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Review Article

Mental health outcomes of adults hospitalized for COVID-19: A systematic review

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Background: Patients hospitalized for COVID-19 may be at high risk of mental health (MH) disorders. This systematic review assesses MH outcomes among adults during and after hospitalization for COVID-19 and ascertains MH care utilization and resource needs.

Methods: We searched multiple medical literature databases for studies published December 2019 to March 2021. Studies of ≥ 200 participants were synthesized. One reviewer completed article selection, data abstraction and assessed study quality and strength of evidence, with verification by a second.

Results: Fifty articles met preliminary inclusion criteria; 19 articles that included ≥ 200 participants were synthesized. Evidence from these primarily fair-quality studies suggests many patients experience symptoms of depression (9–66%), anxiety (30–39%), and insomnia (24–40%) during and 3 months after hospitalization for COVID-19. However, patients infrequently receive a new MH disorder diagnosis 6 months after hospitalization (5% are diagnosed with a new mood disorder, 7% anxiety disorder, and 3% insomnia). Some hospitalized patients – including women and those with more severe COVID-19 – may be at higher risk of poor MH outcomes. Data on MH care utilization and resource needs are currently limited.

Limitations: Most included studies were small, did not report the proportion of participants with preexisting MH disorders, and did not use comparison groups.

Conclusions: While many patients experience MH symptoms after hospitalization for COVID-19, most do not go on to develop a new MH disorder. Future studies should report whether participants have preexisting MH disorders and compare patients hospitalized for COVID-19 to patients hospitalized for other causes.

1. Introduction

As of August 2021, 210 million people have been confirmed to have had COVID-19 and 4 million have died from Coronavirus Disease 2019 (COVID-19) worldwide (Johns Hopkins University, 2021). Despite rapid advancements in the diagnosis and treatment of COVID-19 in the past year, it remains uncertain what patients who have been hospitalized with COVID-19 should expect during their recovery. In particular, experts have warned these patients may be at high risk of exacerbating existing mental health (MH) conditions or developing new MH conditions such as major depression, anxiety disorders, or post-traumatic stress disorder (PTSD) (de Girolamo et al., 2020; Huff, 2020; Kahl and Correll, 2020).

Hospitalization for COVID-19 might worsen MH symptoms or conditions through complex and interrelated mechanisms. First, being hospitalized for a serious illness can negatively affect MH. Research

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from Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) epidemics has found that many patients with serious SARS and MERS infections experienced symptoms of anxiety (36%) and insomnia (42%) during the acute phase of their illness, and some developed PTSD (32%), depressive disorders (15%), and anxiety disorders (15%) after recovery (Rogers et al., 2020). Research has also found patients treated in the intensive care unit (ICU) for any illness are at high risk of MH issues, with one-third developing symptoms of anxiety and depressive disorders, and one-fifth developing PTSD symptoms within a year of their ICU stay (Tingey et al., 2020). Second, addressing complications of COVID-19 may require invasive procedures, including the administration of sedation and/or paralytic agents and intensive intravascular monitoring. These interventions interfere with a patient's ability to respond to and understand their providers, environment, and treatment, which may affect MH outcomes after recovery from COVID-19 (Tingey et al., 2020). Finally, stress associated with isolation from family and friends and financial hardship due to medical costs and disruption to work are additional factors that could contribute to poor MH among those hospitalized for COVID-19.

A recent systematic review found a high prevalence of psychiatric symptoms among general populations during the COVID-19 pandemic—including symptoms of anxiety (up to 51%), depression (up to 48%), and PTSD (up to 54%) (Xiong et al., 2020). However, no reviews have examined the prevalence of MH disorders among patients who have been hospitalized for COVID-19, who may be at especially high risk of poor MH outcomes. The primary objective of this systematic review was to assess the prevalence and incidence of MH disorders among adults who have been hospitalized for COVID-19. In particular, we sought to compare those with versus without preexisting MH disorders; compare those hospitalized for COVID-19 to relevant comparison groups; evaluate whether the prevalence of MH disorders varies by patient, disease, and level of care characteristics; and evaluate patients' post-discharge MH care utilization and self-reported resource needs.

2. Methods

This paper is based on a rapid systematic review conducted by the Department of Veterans Affairs (VA) Evidence Synthesis Program (ESP) (Veazie et al., 2021). The purpose of the review was to inform national VA planning efforts to support Veterans hospitalized for COVID-19 after they have been discharged. A full description of the review's methods can be found on the PROSPERO international prospective register of systematic reviews (http://www.crd.york.ac.uk/PROSPERO/; registration number CRD42020199557).

2.1. Search strategy

A research librarian searched Ovid MEDLINE, the WHO COVID-19 database, PsycINFO, CINAHL, as well as systematic review databases using terms for *COVID-19, mental health*, and *hospitalization* from December 2019 to March 2021 (see Appendix A for complete search strategies). Additional citations were identified from hand-searching reference lists and consultation with content experts. We limited the search to published, peer-reviewed, and indexed articles involving human subjects and available in English.

