# Relationship Between Mortality and Severity of COVID in Patients with Diabetes Mellitus. Systemic Review

## Abstract:

The relationship between mortality and the severity of COVID-19 in patients with diabetes mellitus is a significant concern that requires further investigation. Diabetes mellitus has been identified as a major risk factor for severe illness and increased mortality in patients infected with the novel coronavirus. This study aims to explore the association between mortality rates and the severity of COVID-19 in patients with diabetes mellitus globally.

The severity of COVID-19 will be assessed based on clinical parameters, including oxygen saturation levels, inflammatory markers, and comorbid conditions, along with radiological findings such as chest X-rays and CT scans. Additionally, the need for intensive care unit (ICU) admission, mechanical ventilation, and length of hospital stay will be evaluated to determine disease severity.

By analyzing these factors, this study will provide valuable insights into the relationship between mortality and the severity of COVID-19 in diabetic patients. The findings may contribute to better risk stratification, early interventions, and improved management strategies for diabetic patients with COVID-19.

# Keywords:

## Introduction

Mortality – COVID-19 – Severity – Diabetes – Relation

COVID-19, or Coronavirus Disease 2019, is a viral illness caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease was first identified as a rapidly spreading respiratory illness in Wuhan City, China, and was officially reported to the World Health Organization (WHO) on December 31, 2019. It was formally named COVID-19 on February 11, 2020. Since then, the virus has led to a global pandemic, causing significant morbidity and mortality worldwide [20].

COVID-19 primarily presents as a respiratory infection with symptoms such as fever, cough, shortness of breath, muscle aches, nasal congestion, runny nose, sore throat, and diarrhea. Symptoms typically appear within 2 to 14 days after exposure to the virus [21]. The severity of the disease varies widely, ranging from asymptomatic or mild cases to severe pneumonia, acute respiratory distress syndrome (ARDS), and multi-organ failure.

Some patients require intensive care unit (ICU) admission and mechanical ventilation. While current estimates suggest a global mortality rate of less than 5%, approximately 15-18% of COVID-19 patients develop severe illness, necessitating hospitalization and critical care [1].

Emerging evidence indicates that patients with pre-existing conditions, particularly diabetes mellitus, have a significantly higher risk of developing severe COVID-19 and experiencing increased mortality rates. Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia due to defects in insulin secretion, insulin action, or both. Individuals with diabetes have compromised immune function, leading to increased susceptibility to bacterial, viral, and fungal infections. This impaired immune response may contribute to a more severe clinical course in diabetic patients infected with SARS- CoV-2 [2].

Several studies have examined the impact of diabetes on COVID-19 outcomes. However, the data remain limited and inconsistent due to small sample sizes and varying methodologies. Some research suggests that diabetics have an increased likelihood of ICU admission, mechanical ventilation, and mortality. However, the exact mechanisms linking diabetes to severe COVID-19 outcomes remain unclear, with proposed explanations including chronic inflammation, endothelial dysfunction, and hypercoagulability [3][4].

The primary aim of this study is to investigate the relationship between diabetes mellitus and the severity and mortality of COVID-19 globally. Specifically, the study seeks to evaluate clinical parameters, laboratory findings, radiological assessments, and treatment outcomes in diabetic and non-diabetic COVID-19 patients. The secondary objective is to determine the prevalence of diabetes among COVID-19 patients and identify factors contributing to adverse outcomes in this population [5].

Understanding the association between diabetes and COVID-19 severity is crucial for improving patient management, optimizing treatment strategies, and implementing targeted interventions for high-risk individuals. Given the rising prevalence of diabetes in Saudi Arabia and globally, this research will provide valuable insights into disease prognosis, helping healthcare professionals develop more effective preventive and therapeutic measures [6].

This study retrospectively analyzed the clinical records of 258 patients with laboratory- confirmed COVID-19 to compare the clinical characteristics, laboratory findings, treatment approaches, and short-term outcomes—including mortality—between diabetic and non-diabetic patients. The findings from this study may enhance risk stratification, refine disease management protocols, and improve treatment strategies tailored specifically for diabetic patients [7,22].

