

Psychiatric aspect of persistent somatic symptoms after COVID-19: A systematic review

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Abstract

Persistent somatic symptoms (PSS) represent a prevalent phenomenon frequently co-occurring with mental disorders and a higher incidence of depression and anxiety. There is no clear etiopathophysiology of PSS, which makes the diagnosis process difficult. The prevalence of PSS has been observed to rise in response to the COVID-19 pandemic, with 72.5% of post-COVID-19 patients experiencing persistent symptoms. This condition is predicted to become a public health problem in the future, and researchers need to conduct research on the relationship between the post-COVID-19 condition and PSS to provide comprehensive treatment suggestions. In this study, we tried to investigate and summarize various studies related to PSS after COVID-19, which are discussed from a psychiatric perspective. Three databases, including PubMed, ScienceDirect, and Google Scholar, were used to conduct a systematic review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria. The current search was performed from July to August 2023 by combining the keywords. 21 articles were analyzed descriptively to help describe and summarize the data constructively. The results showed that several studies investigated the prevalence of this case, and all studies that included prevalence information showed that majority of those who recovered from COVID-19 have reported experiencing PSS. Thus, persistent somatic symptoms after COVID-19 are associated with psychiatric problems; this condition requires a multidisciplinary approach to provide appropriate management.

Keywords: Somatic Symptoms; Psychiatry; COVID-19; Mental Disorders

1. Introduction

Persistent somatic symptoms (PSS) become a common condition in 25–50% of cases, which are held by general practitioners and specialists in clinical settings [1,2]. Even though PSS cases were easy to find, they still do not have general etiopathophysiology as a single hypothesis [1,3]. When PSS does not reveal specific signs and symptoms, it will give clinicians some difficulty in bringing a specific diagnosis. This will cause the patient with PSS to experience disruptions in their daily lives in physical, mental, and material ways, which can reduce their quality of life [1,2,4].

PSS brings some physical symptoms that last at least several weeks. The symptoms can arise in various organs, which are called “medically unexplained” [1,2]. There is no evidence about organic or biomedical causes of patients' complaints, making it possible enough to get some suspicion in the biopsychosocial aspect as an important role, which takes the psychiatry aspect as the main topic of discussion. PSS is often accompanied by mental disorders and is widely recognized that there exists a strong correlation between the aforementioned factor and an increased prevalence of depressive and anxious symptoms. [2,5,6].

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During and after the COVID-19 pandemic, PSS incidence increased. This phenomenon was supported by various studies about acute infectious diseases, which often trigger PSS, but it still remains homework to understand their pathophysiology, which is contributed by environment, psychology, and biology aspects [7–9]. A significant proportion, specifically 72.5%, of individuals who have recovered from COVID-19 continue to experience a single chronic somatic symptom. This has been predicted as a public health problem in the future. Clinicians and researchers need to conduct some research about the relationship between post-COVID-19 and this PSS condition to make some suggestions for comprehensive treatment in health services [7,10]. In this research, the authors will reveal a systematic review of the psychiatric aspects of PSS after COVID-19.

2. Material and Methods

2.1. Protocol and search strategy

A systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) standard, which can be found at <http://www.prismastatement.org>. The identification of pertinent studies was conducted through a comprehensive search of reputable databases, namely PubMed (<http://www.ncbi.nlm.nih.gov/pubmed>), ScienceDirect (<https://www.sciencedirect.com>), and Google Scholar (<http://scholar.google.com>). The present investigation was conducted between July and August 2023, utilizing a combination of the terms "persistent somatic symptoms," "COVID-19," and "psychiatry." The identification of these keywords was accomplished by the amalgamation of synonymous terms and the utilization of expanded searching techniques to enhance the understanding of the existing material.

2.2. Inclusion and Exclusion Criteria

This review exclusively encompasses papers that have been authored and published in the English language, adhering to specific inclusion criteria such as: (1) articles that were selected as observational studies (cohort, case control, or cross-sectional), article reviews or case studies; (2) articles published in 2019–2023; (3) confirmed PSS patients with COVID-19; and (4) articles reporting about PSS that persist or appear after the initial infection with COVID-19. Exclusion criteria for the selection were: (1) not an open-access article; (2) PSS patients were confirmed as children and adolescents; and (3) PSS patients were never confirmed as part of COVID-19.

