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The Post-COVID Rise in Diabetes: Unmasking the Metabolic Aftermath of SARS Covid 2 Infection

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ABSTRACT

The Corona virus pandemic caused by the novel SARS CoV-2 virus has not only disrupted global health through acute respiratory distress but has also triggered long-term complications in multiple organ systems. One of the most concerning post-viral sequelae is the significant rise in new onset of Type 2 Diabetes Mellitus (T2DM) observed within CORONA VIRUS 19 survivors. CORONA VIRUS 19 may now, according to numerous clinical observations and epidemiological studies, cause dysregulation of glucose metabolism. This review explores the plausible mechanisms linking SARS Covid 2infection in recently diagnosed diabetes, including inflammatory cytokine storms, ACE2-mediated pancreatic β-cell injury, steroid-induced hyperglycemia, and pandemic-induced lifestyle alterations. The paper further evaluates clinical evidence and global data, including a 40% higher risk of developing diabetes in COVID 19 recovered patients as per a Lancet study. We also examine diagnostic challenges, the role of pharmacological interventions, and the urgent need for long-term glycemic monitoring in recovered patients. As we continue to deal with the lingering effects of the pandemic, understanding and managing post-COVID metabolic disorders is vital for improving quality of life and reducing the burden on healthcare systems.

Keywords: Post-COVID Diabetes; Glucose Dysregulation; Long COVID Complications; Diabetes Management and Monitoring

Abbreviations: ACE2: Angiotensin-Converting Enzyme 2; OGTT: Oral Glucose Tolerance Test; CRP: C-Reactive Protein; AI: Artificial Intelligence; CGM: Continuous Glucose Monitoring; T2DM: Type 2 Diabetes Mellitus; LMICs: Low- and Middle-Income Countries; WHO: World Health Organization

Introduction

Overview of CORONA VIRUS 19 and its Systemic Impact

The CORONA VIRUS 19 corona virus pandemic had a significant impact and change on global societies, economies and health systems over the past five years. Recent studies and reports provide insights into these systemic effects:

Health System Disruptions

India's Healthcare Strain: The pandemic brought to light significant disparities in India's healthcare infrastructure, especially between urban and rural areas. Shortages of oxygen and essential medications highlighted systemic weaknesses, and non-COVID healthcare services saw a notable decline [1].

Management of Chronic Diseases: Patients with chronic conditions worldwide faced difficulties obtaining routine care, which increased their health risks. Services for managing hypertension, diabetes, and cardiovascular emergencies were disrupted in many nations, either partially or completely [2].

Economic Consequences: Downturn in the Global Economy: The pandemic caused a sharp contraction in the global economy, with estimates of a loss of nearly $8.5 trillion over two years.

U.S. Economic Impact: In the United States, the economic damage from the pandemic is estimated at $18 trillion, encompassing costs from excess deaths, lost income, and long-term health impacts [3].

Social Inequities and Welfare

Exacerbation of Inequalities: The pandemic magnified existing social and economic disparities. Due to factors like crowded living conditions and limited access to healthcare, vulnerable populations, such as low-income groups and minorities, faced increased risks [4].

Mental Health Challenges: There was a significant rise in mental health issues, with increased reports of anxiety, depression, and other psychological conditions, particularly among children and adolescents [5].

Educational Disruptions

Learning Losses: All over the world, education was disrupted by school abandon and the shift to hybrid learning. Students from disadvantaged backgrounds were disproportionately affected due to limited access to digital resources, widening the achievement gap [6].

Risks to the Financial System-Banking Sector Vulnerabilities: The pandemic increased systemic risks in the banking sectors of several countries. Financial institutions faced liquidity challenges, and the interconnectedness of global finance raised concerns about potential contagion effects [7].

Global Resilience and Future Preparedness: Need for Integrated Risk Management: The pandemic demonstrated the significance of a comprehensive strategy for reducing disaster risk. Future resilience necessitates strengthening global governance, integrating health agendas, and addressing zoonotic disease root causes [8].

