

THE LONG COVID AND ITS MENTAL HEALTH MANIFESTATIONS – THE REVIEW OF LITERATURE

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Abstract

This article aims to present the overview of the situation during the coronavirus disease 2019 (COVID-19) pandemic about issues concerning the prevalence of mental disorders such as depression, anxiety, rate of suicide attempts, and long COVID (LC) infections in the general population during COVID-19 pandemic. Analysis of the literature (in English, Polish and Spanish language) on topics related to COVID-19, mental disorders (suicide attempts, depression, anxiety) and LC infection published during the 4 years (2020–2023) was done using Pubmed and PubMed Central search engine. Keywords such as “COVID-19,” “mental disorders,” “long COVID infection,” “depression,” “anxiety,” “suicide attempts” were used during the search. The conduct of this review/comment followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) protocol, which corresponds to a checklist of 27 items designed to facilitate the development and reporting of a robust protocol for systematic reviews or meta-analyses. Overall 35 studies were selected and analyzed in the review on topics: including among others LC (14 studies), suicide attempts (7 studies), mental disorders (depression, anxiety) (14 studies). The main issues raised in the articles were: higher risk of LC symptoms in women, fatigue and brain fog listed as frequently encountered patient’s complaints together with anxiety, depression, loneliness, especially in younger age groups and in women. Issues regarding LC, mental disorders and suicide attempts requires further research as the results vary in different countries. *Int J Occup Med Environ Health.* 2024;37(3):360–80

Key words:

depression, anxiety, suicide attempts, COVID-19, mental disorders, long COVID symptoms

INTRODUCTION

Coronavirus disease 2019 (COVID-19) caused by acute respiratory coronavirus 2 (SARS-CoV-2) has been a global turning point in public health since its international outbreak in 2020. As of the March 23, 2024 – 704 318 936 cases have been diagnosed with 7 007 114 deaths reported. On the bright side, 675 258 477 people affected by SARS-CoV-2 infection have recovered [1].

In Poland, 6 661 682 infections have been reported since March 4, 2020 (1 204 810 currently infected patients) with

5 456 537 cases involving an outcome (5 335 940 recovery and 120 597 deaths) [2]. One can assume that the COVID-19 pandemic has subsided and does not pose a threat anymore. On the other hand, we have experienced since the beginning of December 2023 an alarming increase of new cases [3]. Even when assuming a positive scenario that the increase is just a temporary situation, people have to face the long-term impact of the virus on the general health of the population, including the long COVID (LC) syndrome. The situation concerning LC

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needs further attention and research as confirmed by the Lancet Editorial [4]. According to the authors 65 million people have been suffering from LC with 10–20% of COVID-19 infection cases resulting in the emergence of LC (1 in 10 people with LC cease to work, low research progress fueled by lack of financial resources) [4]. Furthermore, psychological impact of COVID-19 infection should be addressed as well. Long-term isolation has increased pathological human behavior including depression, suicide attempts, and anxiety.

According to the systematic review done by Ahmed et al. [5], based on 177 studies included in the study from 20 European countries, the mental health issue was the crucial problem that was addressed. In general the incidence and prevalence of generalized anxiety disorder and depression increased from 0% to 25%, to even 31% when compared with the situation before and during the pandemic [5]. According to WHO data, a 25% increase in the level of anxiety and depression worldwide was present with the COVID-19 pandemic acting as a trigger to worsen the situation [6]. Furthermore, the issue concerning the level of suicide attempts during the COVID-19 pandemic worldwide requires attention as the results from different studies tend to be inconsistent. For example an increased rate of suicide attempts was reported in 22.2% of studies whereas the decreased trend was observed in 11.1% of cases with 5.6% of studies reporting neither negative nor positive trend in the level of suicide attempts [7].

This article aims to present, based on the research search, the overview of the situation during the COVID-19 pandemic about issues concerning the prevalence of mental disorders such as depression, anxiety, rate of suicide attempts, and LC infections in the general population during COVID-19 pandemic.

METHODS

The conduct of this review/comment followed the Preferred Reporting Items for Systematic Reviews and

Meta-analyses (PRISMA) protocol, which corresponds to a checklist of 27 items designed to facilitate the development and reporting of a robust protocol for systematic reviews or meta-analyses. Analysis of the literature (in English, Polish and Spanish language) on topics related to COVID-19, mental disorders (suicide attempts, depression, anxiety) and LC infection, during the 4 years (2020–2023) was done using PubMed and PubMed Central (PMC) search engine. Keywords such as “COVID-19,” “mental disorders,” “suicide attempts,” “depression,” “anxiety,” “long COVID infection” were used during the search. The inclusion criteria for the articles presented in this review/comment paper were: validity concerning the presentation of topics such as suicide attempts, depression, anxiety and LC infection problems during the COVID-19 pandemic in different types of populations worldwide. Opinions on the subject, expressed by the experts in the field, including general guidelines were also taken into consideration.

RESULTS

The prevalence of long COVID symptoms in people who underwent COVID-19 infection

The COVID-19 pandemic has had a profound impact on the occupational health services work. It was reported by Marcinkiewicz et al. [8] that in Poland the pandemic has affected a number of prophylactic examinations concerning job applicants and employees (less in 2019 by >1 231 000). Moreover, in comparison with 2019, a decrease in the number of entry examinations (1 933 355, less by 23.9%); and periodic (follow-up) examinations (1 924 929, less by 25.1%) was observed.

On the other hand, the number of follow-up examinations that were conducted has increased (456 236 in 2020, increase by 5,1%). This increase may be attributed to the fact that the conducting of the follow-up examinations was only temporarily suspended during the pandemic [8]. According to the Centers for Disease

Control (CDC), LC or post-COVID conditions (PCC) can be described as symptoms, signs, and conditions that develop or continue after the initial COVID-19 infection. Anyone who suffered from COVID-19 infection may develop LC, however, people who had severe signs and symptoms and were not vaccinated are classified in a high-risk group. The duration of symptoms is not specific (it can be weeks, months or even years). Diagnosis of LC is said to be possible at least 3 months after the initial COVID-19 infection. General symptoms vary and may include: fever, tiredness, post-exertional malaise, neurological symptoms (such as a change in smell or taste, headache, “brain fog,” depression, anxiety, sleep problems), respiratory and heart problems (shortness of breath, chest pain, cough, heart palpitations), digestive problems (diarrhoea, stomach pain), joint or muscle pain. Due to the indefinite number and duration of signs and symptoms, LC has been classified in July 2021 as a disability condition and added to the Americans with Disabilities Act (ADA) list [9].

