# Persistent symptoms of COVID-19, mental health disorders and dysfunctional breathing in healthcare workers: the cross-sectional PERSYCOVID study.

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received : 03 November 2023
accepted: 19 August 2024

ISSN: 2823-989X
DOI: 10.52057/erj.v6i1.50

## ABSTRACT

**Background**: Healthcare workers (HCW) are particularly at risk of contamination by SARS-CoV-2 because of their exposure to high virus loads through patient contacts. The primary aim of our cross-sectional study was to assess persistent symptoms related to COVID-19 in healthcare workers (HCW). The secondary aim was to observe the influence of these symptoms on quality of life. **Method**: The survey was performed in 192 HCW and began in December 2021. Symptoms at the time of the diagnosis, at 15 days and 1, 3 and 6 months after the infection, anxiety and depression (Hospital Anxiety and Depression Scale) and dysfunctional breathing (Nijmegen questionnaire [NQ]) were collected. **Results**: Nearly all HCW (age 40.8±12.0 years, 79.6% female) were vaccinated (92%) and 18.7% were vaccinated before the infection. No HCW were without symptoms at the time of the infection. Fever, cough, fatigue, muscle ache, throat pain, headache, anosmia or ageusia and dyspnoea were temporarily experienced by more than 50% of the HCW. After 3 months, 48% of the responders still had at least 1 symptom. This proportion depended on the vaccination status (49.6% vs 15.4%, p=0.002). Anxiety, depression, and dysfunctional breathing were respectively found in 16, 8 and 24% of HCW. Vaccination status positively influenced anxiety (p=0.019) but not depression (p=0.114) or dysfunctional breathing (p=0.581). **Discussion**: After 3 months, 48% of the responders still had at least 1 symptom, which was positively influenced by the vaccination status. HCW presented anxiety (16%), depression (8%), and dysfunctional breathing (24%).

**KEYWORDS:** COVID; healthcare workers; vaccination.

## Background

The world has been struggling with the COVID-19 pandemic caused by the SARS-CoV-2 virus since December 2019. Quickly, it became clear that the risk of contamination was high and related to droplets and airborne transmission. In March 2020, the World Health Organization declared the COVID-19 outbreak a global pandemic [1]. As of 12th May 2024, data from ourworldindata, 775.48 million people were confirmed positive to SARS-CoV-2 in the world, and 7.05 million of these people died. The majority of contaminated people present mild to moderate disease (80%), although severe or critical diseases requiring hospitalisation for oxygen supplementation or mechanical ventilation can occur. Healthcare workers (HCW) are at risk of contamination because of their exposure to high virus loads through patient contacts. Despite the use of personal protective equipment, in particular masks with highly effective filters to protect the wearer from particles or from liquid contaminating the face, HCW are at increased risk for being contaminated [2]. Most people recover fully from COVID-19. However, around 30% experience a variety of symptoms weeks and months after the initial illness. In October 2021, the WHO defined a new entity called post-COVID condition that occurs in individuals with a history of probable or confirmed SARS-CoV-2

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infection, usually 3 months from the onset of COVID-19, with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis. The symptoms must negatively impact daily life. Quality of life was found to be reduced in many individuals and their families [3, 4]. The impact of vaccination on the post-COVID condition has already been discussed. Despite limited evidence, vaccination seems to reduce symptoms [5] although the effect varies [6]. Evidently, HCW were similarly concerned by the post-COVID condition. Moreover, dysfunctional breathing and psychological consequences, including depression, anxiety and post-traumatic stress disorder, were associated with the COVID-19 outbreak [7, 8]. The prevalence of these disturbances was dramatically increased during this period [9]. We hypothesised that HCW would be impacted by the post-COVID condition. The primary aim of our study was to assess the persistent symptoms related to COVID-19 in HCW. The secondary aim was to evaluate the influence of these symptoms on their quality of life.

## Methods

### *Design and participants*

This cross-sectional study (PERSYCOVID STUDY) was performed in December 2021 after receiving approval from the local Ethics Committee (2021/22JAN/026). It followed the current guidelines for Clinical Good Practice and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines. All participants signed an electronic informed consent form in accordance with the Declaration of Helsinki. The participants had to be active HCW, defined as people delivering care to individuals at the time of the pandemic, and to have been positive for COVID-19 diagnosed by a RT-PCR on nasopharyngeal swab. Students were excluded. The survey was sent twice by automatic mailing to all the HCW from the Cliniques Universitaires Saint-Luc, a teaching hospital with 1000 beds. The survey included questions about the demographic characteristics and past medical history, the history of the infection, the symptoms at the time of diagnosis, based on the more prevalent symptoms in December 2021 (www.ons.gov.uk), and their persistence after the infection. The symptoms were retrospectively assessed at the time of the diagnosis, 15 days, and 1, 3 and 6 months after the infection. Moreover, symptoms of anxiety, depression and dysfunctional breathing were included in the survey and assessed at the time of the completion of the survey. The vaccination status was determined based on the time of the diagnosis and the vaccination. To be considered as "vaccinated", the vaccination had to be performed within the 6 months before the diagnosis.

