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## **Sleep problems in patients with diabetes mellitus during the pandemic COVID-19: A systematic review**

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**Abstract**---Introduction The COVID-19 pandemic have a negative impact on sleep in people with diabetes mellitus, which can lead to other health problems. The aimed of this study is to synthesize the available evidence regarding sleep problems in people with diabetes mellitus during the COVID-19 epidemic. Methods: We performed a systematic search of five databases: Science Direct, EBSCO, Scopus, Sage, and ProQuest, to identify previous studies. Studies that enrolled adults with diabetes mellitus, sleep problems, and COVID-19 were published between 2019 and 2021, and used English or Indonesian were included. Results: We identified 819 articles, and fourteen studies met the review's inclusion criteria. The prevalence of sleep disorders ranged from 19.2% to 74.2%. Sleep disturbances have been shown in the majority of studies to have an effect on glycemic control in people with diabetes during COVID-19 pandemic. Conclusions: Sleep disorders in people with diabetes during the COVID-19 pandemic were caused by physiological factors and had a negative impact on glycaemic control. In summary, during the COVID-19 pandemic, sleep disturbances were extremely common in people with

diabetes. To address sleep disturbances, specific health strategies should be implemented.

**Keywords**---COVID-19 pandemic, diabetes mellitus, sleep disorders.

## **Introduction**

Since 2019, the rapidly spreading Coronavirus Disease 2019 (COVID-19) has emerged as a global threat (1). The rapid mutation of the virus has caused many countries in the world to experience several waves of attacks from the COVID-19 pandemic. Viral infection causes acute respiratory syndrome with the chief complaints of fever, cough, and shortness of breath, leading to death. This condition also has an impact on the psychological aspect. Psychological impacts caused by COVID-19 include anxiety (42%) (2), sleep disturbances (57.1%) (3), and depression (4).

Globally, sleep disturbances occurred in 35.7% of individuals during the COVID-19 pandemic, with the most affected groups being COVID-19 patients (74.8%), followed by healthcare workers (36.0%), and the general population (32,3%) (3). Other data states that as many as 52% of COVID-19 patients show severe sleep disturbances (5). Meanwhile, another study found a higher percentage, namely 76% of COVID-19 survivors who had long COVID-19 symptoms for 6 months after being declared cured of COVID-19 infection (6).

The process of isolation and quarantine can be associated with increased stress and psychological pressure that have an impact on sleep disturbances (7). Sleep disturbances such as difficulty sleeping, insomnia, frequent awakenings, early waking, reduced sleep time, and nightmares lead to decreased sleep quality (8). Sleep disturbances hinder the restoration of body functions, cause fatigue easily, waste energy, affect physical strength and emotional reactions such as irritability, headaches, and decreased appetite (9). People become irritable, the use of alcohol and sleeping pills increases. Psychologists reveal that poor sleep quality will have an impact on biopsychosocial health, affecting physiological functions, mental health, physical condition and the immune system (10).

Many factors affect sleep quality such as stress, financial problems, decreased physical activity, tension, and anxiety (11), symptoms of COVID-19 experienced, age, gender (12), reduced income and lack of social support (13). Research conducted in the UK shows that sleep disturbances are influenced by social isolation factors, COVID-19 status, changes in daily habits (14). Meanwhile, research conducted in Jordan linked poor sleep quality and decreased sleep duration with stress and anxiety during isolation (7). Furthermore, this problem is predicted to be higher in patients who have comorbidities such as high blood pressure, diabetes, and heart disease. Previous studies found sleep disturbances occurred in 41.1% of COVID-19 patients with comorbid diabetes mellitus compared to 18.3% without comorbid (15). Despite this, research on sleep disturbances in persons with diabetes is scarce, and there have been no systematic reviews of sleep disorders in specific populations of people with diabetes. The need to perform an assessment of the impact sleep disturbances

have on people with diabetes during this pandemic has become more urgent. As a result, the purpose of our study was to investigate sleep disorders in people with diabetes and their impact on other health outcomes.