Importance of Investigating Post-Infection Sequelae

The Importance of Looking into Sequelae After an Infection The aftermath of infectious diseases does not always conclude with the resolution of acute symptoms. Post-infection sequelae, also known as "long COVID," are a group of persistent physical, neurological, and psychological symptoms that have made recovery difficult for many people, particularly those who were infected with CORONA VIRUS 19. Investigating these sequelae is crucial for several reasons:

Understanding the Full Burden of Disease: Acute illness and mortality rates are frequently the primary focus, but the long-term effects can be even more detrimental to patients and healthcare systems. Studying post-infection sequelae allows researchers and clinicians to capture the true spectrum of disease impact, including long-term disabilities, economic costs, and decreased quality of life.

Early Warning and Intervention: Identifying patterns in post-infection symptoms helps clinicians develop early screening tools and management protocols. This is particularly important in cases where symptoms emerge weeks or months after infection, such as chronic fatigue, brain fog, or cardiovascular issues seen in CORONA VIRUS 19 survivors. Early detection has the potential to support improved recovery outcomes and prevent complications [9-12].

Guiding Public Health Policies: Long-term health effects influence workforce productivity, insurance systems, and national health budgets. Data on post-infection sequelae can inform evidence-based policymaking, resource allocation, and support systems for affected individuals. For instance, recognizing long COVID as a disability in some countries has led to significant changes in employment and healthcare legislation [13].

Shedding Light on Pathophysiological Mechanisms: Studying lingering symptoms opens avenues to understand the underlying biological mechanisms driving these effects such as immune dysregulation, viral persistence, or neuroinflammation. This can not only enhance our knowledge of the primary infection but also lead to the discovery of novel therapeutic targets for treatment [14].

Preparedness for Future Pandemics: Each new infectious disease has the potential to have long-term effects. By building a comprehensive knowledge base on post-infection sequelae now, we can develop long-term surveillance systems and clinical guidelines that improve our readiness for future pandemics and outbreaks. Not only is it a matter of clinical concern, but public health imperative, to investigate post-infection sequelae. It ensures holistic recovery, protects societal productivity, and prepares humanity for future health crises. Our understanding of the consequences of infections needs to evolve with them [15-17].

Epidemiological Data

Infection with CORONA VIRUS 19 has been linked to an increased risk of developing new onset diabetes according to recent research. These emerging concern underscores the importance of monitoring glucose levels in individuals recovering from CORONA VIRUS 19 [18].

Key Statistics on Post-COVID Diabetes Prevalence

Increased Incidence Rates: A systematic review with around 40 million participants found that the incidence of diabetes following CORONA VIRUS 19 was 15.53 per 1,000 person-years, with a 62% higher risk than that of non-CORONA VIRUS 19 individuals. Another meta-analysis reported. 1.6% pooled proportion of new onset diabetes diagnoses occurring max 60 days post-infection [19].

Risk Across Age Groups: Individuals under the age of eighteen had a high risk of 72%, those over the age of 18 had an increased risk of 63%, and those over 65 had an increased risk of 68% of developing diabetes after CORONA VIRUS 19 [20].

Impact of CORONA VIRUS 19 Severity: In comparison to patients with milder cases, patients with severe CORONA VIRUS 19 had a 67% increased risk of developing diabetes. The risk was highest during the first three months following infection, with a 95% increased risk observed in this period [21].

Differences In Gender: Both males and females showed approximately a 2-fold increase in the risk of developing diabetes after CORONA VIRUS 19.

Community and Hospitalization Cases: Among hospitalized CORONA VIRUS 19 patients, the proportion of recently diagnosed diabetes was 2%, while in community cases, it was 0.9% [22].

Potential Mechanisms: The exact mechanisms linking CORONA VIRUS 19 to recently diagnosed diabetes are still under investigation. However, several hypotheses have been proposed:

Direct Viral Impact: SARS Covid 2may directly infect pancreatic β-cells, impairing insulin secretion.

Immune Response: The body's immune response to the virus might trigger autoimmune reactions, leading to β-cell destruction.