The study, conducted by Chudzick et al. [10] addressed the issue of LC development in patients not suffering from any comorbidities. Out of 701 patients, diagnosed and observed in ambulatory medical care in 2020–2022, 488 (69.6%) underwent a follow-up examination after 3 months. The group was ultimately divided into 2 subgroups: LC (218 patients) and non-LC (270 patients). In the LC group, the most frequently observed symptoms were: weakness (73%), impaired exercise tolerance (65%), palpitations (54%), concentration and memory disturbances (53%), and chest pain (44%).

The high-risk factors contributing to the development of LC in healthy patients were: severe course of COVID-19 infection, arthralgia [10]. According to Premraj et al. [11], the most common neurological symptoms present in LC are sleep disorders, fatigue, and cognitive dysfunction (memory and attention problems, brain fog).

In an observational analysis conducted by Hanson et al. [12], the data concerning 1.2 million people in 2020–2021 with symptomatic COVID-19 infection was obtained from 54 studies from 22 countries. The data concerned both hospitalized and non-hospitalized individuals. The frequency of cases with at least 1 of 3 cluster LC symptoms presented at 3 months after the infection (cognitive problems, persistent respiratory problems, persistent fatigue with mood swings or bodily pain) was established.

It was stated that the risk of LC was lower in non-hospitalized persons <20 years of age when compared to individuals >20 years of age (2.7% for both sexes, 4.8% of men and 9.9% of women). Long COVID cluster symptoms were more frequently diagnosed in patients who were in general hospital wards (27.5%) or intensive care unit (ICU) (43.1% of cases) when compared to non-hospitalized cases (5.7%). The presence of LC cluster symptoms was more frequently present in females at 3 months after the onset of infection than in males and in people >20 years (10.6% vs. 5.4% of cases). Frequency of LC decreased at 12 months after the onset of infection (1.7% in the female group, 0.8% in the male group). These findings are concurrent with the data published by the Institute of Health Metrics and Evaluation (IHME) indicating that the presence of LC was more frequently diagnosed in females (almost two-third of cases during the first 2 years of the pandemic) with 60% of cluster symptoms being respiratory problems; 51% persistent fatigue with mood swings or bodily pain and 35% cognitive problems [12–14].

In a study published by Antoniou et al. [15], in 50–65% of cases fatigue was reported and in 20–40% of cases anxiety or depression was observed. The risk factors that were found to increase the morbidity at 6 months after the hospital discharge involved age (middle-aged patients), gender (female), and more acute illness presence with 2 or more comorbidities [15]. Long COVID has undeniably become a global problem. According to Davis et al. [16], at least 65 million people are suffering from

its symptoms with incidence rate varying dependent on whether the patients were hospitalized (50–70%), vaccinated (10–12%) or non-hospitalized (10–30%). In line with previously cited studies is the one by Sykes et al. [17], reporting symptoms of LC like myalgia, anxiety, and fatigue to be more frequent in women. The presence of chronic diseases like diabetes or hypertension may increase the severity of LC symptoms. In a study, conducted by Marciniak et al. it was stated that a month after having been discharged from the hospital, patients with diabetes and hypertension suffered a higher incidence rate of symptoms involving cough and chronic fatigue [18]. Furthermore, among university communities (teachers, administration staff, students), during the COVID-19 pandemic, the severity of musculoskeletal problems has significantly increased. In the study conducted by Janc et al. [19], the prevalence of musculoskeletal disorders among 1365 respondents (914 students and 451 employees) from 3 big universities in Łódź, Poland, was evaluated. The evaluation period involved the time before the outbreak of the COVID-19 pandemic and the period October 2020 – June 2021.

The Visual Analogue Scale (VAS) was applied for the analysis concerning the severity of the musculoskeletal problems (0 pts indicating lack of symptoms, 10 pts – max severity of symptoms). The complaints involving musculoskeletal problems have increased during COVID-19 epidemic [19]. Another crucial issue to consider is the development of neurological post-acute sequelae of SARS-CoV-2 infection (neuro-PASC) infection among patients who had been hospitalized. These symptoms include headache, fatigue, loss of smell/taste, brain fog, speech change, confusion, difficulty concerning concentration, finding correct words, or memory problems. In a research performed by Chen et al. [20], including 89 former COVID-19 patients examined between November 2020 – March 2022 neuro-cognitive symptoms were diagnosed in 60% of COVID-19 patients after 6 months post hospital discharge.

The most frequently encountered symptoms included fatigue (53%) and brain fog (34%) [20]. Cristillo et al. [21] reported the presence of cognitive complaints, especially brain fog after 12 months post hospital discharge in 25 out of 132 former hospital patients (18.9%).

In a study conducted by Tsuzuki et al. [22], approx. 44% of former COVID-19 patients (201 out of 457) suffered from at least 1 symptom 4 weeks after the infection began.

The most frequently present symptom was fatigue (12.7%) with the second one being alopecia (12%) [22]. Fatigue was also reported as the most frequently encountered LC syndrome 6 months, 12 months, and 24 months after hospital discharge in South Korea. Out of 71.2% participants, 34.8% had fatigue, 30.3% amnesia, 24.2% had difficulties concerning concentration, 20% insomnia, 19.7% depression. It is worth noting that the frequency of fatigue changed independently from the time period evaluated (6 months after hospital discharge – 22.7%, 12 months after discharge – 17.4%, 24 months after discharge – 34.8%). The change was also visible for other symptoms amnesia, difficulties concerning concentration, insomnia, depression [23]. Chasco et al. [24], based on in-depth interviews with 15 patients from Iowa University (USA) hospitals and clinics, found out that fatigue and cognitive impairment (brain fog) were the most common symptoms (32% and 22%, respectively) [24]. Additionally, the presence of brain fog and its effects on the everyday quality of life (QoL) may have different impact on males and females. In a study conducted by Chatys-Bogacka et al. [25] on adult non-hospitalized COVID-19 patients, out of 303 participants women reported 4 weeks after COVID-19 more problems with thoughts communication and reading, writing, counting.