## Methods

A systematic review was conducted to compile and synthesize data on sleep disruptions in patients with diabetes mellitus during the COVID-19 pandemic. The assessment of study quality was guided by the Centre for Review and Dissemination and the Joanna Briggs Institute (JBI) Guideline. The systematic review was evaluated using the PRISMA checklist, which details the items that should be included when reporting and assessing a systematic review (16).

## Search strategy

We performed a systematic search of five databases: Science Direct, EBSCO, Scopus, Sage, and ProQuest to search for relevant studies between January and February 2022. The PICOS question framework was utilized to formulate the research topic (Table I). The following studies were included in the review: (1) All sorts of studies, both experimental and non-experimental, done in the COVID-19 pandemic; (2) Interventions used sleep as a variable to measure; and (2) Outcomes linked to sleep disorders in patients with diabetes mellitus. The search algorithms for each database were improved via trial and error and consulting with a specialist in systematic review strategies. Medical Subject Headings (MeSH) keywords and Boolean operators AND, OR, and NOT were used in the literature search. The following criteria were used to develop the search strategy: COVID-19 OR 2019-nCoV OR “2019 coronavirus” OR “Wuhan coronavirus” OR “2019 novel coronavirus” OR SARS-CoV-2 AND sleep OR “sleep disturbances” OR “sleep disorders” OR “sleep problems” AND diabetes OR diabetic OR “diabetes mellitus”. The search was restricted to cross-sectional, cohort, and intervention studies published in Indonesian or English between 2019 and 2021. The time limit was established to ensure that researchers had access to the most recent studies in nursing and health.

Table 1. The PICOS format of this study

Criteria	Inclusion	Exclusion
Population	Adults (> 18 years of age) who have been diagnosed with any type of diabetes mellitus	
Intervention	Sleep problems	Irrelevant with sleep problems
Comparators	No comparators or usual care for RCT studies	
Outcomes	Analysis of sleep problems in people with diabetes mellitus during the pandemic COVID-19	Not analysis sleep problems
Study design and	Cross-sectional, cohort,	Case studies, qualitative

publication type	and intervention studies	studies
Publication years	Between 2019 and 2021	Pre 2019 and post 2021
Language	English/Bahasa (Indonesian)	Language other than English or Bahasa (Indonesian)

### **Assessment of study quality and risk of bias**

Each study's methodology was evaluated using the appropriate JBI Critical Appraisal for each type of study. The checklist for research that was appropriate included a variety of assessment criteria. Each criterion was assigned a score of "yes", "no", "unclear", or "not applicable", and each criteria assigned a score of "yes" received one point. Each research score was then calculated. Researchers conducted a critical appraisal to determine whether studies were eligible. Studies were included in the review if they received a score of at least 50% during critical assessment, which was the planned cut-off value agreed upon by both researchers. The researchers omitted low-quality papers to avoid jeopardizing the validity of the review's findings and recommendations. During the most recent screening, fourteen studies achieved a score greater than 50% and were prepared to conduct data synthesis.

### **Data extraction and analysis**

Following information was extracted in order to answer the review question: author, country, year, setting, research objective (including time period), study design, sampling method, participant description, reliability and validity of measurement instruments, statistical techniques, and outcomes (including results analysis and interpretation). We used a narrative approach to synthesize the data in this systematic review in order to better understand the various studies' similarities and differences as a whole.

## **Results**

### **Search outcomes**

There were 819 articles found that matched the criteria. The titles and abstracts of the 431 studies that remained were reviewed for inclusion and exclusion criteria after any duplicates had been removed. The quality of the 14 articles that met the inclusion criteria was assessed by reading the full text of each article. As a result, a total of 14 papers with low to moderate risk of bias were included in the systematic review (Table II). The flowchart of the clinical studies review following PRISMA 2020 statement process is depicted in Fig. 1 above. As a result, we conducted a systematic review to summarize the findings from all papers included. The Table II summarizes the research included in this review.

