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Post-COVID-19 syndrome and its sequelae: a cross-sectional study

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Abstract

Background The long-term post-COVID is a very complex pandemic phenotype disease. The persistence of manifestations had resulted in classifying COVID-19 infection into bipolar phase which is a post-COVID-19 subacute phase by which the ongoing symptoms extended for 4–12 weeks and chronic or long COVID-19 phase by which the associated symptoms and abnormalities were extending for more than 12 weeks even after the pandemic.

Aim Determining the percentage of patients who continued to suffer from different symptoms beyond 12 weeks of COVID-19 exposure and the use of different complementary modalities among patients with post-COVID.

Patients and methods The present study is a cross-sectional analytical observational study which was conducted through an online questionnaire using Google Forms with a total sample of 123 Egyptian patients older than 30 years old diagnosed with symptomatic and/or laboratory-confirmed COVID-19 infection with persistent health problems over 12 weeks prior to December 2021.

Result The findings revealed elevated percentages of persistent symptoms and unfavorable long-term consequences extending beyond 12 weeks post-infection, irrespective of vaccination status or hospitalization. These outcomes significantly affected individuals' health, finances, family dynamics, and lifestyle. Additionally, a notable proportion of cases sought relief through complementary medicine, particularly probiotics and herbal remedies.

Conclusion The questionnaire is an addition for a comprehensive long-term evaluation that might aid the clinician for follow-up of patient infected with COVID-19 and broaden the use of various complementary medical disciplines.

Keywords Post-COVID-19 syndrome, Vaccine, Dyspnea, Headaches

Background

SARS-CoV-2 infection (COVID-19) is a major pandemic that caused devastating mortality and morbidity around the world. Eighty percent of affected individuals developed a mild to moderate disease, and among those who had the severe form, 5% developed critical illness. Some patients after recovery from COVID-19 developed persistent or new symptoms that extended for weeks to months; this is named "long COVID," "long haulers," or "post-COVID syndrome" [1].

In patients with acute COVID-19, symptoms usually appear 4–5 days after exposure to SARS-CoV-2 virus. A study conducted in England, Scotland, and Wales recognized three groups of manifestation (during acute attack of COVID-19). The first group is composed of respiratory symptoms such as shortness of breath, cough, sputum, and fever, while the second group is composed of musculoskeletal symptoms like fatigue, headache, joint pain, and myalgia; lastly, the third group is composed of

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enteric manifestations symptoms which were abdominal cramps, diarrhea, and vomiting [2].

Recovery from mild SARS-CoV-2 infection commonly occurs within 7–10 days after the onset of symptoms in mild disease; it could take up to 3–6 weeks in severe/critical illness. However, follow-up of patients who recovered from COVID-19 revealed a considerable percentage of them to have several symptoms that persisted for weeks to months after recovery resulting in impairment of daily activities beyond the initial acute period [3].

Post-COVID-19 patients suffer from a phenomenon called "long" or "chronic" COVID-19 or more recently post-acute sequelae of COVID-19 or post-acute COVID-19 syndrome (PACS) [4]. The terms "long COVID-19" and "post-acute COVID-19 syndrome (PACS)" do not have a unified definition. The definition approved by the World Health Organization (WHO) and the National Institute for Health and Care Excellence (NICE) comprise a set of "signs and symptoms that emerge during or after an infection consistent with COVID-19, persisting for more than 12 weeks, and are not explained by an alternative diagnosis" [5]. The NICE panel and many other experts also approved to subdivide it into two categories.

The first category included the post-COVID-19 subacute phase of ongoing symptoms extending for 4–12 weeks after beginning of the infection, and the second category included the chronic phase or long COVID-19, defined as symptoms and abnormalities extending for more than 12 weeks after the beginning of the infection without any other diagnostic explanations [6].

This timeframe difference is important because it differentiates between the acute phase of the disease and the complications of possibly irreversible tissue damage with variable degrees of dysfunction and symptoms of several possible conditions as considered by some experts: post-thrombotic or hemorrhagic complications, post-intensive care syndrome, acute-phase immune-mediated complications, and/or multi-systemic inflammatory syndrome in children or adults [7].

Numerous reports have shown that COVID-19 has a variety of long-term effects on almost all systems including respiratory, cardiovascular, gastrointestinal, neurological, psychiatric, and dermatological. Based on previous studies, shortness of breath fatigue, psychological stress (depression, anxiety), post-traumatic stress disorder, sleep abnormalities, and poor concentration were detected in at least 25% or more of the study participants [8].

The nature of symptoms can be continuous or relapsing and remitting [9]. One or more symptoms of acute COVID can persist, or new symptoms can appear. Most people with post-COVID syndrome are PCR negative, which indicates a microbiological recovery. In another explanation, post-COVID syndrome is the time difference between microbiological recovery and clinical recovery [10].