2.2. Study selection and eligibility criteria

We included cross-sectional and cohort studies that reported on patients' MH outcomes during or after hospitalization for COVID-19. We also included studies examining MH care utilization and resource needs after hospitalization (*eg*, studies that track utilization or studies that ask participants what MH services they want or need). We included studies that reported prevalence or incidence of MH disorders as well as studies that reported relative prevalence or incidence (*ie*, before vs. after hospitalization; hospitalized vs. non-hospitalized patients with COVID-19; and patients hospitalized for COVID-19 vs. patients hospitalized for other reasons). MH disorders of interest included mood disorders, anxiety disorders, trauma-related disorders, psychotic disorders, and substance use disorders. We also included clinical features and symptoms when reported, such as insomnia. Titles, abstracts, and full-text articles were reviewed based on predefined inclusion/exclusion criteria (Appendix B) by one reviewer and verified by another. All disagreements were resolved by consensus.

Using a best evidence approach (Treadwell et al., 2011) we made a post-hoc decision to restrict quality assessment, data extraction, and strength of evidence (SOE) assessments to studies that included $\geq$ 200 participants, given that these larger studies likely provide the most reliable estimates of prevalence and incidence of MH disorders among adults hospitalized for COVID-19.

2.3. Data extraction & quality assessment

We used predefined criteria from the Joanna Briggs Institute (JBI) to rate the quality of included studies of $\geq$ 200 participants (Joanna Briggs Institute, 2021). Studies were rated as "good quality" if they had no or only minor methodological limitations that could potentially bias findings (*eg*, studies adjusted for all or most a priori identified key confounders at baseline including patient age, sex, comorbidities, and COVID-19 severity). Studies were rated as "fair quality" if they had several methodological limitations or did not report key methods details that were likely to bias findings (*eg*, high rates of drop-out or inadequate adjustment for confounding variables). Studies were rated as "poor quality" if they had substantial methodological limitations or did not report multiple methods details to the extent that it was impossible to interpret the findings (*eg*, lack of information on participant inclusion/exclusion criteria or characteristics at baseline, lack of information on how MH outcomes were measured). Data extracted from these studies included study characteristics, populations, comparators, and outcomes. All data abstraction and quality ratings were first completed by one reviewer and verified by another. All disagreements were resolved by consensus.

2.4. Data synthesis and analysis

One reviewer graded the SOE of studies of $\geq$ 200 participants based on the Agency for Healthcare Research and Quality (AHRQ) Methods Guide for Comparative Effectiveness Reviews; grading was verified by a second reviewer (Berkman et al., 2013). Although this method is designed for intervention studies, we applied the domains to included non-intervention studies, including risk of bias, consistency, directness, and precision of the evidence. We applied the following algorithm in our SOE assessments: findings supported by at least one large ($n > 5000$ participants) good-quality cohort or cross-sectional study were rated as "moderate" SOE; findings supported by at least one medium-sized ($N =$ 200–4999 participants) fair-quality cohort or cross-sectional study were rated as "low" SOE; findings that were inconsistent across multiple medium-sized fair-quality studies were also rated as "low" SOE; findings that were only supported by poor-quality cohort or cross-sectional studies of any size were rated as "insufficient" SOE. Because of the variety of outcomes and outcome measurements used by these studies, we synthesized data narratively.

3. Results

3.1. Search results

The literature flow diagram (Fig. 1) summarizes the results of the search and study selection processes. Among 4866 potentially relevant citations, we included 50 articles; 19 of these articles enroled $\geq$ 200 participants and were retained in our best-available evidence synthesis. These 19 articles presented data from 17 studies, including 2 prospective