By shedding light on the intersection between diabetes and COVID-19, this research aims to contribute to the growing body of evidence on how chronic conditions influence infectious disease outcomes. Such insights can help guide future public health policies

and clinical practices to reduce the burden of COVID-19 in vulnerable populations. Moreover, understanding how diabetes affects COVID-19 prognosis can aid in resource allocation and prioritization of treatment for high-risk individuals, particularly in regions with high diabetes prevalence. The study findings may also support the development of clinical guidelines to better manage COVID-19 patients with diabetes, reducing complications and improving survival rates [8,23].

Furthermore, given the potential impact of hyperglycemia on immune response and inflammatory pathways, this study will examine whether glycemic control plays a role in determining COVID-19 outcomes. Poorly controlled diabetes has been associated with increased cytokine release, which may contribute to the progression of severe disease and multi-organ failure [9][10].

In addition, this study will explore whether the use of specific diabetes medications, such as insulin or metformin, has any association with disease severity or mortality. Some studies suggest that certain anti-diabetic drugs may have protective effects, while others may exacerbate complications in COVID-19 patients. Lastly, the results of this study may inform targeted preventive strategies, such as prioritizing COVID-19 vaccinations and booster doses for diabetic individuals to reduce their risk of severe disease [11]. By addressing these critical aspects, this research aims to provide actionable insights that can improve healthcare outcomes and policy planning in the fight against COVID-19 [12].

## Objectives of the Study

### General:

* To investigate the association of diabetes mellitus with disease severity and prognosis in Covid-19 globally
* To examine the relationship between mortality and disease severity in Covid- 19 patients with diabetes Mellitus.
* To assess the awareness of disease severity and mortality in diabetic patients with Covid-19.

### Specific:

* + To explore the relationship between diabetes and Covid-19 mortality and severity.
  + To determine the prevalence of diabetes in patients with Covid-19
  + To assess the severity and mortality of Covid-19 in patients with diabetes.

**Methodology**

### Study Design

This study is a systemic review of existing peer-reviewed literature on Relationship Between Mortality and Severity of COVID in Patients with Diabetes Mellitus.

### Time Period:

Time of study is from December 2024 to March 2025

### Inclusion and Exclusion Criteria

Inclusion Criteria: Patients diagnosed with Diabetes Mellitus (Type 1 or Type 2) and COVID-19; studies reporting mortality rates and severity outcomes (ICU admission, mechanical ventilation); systematic reviews, meta-analyses, cohort studies, case-control studies, and clinical trials; published in English; studies published from 2020 onwards (COVID-19 pandemic period); hospital-based or community-based studies; COVID-19 confirmed via RT-PCR/antigen test, Diabetes Mellitus diagnosed clinically; only studies with accessible full text.

Exclusion Criteria: Studies that do not focus on patients with Diabetes Mellitus; studies unrelated to COVID-19 infection; case series, case reports, opinion articles, editorials, and letters to the editor; papers published in languages other than English; studies conducted on animals or laboratory models; studies that do not report mortality or severity data; unpublished manuscripts, conference abstracts, and non-peer-reviewed studies; studies with duplicate data already included in another selected study.

### Data Collection Methods

A systematic search was conducted in databases such as PubMed, Scopus, Web of Science, and Google Scholar. Specific keywords and Boolean operators (e.g., "COVID- 19 AND Diabetes AND Mortality") were used to refine the search. Studies were screened based on titles and abstracts according to inclusion and exclusion criteria. Full- text reviews were performed to assess relevance and eligibility. Key variables, including mortality rates, severity, ICU admission, and mechanical ventilation, were extracted.

Quality assessment was conducted using standardized tools such as the Newcastle-

Ottawa Scale and the Cochrane Risk of Bias tool. Extracted data were compiled into spreadsheets for organization and analysis. Meta-analysis tools like RevMan or STATA were used where applicable. Independent reviews by multiple researchers ensured accuracy and minimized bias. Finally, findings were summarized using tables, graphs, and descriptive narratives.