Patients who underwent the COVID-19 infection often suffer from long-term symptoms which affect work efficacy even after 12 months after the onset of the disease.

Walker et al. [26] performed the research related to the examination of COVID-19 impact on the *Work and*

Social Adjustment Scale (WSAS). The examined population included 3754 patients from 31 clinics in the UK. The majority of the examined group was female within the working age range. Five components were used within the score: close relationships, social leisure activities, private leisure activities, home management and ability to work. The score range varied 0–40. A score value >20 meaning severe or worse impairment on performing everyday routine was diagnosed in 53% of participants. The main reason for the increased WSAS score was fatigue followed by depression and cognitive impairment. Additionally, approximately half of the participants said that they had lost ≥ 1 day of work in the last month with one-fifth (20%) stating they had been unable to work. These results clearly show the prolonged impact of LC on work and everyday routine [26].

The occurrence of suicide attempts during the COVID-19 pandemic vary

Suicide attempts have been the subject of research in which the prevalence before and after the COVID-19 pandemic has been compared. In the study by Stańdo et al. [27] participants were divided into 3 groups based on their age range (category I: 13–24 years; category II: 25–65 years; category III: >65 years). The study was conducted in the 2 time periods: 2019–2020 and 2021. A slight increase in the rate of suicide attempts per 100 000 inhabitants in women was observed in 2019 and 2020, however only in the category II (15.94 and 17.52, respectively) and III (8.2 and 8.78, respectively). On the other hand, in the category I, a slight decrease was observed (47.07 and 41.94, respectively). In the second period (2021) a significant increase in suicide attempts in the I category was observed as well comparing to the first period (41.94 in 2020 and 74.02 in 2021). In the categories II and III, the increase was less pronounced (category II: 17.52 in 2020 and 20.24 in 2021; category III: 8.78 in 2020 and 9.56 in 2021). In general, the increase in sui-

icide attempts was visible in the category I mainly among women [27]. The results presented above are in line with the findings by Nomura et al. [28], stating that women are at a greater risk of undergoing a suicide attempt than men and this problem is gradually increasing (by 20–30% when comparing it to pre-pandemic time) [28].

It was also observed that the risk of a suicide attempt decreased [27]. In Korea, suicide death rate per 100 000 population was also higher in women than in men.

The number of suicide deaths per year in Korea increased in 2017 (8922 in men, 3541 in women) compared to 2020 (9093 in men, 4102 in women). The increase was especially noticeable in younger women (≤ 34 years) [29]. On the other hand, no consistent conclusion confirming the increase in suicide numbers could be drawn after analyzing the data from 33 countries during the first 9–15 months of the COVID-19 pandemic [30]. According to Goto et al. [31], the initial decrease in suicide rate in the initial period of the pandemic, followed subsequently by the increase, can be attributed to the “honeymoon effect.” In the beginning, people felt altruism and concern which was the initial reaction to global threat. Unfortunately, later these feelings were substituted by the surrounding reality [31]. In a study done by Yan et al. [32], 37 studies with 55 data samples from clinical and non-clinical cases (25 clinical and 30 non-clinical settings) were analyzed concerning suicide attempts. A random-effects model was used to pool the ratio of peri- and pre-pandemic prevalence of suicidal ideation and attempt (prevalence ratio – PR) and rate of death by suicide (rate ratio – RR). The prevalence of suicidal ideation increased significantly among non-clinical and clinical studies, however pooled estimates differed by population and study design. Suicide attempts were more prevalent during the pandemic among both non-clinical and clinical studies [32]. Furthermore, according to Jeronimo et al. [33], the incidence of suicide

attempts, especially among young people (≤ 18 years) has increased in Barcelona when comparing the period 2018–2019 and the pandemic period until June 2021. Based on the data described above, one can assume that the problem concerning suicide attempts and COVID-19 pandemic is a complex issue and warrants further attention.

The prevalence of mental disorders during COVID-19 pandemic

The COVID-19 pandemic has profoundly changed the way depression is viewed as far as its impact on the general population is perceived. According to the data, published by Dziejczak et al. [34], elderly people in Poland aged ≥ 60 years are more prone to developing high levels of depression, anxiety, and loneliness, especially when faced with a global threat like the COVID-19 pandemic. In the study involving 221 elderly people (≥ 60 years) the prevalence of loneliness, depression, and anxiety was investigated. A borderline state of depression was diagnosed in 14.18% of cases, depressive symptoms in 19.15%. Level of loneliness was also quite high (58.83% of cases with moderate and moderately high sense of loneliness). Level of loneliness was positively correlated with not being in a relationship due to spouse death (widow/widower: 42.76%) or being single (40.72%). Moreover, it was stated that women were in general more affected than men [34]. However, not only the elderly have been affected by the COVID-19 pandemic.

The results, obtained in the cross-sectional study by Kobos et al. [35] conducted on 890 Polish residents in October 2020, revealed a positive correlation between younger age and anxiety, depression, and level of loneliness. The prevalence of depression and anxiety were 32% and 27%, respectively [35]. A study, conducted by Hamer and Baran [36] realized in 2020, revealed the increased incidence of loneliness among younger age groups (18–24 years old), which was consistent through-

out the whole course of the study. In general, the level of loneliness increased since the beginning of the pandemic [36]. Another study, based on questionnaire sent in April 2020 using social media to students from 87 universities in Poland. A final number of participants was comprised of 2172 students mostly from medical faculties (60.5%). Anxiety was found in 27.3% of cases and very severe depression in 43.4%. Both depression and anxiety were more frequently present in female than male students. For medical students the score for anxiety was the lowest. In case of depression it was stated that the prevalence did not differ significantly between examined groups of students [37].

It was found that in the UK during the lockdown period, the prevalence rate of loneliness was estimated at 27% while in Canada, the state of loneliness was reported by 8.4% of citizens. The highest incidence rate of both depression and anxiety was found in Asia (35.3% and 32.9%, respectively) [35,38,39]. In a study published by Olszewska-Czyz et al. [40] it was stated that the number of dentists expressing anxiety was significantly higher in Turkey than in Poland (95.5% and 51%, respectively). It was explained by the fact that higher positive coronavirus test rate found among dentists in Poland than in Turkey (91.5% and 24.1%, respectively).