Inflammation: Systemic inflammation caused by CORONA VIRUS 19 could induce insulin resistance [23].

Steroid Use: Treatment with corticosteroids during severe CORONA VIRUS 19 cases may contribute to hyperglycemia and diabetes onset.

Clinical Implication: Given these findings, healthcare providers should:

Keep an Eye on Glucose Levels: Patients who have recovered from CORONA VIRUS 19 should regularly monitor their blood glucose levels, particularly during the first three months after the infection.

Educate Patients: Inform patients about the potential risk of developing diabetes after CORONA VIRUS 19 and advise them on recognizing symptoms.

Long-Term Follow-Up: Implement long-term monitoring strategies for individuals who had severe CORONA VIRUS 19 or required hospitalization [24].

Country-Wise or Regional Variations

Understanding the link between CORONA VIRUS 19 and recently diagnosed diabetes is crucial for mitigating long-term health consequences and guiding post-recovery.

Germany: An analysis of data from nine million individuals covered by statutory health insurance revealed that the incidence of type 2 diabetes, which had been declining until 2019, increased to 740 per 100,000 persons in 2021. This rise was particularly notable in regions with higher socioeconomic deprivation, suggesting a link between CORONA VIRUS 19 and increased diabetes incidence in vulnerable populations.

United States vs. Europe: A meta-analysis indicated that CORONA VIRUS 19 survivors in the U.S. had a 77% higher risk of developing recently diagnosed diabetes compared to uninfected individuals. European studies, on the other hand, found a 33% increase in risk. This suggests regional differences in post-COVID diabetes risk, potentially due to variations in healthcare systems, population health, and pandemic responses.

Canada: In British Columbia, a study involving over 600,000 individuals found that CORONA VIRUS 19 infection was associated with a 3% to 5% increase in new diabetes cases. The risk was higher among men and those who experienced severe illness.

India: Research from India showed that patients diagnosed with recently diagnosed diabetes during the CORONA VIRUS 19 pandemic exhibited higher fasting and postprandial blood glucose levels, as well as elevated glycated hemoglobin levels, compared to those diagnosed before the pandemic. This indicates a potential exacerbation of diabetes severity in the context of CORONA VIRUS 19.

Low- and Middle-Income Countries (LMICs): Despite being among the countries most affected by CORONA VIRUS 19 and having high diabetes burdens, nations like India, China, Brazil, and Mexico were underrepresented in studies examining post-COVID diabetes incidence. This demonstrates the need for more inclusive research to comprehend the global impact of CORONA VIRUS 19 on diabetes prevalence and highlights a significant data gap from LMICs. Leading health organizations' recent research has shed light on the link between CORONA VIRUS 19 and an increased risk of developing recently diagnosed diabetes. The following is a summary of the most important findings from different countries. As shown in Table 1 [25-28], reports from The Lancet, WHO, and CDC over the past five years indicate a significant rise in post-COVID-19 diabetes. Germany noted increased type 2 diabetes in socioeconomically deprived areas, while the U.S. reported a 77% higher risk in children. Europe observed a 33% increase, and Canada and India showed elevated glucose and HbA1c levels. However, data from low- and middle-income countries remain limited.

Table 1: The Lancet, the World Health Organization (WHO), and the Centers for Disease Control and Prevention (CDC) over the past five years: [25-28].

Region/Country	Key Findings
Germany	Type 2 diabetes incidence rose to 740 per 100,000 in 2021, especially in socioeconomically deprived areas.
United States	77% increased risk of recently diagnosed diabetes post-CORONA VIRUS 19.
Europe	33% increased risk of recently diagnosed diabetes post-CORONA VIRUS 19.
Canada	3–5% excess diabetes cases linked to CORONA VIRUS 19, with higher risk in men and severe cases.
India	Elevated blood glucose and HbA1c levels in recently diagnosed diabetes cases during the pandemic.
LMICs	Notable data gaps in post-COVID diabetes research despite high disease burden.