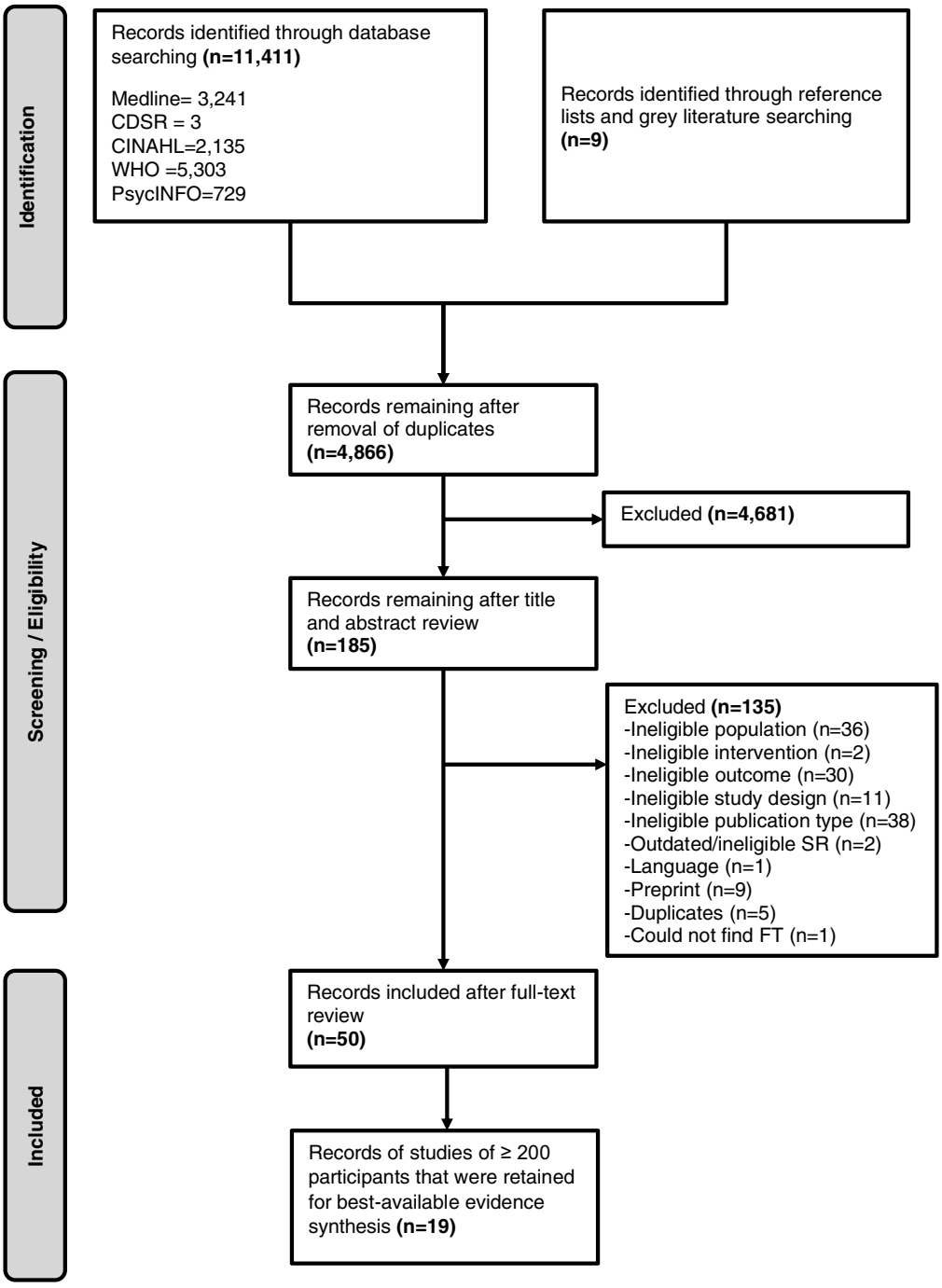

Fig. 1. Study flow diagram.

cohort studies (Mazza et al., 2020, 2021; Turan et al., 2021), 2 retrospective cohort studies (Atalla et al., 2020; Taquet et al., 2021a, 2021b) and 13 cross-sectional studies (Chamberlain et al., 2021; Chen et al., 2021; Einvik et al., 2021; Islam et al., 2021; Jiang et al., 2020; Li et al., 2020; Liu et al., 2020; Ma et al., 2020; Mandal et al., 2020; Moayed et al., 2021; Moradian et al., 2020; Sahan et al., 2021; Wang et al., 2021). Appendix C presents limited data extraction of the 31 studies that enroled $<$ 200 participants. Appendix D presents detailed data extraction, and Appendix E presents quality assessment outcomes, for the 19 articles that enroled $\geq$ 200 participants.

3.2. Study characteristics

Of the 19 articles, 3 were conducted entirely or primarily in the United States (Atalla et al., 2020; Taquet et al., 2021a, 2021b), 6 in China (Chen et al., 2021; Jiang et al., 2020; Li et al., 2020; Liu et al., 2020; Ma et al., 2020; Wang et al., 2021), 2 in Italy (Mazza et al., 2020, 2021), 2 in the UK (Chamberlain et al., 2021; Mandal et al., 2020), 2 in Turkey (Sahan et al., 2021; Turan et al., 2021), 2 in Iran (Moayed et al., 2021; Moradian et al., 2020), 1 in Bangladesh (Islam et al., 2021), and 1 in Norway (Einvik et al., 2021). Study size varied from 200 to 236,379 participants, although most included between 200 and 1000 participants. Nine articles measured outcomes during hospitalization (Atalla et al., 2020; Chen et al., 2021; Jiang et al., 2020; Li et al., 2020; Ma et al.,

2020; Moayed et al., 2021; Sahan et al., 2021; Turan et al., 2021; Wang et al., 2021), while 9 measured outcomes up to 3 months post-hospitalization (Chamberlain et al., 2021; Einvik et al., 2021; Islam et al., 2021; Liu et al., 2020; Mandal et al., 2020; Mazza et al., 2020, 2021; Moradian et al., 2020; Taquet et al., 2021b) and 1 measured outcomes up to 6 months post-hospitalization (Taquet et al., 2021a).

Patient characteristics also varied across articles. Overall, mean age varied from 35 to 60 years, and the percentage who were female ranged from 8 to 65%. Medical comorbidities were inconsistently reported across articles, but those that did report comorbidities reported high prevalence [*eg*, 5 studies reported that 29 to 59% of patients had a co-morbidity, underlying illness, or chronic medical condition (Einvik et al., 2021; Jiang et al., 2020; Liu et al., 2020; Turan et al., 2021; Wang et al., 2021)]. Race and ethnicity were also inconsistently reported. Two studies (presented in 3 papers) reported participants' race (Atalla et al., 2020; Taquet et al., 2021a, 2021b), both of which were conducted primarily in the United States. Two articles (Taquet et al., 2021a, 2021b) reported outcomes from 1 retrospective cohort study of participants with COVID-19 in the United States [N = 62,354 in the first article (Taquet et al., 2021b) and N = 236,379 in the second (Taquet et al., 2021a)]. A relatively large percentage of study participants were Black (18.8 to 23.6% of participants in each article were Black, compared to 13.4% of US population that is Black (U.S. Census Bureau, 2020a). The other study (Atalla et al., 2020) examined a smaller cohort (N = 339) of hospitalized patients with COVID-19 in Rhode Island and reported 37% were Hispanic and 16% were Black—both of which are roughly double the percentage of the general population of Rhode Island that are Hispanic and Black (16.3% and 8.5%, respectively) (U.S. Census Bureau, 2020b). The high proportion of Black and Hispanic patients hospitalized with COVID-19 included in these studies reflects the health inequities exposed in national trends of patients hospitalized with COVID-19 in the United States (Centers for Disease Control and Prevention, 2020).