### *Questionnaires*

***Nijmegen questionnaire*** This questionnaire is intended to screen dysfunctional breathing and mainly hyperventilation [10]. The content validity of this questionnaire has been verified [11]. It assesses the presence of 16 symptoms in daily life. Each symptom is rated on a 5-point scale from 0 "never" to 4 "very often". The total score is calculated by cumulating the scores of each symptom. A cut-off score above 22 suggests hyperventilation syndrome [12].

***Hospital Anxiety and Depression Scale (HADS)*** The HADS is composed of 14 items and identifies borderline or probable anxiety and depression among people without psychiatric conditions. This scale is divided into 2 parts: anxiety (HADS-A) and depression (HADS-D) subscales. Each subscale contains 7 questions. Each question is scored on a 4-point scale (0, never; 1, often; 2, very often; and 3, most of the time). The higher the subscore, the worse the anxiety or the depression. The cut-offs to identify borderline or probable cases of anxiety or depression are: 8-10 doubtful, and 11-21 probable cases [13].

### *Statistical analysis*

The analyses were conducted using SPSS software 27.0 (IBM software, Armonk, NY, USA), and the level of significance was set at $p < 0.05$. The socio-demographic characteristics and survey results for the total population were calculated as mean and standard deviation following the law of large numbers, and the proportion of respondents was also reported by category. The relationship between different items and the vaccination status was analysed using Chi-square tests (bilateral) (or Fisher test for 2x2).

## Results

The survey was sent to the 5200 healthcare workers in the Institution. The demographic data of the 192 respondents are shown in Table 1. They were mainly female, and the mean age was 40.8±12.0 years. The mean time between the survey and the infection was 13.0±5.4 months, and 70.6% of the respondents had a delay longer than 1 year. Based on the national baseline surveillance (www.sciensano.be), the infections were related to the variants before the Omicron variant and did not include it. The proportion of fully vaccinated (2 doses) healthcare workers was high (92%) at the time of the survey, and there was no difference between males and females (6 vs 7% non-vaccinated, p=0.834). Only 155 respondents precisely remembered the time of the vaccination, of whom 27.1% were vaccinated in the 6 months before the infection. The majority of the healthcare workers (89%) were without medical history at the time of the infection.

**Table 1** Demographic data of the healthcare workers

| | |
|---|---|
| **Sex** | |
| Male | 20.6% |
| Female | 79.4% |
| **Marital status** | |
| Single | 41.9% |
| Married | 41.9% |
| Cohabiting | 16.2% |
| **Number of persons under the same roof** | |
| 0 | 7.7% |
| 1 | 27.7% |
| 2 | 23.2% |
| 3 | 18.1% |
| 4 | 14.2% |
| >4 | 8.1% |
| **Employment classification** | |
| Full-time | 69.7% |
| Part-time | 30.3% |
| **Hospitalised** | 5.8% |
| **More than 2h/week of sport** | 25.2% |
| **Medical History** | |
| None | 89.0% |
| Cancer | 1.9% |
| Diabetes | 1.9% |
| Hypertension | 3.9% |
| Immuno-depressed | 1.3% |
| Cardio-vascular disease | 0.7% |
| Chronic respiratory disease | 5.2% |

No healthcare workers were without symptoms, and 95% of them had more than two symptoms at the time of the infection. The presence of symptoms at the different times of assessment is highlighted in Figure 1. Fever, cough, fatigue, muscle ache, throat pain, headache, anosmia or ageusia and dyspnea were punctually experienced by more than 50% of the healthcare workers. As expected, discolouration of fingers or toes

and rash were poorly retrieved. More surprisingly, only a few HCW mentioned functional limitations. Indeed, 15% of the HCW and less than 5% experienced such a limitation at any given time and after one month, respectively. Anosmia and dyspnoea are the two only symptoms that remained stable during the first 15 days. Excluding the 15 days after the infection, 86.5% of HCW had at least one symptom during the follow-up. Fatigue, anosmia and ageusia, and dyspnoea appeared in 18%, 14%, and 14%, and 4%, 3% and 2% of the patients after more than one month and after six months, respectively. After three months, 48% of the respondents still had at least one symptom. The proportion of people with symptoms was not different based on the vaccination status at the time of the infection (p=0.546). However, the proportion of HCW with the persistence of at least one symptom after 3 months was different between vaccinated and non-vaccinated HCW at the time of the diagnosis (Table 2).