2.3. Data Collection Process

After collecting some articles that related to the main topic, we chose the main articles by filtering their specifications based on inclusion and exclusion criteria. Then, we filter it with the CRAAP (currency, relevance, authority, accuracy, and purposes) test. For the selection, articles will be followed by information extracted from each article, such as the author(s) (year, country), research topics, type of study, sample, data collection and analysis method, and results. Divergency of data from around the world will make some differentiation; therefore, this article will focus on an overview, explanation, and description of the psychiatric aspect of PSS.

3. Results

A literature review was conducted to investigate somatic symptoms that endure following infection with COVID-19 from a psychiatric perspective. Literature selection was carried out through three databases, including PubMed, ScienceDirect, and Google Scholar, and processed using CRAAP assessment criteria. Finally, the articles obtained were reviewed according to the PRISMA flow. In the first stage, 72 articles were found, which, after deduplication, were reduced to 66 articles. By using predetermined inclusion and exclusion criteria and conducting feasibility tests using CRAAP (Currency, Relevance, Authority, Accuracy, and Purpose) assessment, 29 articles were excluded. So that there are a total of 21 articles to be included in the data synthesis (Figure 1). These articles were summarized in Table 1.

Table 1 Summary of Key Study Characteristics

Author(s) (year, country) [reference]	Research topics	Type of study	Sample	Data collection and analysis method	Results
[5] Schneider <i>et al.</i> , 2023 (Germany)	To conduct a survey on a population regarding PSS after COVID-19 and investigate its association with daily life impairment (DLI).	Cross-sectional survey	A total of 2828 adult respondents who have had a positive result on the COVID-19 PCR test.	A list of typical post-COVID-19 symptoms from the German COVID-19 guideline and psychometric questionnaires were utilized. Logistic regression and network analysis were utilized to examine correlations among DLI, symptoms, and scores.	A total of 52.5% of the subjects exhibited enduring symptoms lasting beyond a three-month period subsequent to the onset of infection. DLI was primarily associated with fatigue; however, other factors such as excessive preoccupation with a physical symptom, dyspnea, impaired concentration, and depression also played a role.
[11] Nguyen <i>et al.</i> , 2022 (France)	To discuss the prevalence of PSS in COVID-19 survivors and their risk factors.	Systematic Review	A compilation of 37 studies was incorporated, all of which mentioned the presence of somatic symptoms at least 4 weeks following a confirmed positive result on a COVID-19 PCR test.	The authors conducted systematic observations using the PRISMA guidelines. They utilized the PubMed and Google Scholar databases to conduct a comprehensive search for articles that investigated the prevalence of PSS following infection with the COVID-19 virus.	The most common symptoms that persisted were fatigue (16–64%), dyspnea (15–61%), cough (2–59%), arthralgia (8–55%), and thoracic discomfort (5–62%). Comorbidities, female gender, older age, and having severe symptoms during the acute phase of the illness were the greatest risk factors for the symptoms to continue.
[12] Gasnier <i>et al.</i> , 2022 (France)	To investigate the association between long COVID, psychiatric symptoms and psychiatric disorders.	Cross-sectional	A number of 177 ICU survivors in Bicêtre Hospital who reported somatic symptoms 4 months following	The following 8 persistent complaints were looked into: anosmia, fatigue, headache, respiratory and cognitive issues, muscle weakness, paraesthesia, pain. Considerations included the quantity of complaints and whether or not each COVID-19 complaint	The quantity of long COVID-19 complaints was linked to psychological problems. Patients with new-onset mental problems, psychiatric disorders, and patients at severe risk of suicide had more long-term COVID complaints than patients without any mental disorders. Cognitive complaints were linked to a