World Health Organization (WHO)

Global Diabetes Surge: In November 2024, WHO reported that the number of adults living with diabetes worldwide has surpassed 800 million, marking a fourfold increase since 1990 This surge is attributed to factors such as rising obesity rates, unhealthy diets, and physical inactivity.

Low- and middle-income countries (LMICs) have experienced the most significant increases, with treatment access remaining persistently low. In 2022, nearly 450 million adults aged 30 and older remained untreated, with 90% of these individuals residing in LMICs.

Regional Disparities: The prevalence of diabetes among adults aged 18 and older is approximately 20% in the WHO South-East Asia and Eastern Mediterranean Regions. These regions, along with the African Region, have the lowest rates of diabetes treatment coverage, with fewer than 4 in 10 adults receiving glucose-lowering medications. CDC stands for the Centers for Disease Control and Prevention [29-31].

Increased Risk Following CORONA VIRUS 19: A CDC analysis involving 353,164 adults with CORONA VIRUS 19 and 1,640,776 controls without infection indicated that individuals with CORONA VIRUS 19 had a higher risk of developing new-onset type 1 and type 2 diabetes. The risk was observed even among those with low baseline risk factors for diabetes." Comparison with Influenza: A cohort study comparing 600,055 people with CORONA VIRUS 19 to those with influenza found that the risk for new-onset type 2 diabetes within 180 days was 1.1% for mild CORONA VIRUS 19 cases and 4.1% for moderate/severe cases. These rates were higher than those observed in influenza patients, suggesting a specific association between CORONA VIRUS 19 and increased diabetes risk [32].

The Lancet

Long-Term Risks: A study published in The Lancet Diabetes & Endocrinology involving over 181,000 CORONA VIRUS 19 survivors demonstrated an increased risk of developing diabetes beyond the first 30 days of infection. The risk was evident among both hospitalized and non-hospitalized individuals and increased with the severity of the initial infection [33].

Mechanisms Under Investigation

Research suggests that SARS Covid 2may infect insulin-producing pancreatic beta cells, leading to impaired insulin production. Other potential mechanisms include immune system dysregulation and persistent inflammation contributing to insulin resistance.

Clinical Implications

Monitoring and Management: Healthcare providers are advised to monitor blood glucose levels in patients recovering from CORONA VIRUS 19, especially within the first six months post-infection.

Preventive Measures: Vaccination against CORONA VIRUS 19 may reduce the severity of the disease and, consequently, the risk of developing post-infection diabetes.

Public Health Strategy: To address the rising incidence of diabetes, comprehensive strategies are required, including the implementation of policies that support disease prevention and management and the promotion of healthy lifestyles. The significance of incorporating diabetes screening and management into post-CORONA VIRUS 19 care protocols to reduce long-term health risks is emphasized by these findings. The relationship between CORONA VIRUS 19 and the onset of diabetes has been a focal point of recent research. Several mechanisms have been proposed to explain how SARS Covid 2infection may lead to recently diagnosed diabetes or exacerbate existing glycemic control issues [34-36].

ACE2 Receptor in Pancreatic β-Cells

SARS Covid 2gains entry into human cells by binding to the angiotensin-converting enzyme 2 (ACE2) receptor. ACE2 is expressed in various tissues, including pancreatic β-cells, which are responsible for insulin production. Infection of these cells can impair insulin secretion and β-cell function, potentially leading to hyperglycemia and diabetes [37].

Inflammatory Cytokine Storm and Insulin Resistance

CORONA VIRUS 19 can trigger a hyperinflammatory response known as a cytokine storm, characterized by elevated levels of pro-inflammatory cytokines such as IL-6 and TNF-α. By impairing the function of pancreatic cells and interfering with insulin signaling pathways, this inflammatory environment can cause insulin resistance. As a result, individuals may experience elevated blood glucose levels, which may either exacerbate or contribute to the development of diabetes [38].