At the time of the survey (Figure 2), 16 (n=30) and 8% (n=15) of the respondents had a positive score on the HADS-A and HADS-D, respectively. Dysfunctional breathing was suggested in 24% (46/146) of the HCW. The dysfunctional breathing was not associated with the presence of dyspnoea after 6 months (6/40 (15% for dysfunctional breathing) vs 16/130 (12.3% for non-dysfunctional breathing); p=0.791). The working status (full or part-time) did not influence the prevalence of symptoms of anxiety (p=0.893) and depression (p=0.840), or dysfunctional breathing (p=0.562). The sex influenced the symptoms of anxiety (Male/Female: 32/99 vs 0/24 for no anxiety and anxiety symptoms, respectively; p=0.002) but not the symptoms of depression (Male/Female: 32/114 vs 0/9 for no depression and depression symptoms, respectively; p=0.117), or dysfunctional breathing (Male/Female: 28/92 vs 4/31 for no dysfunctional breathing and dysfunctional breathing, respectively; p=0.094). The marital status and the number of people living in the same house were not influencing factors on anxiety (p=0.514 and p=0.893, respectively) or depression (p=0.147 and p=0.314, respectively). The vaccinations status was not associated with the symptoms of anxiety or depression, or dysfunctional breathing (Table 2).

## Discussion

This cross-sectional study highlighted that in HCW who caught SARS-CoV2 and who were symptomatic, at least one symptom persisted in 48% after 3 months, and it was influenced by the vaccination status. These HCW presented symptoms of anxiety (16%) or depression (8%), and dysfunctional breathing (24%).

The prevalence of symptoms in the HCW at the time of the infection was high in our survey compared to previous data (86% vs 26%) (14). It can be explained by the intrinsic motivation of the responders. Indeed, we can expect that the proportion of non-symptomatic HCW who participated in the survey was lower than the proportion of symptomatic individuals, as it was a retrospective survey performed on a voluntary basis. As previously observed in HCW (14) and in the general population (15), the main reported symptoms were fatigue, anosmia or ageusia, or dyspnoea. The same symptoms were found in this study. Brain fog was also highly prevalent in our survey (in more than 20% of the HCW after 1 month), whereas this symptom was just observed in 2% of HCW in another study (14). However, our rate was in line with the prevalence found in a 6-month follow-up of people with COVID-19 (around 30%, whatever the COVID-19 severity) (16). Surprisingly, functional limitation was not frequently reported by HCW in our survey, whereas this limitation was found in 8% of seronegative HCW (14). We cannot compare our rate to that because the serological status was not available in our study. Indeed, this rate was demonstrated to be higher in seropositive HCW (14).

Even if the determination of a precise prevalence of persistent symptoms in people with mild to moderate COVID-19 is difficult, the results of our survey at 3 months are similar to some data suggesting that symptoms also persisted in 50% of HCW after 8 months (14). We observed that the number of symptoms decreased from the diagnosis to the end of the follow-up, similarly to another study (5). This prevalence of persistent symptoms in HCW is higher than in the general population when infected. Indeed, long-term health consequences were observed in less than 30% of a large cohort of SARS-CoV-2-convalescent non-hospitalised individuals (17). This prevalence could be explained by the exposure of the HCW to individuals with a high viral load, even if the local health policies in the hospital were to wear FFP2 masks for all contacts with any patient. However, the low initial functional limitation suggested a mild infection, and it has been demonstrated that the severity of the infection is related to the persistence of symptoms (18). It has to be noted that the vaccination status was high in our sample at the time of the survey, although vaccination was not mandatory in our hospital, but it was strongly encouraged by the hospital and at the national level. The local vaccination rate of the population was lower and around 65% (versus 92% in our sample) at the time of the survey (www.sciensano.be). This is partly explained by the prioritisation of HCP for vaccination.

Interestingly, we found an association between the vaccination and the persistence of post-COVID symptoms after 3 months in HCW. Similarly, a British survey of 28000 adults suggested a potential benefit of the vaccination on these symptoms. They observed that the symptoms decreased by 13% and 9% after the first and second vaccine doses, respectively (5). They hypothesised this was because of an increase in antibody titres and a potential elimination of the viral reservoirs (5). In contrast with our study, the lack of a contemporaneous, non-vaccinated control group reduced the level of evidence of this finding. In our study, this comparison was available. The time of the assessment after the vaccination was included in our analysis of persistent symptoms based on a 6-month delay, although this method is disputable. In a large cohort of individuals, the time between infection and vaccination was not found to be a moderator of the symptoms (5). However, the type of vaccine was not considered in our study because previous results showed no influence of the type on the benefit related to long COVID symptoms (5) and because the HCW were vaccinated with only one type in our hospital, even if a minority of HCW may have been vaccinated with another type.