			hospitalization for COVID-19.	was present. Questionnaires were used to evaluate self-reported mental issues.	higher likelihood of psychiatric illness, and respiratory issues were linked to a higher risk of both new-onset and mental disorders.
[13] Kaulamo <i>et al.</i> , 2022 (Finland)	To determine the prevalence and risk variables associated with chronic, subacute, and acute cough.	Cross-sectional	A number of 5983 geriatric group members of Finnish Pensioners' Federation who became respondent.	The respondent participated in an email-based cross-sectional observational study. Sixty-two questions about general health, medication, social background, date of birth, visits to the doctor, and general health were included in the questionnaire. Symptom questionnaires included for chronic rhinosinusitis, obstructive sleep apnea, gastro-oesophageal reflux disease, and asthma.	In this population, prior COVID-19 infection also acute and subacute cough were infrequent. Compared to earlier research, a higher prevalence of persistent cough was observed in younger persons. Chronic, acute, and subacute cough point prevalences were 9.6%, 1.4%, and 0.7% respectively.
[14] Xiao <i>et al.</i> , 2022 (China)	To investigate the prevalence of depression and anxiety, as well as their risk factors.	Cross-sectional	A number of 199 COVID-19 adult survivors who were discharged from hospitals 6 months ago.	The study included demographic data, clinical observations, post-hospitalization experiences, and psychological variables. The assessment included the quantification of symptoms pertaining to depression and anxiety.	There was a strong and positive correlation seen between somatic symptoms upon discharge and the likelihood of experiencing depression. The study identified notable factors associated with likely anxiety, including those who were permanent residents, had somatic symptoms upon discharge, reported a significant effect from being infected, and exhibited self-stigmatization.
[15] Jamouille <i>et al.</i> , 2022 (Switzerland)	To analyze post-acute COVID-19 syndrome by comprehending the patient's suffering and the long-term pathophysiological processes.	Case series	A number of 55 individuals exhibiting atypical or medically unexplained symptoms (MUS) were longitudinally observed within the field of family medicine.	Data from the 55 patients' medical records, 40 of whom were women, with a mean age of 42.4 (12–79 years), and a semi-open-ended questionnaire used in a qualitative assessment of 6 of them enabled to emphasize the clinical picture that the WHO has classified as post-acute COVID-19 syndrome.	Patients were described into three categories. Sixteen patients fully recovered after a period of 6-8 months, while fifteen patients were able to resume their normal lives and work after 12-18 months, albeit with some remaining symptoms. Out of the third group, a total of 21 patients remained in a serious condition and were unable to resume their work and daily activities even after 18 months.

[16] Voruz <i>et al.</i> , 2022 (Switzerland)	The authors assessed key factors of cognitive impairment to differentiate the phenotype of post-COVID-19 neuropsychological conditions.	Cohort	A total of 102 individuals were included in the study, including patients with mild (non-hospitalized), moderate, or severe (ICU/intubation) illness in the post-SARS acute phase - CoV-2 infection.	Depending on whether anosognosia linked to memory impairments was present or absent, the patient were split into two groups: 26 patients with anosognosia and 76 patients without it. Of them, 49 had magnetic resonance imaging. Visual analysis of the structural pictures was followed by between-group statistical analysis of the functional and behavioral connectivity metrics.	Anosognosia for memory loss was observed in 15.6% of all patients with mild illness, compared to 32.4% of patients with moderate illness and 34.8% of patients with severe illness. Individuals with anosognosia related to memory impairment fared much worse than nosognostic patients. On the other hand, they provided much more favorable subjective evaluations of tiredness, mental condition, and quality of life.
[17] Matsumoto <i>et al.</i> , 2022 (Japan)	To examined the correlation between post-COVID symptoms and mental well-being.	Cross-sectional	A total of 763 individuals, with 135 of them had a history of COVID-19, whereas 628 individuals had no history of COVID-19.	Four psychological measures were used to assess the participants, along with questions concerning COVID-19 symptoms: dread of COVID-19, depression, anxiety, and PTSD. Additionally, logistic regression analyses were performed in the research to assess the effect of post-COVID circumstances on mental health.	Out of the 135 COVID-19 survivors, 37.0% (50 of them) had COVID-19-related aftereffects. All clinical symptom scores showed considerably higher values for this group. The incidence of severe mental symptoms then differed significantly across the groups.
[18] Badinlou <i>et al.</i> , 2022 (Sweden)	To investigate potential mental health issues among those who have had a confirmed or probable case of COVID-19. Further elucidation is offered on how to mitigate the adverse effects of post-COVID-19 infection-induced distraction.	Descriptive analytic	A number of 507 Sweden adult respondents who have had a history of COVID-19.	The study included an online survey that encompassed several demographic inquiries, as well as questions pertaining to the individual's COVID-19 status and subsequent impairments. Additionally, standardized assessments were done to gauge levels of several mental issues.	According to the study's findings, 70% of the sample had considerable levels of anxiety, depression, and insomnia. Those mental issues were linked to increased severity of COVID-19 acute phase, COVID-19-related hospitalization, and increased post-COVID distraction and tiredness rates. The most reliable indicator of poor mental health was found to be decreased participant motivation.