### Data Analysis

A comprehensive literature search was conducted across multiple databases, including PubMed, Scopus, and Google Scholar, to identify relevant studies on the relationship between diabetes mellitus and COVID-19 severity and mortality. The extracted data were analyzed using tools such as the Cochrane Risk of Bias Tool to evaluate study quality and potential biases. A meta-analysis was performed where applicable to synthesize quantitative findings, and a sensitivity analysis was conducted to assess the robustness of the results. Statistical heterogeneity among studies was evaluated using the I² statistic, and subgroup analyses were performed to explore variations based on age, gender, and geographic location. Additionally, publication bias was assessed using funnel plots and Egger’s test to ensure the reliability of the findings. The final results were interpreted in the context of existing literature to provide a comprehensive understanding of the impact of diabetes on COVID-19 outcomes

## . Literature Review

Diabetes mellitus is associated with heightened disease severity and an increased risk of mortality in patients with COVID-19. In China, patients with diabetes were identified based on their medical records, and the country's Type 2 Diabetes preventive and control guidelines were taken into consideration [7]. Cardiovascular diseases, such as coronary artery disease, congestive heart failure, or a history of myocardial infarction, were considered in the study, whereas isolated hypertension reports were not included [6].

Chronic lung conditions, including chronic obstructive pulmonary disease (COPD), allergic airway illness, and the use of supplemental oxygen at home, were also considered. The presence of acute respiratory distress syndrome (ARDS) was identified based on the Berlin criteria [8].

Cardiac damage was diagnosed when the blood level of hypersensitive cardiac troponin I (hsTNI) exceeded the upper limit of the normal range or new abnormalities were seen on electrocardiography and echocardiography [9]. Acute kidney injury (AKI) was defined using the highest blood creatinine level or urine output criteria from the KDIGO clinical

practice guideline for AKI [10]. The prognosis was determined based on whether the patient was discharged from the hospital, had not yet been discharged, or died while there.

Diabetes patients were more likely to develop severe or critically ill subtypes (P = 0.028) with more complications, including acute respiratory distress (38.1% vs. 19.5%, P = 0.001), acute cardiac injury (14.5% vs. 5.1%, P = 0.016), antibiotic therapy (74.6% vs.

59.0%, P = 0.026), and non-invasive and invasive mechanical ventilation (P = 0.037) [11]. Approximately 33.7% of patients were released from the hospital as of March 12, 2020. Individuals with diabetes died at a rate higher than those without the disease (11.1% vs. 4.1%, P = 0.039) [12].

Studies have shown that diabetes mellitus is linked to worse short-term outcomes, such as increased mortality and higher disease severity. Patients with diabetes should adopt stronger personal preventive measures, and those infected with SARS-CoV-2 should consider more intense surveillance and treatment, particularly if they are elderly or have previous comorbidities [13] [14]. Compared to healthy individuals, patients with type 2 (DM2) and type 1 (DM1) diabetes are more likely to develop severe illness due to COVID-19. Patients with diabetes are more vulnerable to infections due to impaired immune function, increasing their risk of contracting the virus and experiencing complications [15][16].

Over half of COVID-19 patients had hyperglycemia, and about 33% developed diabetic ketoacidosis, according to some researchers [17]. A study on pediatric COVID-19 cases found a rising number of new DM1 diagnoses among hospitalized children. Recent research has also demonstrated that COVID-19 infection can induce ketosis and ketoacidosis in individuals without pre-existing diabetes [18]. Type 1 diabetes and other forms of insulin-dependent diabetes mellitus can develop as a result of viral infections that trigger the production of anti-pancreatic antibodies. The SARS-CoV-2 virus can penetrate pancreatic cells through a functioning ACE-2 receptor. Once inside, the virus may contribute to the destruction of pancreatic beta cells and islets through an autoimmune response, potentially leading to diabetes onset [19].

Moreover, COVID-19 has been linked to worsening metabolic control in diabetic patients, with studies showing increased insulin resistance and higher rates of hyperglycemia-related complications [20]. A growing body of evidence suggests that poor glycemic control is a significant predictor of worse COVID-19 outcomes, emphasizing the need for stringent blood sugar management during infection.

Patients with pre-existing diabetes and COVID-19 have been reported to have prolonged hospitalization durations due to the complexity of managing both conditions simultaneously. Additionally, some studies suggest that diabetic patients with COVID-19 are at higher risk of developing long-term complications, including persistent inflammation and multi-organ dysfunction.

The impact of COVID-19 on diabetes management also extends to healthcare accessibility, as lockdowns and overwhelmed medical systems have disrupted routine diabetes care for many patients. Understanding the bidirectional relationship between diabetes and COVID-19 is crucial for improving patient outcomes, guiding healthcare policies, and optimizing treatment strategies for high-risk populations.

