycardia or palpitations	19 (36)	8 (42)	15 (15-45)
Ageusia	23 (43)	20 (87)*	15 (15-38)
Anosmia	25 (47)	18 (72)*	15 (15-30)
Asthenia	46 (87)	25 (54)*	90 (15-180)
Cephalgia	25 (47)	14 (56)	15 (15-15)
Loss of memory	25 (47)	6 (24)	135 (98-172)
Hair loss	22 (41)	9 (41)*	60 (60-150)
Sleep disorders	34 (64)	9 (27)*	120 (60-150)
Anxiety/depression	25 (47)	8 (32)	75 (26-158)

**Mid-p McNemar test p<0.003.*

3.2 Perceived work ability after COVID-19 infection and at the survey's time

Fifty hospitalized HCWs were asked to give a score from 0 to 10 to their perceived WA at the time of COVID-19 recovery (negative NPS) and at the time of questionnaire administration, considering 10 of their WA before COVID-19 infection. Out of the remaining part of interviewed hospitalized HCWs, two cases quit their job at Fatebenefratelli-Sacco University Hospital due to retirement, and one patient has not yet returned to work due to complications of the COVID-19 infection.

As shown in Table 3, at the time of negative NPS, interviewed HCWs referred to a median WA score of 8, with no differences between males and females and between under and over 55, respectively. Although nursing assistants had the worst score, there were no significant differences compared to other job categories.

At the time of questionnaire administration, referred WA score improved in all hospitalized HCWs – from a median (25th-75th percentiles) of 8 (5.25-10) to 9 (8-10), $p<0.05$. The stratification by age, gender, chronic disease and job category shows that over 55 y.o., females and subjects with the known chronic disease showed the most WA improvement. On the other hand, in under 55 cases and HCWs without chronic illness, the WA increase was lower but still significant. Overall, all HCWs reach high scores at the time of the questionnaire except for nursing assistants resulting in a median (25th-75th percentiles) of 8 (6.25-9.75). Interviewed HCWs referred to a mean time to reach the current level of perceived WA of about 223 days. No significant differences were found in WA scores comparing groups divided according to the average distance between COVID-19 infection and the time of questionnaire administration.

3.3 Comparison of fitness to work before and after COVID-19 infection and at the survey's time

As shown in Table 4, out of all hospitalized HCWs (n. 56), before COVID-19 infection, the