Most studies reported the prevalence of symptoms of MH disorders (including depression, anxiety, PTSD, obsessive-compulsive, and insomnia). A few studies reported the incidence of MH diagnoses (including mood disorders, anxiety disorders, psychotic disorders, substance use disorders, and insomnia). Additionally, a few studies reported on MH care utilization and resource needs, but data were limited.

3.3. Quality assessment

Overall, only 2 articles (Taquet et al., 2021a, 2021b) of the same study were rated good quality, 12 articles of 11 studies were rated fair quality (Atalla et al., 2020; Chamberlain et al., 2021; Einvik et al., 2021; Islam et al., 2021; Jiang et al., 2020; Liu et al., 2020; Ma et al., 2020; Mandal et al., 2020; Mazza et al., 2020, 2021; Sahan et al., 2021; Turan et al., 2021), and 5 studies were rated poor quality (Chen et al., 2021; Li et al., 2020; Moayed et al., 2021; Moradian et al., 2020; Wang et al., 2021). Among studies rated as fair-quality, common methodological limitations included limited measurement or reporting of participants' preexisting MH disorders, comorbidities, and COVID-19 severity. Studies rated as poor-quality had additional limitations, including a lack of information on how COVID-19 status was ascertained and use of unvalidated instruments to measure outcomes. Because we have low confidence in the scientific validity of the studies rated as poor-quality, we do not report results in the following sections except when they provide the only available data on a certain outcome. See Appendix D for detailed study-level data extraction and Appendix E for study-level quality assessment.

3.4. Prevalence of MH disorders among hospitalized COVID-19 patients

One fair-quality prospective cohort study described in 2 articles (N = 402 and N = 226) (Mazza et al., 2020, 2021) and 5 fair-quality cross-sectional studies (Einvik et al., 2021; Islam et al., 2021; Liu et al., 2020; Mandal et al., 2020; Sahan et al., 2021) (N = 281 to N = 1002) reported a high prevalence of MH symptoms among patients with COVID-19 during and in the 3 months following hospitalization (Table 1). During hospitalization, approximately 4 out of 10 patients with COVID-19 experienced depression symptoms and 3 out of 10 experienced anxiety symptoms (Sahan et al., 2021). PTSD, obsessive-compulsive symptoms, psychosis, and insomnia were not assessed in studies of hospitalized patients. The prevalence of anxiety symptoms in the 3-month period post-discharge was similar to the reported prevalence during the hospitalization period (Liu et al., 2020; Mazza et al., 2020, 2021). Studies also found approximately 1 out of 10 people hospitalized for COVID-19 experienced PTSD symptoms or met criteria for a PTSD diagnosis, 3 out of 10 experienced insomnia, and 2 out of 10 experienced obsessive-compulsive symptoms within 3 months of leaving the hospital (Einvik et al., 2021; Liu et al., 2020; Mazza et al., 2020, 2021). The prevalence of depression was highly variable across studies conducted within 3 months of hospital discharge (9–66%) (Islam et al., 2021; Liu et al., 2020; Mandal et al., 2020; Mazza et al., 2020, 2021). No studies in the post-discharge period assessed the prevalence of psychotic disorder.

Findings on the prevalence of MH disorders were generally similar across studies. However, this was not the case with depression, where prevalence estimates ranged from 9 to 66%. It is possible part of this variance is due the wide range of measures used across studies as well as differences in the operationalization of measures (e.g., choice of cut-off points for determining if someone has depression symptoms). The lowest prevalance estimate (9%) comes from a study (Mazza et al., 2021) (N = 226) that reported participants had depression if they scored 8 or higher on the 13-item Beck Depression Inventory. The same study found the prevalence of depression was 28% when using a score of 50 or higher on the Zung Self-Rating Depression Scale. The highest prevalence estimate (65.7%) comes from a study (Liu et al., 2020) (N = 675) that

Table 1
Prevalence of MH disorders among all patients hospitalized for COVID-19.

	During hospitalization	0–3 months post-discharge	3+ months post-discharge
Depression or mood disorder	42.0% depression symptoms (Sahan et al., 2021)	9–65.7% depression symptoms (Islam et al., 2021; Liu et al., 2020; Mandal et al., 2020; Mazza et al., 2020, 2021) 19% moderate-severe depression symptoms (Liu et al., 2020)	No data
Anxiety	34.9% anxiety symptoms (Sahan et al., 2021)	30–39.0% anxiety symptoms (Mazza et al., 2020, 2021) 10.4% moderate-severe anxiety symptoms (Liu et al., 2020)	No data
PTSD	No data	9.5–15.4% PTSD symptoms (Einvik et al., 2021; Mazza et al., 2020, 2021) 12.4% PTSD diagnosis (Liu et al., 2020)	No data
Obsessive-compulsive	No data	19.6–26% obsessive compulsive symptoms (Mazza et al., 2020, 2021)	No data
Sleep disorders	No data	24–39.6% insomnia symptoms (Mazza et al., 2020, 2021)	No data