Diagnosis of long COVID has several challenges. Biochemical and radiological recoveries were found in the majority of those with long COVID. The time needed for clinical recovery differs depending on the severity of the disease. Defining the cut-off time for the diagnosis is difficult because of the associated complications. A considerable percentage of SARS-CoV-2-infected individuals have no symptoms, and many individuals would not have undergone any test to confirm infection with SARS-CoV-2 [11].

Countries have different testing policies and during pandemics; it is very common to use clinical diagnosis based on symptoms without the need to laboratory. Therefore, for those who had never checked for COVID, persistence of symptoms is challenging [12]. Similarly, we can face a diagnostic dilemma concerning residual symptoms in patients checked negative for COVID (false negative because of too early or too late testing in the course of the disease) [13]. There is variability in antibody response to infection, and about 20% does not seroconvert. The retrospective diagnosis of recent SARS-CoV-2 infection can be challenged by the decrease in antibody level over time [14].

Among hospitalized patients after COVID infection, the prevalent reports of ongoing symptoms range from 32.6 to 87%. In a non-hospitalized cohort, 30% reported cognitive impairment and 37% fatigue. In Wuhan, China, 76% of infected patients were still suffering from at least one symptom after 6 months after discharge [15].

A Melbourne study found persistent symptoms in 34% even after 45 weeks [16]. These raw data may just reflect local conditions and are unadjusted for standard variables such as age, gender, ethnicity, employment, social deprivation, medications that are sedating, and co-morbidities such as diabetes, obesity, and vascular disease [17].

The reason behind this post-viral syndrome is unknown, though it looks like chronic fatigue syndrome. It is now named post-viral fatigue syndrome (PVFS). The most acceptable theory is an autoimmune process with an exaggerated innate immune response and cytokine activation. Most patients with severe COVID-19 show a considerable degree of elevated serum levels of pro-inflammatory cytokines including interleukins 6, 1-beta, 2, 8, and 17, tumor necrosis factor alpha, granulocyte colony-stimulating factor, granulocyte–macrophage colony-stimulating factor, and chemokine ligands 2 and 10 resulting in cytokine storm [4].

The presence of oligoclonal IgG bands and activated microglia resembles the process causing fatigue and

cognitive impairment in multiple sclerosis (MS) [18]. There are an increasing number of patients recovering from COVID-19 infection worldwide; currently, COVID-19 has infected 429 million individuals globally as of the end of February 2022. Assuming that about 30% of survivors experience persistent symptoms, then over 128,700,000 individuals could be affected by the long-term consequences of COVID-19. With no curative treatment in sight, we need to prevent infection by vaccination. Otherwise, these figures propose an extended public health challenge, so the aim of the present work is to determine the percentage of patients who continued to suffer from different symptoms beyond 12 weeks of COVID-19 exposure and the use of different complementary modalities among patients with post-COVID.

Patients and methods

Patients

This study is a cross-sectional, online survey study that includes 123 patients with COVID-19 infection, older than 30 years old that were diagnosed with symptomatic and/or laboratory-confirmed COVID-19 infection with persistent health problems over 12 weeks prior to December 2021. Survey distribution was via online COVID-19 support groups and social media)Google survey or WhatsApp) in Cairo, Giza, Alexandria, and Sharkia, Egypt.

We were authorized to apply a web-based survey of suspected and confirmed COVID-19 cases with associated manifestations lasting over 12 weeks via Bristol University (6). A translated Arabic electronic version was developed by a multidisciplinary team of researchers and clinicians, to be submitted during the study period regarding multi-symptoms, determining the percent of how many people received vaccinations and booster shots in addition to the assessment of the ability to carry out daily routine activities, asking about the current patient's health condition and their persistent symptoms in the post-COVID period, in addition to the use of complementary and alternative medicine (CAM) modalities among patients with post-COVID-19 symptoms.

Patients older than 30 years old and diagnosed with symptomatic and/or laboratory-confirmed COVID-19 infection prior to December 2021 were enrolled in the study, in addition to the persistent symptoms over 12 weeks. On the other side, patients with resolved COVID-19 symptoms within 3 months of confirmed infection were excluded.

Ethical consideration

The present study was conducted with the Code of Ethics of the World Medical Association, according to the principles expressed in the Declaration of Helsinki. This study has been approved by the local Ethics Committee of National Research Centre, Cairo, Egypt, with approval number 01430422. An electronic submitted consent form was provided by each participant prior to their inclusion in the study.