[19] Ramos-Usuga <i>et al.</i> , 2022 (Switzerland)	To investigate about the neurobehavioral signs of both long-term COVID and COVID-19 infection. This research explored variables that develop & exacerbate symptoms.	Retrospective study (case control)	A total of 1001 individuals who had previously a positive diagnosis for COVID-19, participated in the completion of the Neurobehavioral Symptom Inventory (NSI).	Data on demographics, comorbidities, the characteristics of COVID-19 infection, and its treatment have all been gathered using an online survey. The assessment of enduring symptoms is done using the NSI. In the present survey, respondents were asked to indicate whether each symptom was present at three distinct moments in time: before to the COVID-19 diagnosis, during the COVID-19 infection, and at the moment of survey completion.	Before and after COVID-19, participants reported significant gains across all domains. There was a moderate improvement in physical symptoms (between COVID-19 and now), a little improvement in emotional symptoms, and little to no change in cognitive symptoms. Increased neurobehavioral symptoms were associated with the following risk factors: being female or transgender, having no job, being younger, having low education, having comorbidities, having a more severe case of COVID-19, having been hospitalized, and no history of oxygen therapy.
[20] Perrin <i>et al.</i> , 2022 (Spanish)	To investigate the relationships between persistent COVID-19 neurobehavioral symptoms.	Cross sectional	The sample size included 1093 individuals, consisting of 650 people who had a history of COVID-19, they were investigated on average 147 days after their first diagnosis. Also 443 adults who had never been previously reported as COVID-19 positive.	The participants were tasked with completing their demographic information and the Neurobehavioral Symptom Inventory (NSI). An online survey using the Qualtrics platform was done, and further data analysis through psychometric network technique was conducted. This research done a statistical comparison between networks that were affected by COVID-19 (COVID+) and networks that were not affected by COVID-19 (COVID-).	The COVID+ network was highly linked in comparison to the COVID- network, with each neurobehavioral symptom having a positive correlation with the network. The COVID+ network was more closely associated with the hearing, numbness, and tense symptoms, whereas the sleep, exhaustion, and frustrated symptoms were associated with the latter. The COVID- network was mostly fragmented, with tiredness not being associated with any other symptom.
[7] Ballering <i>et al.</i> , 2022 (Netherlands)	This study examined PSS after COVID-19 within the context of the Netherlands, which was the characteristics, frequency, and intensity of persistent	Cohort	A total of 76422 samples with a mean age of 53 years old and a majority being women, completed the	Digital COVID-19 questionnaire invitations were sent to the adult participants. Using 24 repeat measures, somatic symptoms associated with COVID-19 diagnosis were evaluated. Participants who tested positive for SARS-CoV-2 or	The positive COVID-19 group experienced symptoms that persisted 90–150 days after COVID-19 compared to pre-COVID-19 and compared to appropriate controls. These symptoms included tingling in the extremities, feeling dizzy, sore throat, arms or legs