A high mental health stress is expected in HCW and particularly during such a pandemic. Indeed, the prevalence of anxiety and depression is known to be higher in HCW than in the general population (19-21). Moreover, HCW had to face the health, social and economic impacts of the pandemic, similarly to the general population. However, they faced the burden of the fear of being infected or contaminating their close relatives, as well as the stigma associated with being on the front lines of the disease (22-24). The human-to-human transmissibility, morbidity and fatal condition associated with the COVID-19 were demonstrated to increase this stress in HCW compared to the general population (25, 26). Our survey confirmed the presence of high mental health stress after the initial infection. This mental disturbance after the infection was expected and thought to be higher in contaminated HCW than in contaminated non-HCW based on the previous data on survivors of SARS (27). That was already verified at the beginning of the pandemic in Wuhan in January 2020, with a dramatically high rate of anxiety (44%) and depression in HCW (50%) (28). A similar rate (55%) was found in a survey performed in our hospital in June 2020 (9). These rates were higher than the rates observed in HCW out with the pandemic (19-21). They are also higher than our rates, which can be explained by the longer delay between the infection and the assessment in our study. A psychological impact related to the outbreak was found in 54% of the responders from the general population in China during the same period (29). Our survey found a lower rate of symptoms of anxiety or depression, even if it remained high. This could be because the survey was performed more than one year later during the pandemic and about one year after the infection for most responders. Moreover, the vaccination rate was high in the

HCW in our survey, and the work load was probably reduced at this time, which was demonstrated to influence the mental disturbances (9). As the psychological concerns of healthcare workers also improved with time during the pandemic (30), it is difficult to fully compare prevalences assessed in different periods of the pandemic. However, these rates were expected to be slightly higher during than before the pandemic (31). In contrast to what we expected, neither the marital status nor the number of people living together played a role in the results of our survey. Only the sex was related to the anxiety. That is not surprising because anxiety is more common in women (32, 33). The initial level of anxiety is an important factor, but this pre-pandemic status being unknown in our healthcare workers prevents any interpretation for our results.

The prevalence of dysfunctional breathing was higher in our sample than the expected rate outside the pandemic period. Indeed, the expected rates are around 10% when dysfunctional breathing is assessed with the Nijmegen questionnaire (34). However, our results are similar to the rate found in a cohort study 4 months after discharge from hospitalisation for COVID-19 (21%) (8). These rates are similar to the prevalence of dysfunctional breathing in asthma (35). Hyperventilation was considered a major limiting factor during exercise and a possible explanation of persistent dyspnoea in COVID-19 survivors (36-38). However, we did not confirm the relationship between the persistence of dyspnoea after 6 months and dysfunctional breathing in our survey. The results about dysfunctional breathing must be interpreted carefully. Indeed, the Nijmegen questionnaire quantifies the functional respiratory complaints, and this criterion alone is not sufficient for establishing dysfunctional breathing (39).

This study has several limitations. The main one is that the survey was retrospective and based on self-reporting symptoms. Thus, it was not possible to investigate the expected impact of the different variants as previously highlighted in a survey performed at the same time in non-hospitalised adults (15). The responders were also probably more motivated to participate because of the symptoms they experienced, which could lead to overestimation of some results, mainly the prevalence of the symptoms. Finally, the vaccination status could play a role in the reporting of symptoms by the HCW. It could be (voluntary or not) reassuring due to the strong pressure associated with non-vaccination. The salience of the survey topic is known to be one of the most important factors that influence response rates (40). Moreover, as the delay between the infection and the survey was different for all the respondents, the intrinsic motivation could have been differently influenced. On average, it was long, and this can cause recall bias. Because of the small sample size, this delay was not taken into account in our statistical analysis, but no changes were previously reported on the posttraumatic stress symptoms with the time in HCW in a recent longitudinal study (41). Moreover, anxiety appeared to be poorly influenced by the time from the vaccination in a probability model (5). We did not take into account neither the kind of job nor the psychiatric history of the responders. These could influence the results because COVID-19 had a different impact on the mental health of frontline and non-frontline workers (42) and being a nurse is a predictor of depression, posttraumatic stress, and anxiety compared to physicians (9). The individual's psychiatric history was demonstrated to be related to the course of anxiety and depression in people with COVID-19 (43), but was not linked to mental health-related symptoms in HCW (9).

In conclusion, the HCW who had been infected by SARS-CoV2 self-reported to be symptomatic, with symptoms persisting for a long period in 48%. Being vaccinated reduced the persistence of symptoms. Anxiety, depression, and dysfunctional breathing were highly prevalent among the HCW who had been infected.

## Statement and declaration

### *Acknowledgments*

All authors have read the journal's policy on disclosure of potential conflicts of interest and a statement. They have disclosed any financial or personal relationship with organizations that could potentially be perceived as influencing the described research.

### *Funding*

There was no specific funding for the study. Gregory Reychler received a grant from the Institut de Recherche Expérimentale et Clinique (Université catholique de Louvain – Brussels – Belgium).

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