Statistical analysis

Data were gathered, authenticated, encoded, and analyzed using the Statistical Package for the Social Sciences (SPSS), version 22 (SSPS Inc., Philadelphia, PA, USA). Descriptive statistics were used to assess the baseline characteristics of the research population. The independent *t*-test was used to compare quantitative data between the two groups. The analysis was used when looking at the relationship between two quantitative variables within the same group. *P*-values less than 0.05 is considered significant in this study.

Results

The present study enrolled 123 patients with COVID-19 infections who observed that the contributors' number was 71 (57.7%), diagnosed as COVID-19 positive cases by a positive swab/saliva PCR test, while 24 (19.5%) patients with personal strong suspicion ($n=7$ candidates with 5.7%) were diagnosed based on medical advice without examination nor investigations, 1 with represented percentage of 0.8% was diagnosed based on positive rapid finger prick antibody test, and one candidate was diagnosed by a positive chest X-ray.

The data represented in Table 1 shows sociodemographic characteristics of the participants of this study. The age ranged from 13 to 73 years with an average 42.3 ± 9.2 years. Most of the participants were females

Table 1 Sociodemographic characteristics of study participants

	Number ($n=123$)	Percent (%)
Sex		
Male	9	7.3
Female	114	92.7
Body mass index categorized		
Overweight	38	46.7
Obesity class I	34	41.8
Obesity class II	47	57.8
Obesity class III	4	4.9
Residency		
Cairo	21	17.1
Giza	99	80.5
Sharkia	2	1.6
Alexandria	1	0.8
Age (mean ± SD)	42.3 ± 9.2	
Minimum–maximum	13–73	

($n=114$ (92.7%)), while males were only 9 representing 7.3% of all contributors. The majority of candidates ($n=99$ (80.5%)) reside in Giza, $n=21$ of candidates (17.1%) live in Cairo, $n=2$ (1.6%) in Sharkia, and $n=1$ (0.8%) resides in Alexandria.

Table 2 shows the general condition of the candidates prior, during, and after COVID-19 infection. Eighty of

Table 2 General condition of the study participants prior, during, and after COVID-19 infection

	Number	Percent
In general, in the 3 months before the COVID-19 outbreak in March 2020, would you say your health was		
Excellent	80	65
Very good	32	26
Good	11	9
How was your COVID-19 infection confirmed?		
Based on strong personal suspicion	24	19.5
Based on medical advice without examination or investigations	7	5.7
Based on a positive CBC blood test	19	15.4
Based on positive rapid finger prick antibody test	1	0.8
Based on positive swab/saliva "PCR" test	71	57.7
Based on positive chest x-ray	1	0.8
Have you ever had to stay in hospital because of COVID-19 symptoms?		
Yes	3	2.4
No	120	97.6
Have you ever had to stay in ICU because of COVID-19 symptoms?		
Yes	0	0
No	123	100
Do you think you have caught COVID-19 more than once?		
Yes	39	31.7
No	84	68.3
How was your second infection confirmed? ($n=39$)		
Based on strong personal suspicion	27	69.23
Based on medical advice without examination or investigations	6	15.4
Based on a positive CBC blood test	2	5.12
Based on positive swab/saliva "PCR" test	4	10.25
Thinking of your last, or only, episode of COVID-19, have you now recovered to normal?		
Yes, I am back to normal	100	81.3
No, I still have some or all of my symptoms	23	18.7
Did you have any of the following problems 12 weeks (or more) after first catching COVID-19 (more than one answer allowed)?		
-I was back to my usual self	55	44.7
-Breathing problems, e.g., breathlessness, pain on breathing, cough	65	52.8
-Altered sense of taste or smell	39	31.7
-Problems thinking and communicating, e.g., brain-fog, memory problems, difficulty concentrating, decreased alertness, confusion, difficulty speaking	16	13
-Heart problems, e.g., chest pain, palpitation	8	6.5
-Light-headedness/dizziness on standing	59	47.9
-Abdominal problems, e.g., tummy pain, diarrhea, appetite loss	18	14.6
-Muscle problems, e.g., muscle aches, weakness, severe fatigue	50	40.6
-Altered feelings in your body, e.g., unusual tingling, pain	9	7.3
-Problems relating to mood, e.g., anxiety, feeling "down," or irritable	34	27.6
-Problems sleeping, e.g., poor sleep or excessive sleep	25	20.3
-Skin rashes	6	4.8
-Bone/joint pain	38	30.9
-Headaches	43	35

them (65%) had excellent health, 32 (26%) were with very good health, and 11 participants (9%) had good health before the pandemic in 2020. The majority of patients (120 (97.6%)) did not need hospitalization, while only 3 (2.4%) were hospitalized. No patients needed ICU admission. Thirty-nine contributors (31.7%) think they caught COVID-19 infection more than once, while 84 (68.3%) think they have not. While, of these 39 people, 27 (69.23%) had strong personal suspicion of COVID-19 re-infection, 6 (15.4%) were diagnosed based on medical advice without examination nor investigations, 4 (10.25%) patients were diagnosed by swab/saliva PCR test, and the last 2 patients (5.12%) were diagnosed by positive CBC blood test. Most COVID-19 cases 100 (81.3%) have totally recovered and returned to their normal pre-COVID state, while 23 patients (18.7%) still have symptoms.