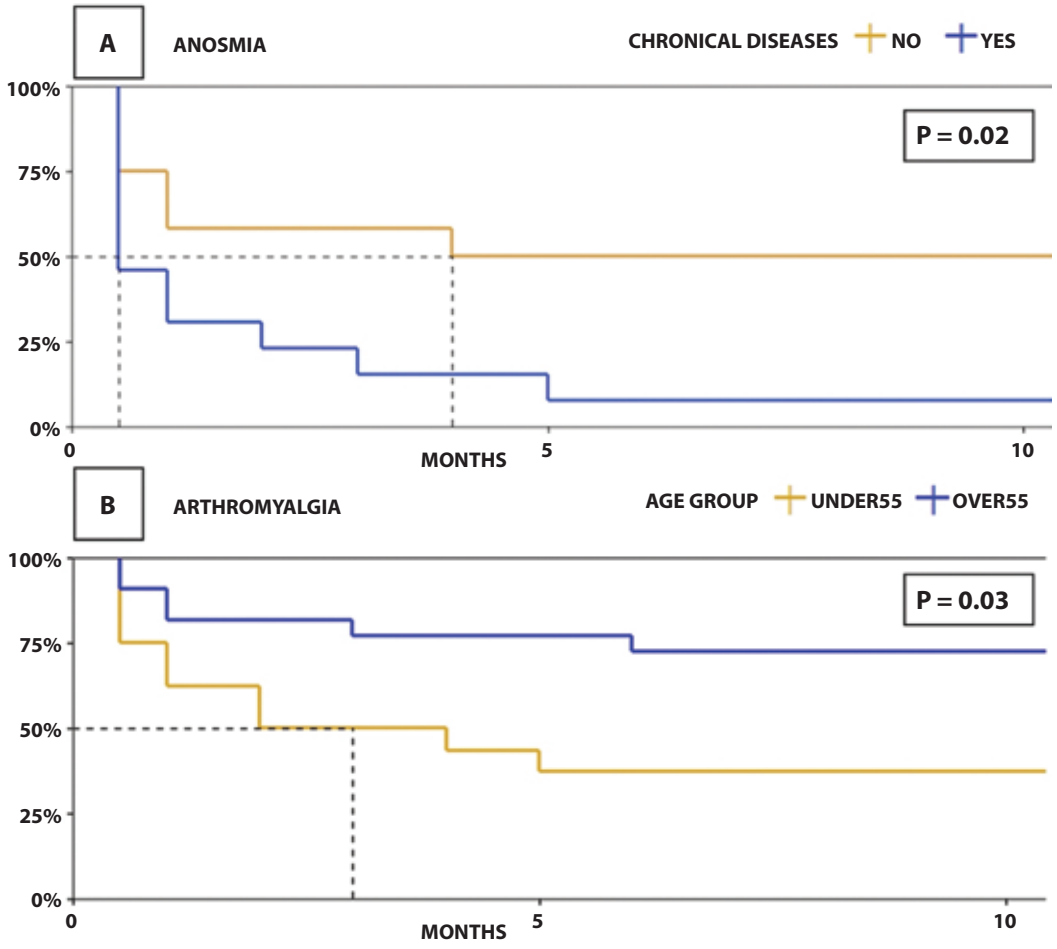

Figure 1: Significant results related to long-COVID symptoms prevalence among subgroups of the studied population at ten months after COVID-19 recovery. A: different prevalence of anosmia between "healthy" cases and cases with one or more chronical disease (p=0.02); B: different prevalence of arthromyalgia between cases under and over 55 years old (p=0.03).

occupational physicians issued a fitness-to-work judgement without restrictions for 69.6% of them. Of the HCWs with a fit-to-work judgement with restriction (n. 17), 39.1% were nurses, 30% were nursing assistants, and 21.1% were physicians. A fit-to-work judgement with restriction was more common among female vs male HCWs (39.3% vs 21.4%) and HCWs with a chronic disease vs those without a chronic illness (38.1% vs 7.1%). Before COVID-19 infection, among our study's population, the occupational physician's most common types of restrictions were jobs leading to physical exertion (19.6%) and night shift work (10.7%).

The occupational physician examined forty-six hospitalized HCWs at the return to work after hospitalization for COVID-19; of the remaining HCWs, nine quit their job at Fatebenefratelli-Sacco University Hospital before the "return to work" medical examination due to retirement or change of workplace. In contrast, one case has not yet returned to work due to complications of the COVID-19 infection. Clinical assessment at the return to work was carried out at 172.3±149.3 (mean±sd) days from the diagnosis: 63% of HCWs returned to work within six months since the infection, while four HCWs continued their

Table 3. Perceived work ability after COVID-19 infection and at the time of the survey stratified by age, gender, chronic disease and job category.

Perceived work ability (min 0 - max 10) *	n.	WA at COVID-19 recovery Median (25th-75th percentiles)	WA at the time of the survey Median (25th-75th percentiles)
All interviewed HCWs§	50	8 (5.25-10)	9 (8-10)
Gender			
Male	25	8 (6-10)	9 (8-10)
Female	25	7 (5-9)	9 (8-10)
Age group			
<55 y.o.	24	8 (6-10)	9.5 (8-10)
>55 y.o.	26	6 (5-8.75)	9 (8-10)
Chronic diseases			
No	13	8 (6-9)	10 (9-10)
Yes	37	7 (5-10)	9 (8-10)
Job category			
Physicians	17	8 (5-10)	9 (8-10)
Nurses	21	8 (6-10)	9 (8-10)
Nursing assistants	10	6 (3.5-7.5)	8 (6.25-9.75)
Other sanitary workers	1	10	10
Non-sanitary workers	1	9	9