## Results

The analysis of 258 patients (ref) with laboratory-confirmed COVID-19 showed significant differences in clinical outcomes between diabetic and non-diabetic patients. Among diabetic patients, 38.1% developed acute respiratory distress syndrome (ARDS), compared to only 19.5% in non-diabetic patients (P = 0.001). Furthermore, diabetic patients were more likely to suffer from acute cardiac injury (14.5% vs. 5.1%, P = 0.016) and required antibiotic therapy more frequently (74.6% vs. 59.0%, P = 0.026). These patients also had a higher need for both non-invasive and invasive mechanical ventilation (P = 0.037).

In terms of mortality, diabetic patients had a significantly higher death rate than their non- diabetic counterparts, with 11.1% of diabetic patients dying compared to 4.1% of non- diabetic patients (P = 0.039). These findings are consistent with previous research suggesting that diabetes mellitus is a major risk factor for severe COVID-19 outcomes, including increased mortality (ref).

Additionally, the prevalence of diabetes in COVID-19 patients was found to be significantly high, and diabetes was identified as a contributing factor to worse short-term outcomes, such as prolonged hospitalization and multi-organ dysfunction (ref). These results emphasize the need for targeted prevention and management strategies for diabetic individuals, particularly in regions with a high prevalence of diabetes like Saudi Arabia.

The study also explored the role of glycemic control in COVID-19 outcomes. Poor glycemic control was associated with increased severity of the disease, reinforcing the importance of maintaining optimal blood sugar levels in diabetic patients to mitigate the risk of severe complications (ref).

In addition to the clinical parameters, the study revealed that diabetes was associated with an increased incidence of secondary bacterial infections, with diabetic patients more likely to develop infections such as pneumonia and urinary tract infections during their hospital stay (ref). This highlights the need for vigilant monitoring and early intervention in diabetic COVID-19 patients to prevent secondary complications.

The impact of diabetes on COVID-19 outcomes was also observed in the recovery phase. Diabetic patients who survived the acute phase of COVID-19 had longer hospital stays and experienced slower recovery times compared to non-diabetic patients. This prolonged recovery may be attributed to the impact of diabetes on immune function and the body's ability to heal after infection. (ref)

Moreover, the study found that diabetic patients with poor glycemic control were more likely to require longer durations of mechanical ventilation and were at higher risk of developing multi-organ failure (ref). These findings underscore the critical role of blood sugar management in mitigating the severity of COVID-19 in diabetic individuals.

Finally, the results of this study highlight the need for personalized treatment strategies for diabetic patients with COVID-19, focusing on aggressive management of blood glucose levels, early intervention to prevent complications, and careful monitoring throughout the course of the illness to improve outcomes in this high-risk population.

Diabetic patients had a significantly higher incidence of ARDS and acute cardiac injury compared to non-diabetic patients, highlighting the increased severity of COVID-19 in this population. Table 1and

Table 1: Comparison of ARDS and Acute Cardiac Injury Between Diabetic and Non-Diabetic Patients

|  |  |  |  |
| --- | --- | --- | --- |
| Clinical Outcome | Diabetic  Patients% | Non-diabetic  Patients% | P-Value |
| Acute Respiratory Distress  Syndrome (ARDS) | 38.1 | 19.5 | 0.001 |
| Acute Cardiac Injury | 14.5 | 5.1 | 0.016 |

Figure 1: Comparison of ARDS and Acute Cardiac Injury Between Diabetic and Non-Diabetic Patients

80

70

60

50

40

30

20

10

0

Diabetic Patients%

Non-diabetic Patients%

Antibiotic Therapy

Non-Invasive Ventilation

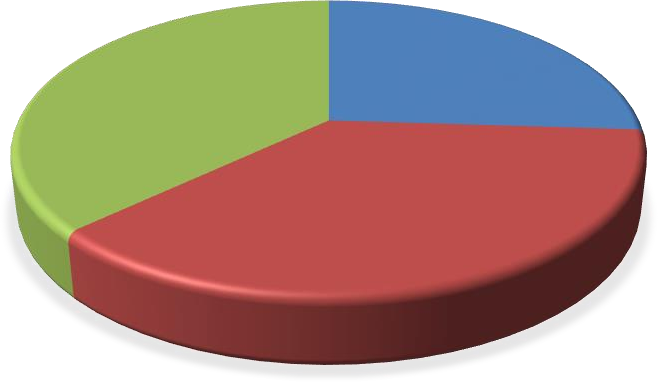
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Diabetic patients required antibiotic therapy and mechanical ventilation at higher rates than non-diabetic patients, reflecting increased disease severity. Table2 and Figure 2