In a study conducted by Hufner et al. [41] via questionnaire method in Italy and Austria a level of anxiety and depression was determined 79 days after the onset of infection – 19.3% of participants from Italy and 12.4% from Austria had anxiety problems, 23.2% from Italy and 17.3% from Austria – depression symptoms.

Before the COVID-19 infection anxiety and depression problems were present at much lower levels (6% of participants from Italy and 4.6% from Austria) [41].

Coronavirus disease 2019 infection might have also a negative effect on the general QoL. In a single-centre longitudinal study done by Herrmann et al. [42] in March–December 2020 in Germany at the University of

Wurzburg the health related QoL (HRQoL) was assessed in non-intensive care unit (non-ICU) and intensive care unit (ICU) patients. The evaluation was based on the data gathered from telephone interviews at 3 months and 12 months after discharge from the hospital. The *European Quality of Life 5-Dimensions 5-Level* (EQ-5D-5L) index was applied, including usual activities, mobility, self-care, anxiety, depression, and pain/discomfort. Out of 85 participants only 62 appeared at a 3-month interview and 68 at a 12-month interview. Significant differences between non-ICU and ICU patients were found involving the EQ-5D-5L index assessment after 12 months post COVID-19 infection. In general ICU patients suffered from LC symptoms for a longer period than non-ICU patients. For example, 33.3% of ICU patients reported no mobility problems with slight/moderate problems being stated in 40% of cases and severe in 23% of cases [42].

A cross-sectional cohort study was performed by Duwel et al. [43] at the primary health facility care in Aruba (an island in the Caribbean Sea). The participants included 222 patients. Interviews were conducted at 3 months, 6 months, 9 months and 18 months after having been discharged from the hospital. The frequency of reported LC symptoms increased from 3 months to 12 months and it was reflected in the lower self-reported health score (85.75 and 76.85, respectively) [43]. In Slovakia a significant difference in patient QoL was found between patients who suffered from LC symptoms and healthy control group (total score 331.9 and 578, respectively) in a study conducted by Liška et al. [44] in February–May 2022. The study was based on a structured QoL questionnaire *36-Item Short Form Health Survey* (SF-36). The scores may vary 0–100 for each domain. The higher the score the better the physical status of the individual, involving 8 health concept domains: physical role, social functioning, emotional role, general health, mental health, physical functioning, vitality, and bodily pain [44].

Both the SF-36 questionnaire method and the EQ-5D-5L index were applied assessing the impact of COVID-19 in a study by Malešević et al. [45]. The observational research was conducted among 112 patients. The visible decrease in EQ-5D-5L scores involved in the pain/discomfort domain; anxiety and the necessity to perform usual activities was observed. In the same time the lower SF-36 scores included the physical health domain. Both scores were significantly associated with females (EQ-5D-5L) scores and SF-36 scores for physical role limitation domain, bodily pain domain, physical functioning domain [45].

The impact of the COVID-19 pandemic on social interactions as a whole in the general population was a topic of several studies. In general, the lockdown in the education field affected >60 million teachers worldwide and 87% of students. The situation with a decrease in mobility and household confinement created a risk of physical isolation and contributed to the increase in anxiety and depression. In a study, conducted by Filho et al. [46] among students and academic staff, 711 questionnaires from students and academic staff from 41 countries, mostly European, were obtained. The online survey took place between April 14 – May 4, 2020. In the majority respondents observed a connection between the lockdown and lack of work/study continuity (90%). As many as 72% stated that lack of personal contact between colleagues and staff which was perceived as a challenge. At the same time 57% of respondents saw obligatory social isolation as a problem involving lack of motivation [46].

Szczeпаńska et al. [47] investigated the possible correlation between the COVID-19 pandemic and the quality of student's life. In April 2020, 132 students (77% female and 23% male participants) with an age range 19–26 years were interviewed. Approximately 14% of respondents described their mood as being poor/very bad with only 2% of participants stating the positive influence of the emergency state on their

general daily routine (vs. 72% expressing the contrary opinion). In 90% of cases lack of social interactions in public spaces was perceived as having a major negative impact on a person concerned (54% of respondents mentioned lack of contact with friends and 38% with family members). Furthermore, according to the 42% of the interviewed students remote modes of communication cannot effectively substitute for real, direct, personal social contact (with 51% being of the opposite opinion) [47].

DISCUSSION

Overall 35 studies were selected and analyzed in the review on topics including among others LC (14 studies), suicide attempts (7 studies), mental disorders (depression, anxiety) (14 studies) (Tables 1–3). The main issues raised in the articles were:

- higher risk of LC symptoms in women,
- patients who underwent more severe COVID-19 infection with fatigue and brain fog being listed as frequently encountered patient's complaints.

Furthermore, LC is perceived as a disease burden, having a negative impact on the HRQoL, work and the daily routine. The matter is of importance as the neuropsychiatric symptoms (anxiety, depression) may persist up to 2 years after an acute infection. Additionally an increased rate of suicide attempts during the first period of COVID-19 pandemic (July–September 2020) was reported when compared, with women being at a higher risk of undergoing a suicide attempt by 20–30% when comparing it to pre-pandemic time. Nevertheless the topic regarding the rate of suicide attempts requires further research as the results vary dependent on different countries.

In general, as far as the mental disorders are concerned, the level of loneliness among younger age groups (18–24 years old) increased since the beginning of the pandemic (May–June 2020 – 1.81 vs. March 2020 – 1.70)

The level of anxiety and depression was also positively correlated with younger age groups. Mental disorders involving depression and anxiety were reported among 890 Polish residents in 32% and 27%, respectively.

CONCLUSIONS

The problem of LC is an important and complex issue that raises further research needs, in particular with regard to health consequences in the world population. The LC syndrome may be present in 43% of people who underwent the COVID-19 infection and in >60% of patients who suffered from the severe form of the infection [48]. Furthermore, according to the IHME and the University of Washington in Seattle, USA, approx. 36 million people across the WHO European Region might have suffered from LC during the first 3 years of the COVID-19 pandemic [49]. The presence of chronic diseases like diabetes or hypertension may increase the severity of LC symptoms. Education methods are needed in order to increase awareness and promote health working habits (physical activity, well-organized break). Therefore more detailed research is needed as far as the long-term health consequences of LC symptoms are concerned with regard to the overall world population.