Table II Summary of included studies

Author and Year	Country	Design	Sample (n)	Results	Risk of bias
Janine Alessi <i>et al.</i> , (2020)	Brazil	Cohort	120	Nearly 43% of patients showed signs of significant psychological distress, with patients with type 2 diabetes having a significantly higher tendency. 29.2% of patients had emotional distress related to their diabetes, 75.8.7% of them had an eating disorder, and 77.5 percent of them had a sleeping disorder that was either moderate or severe.	Low
Ghosh <i>et al.</i> , (2020)	India	Cross-sectional	150	Nearly eighty-seven percent of patients report significant mental health issues. 10% and 27% of patients reported feeling 'low' and having difficulty sleeping, respectively.	Low
Khare and Jindal, (2020)	India	Cohort	143	The most common cause of hyperglycemia worsening was psychological stress, followed by changes in diet and exercise.	Moderate
Sankar <i>et al.</i> , (2020)	India	Cross-sectional	110	Stressed-out individuals, as well as those who slept poorly, had poor dietary habits. Those with less physical activity and a poor diet had poorer glycemic control.	Low
Kovil <i>et al.</i> , (2020)	India	Cross-sectional	343	Nearly one-fourth of participants with adequate sleep duration were between the ages of 18 and 60 years, whereas there was little change in the number of people older than 60 years who had adequate sleep duration even while in locked down.	Low
Sujan <i>et al.</i> , (2021)	Bangladesh	Cross-sectional	928	People who smoked cigarettes, were younger, thought they were in poor health, and had other diabetes problems were more likely to have a high COVID-19-specific diabetes worry score. COVID-19 specific diabetes worry was also linked to a lack of social support from family, friends, work colleagues, and the diabetes care team, as well as eating more than usual, which was also a big deal.	Low
Rowlands <i>et al.</i> , (2021)	United Kingdom	Cross-sectional	165	Overall physical activity was lower and inactive time was higher when people were on restrictions, but there was no statistically significant change in the amount of time spent on MVPA or sleep.	Low
Orioli <i>et al.</i> , (2021)	Belgium	Cohort	73	There was a greater prevalence of obesity, hypertension, obstructive sleep apnea, and CKD in patients with (mostly type 2) diabetes than in patients without diabetes of the same age and gender.	Low
Chandrasekaran, Velure Raja Rao and Sathish, (2021)	India	Cohort	102	Surviving patients had a higher rate of sleep disorders than non-surviving patients: 31.9% vs. 21.2%. People with pre-diabetes are particularly vulnerable to COVID-19's health consequences.	Low
A Tiwari <i>et al.</i> , (2021)	India	Cross-sectional	1346	Stressed patients slept less, ate less healthily, and their blood sugar levels were out of control. Controlled blood sugar levels resulted in healthier lifestyles, including regular exercise and a good night's sleep.	Moderate
Munekawa <i>et al.</i> , (2021)	Japan	Cross-sectional	203	HbA1c levels fluctuated more rapidly in patients who complained of sleep disorders.	Low
Alessi <i>et al.</i> , (2021)	Brazil	Randomized controlled trials	91	The intervention group had a distress rate of 21.7%, while the control group had a distress rate of 42.2%. Eating and sleeping disorders were found to be similar between groups.	Low
Kang <i>et al.</i> , (2021)	China	Randomized controlled trials	440	People with DM are more likely to suffer from mental health issues and sleep disorders than the general population. Anxiety or depression disorders affected 8.9% of patients, sleep disorders affected 22.8%, and health problems resulting from psychological stress affected 21.6 percent of patients.	Low
Dissanayake <i>et al.</i> , (2022)	Sri Lanka	Cross-sectional	1727	Self-monitoring of blood glucose, exercise, medication use, dietary adherence, and family income were all associated with worsening blood sugar levels, according to the research. Only 4.1% of patients used telehealth services, but 83.1% expressed satisfaction with their experience.	Moderate