Regarding the candidates' symptoms in the 12-week period following the COVID-19 infection, 55 patients (44.7%) returned to their original health state; 65 (52.8%) suffered from persistent breathing problems such as dyspnea, cough, and chest pain; 39 (31.7%) suffered from altered taste and smell; 16 (13%) of participants had problems thinking and communicating (e.g., brain fog, memory problems, difficulty in concentration, decreased alertness, confusion, and difficulty speaking); and 8 (6.5%) had cardiac symptoms such as chest pain and palpitation, where light-headedness and/or dizziness on standing were present $n=59$ candidates (47.9%). Abdominal problems affected 18 patients (14.6%) in the form of abdominal pain, loss of appetite, and diarrhea. Fifty patients (40.6%) suffered from muscle pain and weakness, while unusual tingling and body aches were the symptoms of 9 participants (7.3%). Mood changes affected 34 (26.6%) of the patients mainly in the form of anxiety, irritability, or depression. Twenty-five (20.3%) of our candidates had sleeping problems (either poor or excessive sleep). Skin rash affected 6 (4.8%). Bone and joint pains affected 38 (30.9%), and headaches affected 43 (35%) of the participants.

The data expressed in Table 3 interprets the difficulty in certain activities in the 3 months following COVID-19 infection. Concerning the standing for 30 min or more, 68 patients (55.3%) had no difficulties, 37 (30.1%) had mild difficulties, 17 (13.8%) suffered from moderate difficulties, and 1 person (0.8%) suffered from severe difficulty, while in the case of doing household responsibilities, 66 participants (53.7%) had no difficulties, 37 (30.1%) had mild difficulty, 19 patients (15.4%) had moderate difficulty, and 1 (0.8%) had severe difficulty doing house work.

Also, in the case of joining community activities, 91(74%) of the candidates had no difficulties, 21 (17.1%) had mild difficulty, and 11 (8.9%) had moderate difficulty joining community events. In addition, being emotionally affected by his/her health problem, the majority of the candidates 60 (48.8%) did not suffer emotionally, while 38 (30.9%) of them were mildly affected, 19 (15.4%) were moderately affected, and 6 (4.9%) had severe emotional affection by their health problems. Lastly, regarding concentration on doing something for 10 min, there has been 70 of the candidates (56.9%) who did not have difficulty in concentrating for 10 min, while 38 (30.9%) had mild difficulty. Moderate difficulty in concentration for 10 min was the problem of 14 (11.4%) of our participants, and 1 patient (0.8%) was severely affected.

The observed outcome for walking for 1 km/half a mile was as follows: 56 (45.5%) had no difficulty, 37 (30.1%) had mild difficulty, 22 (17.9%) had moderate difficulty, 6 (4.9%) patients had severe difficulty, and 2 (1.6%) were extremely unable to walk for a long distance; for getting dressed, 111 (90.2%) had no difficulty getting dressed, 10

Table 3 The difficulties and activities 3 months following COVID-19 infection in all study participants

	No difficulty	Mild	Moderate	Severe	Extreme/unable to do
Standing for long periods, such as 30 min?	68 (55.3%)	37 (30.1%)	17 (13.8%)	1 (0.8%)	0 (0%)
Taking care of your household responsibilities?	66 (53.7%)	37 (30.1%)	19 (15.4%)	1 (0.8%)	0 (0%)
Joining in community activities (e.g., festivities, religious, other)?	91 (74%)	21 (17.1%)	11 (8.9%)	0 (0%)	0 (0%)
Being emotionally affected by your health problems?	60 (48.8%)	38 (30.9%)	19 (15.4%)	6 (4.9%)	0 (0%)
Concentrating on doing something for 10 min?	70 (56.9%)	38 (30.9%)	14 (11.4%)	1 (0.8%)	0 (0%)
Walking a long distance such as 1 km or half a mile?	56 (45.5%)	37 (30.1%)	22 (17.9%)	6 (4.9%)	2 (1.6%)
Getting dressed?	111 (90.2%)	10 (8.1%)	2 (1.6%)	0 (0%)	0 (0%)
Dealing with people you do not know?	96 (78%)	22 (17.9%)	4 (3.3%)	1 (0.8%)	0 (0%)
Maintaining a friendship?	103 (83.7%)	16 (13%)	2 (1.6%)	2 (1.6%)	0 (0%)
Your day-to-day work school?	82 (66.7%)	26 (21.1%)	14 (11.4%)	1 (0.8%)	0 (0%)