	symptoms linked to COVID-19, as well as to address pre-existing symptoms prior to SARS-CoV-2 infection and manage symptoms that may arise in the uninfected population.		questionnaires. Out of the whole sample, a total of 4231 individuals, accounting for 5.5% of the sample, were positive for COVID-19.	who had been diagnosed with COVID-19 by a doctor were matched to COVID-19-negative controls based on age, sex, and time. In individuals with COVID-19, we measured the severity of symptoms both before and after the virus and compared the results with matched controls.	feeling heavy, and fatigue throughout the body. According to this study, symptoms in 12.7% of patients could have been brought on by COVID-19. Of the 1,782 participants, 381 (21.4%) tested positive for the virus, while 361 (8.7%) from the control group reported at least one significantly improved symptom (of at least moderate severity) 90–150 days after the diagnosis.
[21] Horn <i>et al.</i> , 2023 (UK)	To evaluate the prevalence of enduring physical symptoms and Somatic Symptom Disorder (SSD) in individuals diagnosed with COVID-19, as well as to identify the variables associated with these symptoms.	Cohort study (retrospective)	Out of 377 individuals who tested positive for COVID-19 in a laboratory setting, a subset of 220 participants (58.4%) successfully completed the questionnaire. Consequently, they were deemed eligible for inclusion.	Physical symptoms and preoccupation with these symptoms were assessed in individuals with confirmed COVID-19, persisting for a duration of 8 to 10 months following the initial beginning of the disease. The questionnaire employed for the evaluation of individuals who are prone to experiencing SSD. Two linear regression models were conducted in order to ascertain sociodemographic and risks associated with SSD.	Out of the total sample size of 220 patients who were hospitalized, 65% exhibited at least one enduring physical symptom, while 53.6% of the patients required hospitalization. Additionally, 10.4% of the patients met the criteria for somatic symptom disorder. The intensity of SSD was found to be strongly associated with certain factors, namely female gender, older age, and experiencing a second wave of infection. Additionally, there was a notable correlation between somatic symptom disorder and an increased utilization of health services.
[22] Huang <i>et al.</i> , 2021 (China)	To identify the burden of somatic symptoms and self-reported sleep quality in COVID-19 patients and ascertain their prognostic variables.	Cohort study	The study sample included 74 individuals diagnosed with COVID-19 who were selected from the hospitals engaged in the research.	The sample was prospectively monitored in order to measure the load of somatic symptoms and the quality of their sleep over time. Independent variables related to the burden of somatic symptoms and sleep quality were found using univariate and multivariate analysis.	Over time, there was a substantial reduction in somatic symptoms ($P < 0.001$). Hospitalization resulted in much higher rates of remission for cumulative symptoms than self-isolation did. Patients still endure some degree of physical pain and poor sleep quality during self-quarantine, although these issues generally decreasing.
[10] Hufner <i>et al.</i> , 2023 (Austria)	To provide a description of illness perception (IP) and its	Cross sectional	The study sample included 145 adult individuals	To provide a description of illness perception (IP) and its components. Additionally, it seeks to discover	Fatigue intensity, impaired physical performance, and PSS all accounted for 33% of the total variation in IP. The

	components, this study investigate the patterns of IP in convalescents who continue to experience PSS, as well as those with lung or cardiac abnormalities one year after recovering from COVID-19.		diagnosed with COVID-19 and symptomatic who were selected from the hospitals engaged in the research.	demographic and clinical characteristics that may influence IP. This study investigate the patterns of IP in convalescents who continue to experience PSS, as well as those with lung or cardiac abnormalities one year after recovering from COVID-19.	impact of persistent somatic complaints, as opposed to anomalies shown in cardiopulmonary testing, is a determining factor in the effect on individual performance one year after COVID-19.
[23] Kamata <i>et al.</i> , 2023 (Japan)	To ascertain the potential correlation between COVID-19 and symptoms indicative of post-COVID-19 state, as well as their prevalence.	Cross-sectional	A total of 30,130 participants who took part in the JUSTIS study (Japan Society and New Tobacco Internet Survey)	Participants were divided into 3 groups: negative COVID-19, COVID-19 with oxygen therapy, and COVID-19 without oxygen therapy. The primary outcome was EQ-5D-5L (health related quality of life), secondary outcome was SSS-8 score (somatic symptoms).	The collective analysis revealed that those with a prior experience of COVID-19 had notably lower scores on the EQ-5D-5L scale and higher scores on the SSS-8 scale, in comparison to those who were negative COVID-19. The cohort necessitating oxygen therapy exhibited notably reduced EQ-5D-5L scores and elevated SSS-8 scores in comparison to the cohort not requiring oxygen therapy.
[24] Anaya <i>et al.</i> , 2021 (Colombia)	The authors report on the variation in symptoms of a series of patients with post-COVID-19 syndrome (PCS)	Cross-sectional with comprehensive review	A total of 116 patients came to the post-COVID unit.	Using a validated, semi-structured survey, adult patients with PCS and previously proven SARS-CoV-2 infection were thoroughly evaluated. An electrochemiluminescence immunoassay was used to assess blood levels of total IgG, IgA, and IgM antibodies to SARS-CoV-2. Data analysis techniques included both univariate and multivariate approaches.	The most common symptoms seen in PCS patients were musculoskeletal, digestive, and neurological, including depression. More than 20% of patients reported experiencing pain and discomfort, fatigue/muscle weakness, dyspnea, anxiety/depression, and difficulty concentrating. The primary characteristics of PCS include neurological, pulmonary, digestive, and musculoskeletal involvement, including depression.
[25] Poyraz <i>et al.</i> , 2021 (Turkey)	This study examined psychiatric symptoms and prolonged symptoms in individuals who had recovered from an	Cross-sectional	284 subjects took the survey with a complete IES-R	Psychiatric status was assessed using the IES-R, HADS, PSQI, and MINI suicidality scale (patients completed a checklist of protracted symptoms experienced after acute infection).	98 patients (34.5%) had clinically severe PTSD, anxiety, and/or depression after a median of almost 50 days after diagnosis; PTSD was the most frequently reported condition (25.4%). One or more persistent somatic symptoms were observed by 118 individuals (44.3%).