Abbreviations: GAD = Generalized Anxiety Disorder; PTSD = Post-Traumatic Stress Disorder.
This table presents findings from studies of ≥ 200 participants that were rated as either fair or good quality. The table does not include studies of < 200 ppts. The following studies also do not appear in the table, as they were rated as poor quality: Chen et al. (2021), Li et al. (2020), Moradian et al. (2020), Moayed et al. (2021), Wang et al. (2021). Ma et al. (2020) also does not appear in the table, as the study only reported data for those with severe COVID-19.

reported that 19% of participants had moderate-severe symptoms (score of 10 or higher on the Patient Health Quesionnaire-9 [PHQ-9]) and 46.7% had mild symptoms (score of 5–9 on the PHQ-9) for a total of 65.7% with any depression symptoms.

Overall, we have low confidence in these findings (low SOE), as most are only supported by 1–3 studies, and findings on the prevalence of depression symptoms varied between studies (*ie*, were inconsistent).

3.5. Prevalence of MH disorders among hospitalized patients without preexisting MH conditions

A good-quality, retrospective cohort study (Taquet et al., 2021a) of over 200,000 people from the TriNetX Analytics Network found that approximately 4.5% of hospitalized patients were diagnosed with a mood disorder for the first time within 6 months of their COVID-19 diagnosis. Within the same time period, an estimated 6.9% of hospitalized COVID-19 survivors were diagnosed with an anxiety disorder for the first time, 3.1% were diagnosed with insomnia for the first time, 2.1% were diagnosed with a substance use disorder for the first time, and 0.9% were diagnosed with a psychotic disorder for the first time. Strengths of this study include its large sample size, long follow-up time (6 months), and the fact that it was designed to detect incidence of new MH disorder diagnoses. However, authors provided limited information on the hospitals that comprise the TriNetX database, making it difficult to gage generalizability to other hospital settings.

Additionally, a fair-quality, prospective cohort study (Mazza et al., 2021) ($N = 226$) reported the prevalence of MH symptoms 3 months after COVID-19 hospitalization among patients *without a MH history*. The prevalance of MH symptoms among patients without a MH history ($n = 164$) were as follows: depression symptoms (5–23%), PTSD symptoms (6%), anxiety symptoms (21%), insomnia symptoms (22%), obsessive compulsive symptoms (18%).

Overall, we have moderate confidence in estimates of the incidence of receiving a first MH disorder diagnoses within 6 months of being hospitalized for COVID-19 (moderate SOE), as these estimates are based on a large, good-quality cohort study. We have low confidence in the estimates of MH symptom prevalence among those without a MH history (low SOE), as the study supporting this finding only included 226 participants.

3.6. Prevalence of MH disorders among hospitalized patients with preexisting MH conditions

A single fair-quality prospective cohort study (Mazza et al., 2021) ($N = 226$) reported the prevalence of MH symptoms 3 months after COVID-19 hospitalization among patients *with a MH history*. Prevalence of MH symptoms among patients with a MH history ($n = 62$) were as follows: depression (26–40%), PTSD symptoms (27%), anxiety symptoms (50%), obsessive-compulsive symptoms (39%), insomnia symptoms (33%). Overall, we have low confidence in these findings (low SOE) as they are based on a single, relatively small study.

3.7. MH outcomes of hospitalized vs. non-hospitalized patients

One good-quality retrospective cohort study (Taquet et al., 2021a) of the TriNetX Analytics Network found that patients who had been hospitalized with COVID-19 were at higher risk of being diagnosed with a mood disorder (Hazard Ratio [HR] 1.53 [1.33–1.75]), anxiety disorder (HR 1.49 [1.34–1.65]), psychotic disorder (HR 2.77 [1.99–3.85]), substance use disorder (HR 1.68 [1.40–2.01]) and insomnia (HR 1.49 [1.28–1.74]) for the first time compared to outpatients with COVID-19. This analysis and a previously conducted analysis on a smaller cohort of patients from the same dataset found that hospitalized patients have a 40% increased risk of being diagnosed with a new psychiatric disorder within 3 months and 55% increased risk of being diagnosed with a new mood, anxiety or psychotic disorder within 6 months compared to outpatients (Taquet et al., 2021a, 2021b). Strengths of both analyses include their large sample sizes, long follow-up time (between 3 and 6 months), and the fact that they were designed to detect incidence of new MH disorders. However, as noted previously, there was limited information about the hospitals that comprise the TriNetX database.

Overall, we have moderate confidence that hospitalized patients are at increased risk of being diagnosed with a new psychiatric disorder, relative to outpatients (moderate SOE), as this finding is supported by a large, good-quality, retrospective cohort study.