Table 4 Type of complementary treatment used

	Number	Percent
-Herbal therapy	11	9
-Hijama	1	0.8
-Chinese needles	1	0.8
-Homeopathy	1	0.8
-I did not seek any medications other than (protocol of medical treatment with vitamins and probiotics)	109	88.6

Table 5 Type of the administrated vaccination

	Number	Percent
Did you take COVID-19 vaccine		
Yes	102	82.9
No	21	17.1
COVID-19 vaccine type		
AstraZeneca	43	42.1
Sinopharm	19	18.6
Pfizer	15	14.7
Johnson	14	13.7
Sinovac	9	8.8
Moderna	1	1
Sputnik	21	
None		

(8.1%) of candidates had mild difficulty, and 2 patients (1.6%) had moderate difficulty.

The reported result in the case of dealing with strangers (stranger anxiety) was 96 (78%) had no problem dealing with strangers, 22 (17.9%) had mild difficulty, 4 (3.3%) had moderate difficulty, and 1 (0.8%) had severe difficulty, while for maintaining friendship, it was as follows: 103 (83.7%) had no difficulty, 16 (13%) had mild difficulty, 2 (1.6%) had moderate difficulty, and 2 (1.6%) had severe difficulty; for everyday work/school, 82 (66.7%) had no difficulty, 26 (21.1%) had mild difficulty, 14 (11.4%) had moderate difficulty, and 1 patient (0.8%) had severe difficulty.

The various treatments received for COVID-19 received by the patients were presented in Table 4. Table 5 exhibited the vaccination status of the candidates, where 102 (82.9%) were vaccinated while 21 (17.1%) participants were not. Among the vaccines, 3 (42.1%) candidates received AstraZeneca vaccine, 19 (18.6%) received Sinopharm vaccine, 15 (14.7%) received Pfizer vaccine, 14 (13.7%) received Johnson vaccine, 9 (8.8%) received Sinovac vaccine, 1 (1%) received Moderna vaccine, and 1 (1%) received Sputnik vaccine.

The confirmation of second COVID-19 infection was only reported for 39 cases in Fig. 1, and the cases who recovered to normal after COVID-19 infection were shown in Fig. 2. Hereby, the various post-COVID-19 symptoms were represented in Fig. 3, and the reported difficulty with different activities after COVID-19 illness is illustrated in Fig. 4.

Discussion

Infection with SARS-CoV-2 virus has resulted in increased deaths and mortality worldwide and posed a serious challenge on healthcare systems [19]. Furthermore, COVID-19 viral infections have been associated with long standing symptoms that continued to be

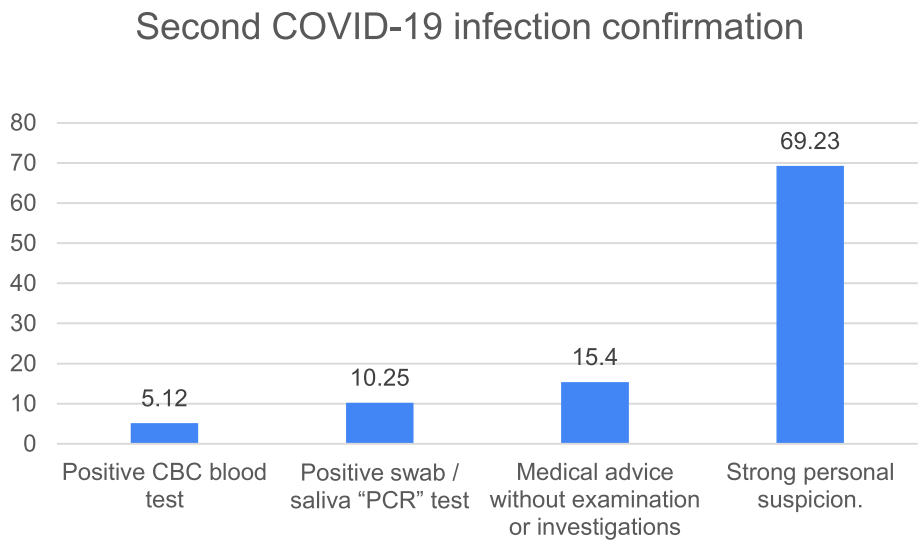

Fig. 1 Second COVID-19 infection confirmation (*N* = 39)