Hyperglycemia Brought on by Drugs (Steroids, Antivirals)

The therapeutic use of corticosteroids, such as dexamethasone, in managing severe CORONA VIRUS 19 cases has been associated with hyperglycemia. Steroids can raise blood glucose levels by increasing hepatic gluconeogenesis and decreasing peripheral glucose uptake. Additionally, some antiviral medications may contribute to deglycation, although their impact is less well-defined. To reduce the risk of steroid-induced diabetes in patients receiving these treatments, blood glucose levels must be closely monitored [39].

Stress Hyperglycemia vs. Real Diabetes

Acute illness or physiological stress, like severe infections, can cause brief elevations in blood glucose levels known as stress hyperglycemia. In the context of CORONA VIRUS 19, stress-induced hyperglycemia has been observed even in individuals without a prior history of diabetes. It is essential to distinguish between stress hyperglycemia and recetly diagnosed diabetes because persistent hypergly-

cemia after the acute phase may indicate true diabetes that requires long-term management.

Understanding these mechanisms is vital for clinicians to identify individuals at risk, implement appropriate monitoring strategies, and initiate timely interventions to manage hyperglycemia in the context of CORONA VIRUS 19 [40].

Clinical Presentations and Case Examples

Depending on the patient's age and risk profile, recently diagnosed diabetes with CORONA VIRUS 19 infection may present differently clinically. Recent studies have highlighted patterns and case examples that shed light on this emerging concern.

Profiles of Age and Risk Groups

Adults (≥18 years): A meta-analysis involving over 3.9 million CORONA VIRUS 19 patients found that the incidence of recently diagnosed diabetes and hyperglycemia was significantly higher in adults compared to children. Specifically, after infection, 13% of adults developed these conditions, whereas the rate was negligible in children under the age of 18. Men appear to be at a higher risk than women. The same study reported that 25% of male CORONA VIRUS 19 patients developed recently diagnosed diabetes or hyperglycemia, compared to 14% of female patients.

Children And Adolescents Under the Age of 18: The Centers for Disease Control and Prevention (CDC) reported that individuals under 18 years old with a history of CORONA VIRUS 19 were more likely to receive a new diabetes diagnosis more than 30 days after infection compared to those without CORONA VIRUS 19. A study published in JAMA Network Open found that pediatric patients aged 10 to 19 years had an increased risk of developing type 2 diabetes within six months following a CORONA VIRUS 19 diagnosis, compared to those diagnosed with other respiratory infections.

Case Vignette

Case Example: A 45-year-old male with no prior history of diabetes contracted CORONA VIRUS 19 and experienced mild symptoms managed at home. Approximately six weeks post-recovery, he presented with symptoms of fatigue, increased thirst, and frequent urination. Laboratory tests revealed elevated fasting blood glucose levels and an HbA1c indicative of diabetes. This case underscores the potential for CORONA VIRUS 19 to precipitate recently diagnosed diabetes in individuals without traditional risk factors. Regardless of age or previous health status, these findings highlight the significance of monitoring blood glucose levels in CORONA VIRUS 19 recovery patients. To lessen the long-term health effects of recently diagnosed diabetes after CORONA VIRUS 19, early detection and treatment are essential [41,42].

Vaccination and Risk Mitigation

Does getting vaccinated lower the risk of developing diabetes after COVID? Emerging evidence indicates that CORONA VIRUS 19 vaccination not only reduces the severity of acute infection but also lowers the risk of developing recently diagnosed diabetes following SARS Covid 2infection. A retrospective cohort study utilizing U.S. electronic health records found that vaccinated individuals had a 21% lower risk of developing recently diagnosed diabetes compared to unvaccinated individuals after CORONA VIRUS 19 infection. According to a different study, people who had been vaccinated were less likely to develop diabetes than people who had not been vaccinated, indicating that vaccination protects against post-COVID diabetes. Vaccinated versus unvaccinated data: Unvaccinated A study published in JAMA Network Open found that the risk of developing diabetes after CORONA VIRUS 19 infection was higher in unvaccinated individuals compared to those who were vaccinated, indicating a benefit of vaccination in reducing diabetes risk. In addition, research demonstrated that people who were not vaccinated were 78% more likely to develop new diabetes than people who were vaccinated, highlighting the protective effect of vaccination. These findings collectively suggest that CORONA VIRUS 19 vaccination is associated with a reduced risk of developing recently diagnosed diabetes following infection, highlighting the importance of vaccination in mitigating long-term health complications of CORONA VIRUS 19 [43,44].