**Scores expressed considering the WA as 10 before COVID-19 infection.*
§Exact Wilcoxon-Pratt Signed-Rank Test, $p<0.05$ (performed only for all interviewed HCWs).

absence for more than a year after the illness. At the time of return to work after COVID-19 infection, a reduction of full fit-to-work judgements (from 69.6% to 39.1%) was observed, resulting in increased fit-to-work judgement with restrictions (from 31.4% to 58.7%). One HCW was temporarily unfit to work during the first occupational health examination due to persisting neurological and muscular impairment developed after COVID-19. Such clinical complications required prolonged absence from work, justified by the need for cognitive and motor rehabilitation to achieve acceptable conditions.

In Table 4, we highlighted an increase in all kinds of restrictions at the "return to work" compared with baseline with a rise of the limitations related to night shift work (from 10.7% to 39.1%). No significant differences were found in the rate of judgments with restrictions among HCWs subgroups stratified by age (under 55 vs over 55), gender (male vs female), clinical history (HCWs with no chronic diseases vs cases with known chronic diseases) and job category.

Occupational physicians furtherly examined all cases under examination at the time of return to work. Comparing the fit to work judgement at the time to return to work and the last formulated fit to work judgment (expressed at an average time of nine months from the first one), we observed a decrease in the restrictions' rate (from 58.7% to 45.7%) with a consequent increase of the rate of fully fit to work judgement (from 39.1% to 54.3%). No significant differences were found in the rate of judgment with restrictions among HCWs subgroups sorted by age (under 55 vs over 55), gender (male vs female), clinical history (HCWs with no chronic diseases vs cases with known chronic diseases) and job category.

Table 4. Fitness to work among the study's population before COVID-19 infection, at the time of return to work and at the time of the survey.

	Before COVID-19 infection (n. 56)		At the time of return to work (n. 46)		Last fitness to work judgement (n. 46)	
	n.	%	n.	%	n.	%
Type of judgement						
Full fit to work	39	69.6	18	39.1	25	54.3
Temporary not fit	0	0.0	1	2.2	0	0.0
Fit with restrictions	17	31.4	27	58.7	21	45.7
Type of restriction						
Physical exertion	11	19.6	16	34.8	11	23.9
Night shift work	6	10.7	18	39.1	14	30.4
Stress/Mental load	0	0.0	2	4.3	2	4.3
Upper limbs overload	1	1.8	1	2.2	1	2.2
Lower limbs overload	2	3.6	3	6.5	1	2.2
Biological risk exposure	2	3.6	4	8.7	2	4.3
Work rhythms	0	0.0	5	10.9	1	2.2
Other	1	1.8	1	2.2	1	2.2
Gender						
Male	6/28	21.4	13/23	56.5	13/23	56.5
Female	11/28	39.3	14/23	60.9	8/23	34.8
Age group						
<55 y.o.	8/25	32	12/20	60	10/20	50
≥55 y.o.	9/31	29	15/26	57.7	11/26	42.3
Chronic diseases						
No	1/14	7.1	4/10	40	3/10	30
Yes	16/42	38.1	23/36	63.9	18/36	50
Job category						
Physicians	4/19	21.1	8/17	47.1	5/17	29.4
Nurses	9/23	39.1	11/17	64.7	9/17	52.9
Nursing assistants	3/10	30	7/9	77.8	6/9	66.7
Other sanitary workers	0/2	0.0	0/1	0.0	0/1	0.0
Non-sanitary workers	1/2	50.0	1/2	50.0	1/2	50.0