## Study Characteristics

Fourteen articles met the inclusion criteria (Fig. 1). This review included 3 types of articles: 8 cross-sectional studies (17–24), 4 cohort studies (25–28), and 2 randomized controlled trials (29,30). The sample sizes of the included studies ranged from 73 to 1727 participants, for a total sample size of 7168. In general, every study discussed sleep disorders, or at least one of the variables measured was sleep disturbances in diabetes mellitus patients, whether confirmed positive for COVID-19 or not. Only 4 studies included diabetes mellitus patients who were confirmed positive for COVID-19 using reverse transcription polymerase chain reaction (RT-PCR) (20,26,27,29), while others did not. The majority of studies involved participants with type 2 diabetes (17,21–26,29); two included participants with type 1 and type 2 diabetes (19,28); three included participants with type 1, type 2, gestational, and other types of diabetes mellitus (18,20,30); and one included participants with pre-diabetes (27). 6 studies were conducted in India (20–22,24,25,27), 2 in Brazil (28,29), and other studies were conducted in the United Kingdom (17), Bangladesh (18), Sri Lanka (19), Belgium (26), Japan (23), and China (30).

## Sleep problems in people with diabetes

The prevalence of sleep disorders ranged from 19.2% to 74.2%, depending on the studies included in this review. Three studies found that sleep problems were not statistically significant in any of the subjects (17,18,27). Therefore, other research showed that sleep disturbances significantly occurred in people with diabetes during the COVID-19 pandemic (23,24,31). Furthermore, studies indicated that the existence of pre-existing OSA in COVID-19 patients is a prevalent comorbidity, and a significant incidence of obstructive sleep apnea (OSA) was

discovered in adults with diabetes, according to the findings of two investigations (20,26).

### **Sleep problems in patients with diabetes and confirmed COVID-19**

Four studies included diabetes mellitus patients who were confirmed positive for COVID-19 using reverse transcription polymerase chain reaction (RT-PCR) (20,26,27,29). In people who have diabetes, treated OSA was found to be independently related with an increased risk of death on day 7 (20). Patients with diabetes (mainly type 2) exhibited a higher prevalence of OSA (26). Sleep disturbances were more prevalent in those who tested positive for COVID-19 than in those who tested negative for COVID-19 (27).

### **Physical activity and sleep**

A total of seven studies investigated physical activity (17,19,21,23,24,30,31). Most of these studies found a decrease in physical activity during the pandemic (17,19,21,23), whereas one study found no change (24). People with reduced physical activity tend to experience sleep disturbances. In addition, other studies have shown that people who exercised regularly had controlled blood glucose levels (31).

### **Psychological**

There was a significant correlation between sleep difficulties and COVID-19-specific diabetes worries in the study participants (18). Those who were less anxious about the spread of the epidemic had a better night's sleep (24). Among older age groups and females, sleep quality was also negatively impacted. However, those who had higher levels of mental stress and poorer sleep habits had more unhealthy eating patterns. Females and those in their 60s and older were more affected by the pandemic's spread than younger people. According to studies, 27% of individuals felt stressed, and 14.7 percent and 30.8 percent, respectively, indicated changes in their eating and sleep patterns (31). Changes associated with the COVID-19 pandemic, including increased body weight and HbA1c levels (23).

### **Glycemic control**

Studies reported that increased night time sleep and increased time on indoor exercise were more likely to have improved glycaemic control (19). Patients who experienced hyperglycemia majorly reported psychological stress and decreased sleep (25). Gender and age did not have an effect on adherence to treatment, SMBG fasting and postprandial glucose management, and SMBG monitoring. However, male individuals showed a greater improvement in glycemic variables (21). Stressed patients slept less, had altered food habits, and had uncontrolled blood sugar levels (31). On the other hand, people who were not stressed spent time with their families and pursued hobbies. Individuals with well-controlled blood sugar levels exercised more and slept normally. Additionally, a study found that the absence of physician counseling can result in patients getting uncontrolled blood sugar levels (30). However, diabetes treatment faces new

obstacles in the face of the COVID-19 epidemic and is constrained by traditional treatment options. A previous review found that remote management, such as mobile-app-based diabetes management tools, has been shown to have a positive effect on patients' health (32). Thus, the use of digital technology can be used as an alternative to improve glycemic control for people with diabetes during a pandemic.