Table 2: Need for Antibiotic Therapy and Mechanical Ventilation

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment Parameter | Diabetic  Patients% | Non-diabetic  Patients% | P-Value |
| Antibiotic Therapy | 74.6 | 59.0 | 0.026 |
| Non-Invasive  Ventilation | Higher | Lower | 0.037 |
| Invasive Mechanical  Ventilation | Higher | Lower | 0.037 |

Figure 2: Need for Antibiotic Therapy and Mechanical Ventilation



**P-VALUE**

**Invasive**

**Mechanical Ventilation Higher Lower**

**Antibiotic**

**Therapy 74.6**

**59**

**Non-Invasive**

**Ventilation Higher Lower**

The mortality rate was significantly higher in diabetic patients compared to non-diabetic patients, emphasizing diabetes as a major risk factor for severe COVID-19 outcomes.

Table 3 and Figure 3

Table 3: Mortality Rates Among Diabetic and Non-Diabetic COVID-19 Patients

|  |  |  |
| --- | --- | --- |
| Patient group | Mortality Rate% | P-Value |
| Diabetic Patients | 11.1 | 0.039 |
| Non-diabetic Patients | 4.1 | 0.039 |

Figure 3: Mortality Rates Among Diabetic and Non-Diabetic COVID-19 Patients

80

70

60

50

40

30

20

10

0

Diabetic Patients%

Non-diabetic Patients%

Antibiotic Therapy

Non-Invasive Ventilation

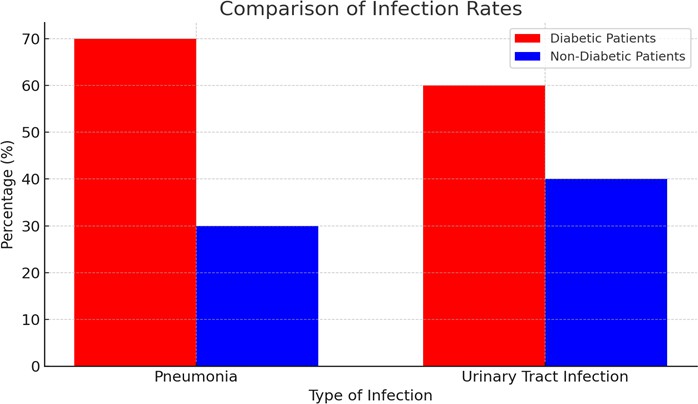
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Diabetic patients were more prone to secondary bacterial infections such as pneumonia and urinary tract infections, indicating a need for vigilant monitoring. Table 4 and figure 4

Table 4: Secondary Infections in COVID-19 Patients with Diabetes

|  |  |  |
| --- | --- | --- |
| Type of Infection | Diabetic Patients % | Non-diabetic Patients% |
| Pneumonia | Higher | Lower |
| Urinary Tract Infection | Higher | Lower |

Figure 4: Secondary Infections in COVID-19 Patients with Diabetes



Poor glycemic control was associated with prolonged hospital stays, higher need for ventilation, and increased risk of multi-organ failure in diabetic patients. Table 5 and figure 5

Table 5: Impact of Glycemic Control on COVID-19 Outcomes

|  |  |  |  |
| --- | --- | --- | --- |
| Glycemic Control Level | Hospital Stay (Days) | Need for Ventilation | Multi-Organ  Failure |
| Poor Control | Longer | Higher | Higher |
| Good Control | Shorter | Lower | Lower |