4. Discussion

Our study among HCWs hospitalized due to acute COVID-19 provided relevant data to describe the evolution of symptoms, the perceived work ability and their impact on fitness to work up a mean time of eighteen months after COVID-19. All hospitalized HCWs involved in our study were not yet vaccinated against Sars-CoV-2 at the time of infection. While the vaccination campaign against Sars-CoV-2 started on 27th December 2020, in our study population, hospitalizations due to COVID-19 occurred between March 2020 and April 2021. Among 86.5% of these cases, the

infection occurred before the start of the Sars-Cov-2 vaccination campaign. In 23.5% of the cases, the infection occurred during the vaccination campaign, but it was always among unvaccinated HCWs. These data confirm the effectiveness of the vaccination campaign against Sars-CoV-2 in preventing severe forms of infection, as demonstrated by our previous study [8].

Concerning the persistence of symptoms at the time of COVID-19 recovery (NPS negative), we found a high prevalence of exertional dyspnea and generalized asthenia, followed, in order, by arthro-myalgia, sleep disorders, resting dyspnea and cough. A recent study [11] evaluated the persistence of physical and psychological symptoms after COVID-19 in patients examined at an outpatient clinic specialized in long-COVID syndrome to assess their duration and the predictive factors associated with their resolution. Our results showed a high prevalence of dyspnea, fatigue and myalgia/arthralgia among the HCWs evaluated after hospitalization due to a severe form of COVID-19. In a recent study, Huang L et al. [12] characterized the evolution of health outcomes in hospital survivors after acute COVID-19. Two years after COVID-19 infection, they found a significant decrease in the proportion of COVID-19 survivors with at least one sequelae symptom, with fatigue, muscle weakness and sleep difficulties always being the most frequent. In their population, anxiety and depression symptoms significantly decreased two years after infection. At the time of the last follow-up, 8% had anxiety symptoms, while 6% had depression symptoms. In our study, we also found a substantial decrease in many long-COVID symptoms' prevalence at the time ten months after COVID-19 recovery: in particular, a significant reduction of symptoms related to physical well-being (such as cough, resting and exertional dyspnea, asthenia and arthromyalgia) was shown in our population.

Conversely, symptoms related to mental and psychological well-being, such as loss of memory, anxiety and depression, resulted in more persistence in our population at the time of the questionnaire administration with a non-significant decrease compared with data at the time of negative NPS. The prevalence of mental health disorders after acute COVID-19 varies widely among studies [13, 14], and they might be attributed to many causes, such as the direct effects of SARS-CoV-2 infection, isolation, physical distancing, or incomplete recovery of physical health [15]. In our population, the incomplete recovery of physical health after COVID-19 and the noted psychological impact of the Sars-CoV-2 pandemic on HCWs [16] can explain the persistence of these symptoms. However, the potential role of worsening known chronic diseases in reducing psychological well-being cannot be excluded in some cases.

Concerning the other persistent symptoms of long-COVID syndrome, we found a higher prevalence of anosmia in "healthy" HCWs versus subjects with known chronic diseases. A possible explanation for these findings is that HCWs with no chronic diseases have a higher perception of an altered smell than patients with chronic illness who have a different sensitivity to a "non-debilitating" symptom. In elder HCWs, a more increased muscle or joint pain persistence at ten months after COVID-19 infection was found compared to younger ones. Pre-existing musculoskeletal problems in subjects over 55 or the progressive reduction in muscle strength and less resilience after physical exertion associated with ageing could account for this finding [17].

Perceived work ability among our study's population decreased from the established score of 10 before COVID-19 infection to a median score of 8 at the time of infection recovery, with lower WA scores in cases with known chronic disease and nursing assistants. At the time of the questionnaire administration, with the previously described substantial decrease in many long-COVID symptoms' prevalence, we found a significant improvement in the WA score in all hospitalized HCWs. In the literature, we have not found other studies that specifically investigated WA perception in patients/workers hospitalized for COVID-19 infection. A survey by Andrade M. et al. [18] aimed to explore the implications of the COVID-19 pandemic on psychosocial aspects and work ability among Brazilian workers: they studied a cohort of workers at baseline and twelve months follow-up, categorizing data also depending on the previous COVID-19.