3.8. Differences by patient characteristics, COVID-19 disease severity, and level of care

Four studies [1 prospective cohort (Mazza et al., 2021) and 3 cross-sectional (Einvik et al., 2021; Jiang et al., 2020; Sahan et al., 2021)] examined the association between patient characteristics, COVID-19 disease severity, level of care and MH symptoms among populations with either low or unclear prevalence of preexisting MH conditions (Table 2). In terms of patient characteristics, female sex was associated with worse depression and anxiety symptoms during hospitalization and worse depression, anxiety, obsessive-compulsive, and insomnia symptoms post-discharge (Jiang et al., 2020; Mazza et al., 2021; Sahan et al., 2021). Findings were mixed with respect to post-discharge PTSD symptoms: female sex was associated with worse PTSD symptoms in 1 prospective cohort study (Mazza et al., 2021), but there was no such association in a cross-sectional study (Einvik et al., 2021). Older age was associated with worse depression symptoms during hospitalization (Jiang et al., 2020; Sahan et al., 2021) but not with PTSD symptoms post-discharge (Einvik et al., 2021). There was no association between number of comorbidities and PTSD symptoms post-discharge (Einvik et al., 2021). No studies reported on the association between race/ethnicity and MH disorder diagnoses or symptoms.

In terms of COVID-19 disease characteristics, COVID-19 severity was associated with worse anxiety, PTSD, and depression symptoms post-discharge (Liu et al., 2020). In terms of level of care, longer duration of hospitalization was associated with less severe depression, PTSD, obsessive-compulsive, and insomnia symptoms post-discharge in a prospective cohort study (Mazza et al., 2021). However, duration of hospitalization was not associated with depression or anxiety symptoms during hospitalization in a cross-sectional study (Jiang et al., 2020). Receipt of ICU care was associated with depression symptoms post-discharge (Liu et al., 2020). Receipt of ventilation, however, was not associated with depression, anxiety, or PTSD symptoms post-discharge (Liu et al., 2020). Receipt of corticosteroids was associated with higher risk of anxiety symptoms and lower risk of PTSD symptoms post-discharge (Liu et al., 2020). Overall, we have low confidence in these findings (low SOE), as each association was only examined in 1–3 studies, and findings tended to be inconsistent across studies.

3.9. MH care utilization and resource needs

There is limited evidence on MH care utilization and resource needs after hospitalization for COVID-19. One fair-quality cross-sectional study (Turan et al., 2021) reported that 89 out of 892 hospitalized COVID-19 patients (10%) required psychiatric consultation during hospitalization. The most common reasons for psychiatric consultation in these 89 patients were psychomotor agitation/restlessness (25.8%), impairment of sleep (23.6%), evaluation of prior psychiatric treatment (16.7%), anxiety/fear (14.6%), and suicidal ideation (9%). Delirium was the most common diagnosis made (38.2%), followed by adjustment disorder (27.0%), depressive disorder (19.1%), and anxiety disorder (11.2%). Of note, 23 out of the 89 patients (25%) who had a psychiatric consultation had a prior neuropsychiatric diagnosis.

Another fair-quality cross-sectional study (Atalla et al., 2020) of 339 hospitalized COVID-19 patients examined the reasons for readmission of

Table 2
MH disorders among patients hospitalized for COVID-19 by patient characteristics, COVID-19 disease severity, and level of care.

	Sex	Age	Comorbidities	COVID-19 disease severity	Level of care
Depression	1 DH and 1 PD study found females had worse depression symptoms (Jiang et al., 2020; Mazza et al., 2021)	1 DH study found being over 50 years old was associated depression symptoms (Sahan et al., 2021) 1 DH study found age was associated with depression symptoms (Jiang et al., 2020; Mazza et al., 2021)	No data	1 PD study found COVID-19 severity was associated with depression symptoms (Liu et al., 2020)	1 PD study found receipt of ventilation not associated with depression symptoms, but receipt of ICU care was associated with depression symptoms (Liu et al., 2020) 1 PD study found duration of hospitalization associated with better depression symptoms while 1 DH study found no association (Jiang et al., 2020)
Anxiety	2 DH & 1 PD study found female sex was associated with anxiety symptoms (Jiang et al., 2020; Mazza et al., 2021; Sahan et al., 2021)	No data	No data	1 PD study found COVID-19 severity was associated with anxiety symptoms (Liu et al., 2020)	1 PD study found receipt of ventilation not correlated with anxiety symptoms, but receipt of corticosteroids was associated with anxiety symptoms (Liu et al., 2020) 1 DH study found duration of hospitalization was not associated with anxiety symptoms (Jiang et al., 2020)
PTSD	1 PD study found females had worse PTSD symptoms (Mazza et al., 2021) 1 PD study found no association between female sex and PTSD symptoms (Einvik et al., 2021)	1 PD study found no association between age and PTSD symptoms (Einvik et al., 2021)	1 PD study found no association between number of comorbidities and PTSD symptoms (Einvik et al., 2021)	1 PD study found COVID-19 severity was associated with PTSD symptoms (Liu et al., 2020)	1 PD study found receipt of ventilation not correlated with PTSD symptoms, but receipt of corticosteroids was associated with lower risk of PTSD symptoms (Liu et al., 2020) 1 PD study found duration of hospitalization associated with better PTSD symptoms (Mazza et al., 2021)
Obsessive-compulsive	1 PD study found females had worse obsessive-compulsive symptoms (Mazza et al., 2021)	No data	No data	No data	1 PD study found duration of hospitalization associated with better obsessive-compulsive symptoms (Mazza et al., 2021)
Sleep disorders	1 PD study found females had worse insomnia symptoms (Mazza et al., 2021)	No data	No data	No data	1 PD study found duration of hospitalization associated with better insomnia symptoms (Mazza et al., 2021)

Abbreviations: DH = During hospitalization; PD = Post-discharge; PTSD = Post-Traumatic Stress Disorder.
This table presents findings from studies of ≥ 200 participants that were rated as either fair or good quality. The table does not include studies of < 200 ppts. Chen et al. (2021) and Wang et al. (2021) were excluded from table as they were rated as poor quality.