	acute COVID-19 infection.				
[26] Zakia <i>et al.</i> , 2023 (Italy)	The authors of this study focused on summarizing the reported psychiatric symptoms in Long COVID-19 patients and their risk factors	Systematic review	There were 23 articles in all that discussed the occurrence of psychological symptoms for a minimum of 4 weeks following a positive COVID-19 diagnosis.	The authors conducted systematic review using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Scopus, Embase, and PubMed databases were used to search for studies desired. Title and abstract screening was carried out, then continued with a full-text reading.	Anxiety, depression, posttraumatic stress disorder (PTSD), poor sleep quality, somatic symptoms, and cognitive deficits were the most and least common psychiatric symptoms. Risk variables for people with reported psychiatric problems were female gender and a positive history of mental diseases. symptoms.
[8] Kachaner <i>et al.</i> , 2022 (France)	The goal of the study was to identify SSD in individuals whose neurological symptoms following a SARS-CoV-2 infection were long-lasting and inexplicable.	Observational study	A total of 50 adult respondents who had symptoms of neurosensory or neurocognitive disorders post-COVID-19 which could not be categorized as a diagnosis of another disease.	Standard psychometric evaluations were carried out on patients via telephone, then patients were directed to fill out a questionnaire that has been sent via email. Next, using the Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5) criteria, the positive diagnosis of SSD was examined.	A total of 32 (64%) patients were positively diagnosed with SSD based on DSM-5 criteria. In the remaining 18 patients, SSD was considered probable due to its high score on the diagnostic scale.
[27] Jowett <i>et al.</i> , 2020 (UK)	Researchers focused on evaluating the three clusters of PTSD symptom (re-experiencing, avoidance, and sense of threat) in association with somatisation variables after COVID-19.	Cross sectional	Through stratified quota sampling, 1041 persons who were residents of Ireland and had a positive history of COVID-19 participated in this study.	The respondents completed questionnaires, such as the International Trauma Questionnaire to measure PTSD symptoms and the Patient Health Questionnaire to evaluate physical health issues, during interview sessions.	One of the three clusters of PTSD symptom, which was sense of threat is related with pain, exhaustion, gastrointestinal, and cardiovascular symptoms. Meanwhile, the avoidance group was only related to pain. In COVID-19 somatic issues topic, sense of threat was the most strongly related of PTSD symptom clusters.