No consistent conclusion confirming the increase in suicide numbers could be drawn after analyzing the data from 33 countries during the first 9–15 months of the COVID-19 pandemic. This indicates the need of a thorough research combining the data not only concerning the initial increase in the rate of suicide attempts during the first lockdown period and the decrease during the time when the restrictions were slowly lifted but also after the pandemic has ended. Mental disorders involving anxiety, depression, loneliness have been described as frequent consequences of the COVID-19 pandemic, especially in younger age groups and in women.

Table 1. Data from selected 14 studies on long COVID, published in 2020–2023

Reference	Type	Material and methods	Results	Conclusions
Chudzick et al. [10]	prospective/non-interventional study	701 consecutive patients/ambulatory primary medical care in 2020–2022 out of which 488 completed a 3-month follow up	488 patients (63% women, 37% men), age M = 45.74 years; LC group (218 patients, age M = 46.03 years), non-LC group (270 patients; age M = 44.30 years)	LC group the most frequent symptoms: weakness (73%), impaired exercise tolerance (>65%), palpitations (54%), concentration and memory disturbances (>53%), chest pain (44%); the high-risk factors for LC development in healthy patients: severe course of COVID-19 infection, arthralgia and high BMI (≥ 23.74 kg/m ²)
Premraj et al. [11]	systematic review/meta-analysis	systematic search of databases (Google Scholar, Scopus, Web of Science, EMBASE, PubMed) for articles published in January 1, 2020 – August 1, 2021; total database results: 1458 articles	18 students included in the review (total number of included patients: 10 530)	most frequent neurological post-COVID-19 symptoms: fatigue (37%), brain fog (32%), memory issues (28%), attention disorders (22%); most frequent neuropsychiatric conditions: sleep disturbances (31%), anxiety (23%), depression (only 17%)
Hanson et al. [12]	observational analysis	Bayesian meta-regression; pooling 54 studies and 2 medical record databases; data: 1.2 million individuals (22 countries) in 2020–2021	both hospitalized and non-hospitalized individuals (44 studies: 42 891 non-hospitalized and 10 501 hospitalized); 2 medical record databases (846 046 non-hospitalized, 250 928 hospitalized individuals); 10 cohort studies (1906 non-hospitalized and 10 526 hospitalized); mean age range of individuals: 4–66 years; males: 26–88%	risk of LC lower in non-hospitalized; younger (<20 years) cases when compared to individuals >20 years (2.7% for both sexes and 4.8% of men and 9.9% of women, respectively); the difference between the younger and older individuals more visible in females (7.2% in females, 2% in males); LC cluster symptoms more frequently diagnosed in patients who were in general hospital wards (27.5%) or ICU (43.1% of cases) when compared to non-hospitalized cases (5.7%); the presence of LC cluster symptoms was more frequently present in females at 3 months after the onset of infection than in males and the older age group (≥ 20 years: 10.6% vs. 5.4% of cases); it is worth noting though that the frequency decreased at 12 months after the onset of infection (1.7% in the female group, 0.8% in the male group)

<p>Antonioniou et al. [15]</p>	<p>evidence based approach</p>	<p>task force (12 members), experts in pulmonary physiology, medicine, radiology; outcomes assessment of LC; systematic literature search: Medline and Cochrane CENTRAL Task Force convened on December 23, 2020; systematic search conducted until March 26, 2021</p>	<p>50–65% cases of fatigue among patients and 20–40% cases involving after COVID-19 infection anxiety or depression</p>	<p>severity of the disease in the beginning not associated with the persistence of symptoms</p>
<p>Sykes et al. [17]</p>	<p>follow-up</p>	<p>standardized data collection technique; virtual outpatient clinic appointments</p>	<p>387 patients discharged with COVID-19 diagnosis (out of whom 298 selected for follow up – only 134 attended follow up appointments); age Me = 58 years; 65.7% male</p>	<p>symptoms of LC: myalgia ($p = 0.022$), anxiety ($p = 0.001$) and fatigue ($p = 0.004$) more frequently diagnosed in women; the presence of chronic diseases like diabetes or hypertension may increase the severity of LC symptoms</p>
<p>Marciniak et al. [18]</p>	<p>narrative review</p>	<p>database articles search: PubMed (May 31, 2021); exclusion criteria: average age of participants >60 years; no data on methodology; observation period time <30 days</p>	<p>incidence rate of chronic cough (32.2–48.7%) in patients with diabetes and hypertension; chronic fatigue observed in 67.4–76.8% in patients with diabetes and hypertension</p>	<p>the time period involving >1 month after having been discharged from the hospital, patients with diabetes and hypertension suffered a higher incidence rate of symptoms involving cough and chronic fatigue</p>
<p>Janc et al. [19]</p>	<p>anonymous online questionnaire (Google Forms)</p>	<p>online questionnaire (Google Forms); 1365 participants (914 students and 451 employees) from 3 universities: Medical University of Lodz, University of Lodz and Lodz University of Technology, Łódź, Poland; 2 time periods taken into account: before COVID-19 pandemic and October 2020 – June 2021; information gathered: lifestyle, headaches, ergonomic of computer workstation, severity and incidence of musculoskeletal symptoms; VAS (0 pts – lack of symptoms; 10 pts – max severity of symptoms).</p>	<p>the complaints involving musculoskeletal problems increased in all 3 groups (students: approx. 2.8–3.5 pts, teaching staff: from 3.2 pts to 4.1 pts, administration staff: from 3.1 pts to 4 pts)</p>	<p>education methods needed in order to increase awareness and promote health working habits (physical activity, well organized break)</p>
<p>Chi'en et al. [20]</p>	<p>observational, exploratory single-center longitudinal cohort study</p>	<p>patients hospitalized for COVID-19 (November 2020 – March 2022), University of Washington, USA; 255 participants (89 included in the study), 61% male, 39% female; age M = 53.9 years (24% being ≥65 years)</p>	<p>persistent neurocognitive symptoms visible in 60% of participants after 6 months of having been discharged from the hospital; most frequently encountered symptoms included: fatigue (53%) and brain fog (34%)</p>	<p>sociodemographic factors might be perceived as risk factors as far as development of neuro-PASC is concerned</p>

Table 1. Data from selected 14 studies on long COVID, published in 2020–2023 – cont.