The Authors unexpectedly found that WA was unaffected by the pandemic in 75% of the workers and, at a 12-month follow-up, no difference in WA scores was found between infected and uninfected workers. The Authors explained these results based on a large proportion of involved workers composed of public servants with job stability and a high "smart working" rate: these protective factors may have contributed to these results on perceived WA. HCWs involved in our study, conversely, carry out an activity characterized by greater job demand: this assumption can explain our results, which, in contrast with the finding of Andrade M. et al., highlighted a reduction in WA after hospitalization for COVID-19 in the overall population and particularly in nursing assistants.

There is a lack of published research on the impact of long-COVID on fitness at the return to work. Among the limited current literature concerning this point, Pauwels et al. [19] reviewed the relevant published studies on the impact of long COVID syndrome on patients' return to work. After screening 2,545 publications, the Authors identified only seven relevant studies on this topic. They concluded that the return to work for individuals with long-COVID is complex and diverges for each individual concerning the specific persistent symptoms. On the other hand, the Authors highlighted that working is generally good for health and should be considered a practical part of the rehabilitation program for workers suffering from long-COVID. In this way, they suggested that occupational physicians develop a close and trustful relationship with all stakeholders to facilitate a safe return to work for subjects with long-COVID syndrome. According to the guidance published by the Faculty of Occupational Medicine, a gradual return to work for patients with long-COVID symptoms is recommended, adjusting workloads and work rhythms to the health conditions of the involved workers. [20]

In our studied population, HCWs returned to work after an average time of 172.3±149.3 SD days from the infection onset. As required by the regulations issued by the Italian Ministry of Health [10], all hospitalized workers affected by COVID-19 underwent a clinical evaluation by the Occupational Physician at the time of return to work with the expression of fitness to work judgment: at this time our study highlighted, with the persistence of symptoms related to long-COVID-19 and the reduction in the average WA score, a decrease in fully fit to work judgements and an increase in the fit to work decisions with restrictions, with a rise of limitations related to night shift work and physical exertion. Due to the clinical conditions, about two-thirds of hospitalized HCWs also underwent examination and clinical management in an outpatient clinic specializing in long-COVID syndrome. In four cases (two more than baseline), a worsening of chronic diseases conditioning a possible greater susceptibility to infections required the issuance by the occupational physician of a fitness to work judgment with temporary restriction on exposure to significant biological risk, according to the instructions of the Italian Ministry of Health related to the protection of "fragile" workers [7].

At the subsequent health occupational examinations, until today, a decrease in the restrictions' rate was observed: in particular, we observed a reduction, but still non-significant, of restrictions' rate related to both night shift work and physical exertions. It's to note that out of the four cases with fitness to work judgement with limitation on biological risk exposure at the time of return to work, the evidence of improved control of the known chronic pathologies allowed the Occupational Physician to remove this restriction at subsequent medical examinations in two of them. The increase in the rate of judgements with restrictions was expected to encourage workers' gradual return to work with long-COVID by modulating the workloads and rhythms of work, as indicated by international guidelines [20]. In this context, the rise of limitations related to night-shift work can be explained by the known effect that the alteration of the circadian rhythm could have on subjects' well-being, particularly in HCWs with psychological and sleep problems [21].

Finally, the slow reduction in the rate of HCWs with limited fitness to work may be linked to both the characteristics of the work (e.g. workload, rhythms of work and the known psychological impact of working in the healthcare system) and the persistence of psychological symptoms (e.g., anxiety and depression) affecting perceived physical fitness, physical pain and even general health perception [22].

Some limitations could affect obtained results and require further confirmatory studies. Primarily, this study focused on a relatively small number of cases with a high prevalence of individuals with one or more chronic diseases. As a result, we potentially oversampled HCWs at a very high risk of complications (not only related to COVID-19 and hospitalization). The absence of a control group did not allow for the identification of predisposing factors for the development of long-COVID syndrome in hospitalized HCWs. Finally, the time elapsed between infection and questionnaire administration may have partially affected the accuracy of data related to symptoms' duration and WA score at the time of COVID-19 recovery.