19 patients who were readmitted. The authors reported that 3 out of 19 (16%) readmitted patients had a psychiatric illness as their reason for readmission. Of note, 2 of those 3 patients had psychiatric illness at their initial presentation to the hospital.

A final, poor-quality study (Li et al., 2020) found 59% of hospitalized patients reported at least some need for psychological guidance in rehabilitation; however, the study does not provide any additional information on what is meant by "guidance." Evidence is therefore insufficient to draw conclusions on MH care resource needs (insufficient SOE).

4. Discussion

The aim of this systematic review was to assess the prevalence and incidence of MH disorders among patients during and after COVID-19 hospitalization. Although previous systematic reviews have examined the prevalence of MH disorders during the COVID-19 pandemic, they have either focused on general populations (Vindegaard and Benros, 2020; Xiong et al., 2020) or evaluated hospitalized patients with COVID-19 together with SARS and MERS patients (Rogers et al., 2020). This review builds upon this work by specifically examining MH disorder prevalence and MH care utilization and resource needs for patients hospitalized for COVID-19, who may have unique risk factors for poor MH outcomes as well as different MH resource needs.

The best available evidence from 19 articles indicates there may be a high prevalence of MH symptoms during and in the 3 months after hospitalization for COVID-19 (9–66% of patients may experience depression symptoms, 30–39% anxiety symptoms, 24–40% insomnia symptoms, 20–26% obsessive-compulsive symptoms, and 10–15% PTSD symptoms). However, the incidence of receiving a new MH disorder diagnosis in the 6 months after hospitalization is probably much lower than the reported symptom rate (range of 2–7% of patients were diagnosed with substance use, insomnia, anxiety, or mood disorder for the first time). These data suggest that while many patients may experience MH symptoms after hospitalization for COVID-19, most do not go on to develop a new MH disorder. As with any serious medical condition, clinicians should provide patients who were recently hospitalized for COVID-19 with general MH resources (*eg*, stress management strategies; local MH contact information in case of new, persistent, or worsening MH symptoms). Furthermore, hospitalization for COVID-19 may represent a point of contact for patients who do not frequently utilize healthcare services, which provides clinicians with a unique opportunity to screen these patients for MH disorders and refer to MH services when needed.

Hospitalized COVID-19 patients are probably at a slightly elevated risk of receiving a first MH disorder diagnosis 6 months after COVID-19 diagnosis compared to outpatients with COVID-19. Because we did not find studies comparing hospitalized COVID-19 patients to patients hospitalized for other reasons, we do not know if this increased risk is due to hospitalization for COVID-19 specifically or hospitalization generally. Furthermore, although there have been case reports (Belluck, 2020; Parra et al., 2020) of psychotic episodes following COVID-19 diagnosis, the incidence of receiving a new psychotic disorder diagnosis in the 6 months following hospitalization for COVID-19 is likely extremely low (around 1%) (Taquet et al., 2021a). It is noteworthy, however, that the risk is higher in hospitalized patients than outpatients (HR 2.77 [1.99–3.85]). Overall, clinicians should be aware that hospitalized patients may be at slightly elevated risk of developing new MH disorders than outpatients with COVID-19, and that some patients may develop a psychotic disorder after hospitalization for COVID-19. However, psychosis is extremely rare.

Relatively few studies reported on differences in MH outcomes by patient characteristics, COVID-19 disease severity, and level of care. However, preliminary findings from these studies indicate female sex and COVID-19 severity are the demographic and disease characteristics most consistently associated with worse MH outcomes. Other studies conducted during the COVID-19 pandemic have similarly found that women (including women who work in emergency departments and women in general populations) experience worse MH symptoms than their male counterparts (González-Sanguino et al., 2020; Rodriguez et al., 2021). Given women are more likely to report and seek help for MH symptoms than men (World Health Organization, 2021) these findings could be the result of sex-related reporting biases, rather than a true difference in symptoms. It is also not surprising that COVID-19 severity was associated with worse MH symptomology, given treatment of severe COVID-19 requires isolation from family and friends and potentially invasive medical treatments. Studies had mixed findings on other demographic, disease, and treatment characteristics such as older age, duration of hospitalization, and receipt of specific treatment such as ventilation and corticosteroids, with some studies showing an association with MH outcomes and others showing no association. Of note, several studies found that older patients had worse depression symptoms during COVID-19 hospitalization than younger patients (Jiang et al., 2020; Sahan et al., 2021). The association between older age and symptoms of depression during hospitalization is not surprising given the well-known finding that older adults are more likely to die if they contract COVID-19 (Centers for Disease Control and Prevention, 2021a; Yanez et al., 2020).

Although no studies reported the prevalence or severity of MH disorders among hospitalized COVID-19 patients by race/ethnicity, the percentage of hospitalized patients who were Black and Hispanic was disproportionately high in two studies (Atalla et al., 2020; Taquet et al., 2021a, 2021b). This observation aligns with a 2021 evidence review that found Black and Hispanic populations are at higher risk of hospitalization from COVID-19 than white populations (Mackey et al., 2021). Given these disparities, future research is needed to better understand how hospitalization for COVID-19 impacts the development and/or exacerbation of MH disorders specifically among Black and Hispanic populations.