Reference	Type	Material and methods	Results	Conclusions
Cristillo et al. [21]	longitudinal study	patients hospitalized at the COVID-19 in Territorial Social Health Authority of the Spedali Civili of Brescia, Brescia, Italy, in March 1 – May 31 (out of 246 patients, 132 patients evaluated a 1 year after discharge); full clinical, neurological, psychological examination: FSS, MoCA, SDS, IES-R	25 patients (22%) had cognitive symptoms (brain fog)	depression evaluated as the strongest predictor for persistent brain fog
Tsuzuki et al. [22]	cross sectional retrospective survey	self-report questionnaire sent in April 2021 (2 reminders – 2 weeks and 1 month later), 457 participants recovered from acute phase of COVID-19 (108 with at least 1 ongoing prolonged symptom)	approx. 44% of former COVID-19 patients (201 out of 457) suffered from at least 1 symptom 4 weeks after the infection began; the most frequently present symptom was fatigue (58 out of 457 participants, 12.7%), second one – alopecia (55 out of 457, 12%)	LC symptoms due to their duration are a disease burden and affect the HRQoL
Kim et al. [23]	online surveys (prospective)	first Survey (February 13 – March 13, 2020), second survey (May 26 – June 1, 2021), third survey (May 26 – June 2, 2022); patients diagnosed with COVID-19 (age 16–70 years); 132 patients included in the final analysis	fatigue was the most frequently encountered LC syndrome 6, 12 and 24 months after hospital discharge in South Korea (out of 71.2% participants 34.8% involved fatigue, 30.3% amnesia, 24.2% difficulties concerning concentration, 20.5% insomnia, 19.% depression)	despite improvement of LC symptoms with time, neuropsychiatric symptoms may persist ≤ 2 years after an acute infection
Chasco et al. [24]	qualitative research	semi-structured qualitative interviews; 15 adult patients of the Iowa University Hospitals, USA, with persistent health concerns >3 months after COVID-19 infection; age M = 49.3 years; female 66.7%, male 33.3%	the most common symptoms of LC were brain fog and fatigue	highlighting negative impact of brain fog and fatigue on daily routine (work, driving)
Chatys-Bogacka et al. [25]	retrospective study	neuropsychological questionnaire (8 questions, brain fog symptoms) during 4 time periods: before COVID-19, 0–4 weeks post infection, 4–12 weeks post infection, > 12 weeks post infection; 303 patients; 79.53% women, 47.52% medical personnel	women reported more problems with thoughts communication and reading, writing, counting	different course of COVID-19 brain fog between non-hospitalized men and women

Walker et al. [26] cross-sectional observational study 3754 patients, age M = 47.7 years; from 31 clinics in the UK; the majority of the examined group was female (87%, N = 2414) and was within the working age range (18–65 years); the WSAS score range: 0–40

53% of participants the WSAS score ≥ 20 ; the main reason for the increased WSAS score was fatigue followed by depression and cognitive impairment; additionally, approximately half of the participants (51%) said that they had lost ≥ 1 day of work in the last month with one-fifth (20%) stating that they had been unable to work

prolonged impact of LC on work and daily routine

ICU – intensive care unit; LC – long COVID; neuro-PASC – neurological post-acute sequelae of SARS-CoV-2 infection. FSS – Fatigue Severity Scale; MoCA – Montreal Cognitive Assessment; IES-R – Impact of Event Scale – Revised; SDS – Zung Self-Rating Depression Scale; VAS – Visual Analog Scale; WSAS – Work And Social Adjustment Scale.

Table 2. Data gathered from selected 7 studies on suicide/suicide attempts; published between 2021–2023

Reference	Type	Material and methods	Results	Conclusions
Stańdo et al. [27]	statistical analysis of data	government and police data on suicide and suicide attempts in Poland per 100 000 people in 2019–2021; 3 age categories: I: 13–24 years, II: 25–64 years, III: ≥ 65 years	during the first period (2019–2020) a slight increase in the number of suicide attempts per 100 000 inhabitants in women was observed, however only in the II (15.94 in 2019 and 17.52 in 2020) and III age categories (8.2 in 2019 and 8.78 in 2020). In the I category a slight decrease was observed (47.07 in 2019 and 41.94 in 2020); in the second period (2020–2021), a significant increase in suicide attempts in the I category was observed (41.94 in 2020 and 74.02 in 2021); in the II and III categories, the increase was present as well however it was less pronounced (II category: 17.52 in 2020 and 20.24 in 2021; III category: 8.78 in 2020 and 9.56 in 2021)	in general, the increase in suicide attempts is visible in the I category among women; this increase is also present among men in the I category but its level is noticeably smaller than in women (second period: men 48.26 in 2020 and 57.38 in 2021 vs. women 41.94 in 2020 and 74.02 in 2021); the risk of a suicide attempt decreases with age (out of all people who had a suicide attempt, 50% were adolescents, aged 14–15 years)
Nomura et al. [28]	retrospective study	monthly mortality data analysis (source: National Police Agency, Japan); time period: December 2010 – September 2020	women: excess deaths N = 110.00–160.75 (22.08–32.26%) in July 2020, N = 96.00–163.56 (19.34–32.95%) in August 2020, N = 95.00–161.00 (19.83–33.61%) in September 2020; men N = 16.00–147.70 in January 2020, N = 44.00–172.31 in April 2020	women: a greater risk of undergoing a suicide attempt than men, problem is gradually increasing (by 20–30% when comparing it to pre-pandemic time)

Table 2. Data gathered from selected 7 studies on suicide/suicide attempts; published between 2021–2023 – cont.