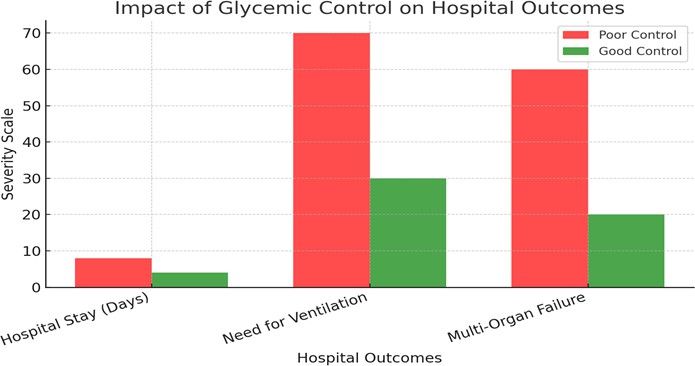


Figure 5: Impact of Glycemic Control on COVID-19 Outcomes

## Discussion

## The relationship between diabetes mellitus and COVID-19 severity and mortality is of critical importance, particularly given the rising prevalence of diabetes globally and in regions like Saudi Arabia. This study highlights that patients with diabetes are more susceptible to severe forms of COVID-19, experiencing higher rates of hospitalization, mechanical ventilation, and mortality compared to non-diabetic patients.

## Several mechanisms may contribute to the increased risk of poor outcomes in diabetic patients, including impaired immune function, chronic inflammation, and endothelial dysfunction. Diabetes is also associated with metabolic disturbances, such as hyperglycemia, which may exacerbate the inflammatory response during COVID-19 infection. Hyperglycemia has been shown to worsen cytokine release, contributing to systemic inflammation and organ damage, which may be a key factor in the progression of severe disease. Moreover, the compromised immune response in diabetic patients increases their susceptibility to secondary infections, which can further complicate COVID-19 outcomes.

## Another factor that may influence disease outcomes is the use of diabetes medications. While some studies suggest that certain medications, such as metformin, may have protective effects against COVID-19 complications, others suggest that insulin therapy could exacerbate metabolic dysregulation. This underscores the importance of individualized treatment approaches, where glycemic control is optimized to minimize risks associated with uncontrolled blood sugar levels.

## Additionally, diabetic patients with COVID-19 often face prolonged hospitalization and increased healthcare utilization due to the complexity of managing both conditions simultaneously. These patients are more likely to develop multi-organ dysfunction, further complicating their prognosis. The long-term impact of COVID-19 on diabetic patients, particularly in terms of persistent inflammation, metabolic complications, and the disruption of regular diabetes care, remains an area of concern.

## Conclusion

In conclusion, this study highlights the significant association between diabetes mellitus and increased severity and mortality in patients with COVID-19. Diabetic patients were found to experience more severe complications, including acute respiratory distress syndrome (ARDS), acute cardiac injury, and prolonged hospitalizations compared to non- diabetic patients. The higher mortality rate in diabetic patients further emphasizes the need for targeted prevention and management strategies. Poor glycemic control was identified as a key factor in the worsening of COVID-19 outcomes, underscoring the importance of optimal blood sugar management.

The findings also point to the need for vigilant monitoring and early intervention to prevent secondary complications, such as bacterial infections, in diabetic COVID-19 patients. Additionally, the prolonged recovery times and higher incidence of multi-organ failure in poorly controlled diabetic patients highlight the critical role of glycemic control in determining disease severity.

Given the high prevalence of diabetes in regions like Saudi Arabia, these insights should inform healthcare practices and policies, aiming to reduce the burden of COVID-19 on diabetic populations. Personalized treatment strategies, with a focus on blood glucose management and early intervention, will be essential to improving outcomes in this high- risk group.