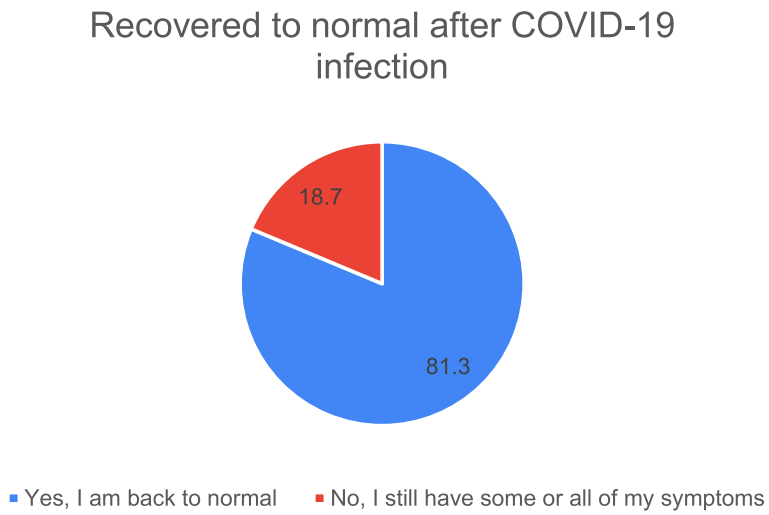

Fig. 2 Recovered to normal after COVID-19 infection

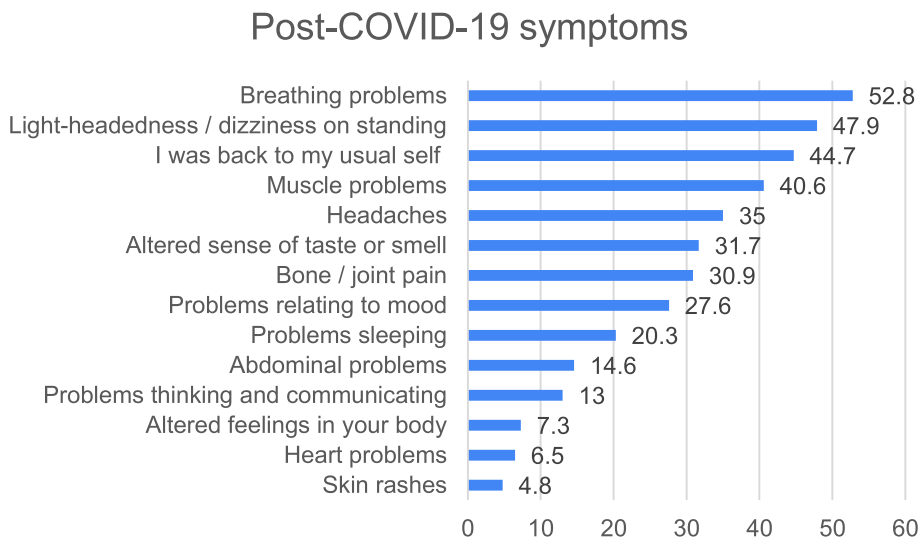

Fig. 3 Post-COVID-19 symptoms

present beyond 12 weeks or even months after of the onset of acute COVID-19 and were not attributable to alternative diagnoses establishing what has been clinically known as post-acute COVID-19 syndrome or long COVID-19 [20].

The primary objective of our work was to determine the number of patients with persistence of COVID-19 symptoms 12 weeks post-recovery from the viral infection. Demographic data of the included patients are summarized in Table 1, while their clinical characteristics before and during the COVID-19 infection are shown in Table 2, and we found that among our studied cohort, 55.3% of the patients still complained of ongoing symptoms beyond 12 weeks after recovery in line with what was previously reported [21–23].

This result is slightly higher than that of the recent findings of a metanalysis that included 194 studies with approximately 700,000 participants and concluded that 45% of COVID-19 survivors still experienced a range of unresolved symptoms after 4 months of infection [24]. However, other studies, notably Egyptian cohorts, reported a higher percentage of patients affected with long COVID compared to our result. Kamal et al. [25] and Galal et al. [26] showed respectively that post-COVID-19 manifestations were recorded for about 90%