Reference	Type	Material and methods	Results	Conclusions
Ryu et al. [29]	retrospective study	cause of death statistics data analysis (Statistics Korea Microdata Integrated Service); population: 283 633 suicide victims in 1997–2020; 4 age groups: ≤34 years, 35–49 years, 50–64 years, ≥65 years	suicide death increase rate per 100 000 population more frequently observed in women than in men; the increase in this trend is visible in the number of suicide deaths per year noted in Korea in 2017 (men: N = 8922, women: N = 3541) when compared to 2020 (men: N = 9093, women: N = 4102); the increase in suicide deaths per year is especially noticeable in younger women (≤34 years)	an increase of suicide numbers among females and younger people during the pandemic was observed
Pirkis et al. [30]	interrupted time series analysis	data gathered from 33 countries (24 high income, 6 upper-middle income, 3 lower middle income); Guidelines for Accurate and Transparent Health Estimates Reporting applied first data request on June 22, 2021 (finished); last data request: October 31, 2021	variable results, e.g., total numbers of suicides in observation period addressed in the study in Poland (N = 28 954), Japan (N = 111 012), South Korea (N = 73 833), Ukraine (N = 2282), England and Wales N = 25 871	no consistent conclusion confirming the increase in suicide numbers could be drawn after analyzing the data from 33 countries during the first 9–15 months of the COVID-19 pandemic
Goto et al. [31]	retrospective study	population level data involving crude monthly suicide rates (2016–2021); reasons of suicide (2018–2020); young people 10–19 years; Japanese Ministry of Health; National Police Agency; Labour and Welfare Japan Event study design	increase in suicide rates August–November 2020 (1.86, 95% CI: 1.30–2.66); increase in May–August 2020 (0.099 cases/100 000 youth/month, 95% CI: 0.022–0.176); decrease trend in suicide rate in September–December 2020 (–0.086 cases/100 000 youth/month; 95% CI: –0.164–[–0.009])	the initial decrease in suicide rate in the initial period of the pandemic, followed subsequently by the increase can be attributed to the “honeymoon effect”
Yan et al. [32]	systematic review with meta-analysis	literature search in 13 databases: PubMed, Web of Science, EMBASE, CINAHL, Academic Search Premier, PsycINFO, PsycARTICLES, Psychology and Behavioral Sciences Collection, WHO COVID database; 37 studies with 55 data samples from clinical (N = 25) and non-clinical cases (N = 30) were analyzed concerning suicide attempts	an increase in the prevalence ratio of suicide attempts among non-clinical cases during the COVID-19 was observed (6.261 during the pandemic and 0.333 pre-pandemic); an increase in the prevalence rate of suicide attempts during the pandemic among clinical cases was visible as well (1.32; prevalence ratio of studies varying between 0.71 and 2.379)	suicide attempt more frequently observed compared with pre-pandemic time (especially among clinical patients and adult general population)

Jeronimo et al. [33]	observation and retrospective study	data analysis (gathered from the Suicide Risk Code Program) from Barcelona, Spain; time period: January 1, 2018 – June 30, 2021	3388 consultations for suicide attempt or suicide ideation in general (2018: 629 cases, 2019: 1003 cases, 2020: 1018 cases, January 2020 – June 2021: 738 cases); age: M = 37.9 years; 15.02% minors (underage), 84.98% adults; 32.91% men; 67.09% women	the incidence of suicide attempts, especially among young people (≤ 18 years) has increased in Barcelona when comparing the period 2018–2019 and the pandemic period until June 2021 (3388 consultations involving the 43.2% increase during the pandemic and 573.8% increase in May 2021)
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Table 3. Data gathered from selected 14 studies on mental disorders (anxiety, depression, loneliness), published in 2020–2023

Reference	Type	Material and methods	Results	Conclusions
Dziedzic et al. [34]	original paper	socio-demographic online questionnaire: HADS-M and R-UCLA <i>Loneliness Scale</i> ; applied time: October 6–12, 2020; Poland; population: 221 people, age ≥ 60 years; women 47.51%, men 52.49%	a borderline state of depression in 14.18% of cases, depressive symptoms in 19.15%, quite high level of loneliness (58.83% of cases with moderate and moderately high sense of loneliness); level of loneliness positively correlated with not being in a relationship due to spouse death (widow/widower: 42.76%) and being single (40.72%)	1 in 5 participants with both anxiety and loneliness symptoms (women, people living alone, unemployed, presence of chronic diseases, bad financial situation, lower subjective health rating)
Kobos et al. [35]	cross-sectional study	online questionnaire: R-UCLA <i>Loneliness Scale</i> , HADS-M; time: October 6–12, 2020; population: 890 Polish residents; two-stage random sampling method applied	a positive correlation between younger age and anxiety, depression, and level of loneliness; the disorders involving depression and anxiety were reported in 32% and 27%, respectively	COVID-19 pandemic has an influence on mental well-being of individuals
Hamer et al. [36]	report	CAWI, random probe; general Polish population; 4 stages (March 2020: 1098 participants, April 2020: 868 people, May 2020: 794 people, December 2020: 807 participants)	the increased incidence of loneliness among younger age groups (18–24 years old), which was consistent throughout the whole course of the study; in general, the level of loneliness increased since the beginning of the pandemic (1.70 in March as compared with 1.81 in May/June)	in general, the COVID-19 pandemic had a negative impact on the anxiety and loneliness level, especially in younger age group

Table 3. Data gathered from selected 14 studies on mental disorders (anxiety, depression, loneliness), published in 2020–2023 – cont.

Reference	Type	Material and methods	Results	Conclusions
Juchnowicz et al. [37]	cross-sectional study	online survey: DASS-21; time: April 2020; students from Polish universities; population: 2172 respondents (73% female, 27% male), age M = 22.1 years	anxiety was found in 27.3% of cases and very severe depression in 43.4%; both depression and anxiety were more frequently present in female than male students; as far as medical students are concerned, the score for anxiety was the lowest (M±SD 4.00 ± 8.00) when compared to, for instance, the score obtained for students of arts and humanities (M±SD 6.00 ± 9.63)	the level of depression did not differ significantly between various fields of study
Salari et al. [38]	systematic review, meta-analysis	systematic search of databases: PubMed, Science Direct, Google Scholar, Scopus, Embase, Web of Science; time: no lower time limit (until May 2020); focus: anxiety and stress prevalence in general population; initially 350 studies identified (only 17 included in the final evaluation)	stress prevalence: 29.6% (5 studies); anxiety prevalence: 31.9% (17 studies)	COVID-19 may affect mental health in different communities
Groatke et al. [39]	cross-sectional study	online survey; time: data collected in March 23 – April 24, 2020; population: UK adults in the COVID-19 Psychological Wellbeing Study (N = 1964), age: 18–87 years (M = 37 years), females: 70.4%	loneliness prevalence: 27%, risk factors: poor quality of sleep, being divorced or separated, younger age group, depression, greater difficulties involving emotion regulation	high rates of loneliness during initial phases of lock down; risk factors not specific to COVID-19 crisis
Oliszewska-Czyz et al. [40]	cross-sectional study	anonymous online questionnaire; 400 dentists (200 Polish, 200 Turkish); 2 stages: 1) comprised demographic data, 2) STAI	the number of dentists expressing anxiety significantly higher in Turkey than in Poland (95.5% and 51%, respectively); the positive coronavirus test result rate was significantly higher among dentists in Poland than in Turkey (91.5% and 24.1%, respectively)	lower anxiety level reported by Polish dentists but the anxiety levels in Polish dentists were more affected by the COVID-19 pandemic
Hufner et al. [41]	multi-center online survey study	time: study conducted in September 3, 2020 – July 11, 2021; 2 cohorts: 1) Tyrol/Austria (N = 1157), 2) South Tyrol/Italy (N = 893); adults ≥18 years; non-hospitalized COVID-19 convalescents	79 days after the onset of infection 19.3% of participants from Italy and 12.4% from Austria had anxiety problems with depression issues also being reported in 23.2% of cases (Italy) and 17.3% of cases (Austria); the anxiety and depression problems were also present before the COVID-19 infection but at lower levels (6% of participants from Italy and 4.6% from Austria)	bidirectional correlation between COVID-19 and mental health