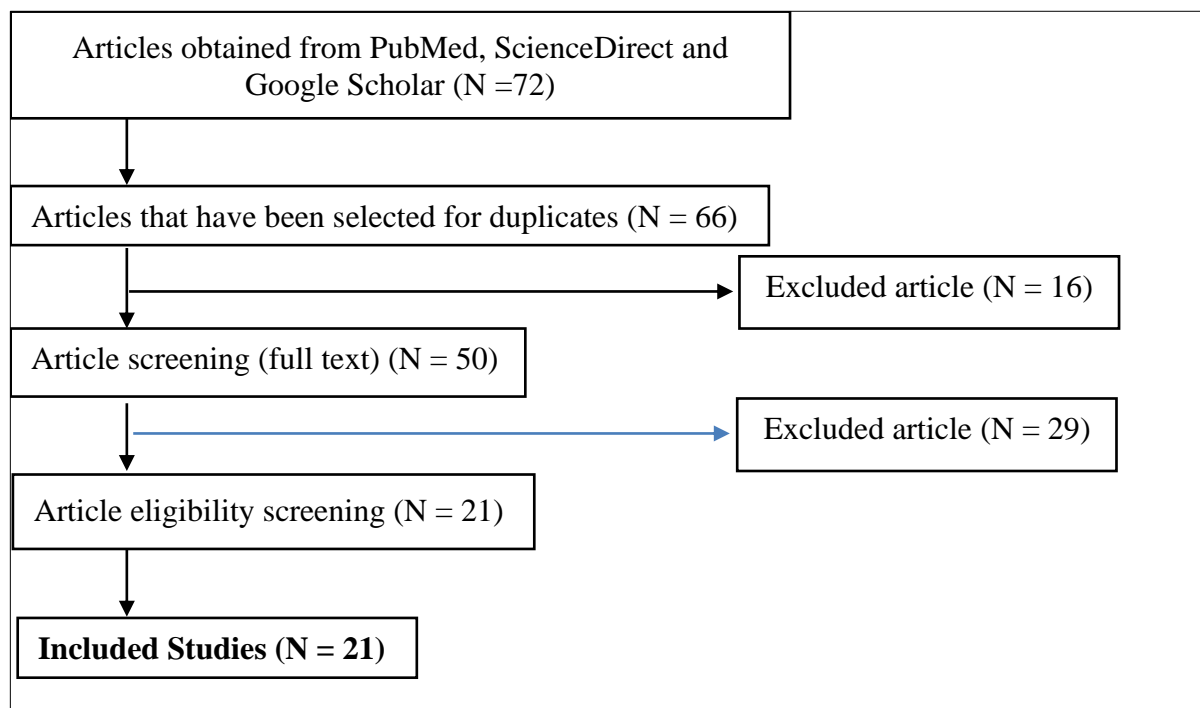


Figure 1 PRISMA Diagram for Literature Selection.

Based on the scientific articles that we have summarized, it was evident that persistent somatic symptoms after COVID-19 have been a topic of interest in recent research. Several studies investigated the prevalence of this case, and all studies that included information on prevalence showed that a majority of those who have recovered from COVID-19 have reported experiencing PSS. Matsumoto et al. also showed that post-COVID patients had a significantly higher incidence rate on all clinical symptom scales than people who had never been infected with COVID-19. The large number of individuals who experienced this made PSS after COVID-19 noteworthy for further research and evaluation, since it may hold significant importance in relation to the overall welfare and life quality of individuals affected by PSS after COVID-19.

There are two studies that explain the post-infection effects of COVID-19 related to DLI (daily life impairment) & biopsychosocial consequences, Schneider et al., 2023 this study examines the incidence of PSS after COVID-19 and investigates its relationship with daily life impairment (DLI), 52.5% (n = 2828) of participants experienced persistent symptoms for a duration exceeding three months following infection with SARS-CoV-2, has been primarily linked with fatigue, but other factors such as excessive preoccupation with physical symptoms, dyspnea, impaired concentration, and depression also play a role [5]. Furthermore, in the study by Jamouille et al. (2022), which examined the long-term symptoms of post-acute COVID-19 syndrome, a total of 55 patients were divided into three groups: 16 patients achieved full recovery within a period of 6-8 months, 15 patients capable to resume their daily activities and work after 12-18 months, albeit with some lingering symptoms. However, 21 patients remained in a very ill state and were unable to resume their normal work and living routines even after 18 months. They experienced significant biopsychosocial ramifications that had a profound impact on their life [15]. There is also a study that explains that post-COVID-19 symptoms can appear at least 4 weeks after a positive COVID-19 diagnosis [26].

Each study had various time periods for PSS after COVID-19, from the articles included, the time period ranges from 4 weeks to 18 months after being diagnosed with COVID-19. The most frequent physical symptoms were fatigue [5,7,10,11,15,18,20,24], dyspnea [5,10,11,24], cough [11,13], arthralgia [11,24], thoracic pain [7,10], and headache/dizziness [19,20]. According to all this study, the physical symptoms experienced by patients are related to psychological factors.

Several studies have also reported risk factors for the emergence of persistent somatic symptoms after COVID-19. The most common risk factors described were female [11,19,21,26], older [11,21], having comorbidities and severity at the acute phase of the disease [10,11,14,18], patients with psychiatric disorders [12,17,25,26], participants' emotional

representations, complaints, timeline of illness, and consequences of illness perception [10,12,16]. These risk factors contribute to the emergence of persistent somatic symptoms and the severity of each symptom.