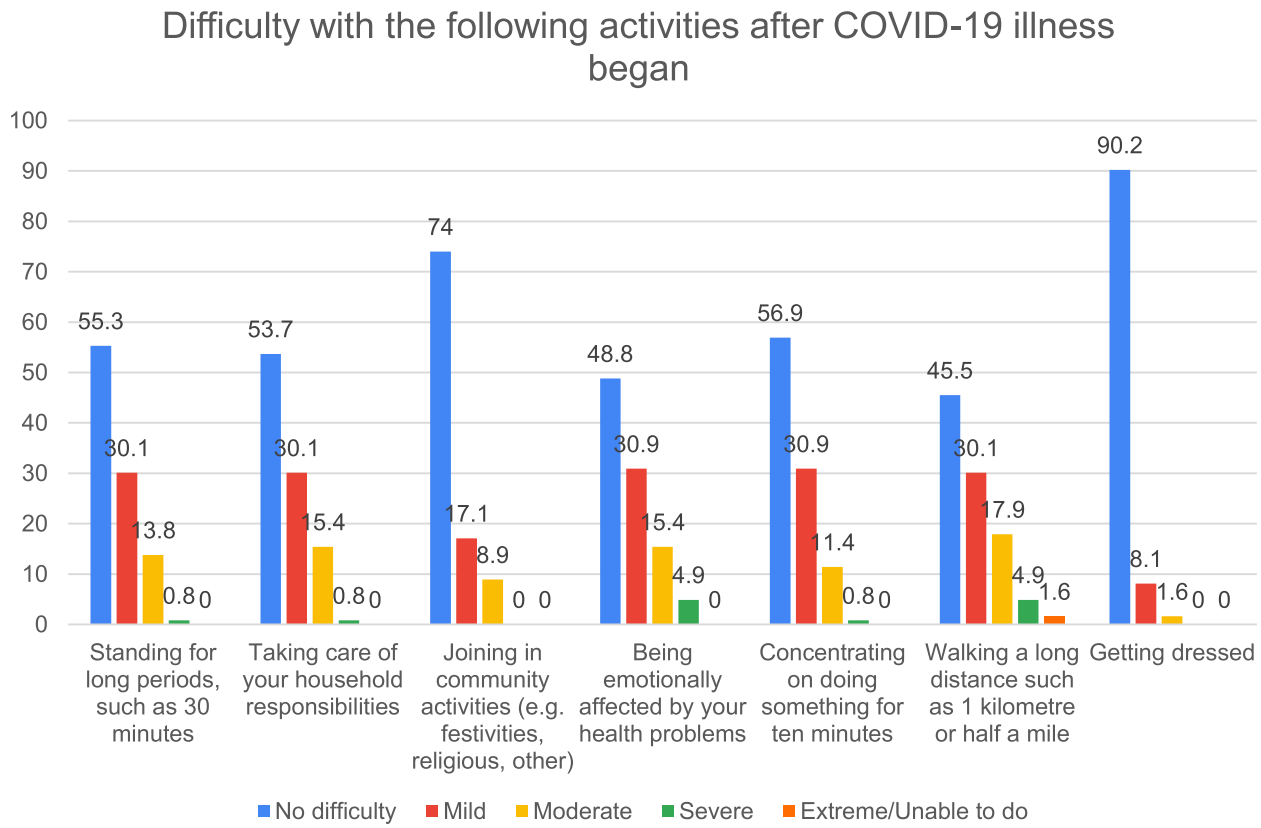

Fig. 4 Difficulty with the following activities after COVID-19 illness began

and 86% of the recovered subjects, with a wide range of symptoms.

In contrast, a lower percentage (33.3%) was noted among Egyptian health care workers [27] similar to the findings of Chopra et al. [28]. The variation of the results in those mentioned studies is probably due to the heterogenicity in study design, number of participants, follow-up duration, and in particular the measurements tools employed.

For instance, while in our study we relied specifically on a subjective questionnaire, an earlier prospective study that evaluated around 1300 patients who were subject to questionnaires such as the modified British Medical Research Council dyspnea scale or the Euro quality of life five-dimension five-level questionnaire to assess health-related quality of life in addition to physical examination, 6-min walking test (6MWT), blood tests, and, in selected cases, pulmonary function tests, high-resolution chest CT (HRCT) CHEST, and U/S, observed that the majority of the patients (68%) were still troubled by at least one symptom even after 6 months which was further reduced to 49% 1 year after the acute onset of infection [29].

The commonly reported symptoms after acute COVID-19 were fatigue and dyspnea [30–33]. Other common symptoms included joint pain and chest pain [34–36]. Cognitive impairment, neurological complaints, anxiety and depression, or dermatological manifestations were also observed in various studies [37–39].

Our results were not different from the published literature. In our cohort, 52.8% suffered from persistent breathing problems such as dyspnea, cough, and chest pain, 47.9% complained from light-headedness and/or dizziness on standing, 40.6% suffered from muscle pain and weakness, 35% of the participants suffered from headache while bone and joint pains affected 30.9% of them, and 26.6% had persistent anxiety, irritability, or depression. Other and less common complaints among our participants in the present study showed the difficulty in certain activities that were encountered by our studied subjects in the 3 months following COVID-19 infection in line with the results of a Dutch study evaluating the impact of the post-COVID syndrome on the self-reported physical activity [40].