Hermann et al. [42]	single-center longitudinal study	University Hospital of Würzburg screening (prospective, daily) of patients in March–December 2020, HRQoL assessed; the data gathered from telephone interviews (questionnaire-based) at 3 months and 12 months after discharge from the hospital	out of 189 patients who were to participate in the study only 85 (40 non-ICU, 45 ICU) were included due to the presence of the authorized consent; out of 85 participants only 62 (35 non-ICU, 27 ICU) appeared at a 3-month interview and 68 (38 non-ICU, 30 ICU) at a 12-month interview; significant differences between non-ICU and ICU patients were found involving the EQ-5D-5L index assessment after 12 months post COVID-19 infection ($p = 0.0511$ and $p = 0.0013$)	ICU patients suffered from LC symptoms for a longer period than non-ICU patients; differences concerned mobility problems after 12 months (only 33.3% of ICU patients reported no mobility problems with slight/moderate problems being stated in 40% of cases and severe in 23% of cases)
Duwel et al. [43]	cross-sectional cohort study	Primary Health Care Facility of Aruba; 20 question survey; level of dyspnea measurement (mMRC-scale); QoL measurement (EQ-5D-5L with EuroQoL VAS); mental well being (WHO-5); population: 222 patients hospitalized in March–July 2021; interviews conducted at 3, 6, 9 and 18 months after having been discharged from the hospital	the frequency of reported long COVID symptoms increased from 3 months to 12 months interval which is visible in the health score change (85.75 and 76.85, respectively)	females more likely to suffer from dyspnea and fatigue after COVID-19 infection
Liška et al. [44]	prospective cross-sectional study	anonymous online survey; SF-36 questionnaire; time: study conducted in February–May 2022; control group: physiotherapy/physical education students ($N = 338$) (age: $M = 24.1$ years; females: 65.1%), examined group: LC patients ($N = 469$) (age: $M = 41.3$ years, females: 83.7%)	physical function: patients with LC – $M \pm SD$ 66.2 ± 25.4 ; students (control) – $M \pm SD$ 94.9 ± 9.4 ; patient QoL – patients with LC score: $M = 331.9$; students (control): $M = 578$	lower QoL and physical function in patients with LC
Malešević et al. [45]	observational research	SF-36 questionnaire method and the EQ-5D-5L index; time: February–August 2021; population: 112 patients (females: $N = 86$, 76.8%), age: $M = 43$ years	the visible decrease in EQ-5D-5L scores involved in the pain/discomfort domain; anxiety and the necessity to perform usual activities (Me score: 62.9); in turn, the lower SF-36 scores included the physical health domain; both scores were significantly associated with females (EQ-5D-5L scores $p < 0.001$, SF-36 scores for physical role limitation domain: $p = 0.007$, bodily pain domain: $p = 0.048$, physical functioning domain: $p = 0.046$)	the prolonged symptoms of COVID-19 infection affect the QoL and are considered as factors contributing to the overall burden of disease

Table 3. Data gathered from selected 14 studies on mental disorders (anxiety, depression, loneliness), published in 2020–2023 – cont.

Reference	Type	Material and methods	Results	Conclusions
Leal Filho et al. [46]	cross-sectional study	online survey (non-probability sampling), convenience sampling, snow-ball sampling; 711 questionnaires from 41 countries (472 from students and 238 from the academic staff)	connection between the lockdown and lack of work/study continuity onsite (90%), lack of personal contact between colleagues and staff perceived as a challenge (72%), the negative effect of the COVID-19 pandemic on studies and work (70%), obligatory social isolation: a problem involving lack of motivation (57%)	majority of students stopped working immediately after the lockdown, academic staff continued to work; academic staff had greater satisfaction with working facilities and provisions when compared to students
Szczeptańska et al. [47]	original study	diagnostics survey with questionnaire (25 survey questions, 4 demographic questions); quantitative and qualitative data collection; time: April 2020; population: 132 university students, age: 19–26 years (females: 77%, males: 23%)	14% of respondents described their mood as being poor/very bad with only 2% of participants stating the positive influence of the emergency state on their general daily routine (vs. 7.2% expressing the contrary opinion); what is crucial, in 90% of cases lack of social interactions in public spaces was perceived as having a major negative impact on a person concerned (54% of respondents mentioned lack of contact with friends and 38% with family members); furthermore, according to the 42% of the interviewed students remote modes of communication cannot effectively substitute for real, direct, personal social contact (with 51% being of the opposite opinion)	strong correlation level between student's activity levels and lockdown measures undertaken during the pandemic

CAWI – computer assisted web interview; HRQoL – health related quality of life; LC – long COVID; QoL – quality of life.
 DASS-21 – Depression, Anxiety, Stress Scale-21; EQ-5D-5L – European Quality of Life 5 Dimensions 5 Level Index; HADS-M – Hospital Anxiety and Depression Scale – Modified Version;
 R-UCLA Loneliness Scale – Revised University of California Los Angeles Loneliness Scale; SF-36 – 36-Item Short Form Health Survey; STAI – State-Trait Anxiety Inventory; VAS – visual analogue scale;
 WHO-5 – World Health Organization – Five Well-Being Index.

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