Somatic symptoms after COVID-19 were significantly and positively associated with probable depression, anxiety, insomnia & PTSD. Schneider et al., 2023 & Xiao et al., 2022, these two studies stated in their research that depression plays an important role in the emergence of persistent somatic symptoms, and is reinforced by a significant correlation with the emergence of anxiety [5,14]. Then, four other studies [18,24–26] also stated that levels of depression and anxiety were associated with a higher severity of acute COVID-19 infection, hospitalization due to COVID-19, and higher post-COVID disorders, and is believed to be an important factor in the emergence of persistent somatic symptoms. Sleep problems have also been believed to be related to or may play an important role in the emergence of persistent somatic symptoms, the most frequently felt sleep problems are insomnia and poor sleep quality [10,18,20,22,26]. Post-traumatic stress disorder (PTSD) is a condition that appears quite often in persistent somatic symptoms, in several articles it is stated that PTSD is significantly related to the severity of somatic symptom disorders, PTSD conditions with PSS were associated with significantly higher use of health services and PTSD is the most common condition reported in patients with persistent somatic symptoms [21,25–27].

4. Discussion

PSS after COVID-19 refers to the long-term effects and physical symptoms experienced by individuals after recovering from an acute COVID-19 infection [28–30]. These symptoms could persist for weeks to months after the initial infection [26,28,30]. PSS cases were often found in clinical practice, and it became questionable when the incidence of PSS increased after the COVID-19 pandemic [1,2,7,8]. This was later also proven by Matsumoto et al., which found that the incidence of various clinical symptoms was significantly higher in COVID-19 survivors compared to patients who had never been infected with COVID-19 [17].

The exact pathophysiology of PSS after COVID-19 was not fully understood and was likely multifactorial. However, several potential mechanisms had been proposed: 1) Viral persistence: It was possible that the SARS-CoV-2 virus persisted in certain tissues or organs, leading to ongoing inflammation and damage. This persistent viral presence may contribute to the development of persistent symptoms [31,32]; 2) Dysregulated immune response: COVID-19 could trigger an exaggerated immune response, leading to a cytokine storm and widespread inflammation. This dysregulated immune response may persist even after the acute infection has resolved, contributing to ongoing symptoms [14,33]; 3. Organ damage: COVID-19 could cause damage to various organs, including the lungs, heart, kidneys, and brain. This organ damage may result in long-term complications and symptoms [34,35]. 4. Neurological involvement: SARS-CoV-2 could invade the central nervous system, leading to neurological symptoms. Persistent neurological symptoms, such as cognitive difficulties, headaches, and dizziness, may be related to ongoing neurological inflammation or damage [36,37]. 5. Psychological factors, such as anxiety, depression, and PTSD could contribute to the development and persistence of somatic symptoms. The stress and emotional impact during COVID-19 may exacerbate or prolong these symptoms [10].

The psychological factors were intriguing since it was important to note that the relationship between PSS and psychiatric disorders was complex and bidirectional. While somatic symptoms could contribute to the development of psychiatric disorders, individuals with pre-existing psychiatric disorders may also be more susceptible to experiencing PSS after COVID-19 [11]. We found that various articles were linear with this, where individuals with PSS after COVID-19 were more likely to experience depressive symptoms, anxiety, PTSD, and insomnia compared to those without PSS. Vice versa, where anxiety, depression, PTSD, and insomnia were highly associated with persistent symptoms, including somatic and pain complaints, which suggest that they may contribute to the development of PSS after COVID-19 [12,14,17,18,24–26,38].

PSS after COVID-19 have been reported in a significant proportion of individuals who have recovered from the virus. Several studies have investigated the prevalence of these symptoms, even there have been systematic reviews related to this. However, to the best of our knowledge this study was the first review to discuss psychiatric aspects of PSS after COVID-19, where we managed to reconcile various somatic symptoms with possible psychiatric pathological preconditions. On the other hand, our study also had limitation related to the number of articles included in this review was still relatively small, since there were only few research articles discussing psychiatric aspects in COVID-19 survivors. This topic still requires a lot of research articles or case reports from various countries.

5. Conclusion

In conclusion, it was equitable to propose an association between PSS after COVID-19 and various psychiatric aspects. Addressing the mental health needs of individuals with PSS, including screening and providing appropriate management, is important for their overall well-being. This may involve a multidisciplinary approach, including healthcare professionals from various specialties such as primary care, mental health, and rehabilitation.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflict of interest.

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