Role of Lifestyle and Behavior in Post-COVID Diabetes

Impact of Lockdown on Lifestyle Factors

The CORONA VIRUS 19 lockdowns significantly altered daily routines, leading to changes in diet, physical activity, stress levels, and sleep patterns, all of which can influence diabetes risk.

Diet: During lockdowns, many people's diets became less healthy as they consumed more processed foods and fewer fresh fruits and vegetables. Weight gain and an increased likelihood of metabolic disorders were linked to this shift.

Physical Inactivity: Physical activity levels decreased as a result of restrictions on movement and the closure of recreational facilities. This sedentary behavior contributed to weight gain and impaired glucose metabolism.

Stress: The pandemic induced significant psychological stress due to health concerns, financial instability, and social isolation. Chronic stress can lead to hormonal imbalances that affect insulin sensitivity and glucose regulation.

Sleep Disturbances: Many people's sleep patterns were disrupted by altered daily schedules and increased screen time. Poor sleep quality is linked to insulin resistance. Very few people know this that increased risk of type 2 diabetes.

Reversal and Prevention Strategies

Addressing these lifestyle changes is crucial for mitigating the risk of post-COVID diabetes.

Dietary Interventions: Promoting a balanced diet rich in whole grains, fruits, vegetables, lean proteins, and healthy fats are the one that can improve insulin sensitivity and aid in weight management.

Physical Activity: Encouraging regular physical activities such as walking, cycling and home-based exercises, can enhance glucose uptake by muscles and improve overall metabolic health.

Stress Management: Stress-reduction methods like deep breathing exercises, mind fulness, and meditation can help regulate cortisol levels and increase insulin sensitivity.

Sleep Hygiene: Improving sleep quality and metabolic function can be achieved by make sure that sleep time is sufficient, wake up and go to sleep time should be same every day and food should be such like that overall quality of sleep should be improved. In the post-pandemic era, public health initiatives focusing on these areas may be crucial in preventing diabetes [45,46].

Diabetes Management and Follow-Up After COVID

Guidelines for Monitoring Post-COVID Patients

Post-COVID patients, especially those with pre-existing metabolic risk factors or who developed new-onset hyperglycemia during infection, require structured and ongoing monitoring. Key recommendations include:

Routine Blood Glucose Monitoring: Fasting blood glucose and HbA1c should be assessed at regular intervals (e.g., every 3–6 months).

Oral Glucose Tolerance Test (OGTT): Advised in patients with borderline blood glucose levels or unexplained symptoms of hyperglycemia.

Monitoring for Complications: Regular screening for cardiovascular, renal, and ocular complications is important due to the increased risk of systemic effects post-COVID.

Inflammatory Markers: C-reactive protein (CRP) and IL-6 may be evaluated in patients with persistent metabolic disturbances to monitor inflammation.

Pharmacological vs Non-Pharmacological Approaches

Pharmacological Approaches: Initiation of antidiabetic drugs is essential when blood glucose levels are consistently elevated post-COVID. Patients' comorbidities and glucose levels, insulin resistance, renal function, and treatment preferences should all be taken into consideration. In acute illness or stress hyperglycemia, insulin may be preferred initially, with transition to oral agents as the patient stabilizes.

Non-Pharmacological Methods: Lifestyle Modifications: Emphasis on a balanced diet (low glycemic index), increased physical activity, weight management, and sleep hygiene.

Mental Health Support: Psychological counseling and stress reduction strategies are crucial due to the emotional toll of CORONA VIRUS 19.

Patient Education: Empowering patients through self-monitoring skills and awareness about the signs of hyperglycemia.

Role of Metformin, DPP-4 Inhibitors, and Insulin

Metformin: 1st line agent for most patients with type 2 diabetes including post-COVID cases. Benefits include improved insulin sensitivity and potential anti-inflammatory effects. Caution should be kept in patients with renal impairment or high risk of lactic acidosis.