4.1. Systematic review limitations

The main limitation of our systematic review methods was that we had a single reviewer assess articles for inclusion, abstract data, and assess study quality, with a second reviewer verifying selection and abstraction. This could have resulted in missing eligible studies or data, although we attempted to reduce this risk by establishing explicit inclusion criteria for studies, developing and using a piloted data abstraction tool, and developing a key for determining whether a study met each of JBI's quality criteria (Appendix E).

A second limitation of our rapid review methods is that we focused our synthesis on the 19 articles of $\geq$ 200 participants that provided the best available evidence, rather than all 50 articles. As a result, we do not include an exhaustive account of all results reported by all studies. Given that studies of $\geq$ 200 participants likely have more reliable estimates of prevalence than the smaller studies published on this topic to date, we likely captured the most reliable estimates of MH disorder prevalence among patients hospitalized for COVID-19.

4.2. Limitations of included studies and implications for future research

There were several important limitations of the articles synthesized in this review. As described in the "Results" section, only 2 articles (Taquet et al., 2021a, 2021b) of 1 study were rated as being good-quality. The other 16 studies were rated as fair- or poor-quality, with common methodological limitations including not reporting or accounting for the prevalence of preexisting MH disorders in analyses, limited information on other medical comorbidities that could be confounders, and limited information on the severity of COVID-19 and how COVID-19 status was ascertained among participants. An additional limitation of the literature is that with few exceptions, studies either examined MH symptoms or MH diagnoses, but not both. As a result, our

finding that most people who experience MH symptoms probably do not go on to develop a new MH diagnoses is based on an indirect comparison of two separate bodies of literature. A future longitudinal study should examine both sets of outcomes to provide more robust evidence on the course of MH symptoms and disorders both during and after hospitalization.

Furthermore, while the overall proliferation of studies on MH outcomes among patients with COVID-19 is remarkable, there remain important knowledge gaps that should be informed by future research. First, few studies reported whether participants had preexisting MH disorders. This is problematic because the prevalence of post-hospitalization MH disorders is likely influenced by the prevalence of pre-hospitalization MH disorders. For cross-sectional studies, researchers should at minimum report the proportion of participants with specific preexisting MH disorders. For comparative cross-sectional studies or longitudinal studies, researchers should report the proportion of participants with specific preexisting MH disorders for each comparison group. Ideally, researchers would account for preexisting MH disorders in prevalence estimates (e.g., by separately reporting the proportion of participants with MH disorders among those who had preexisting disorders and the proportion of participants with new-onset MH disorders, and by estimating adjusted prevalence or risk ratios).

Second, studies rarely compared patients hospitalized for COVID-19 to relevant comparison groups, such as the same patients prior to hospitalization or to patients who were similar but hospitalized for other causes. Comparing the incidence of new MH disorder diagnoses in the 6 months after hospitalization to the incidence 6 months before hospitalization could help determine to what extent new MH diagnoses are attributable to COVID-19 (either because of pandemic-related factors or due to hospitalization for the illness). Comparing patients hospitalized for COVID-19 to patients hospitalized for other causes could help determine to what extent MH outcomes are due to being ill with COVID-19 specifically versus the experience of being hospitalized. Future research should explore these comparisons.

Finally, while we identified two studies that provide some information about MH care needs of COVID-19 patients after hospitalization, the studies were small and rated as poor quality. Future researchers should survey or interview patients with COVID-19 about what types of MH support they would like, both short and long-term.

4.3. Evolving nature of COVID-19 and MH

Due to the different ways the pandemic is evolving, factors such as vaccination, treatment, variants, and policy changes could influence MH outcomes for patients hospitalized for COVID-19. As an example, some healthcare systems are allowing patients hospitalized for COVID-19 to have a single visitor per day (Cleveland Clinic, 2021). Being able to see family and friends has the potential to reduce depression, anxiety, and PTSD symptoms among hospitalized COVID-19 patients. Additionally, the knowledge that treatments are available could contribute to lower stress and anxiety among patients hospitalized for COVID-19 more recently, compared to those hospitalized closer to the beginning of the pandemic. On the other hand, numerous variants of the SARS-CoV-2 virus have emerged and received considerable press in recent months, some of which may be associated with more serious illness (Centers for Disease Control and Prevention, 2021b). As a result, it will be important for researchers to continue to evaluate MH outcomes among those hospitalized for COVID-19, especially in places with high rates of hospitalizations. Regardless of the way COVID-19 evolves, continuous assessment of the impact of COVID-19 hospitalization on MH outcomes will be critical to ensuring the needs of these patients are met.

5. Conclusions

Evidence from primarily fair-quality studies suggests that many patients experience MH symptoms such as depression, anxiety, and insomnia during and in the 3 months following hospitalization for COVID-19. However, patients infrequently receive a new MH disorder diagnosis in the 6 months following hospitalization. Some patients (such as women and those with more severe COVID-19) may be at higher risk of poor MH outcomes. Future research should compare patients hospitalized for COVID-19 to similar patients hospitalized for other reasons and evaluate MH treatment utilization and resource needs following hospitalization.

Declaration of Competing Interest

Authors declare they have no conflicts of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jadr.2022.100312.

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