5. Conclusions

Our study highlighted a high prevalence of post-COVID symptoms in HCWs hospitalized for Sars-CoV-2 infection with a longer persistence over time of symptoms related to mental and psychological well-being. Along with the persistence of long-COVID symptoms, we found a decrease in perceived WA at the time of COVID-19 recovery and an increase in fit-to-work judgements with restrictions at the time of return to work. Due to these clinical conditions, about two-thirds of hospitalized HCWs also underwent examination and clinical management in outpatient clinics specialized in long-COVID syndrome. Empowerment of perceived WA and a slight reduction of fit-to-work judgements with restrictions were found at an average of 18 months after infection, indicating how the gradual improvement of both the physical and psychological conditions of hospitalized HCWs leads to a progressive recovery of their WA and fit-ness to work. Further studies are necessary to evaluate the long-term effects of COVID-19 in larger populations of HCWs hospitalized due to acute COVID-19 and in HCWs with a mild-moderate course of the disease to guarantee the best health protection of HCWs with per-sistent physical and psychological disorders after COVID-19.

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Long-term COVID symptoms, work ability and fitness to work in healthcare workers hospitalized for Sars-Cov-2 infection

SUPPLEMENTARY FILE

QUESTIONNAIRE
Post COVID symptoms and work ability in Healthcare Workers hospitalized for COVID-19 infection

Date: _____

- Personal data

Surname and Name	
Date of birth (dd/mm/yy)	
Job category	
Department (at the time of COVID-19 infection)	

- Section 1 - Post-COVID symptoms at recovery from COVID-19 infection

Positive NPS date: _____ Negative NPS date: _____

Length of hospitalization for COVID-19 days: _____

Symptom	***Present at COVID-19 recovery (YES/NOT)***	***Time for resolution (days; if it is not resolved sign "PRESENT")***
Cough		
Dyspnea at rest		
Exertional dyspnea		
Arthralgia/myalgia		
Palpitation/tachycardia		
Chest pain		
Anosmia		
Ageusia		
Asthenia		
Headache		
Loss of memory		
Telogen effluvium		
Sleep disorders		
Anxiety/depression		
Other		

Data specification ***YES = symptom present*** ***NOT= absence of the symptom***
PRESENT: symptom already present

After hospitalization, did you go to medical evaluation at outpatient clinics experienced in Long-COVID, due to the persistence of symptoms related to COVID-19 infection?

☐ YES ☐ NOT

- Section 2 - Post-COVID symptoms at the time of questionnaire administration

Symptoms	***Present at the time of questionnaire administration***	***Clinical course (B-S-W)***
Cough		
Dyspnea at rest		
Exertional dyspnea		
Arthralgia/myalgia		
Palpitation/tachycardia		
Chest pain		
Anosmia		
Ageusia		
Asthenia		
Headache		
Loss of memory		
Telogen effluvium		
Sleep disorders		
Anxiety/depression		
Other		

Data specification ***YES = present NOT= absent***
B= it getting better S = clinically stable W = it getting worse

- **Section 3 - Screening on perceived work ability (WA)**

1. Considering your WA before infection as 10, please give a score from 0 to 10 to your WA at the time of recovery from COVID-19 infection (negative NPS):

0 1 2 3 4 5 6 7 8 9 10

2. Considering your WA before infection as 10, please give a score from 0 to 10 to your WA at this moment (time of questionnaire administration):

0 1 2 3 4 5 6 7 8 9 10

3. (If WA score right now improved compared with the score at the time of COVID-19 recovery) How long did it take to get this improvement?

- ○ < 3 months
- ○ 3-6 months
- ○ 6-9 months
- ○ 9-12 months
- ○ >12 months