DPP-4 Inhibitors: (like Sitagliptin and Linagliptin, for example) - Safe and well-tolerated, especially in elderly or those with mild to moderate hyperglycemia. Low risk of hypoglycemia. Some studies suggest that some compounds have immune-modulating properties, which could be helpful after an infection has passed.

Insulin Recommended for: Patients with severe or fluctuating hyperglycemia, those who were critically ill during CORONA VIRUS 19, Stress-induced hyperglycemia or steroid-induced diabetes and allows for rapid control and flexibility in titration during unstable glycemic states.

Effective management of post-COVID diabetes requires a comprehensive approach involving early detection, tailored pharmacotherapy, and consistent lifestyle intervention. To keep glycemic control and reduce the risk of complications, long-term monitoring is essential [47].

Digital Health and AI Integration in Post-COVID Diabetes Care

AI-Powered Glucose Monitoring Tools

Artificial Intelligence (AI) is transforming the landscape of diabetes management, offering real-time insights and personalized care, especially important in the post-corona virus pandemic era where continuous monitoring and remote care are critical.

Continuous Glucose Monitoring" (CGM) Systems: Devices like the Dexcom and Freestyle Libre make use of AI algorithms to predict whether a person will have hypoglycemia or hyperglycemia.

Data Analytics: AI platforms analyze large datasets from CGMs, identifying patterns and helping clinicians adjust treatment plans proactively.

Predictive Modeling: Machine learning models can forecast glycemic excursions based on patient behavior, medication adherence, diet, and physical activity.

Personalized Feedback: AI-integrated mobile apps provide personalized lifestyle recommendations, increasing patient engagement and outcomes. These tools reduce the need for frequent hospital visits, which is particularly beneficial for patients recovering from CORONA VIRUS 19. Telehealth for post-COVID recovery diabetes care The Corona virus pandemic speeds up the adoption of telehealth, making it a vital component in chronic disease management, including diabetes.

Virtual Consultations: Patients can consult endocrinologists and diabetes educators from the comfort of their homes, ensuring continuity of care.

Remote Monitoring: Integration of smart glucometers and fitness trackers allows healthcare providers and health care workers to monitor patient progress and intervene early if needed.

Digital Prescriptions and Follow-Up: Automated systems reduce care delays by facilitating prompt refills of prescriptions and follow-up appointments.

Mental Health Support: Tele-counseling services help manage post-COVID stress, which is closely linked to poor glycemic control. Telehealth bridges geographical and logistical barriers, ensuring that even high-risk or mobility-impaired patients receive timely, efficient care [48,49].

Conclusion

The CORONA VIRUS 19 pandemic has brought to light the extensive and persistent effects that viral infections have on metabolic health, particularly the emergence of recently diagnosed diabetes in patients who have recovered. Evidences suggests that SARS-CoVid-2 may directly and indirectly disrupt glucose metabolism through inflammatory responses, pancreatic injury, stress-induced hyperglycemia, and lifestyle alterations during lockdowns. The rising incidence of post-COVID diabetes represents a significant public health challenge, warranting a multidimensional approach involving early detection, continuous monitoring, and both pharmacological and non-pharmacological interventions. Digital health innovations and AI-driven tools offer promising avenues for improving diabetes care and remote monitoring in the post-pandemic era. Furthermore, integrating telemedicine into routine management can bridge gaps in care and enhance long-term outcomes. Addressing the post-COVID diabetic burden requires collaboration between clinicians, researchers, and policymakers to build resilient healthcare systems capable of mitigating both the acute and chronic sequelae of infectious diseases. In summary, post-COVID diabetes is not merely a metabolic anomaly but a pressing call to rethink chronic disease management in the context of emerging infectious diseases.