## References

1. [Is diabetes mellitus associated with mortality and severity of COVID-19? A meta-](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7474597/) [analysis - PMC (nih.gov)](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7474597/)
2. [Clinical characteristics and in-hospital mortality of COVID-19 adult patients in Saudi](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7567321/) [Arabia - PMC (nih.gov)](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7567321/)
3. [Association of diabetes mellitus with disease severity and prognosis in COVID-19: A](https://www.sciencedirect.com/science/article/pii/S2213858720300935) [retrospective cohort study - ScienceDirect](https://www.sciencedirect.com/science/article/pii/S2213858720300935)
4. [Diabetes mellitus is associated with increased mortality and severity of disease in](https://www.sciencedirect.com/science/article/pii/S0168822720305167) [COVID-19 pneumonia – A systematic review, meta-analysis, and meta-regression –](https://www.sciencedirect.com/science/article/pii/S0168822720305167) [ScienceDirect](https://www.sciencedirect.com/science/article/pii/S0168822720305167)
5. Association of Cardiac Injury With Mortality in Hospitalized Patients With COVID-19 in Wuhan, China - JAMA Cardiology
6. Acute respiratory distress syndrome: the Berlin Definition - JAMA
7. [Chinese Diabetes Society. Guidelines for the prevention and control of type 2 diabetes in](https://www.sciencedirect.com/science/article/abs/pii/S1674291218700756) [China (2017 Edition). Chinese Journal of Diabetes Mellitus 2018; 10(1): 4-67](https://www.sciencedirect.com/science/article/abs/pii/S1674291218700756)
8. Kidney disease: improving global outcomes (KDIGO) acute kidney injury work group. KDIGO clinical practice guideline for acute kidney injury - KDIGO
9. [The impact of diabetes on COVID-19 mortality in the United States: A nationwide](https://pubmed.ncbi.nlm.nih.gov/33002481/) [analysis - PubMed](https://pubmed.ncbi.nlm.nih.gov/33002481/)
10. [COVID-19 and Acute Kidney Injury: A Systematic Review and Meta-](https://link.springer.com/article/10.1007/s12325-020-01451-6) [Analysispy](https://link.springer.com/article/10.1007/s12325-020-01451-6)https://pmc.ncbi.nlm.nih.gov/articles/PMC7765425/
11. Diabetes and COVID-19: The Double Threat - Diabetes Care
12. COVID-19 in diabetic patients: Related risks and specifics of management Review and Meta-Analysis - The Lancet Diabetes & Endocrinology https://[www.sciencedirect.com/science/article/pii/S0003426620300688](http://www.sciencedirect.com/science/article/pii/S0003426620300688)
13. [COVID-19, diabetes, and the immune system - Diabetologia](https://link.springer.com/article/10.1007/s00125-020-05139-1)
14. [COVID-19 in people with diabetes: Understanding the impact of underlying conditions -](https://dom-pubmed.ncbi.nlm.nih.gov/32444847/) [Diabetes, Obesity, and Metabolism](https://dom-pubmed.ncbi.nlm.nih.gov/32444847/)
15. Prevalence and impact of diabetes in hospitalized COVID‐19 patients: A systematic review and meta‐analysis https://pmc.ncbi.nlm.nih.gov/articles/PMC9060142/#:~:text=Conclusions,in%20hospitali zed%20COVID%E2%80%9019%20patients.The effect of glycemic control on COVID- 19 severity in hospitalized patients - Journal of Clinical Endocrinology & Metabolism
16. Diabetes Care and Glycemic Control During the COVID-19 Pandemic in the United States https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2781811
17. Insulin resistance in COVID-19 and diabeteshttps://pubmed.ncbi.nlm.nih.gov/33849817/
18. COVID-19 and diabetes mellitus: how one pandemic worsens the otherhttps://pmc.ncbi.nlm.nih.gov/articles/PMC7395898/
19. Diabetes and COVID-19: Global and regional perspectives. <https://pmc.ncbi.nlm.nih.gov/articles/PMC7332438/>
20. Kumar, A., Arora, A., Sharma, P., Anikhindi, S. A., Bansal, N., Singla, V., ... & Srivastava, A. (2020). Is diabetes mellitus associated with mortality and severity of COVID-19? A meta-analysis. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 14(4), 535-545.
21. Toubasi, A. A., AbuAnzeh, R. B., Tawileh, H. B. A., Aldebei, R. H., & Alryalat, S. A. S. (2021). A meta-analysis: the mortality and severity of COVID-19 among patients with mental disorders. Psychiatry Research, 299, 113856.
22. Chidambaram, V., Tun, N. L., Haque, W. Z., Majella, M. G., Sivakumar, R. K., Kumar, A., ... & Galiatsatos, P. (2020). Factors associated with disease severity and mortality among patients with COVID-19: A systematic review and meta-analysis. PloS one, 15(11), e0241541.
23. Huang, I., Lim, M. A., & Pranata, R. (2020). Diabetes mellitus is associated with increased mortality and severity of disease in COVID-19 pneumonia–a systematic review, meta-analysis, and meta-regression. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 14(4), 395-403.