The above-described wide variation in symptoms might be explained by the fact that long COVID cannot be considered as a single syndrome but separate ones with different trajectories that overlap in the same individual as time progresses as was suggested by a recent review [41].

Also, it is now well recognized that COVID-19 presents with an organ-dominant disease. The damage is thought to be multifactorial and could be explained by severe inflammatory responses, microangiopathy, unresolved inflammation, and/or oxygen deprivation leading to more pronounced symptoms in certain individuals compared to others [42].

Thus, like other chronic or critical illnesses with lingering respiratory impairment, COVID-19 was reported to be complicated by reduced diffusion capacity, restrictive pulmonary physiology, and ground-glass opacities and fibrotic changes on imaging, all of which have been noted with many follow-up studies leading to persistent dyspnea and decreased exercise capacity [30, 43–46]. Similarly, patients with major neurological deficits due to COVID-19 infections continued to manifest principally abnormalities such as fatigue, myalgia, headache, and cognitive impairment [20, 23, 31, 32].

Noteworthy, the persistence of long COVID-19 manifestations was observed to be independent of the duration or the status of hospitalization [24], and interestingly, in our cohort, very few patients had to be admitted for hospital recovery due the acute infection, and no single case was recorded to be admitted in the ICU. In our opinion, the vaccination status of our participants might explain why only few of them needed hospital admission since about 83% of them were vaccinated with various types of vaccines.

COVID-19 vaccines appear to be safe and effective tools to prevent severe infection contacted by SARS-CoV-2 virus [47]; still, some studies do not agree on their protective effect against long COVID. Vaccines lower the chance of getting COVID-19 infection in the first place, thus reducing the risk of long COVID; however, for patients who do experience the infection, trials suggest that vaccination might have no effect on it at all [48]. More long-term prospective research is still needed to elucidate the effects of COVID-19 vaccines on the long COVID manifestations.

In summary, long COVID is a very complex phenotype of a novel disease that even after the pandemic, research working groups are still trying to uncover all the mechanisms and pathophysiological interactions triggering the disease with different propositions for the definition and the description of long COVID [42, 49, 50]. Hence, we preferred in our questionnaire to rely on the widely used 12 weeks duration as a cut off time to describe this syndrome.

Secondly, we shed the light on the vaccination status of our participants and that it might have played a role along with conventional medical treatment and not alternative treatment which was remarkably exceptional in almost preventing hospital and ICU admission among our cohort of subjects in whom COVID-19 infection was confirmed. Notwithstanding these measures, and as was discussed, patients were still unable to carry on with their routine and daily activities.

Despite concluding our objectives, some limitations of this work should be put into consideration before interpreting the results. We conducted this work on a relatively small number of patients via an online survey questionnaire that is not without subject biases. Data on comorbidities or baseline chronic illnesses is missing, and thus risk factors associated with the long COVID manifestations could not be assessed. Moreover, females represented more than 90% of our sample, possibly due to the higher proportion of women that are part of COVID-19 online support groups and support groups. In fact, this gender distribution was in accordance with other studies [51, 52].

Conclusion

In conclusion, a high percentage of patients still experience varying symptoms long after the onset of the infection regardless of the vaccination or the hospitalization status. Moreover, a considerable portion of individuals sought relief through complementary medicine, particularly probiotics and herbal remedies. More prospective and multicenter studies, particularly in Egypt, with a large number of patients are needed to fully investigate the deleterious effects of long COVID symptoms on the quality of life of patients. Future and undergoing research should be able to reveal the appropriate diagnostic tools and modalities to find and guide those patients with possible management approaches while recovering from these long-term sequelae of the COVID-19 viral infection.

Abbreviations

6MWT	6-Min walking test
CAM	Complementary and alternative medicine
HRCT	High-resolution chest CT
MS	Multiple sclerosis
NICE	National Institute for Health and Care Excellence
PACS	Post-acute COVID-19 syndrome
PVFS	Post-viral fatigue syndrome
WHO	World Health Organization

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None.

Authors' contributions

Hemat Allam: conceptualization and review. Mai S. Elsheikh: manuscript review and editing. Ahmad Elwahidy: data collection, statistical analysis, literature search.Rasha Monir: data collection, statistical analysis. Amira Medhat: data collection and literature search. Yasmin M. Ziada: statistical analysis and literature search. Ahmed Gharib: manuscript drafting, review and editing. Gehan Hamdy: literature search, methodology, conceptualization, and review.

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

Declarations

Ethics approval and consent to participate
This study has been approved by the local Ethics Committee of National Research Centre, Cairo, Egypt, with approval number 01430422. An electronic submitted consent form was provided by each participant prior to their inclusion in the study.

Consent for publication
Not applicable.

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

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