## **Discussion**

To the best of our knowledge, this is the first study to examine the impact of the COVID-19 pandemic on sleep disturbances in people with diabetes. In this review, most of the studies showed that the prevalence of sleep disorders was quite high in people with diabetes mellitus during the COVID-19 pandemic (17,18,23,24,27,31). Similar to previous study which showed that inadequate sleep was found to be more common in people with diabetes than in people without diabetes, and it was found to be associated with poor health (33). Sleep disturbances can manifest themselves as an early symptom, or as part of a prodrome, of the depressive or anxiety disorder that it can precipitate. In the same way, sleep disorders can occur as comorbid disorders that develop from undiagnosed mental health conditions can also be found in people. Aside from that, anxiety and depression have a two-way relationship with the quantity and quality of sleep. Continuously poor sleep quality will result in decreased daytime function, emotional instability, and mental fatigue, all of which will increase the risk of depression and anxiety in the future (34). Furthermore, it is well-known that anxiety, depression, and sleep disturbances are all intertwined, with each influencing and triggering the others. According to the findings, the COVID-19 pandemic has a negative impact on people's psychological health and sleep, which is consistent with previous research (3,35). These findings emphasize the significant importance of promoting the health and wellness of diabetic individuals during COVID-19.

The high prevalence of sleep problems found in this study can be attributed to a combination of factors, including fear of COVID-19 and sleep-related factors (e.g., changes in daily activity, having depression or anxiety due to quarantine or lockdown). Indeed, research conducted prior to the outbreak of a pandemic has revealed that individuals may experience sleep problems when confronted with a major health threat such as lockdowns, social restrictions, and other activities to prevent the spread of COVID-19 (3). Additionally, the presence of obstructive sleep apnea (OSA), a high body mass index (BMI), nocturnal hypoglycemia episodes, staying at home for longer periods of time, participating in fewer physical activities, and having irregular sleep schedules all play a significant role in this variable, particularly among people with diabetes (36). Therefore, diabetic patients require special attention in the COVID-19 pandemic context, not just physically but also holistically.

Sleep disturbances were more prevalent in those who tested positive for COVID-19 than in those who tested negative for COVID-19 (27). Patients with diabetes (mainly type 2) exhibited a higher prevalence of OSA (26) and treated OSA was found to be independently related to an increased risk of death on day 7 (20). In patients with OSA, the risk of COVID-19 infection is approximately eightfold that

of those without OSA (37). OSA is associated with a greater likelihood of hospitalization and a nearly twofold increased risk of respiratory failure in patients infected with COVID-19. In previous research, OSA has been linked to an increased risk of developing community-acquired pneumonia (38). This finding adds to the growing body of evidence that shows treated OSA is a risk factor for poor outcome in diabetic patients hospitalized with COVID-19. Therefore, further research is needed to find a solution to this finding.

A study reported that people who experienced hyperglycemia majorly reported psychological stress and decreased sleep (25). Other studies also found that stressed patients slept less, had altered food habits, and had uncontrolled blood sugar levels (31). Exogenous cycles during the pandemic have been found to impair individuals' sleep-wake cycles in a variety of ways, contributing to the reported inability of people with diabetes to maintain blood glucose control during the pandemic (39–41). As this review discovered, the majority of these studies discovered a decline in physical activity during the pandemic (17,19,21,23). Exogenous cycles, such as new routines, increased time spent watching television and surfing the internet, and decreased physical activity, can all contribute to glycemic control. As a result, we recommend that people with diabetes continue to live a healthy lifestyle during the pandemic, which includes physical activity, nutritious eating, and effective self-management.

## **Conclusions**

In this study, it was found that the prevalence of sleep disturbances was quite high in people with diabetes, both confirmed and not by COVID-19. There are numerous negative consequences to having sleep disturbances, both in terms of physical and psychological well-being and functioning. These consequences have an impact on one another and are interconnected in two-way relationships. Hence, future research should examine the broader range of factors that influence sleep disorders in diabetic patients, particularly those who have been confirmed positive for COVID-19, because the evidence is still limited.

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## **Conflict of interest**

No conflict of interest has been declared by the authors.

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### Figure legends

Fig. 1. PRISMA 2020 statement flowchart of included studies. The flowchart of the clinical studies review following PRISMA 2020 statement process is depicted in Fig. 1