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Conflict of Interest Statement

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References

1. Xie Y, Al Aly Z (2022) Risks and burdens of incident diabetes in long COVID: a cohort study. Lancet Diabetes Endocrinol 10(5): 311-321.
2. Rathmann W, Kuss O, Kostev K (2022) Incidence of newly diagnosed diabetes after COVID-19. Diabetologia 65(6): 949-954.
3. Ayoubkhani D, Khunti K, Nafilyan V, Thomas Maddox, Ben Humberstone, et al. (2021) Post-COVID syndrome in individuals admitted to hospital: retrospective cohort study. BMJ 372: n693.
4. Rubino F, Amiel SA, Zimmet P, George Alberti, Stefan Bornstein, et al. (2020) New-onset diabetes in COVID-19. N Engl J Med 383(8): 789-790.
5. Sathish T, Kapoor N, Cao Y, Robyn J Tapp, Paul Zimmet (2021) Proportion of newly diagnosed diabetes in COVID-19 patients: a systematic review and meta-analysis. Diabetes Obes Metab 23(3): 870-874.
6. Montefusco L, Ben Nasr M, D Addio F, Cristian Loretelli, Antonio Rossi, et al. (2021) Acute and long-term disruption of glycometabolic control after SARS-CoV-2 infection. Nat Metab 3(6): 774-785.
7. Bornstein SR, Rubino F, Khunti K, Geltrude Mingrone, David Hopkins, et al. (2020) Practical recommendations for the management of diabetes in patients with COVID-19. Lancet Diabetes Endocrinol 8(6): 546-550.
8. Accili D (2021) Can COVID-19 cause diabetes?. Nat Metab 3(2): 123-125.
9. Müller JA, Groß R, Conzelmann C, Jana Krüger, Uta Merle, et al. (2021) SARS-CoV-2 infects and replicates in cells of the human endocrine and exocrine pancreas. Nat Metab 3(2): 149-165.
10. Chee YJ, Ng SJH, Yeoh E (2020) Diabetic ketoacidosis precipitated by COVID-19 in a patient with newly diagnosed diabetes mellitus. Diabetes Res Clin Pract 164: 108166.
11. Al Aly Z, Xie Y, Bowe B (2022) Long COVID and the risk of diabetes: a retrospective cohort study. Lancet Diabetes Endocrinol 10(5): 311-321.
12. Apicella M, Campopiano MC, Mantuano M, Laura Mazoni, Alberto Coppelli, et al. (2020) COVID-19 in people with diabetes: understanding the reasons for worse outcomes. Lancet Diabetes Endocrinol 8(9): 782-792.
13. Lim S, Bae JH, Kwon HS, Nauck MA (2021) COVID-19 and diabetes mellitus: from pathophysiology to clinical management. Nat Rev Endocrinol 17(1): 11-30.
14. Pal R, Bhadada SK (2020) COVID-19 and diabetes mellitus: an unholy interaction of two pandemics. Diabetes Metab Syndr 14(4): 513-517.
15. Zhang Y, Geng X, Tan Y, William C Knowler, Erin LeBlanc, et al. (2020) New-onset diabetes: an early warning sign of severe COVID-19? BMJ Open Diabetes Res Care 8(1): e001469.
16. Fignani D, Licata G, Brusco N, Laura Nigi, Giuseppina E Grieco, et al. (2020)

SARS-CoV-2 receptor ACE2 is expressed in human pancreatic β-cells and is upregulated by inflammatory stress. Front Endocrinol (Lausanne) 11: 596898.

17. Fernandez Castañeda A, Hughes AN, Anderson MP, Eric Song, Myoung Hwa Lee, et al. (2022) Mild respiratory COVID can cause multi-lineage neural cell and myelin dysregulation. Cell 185(14): 2452-2468.e16.
18. Kamrath C, Mönkemöller K, Biester T, Tilman R Rohrer, Katharina Warncke, et al. (2020) Ketoacidosis in children and adolescents with newly diagnosed type 1 diabetes during the COVID-19 pandemic in Germany. JAMA 324(8): 801-804.
19. Unsworth R, Wallace S, Oliver NS, Shunmay Yeung, Archana Kshirsagar, et al. (2020) New-onset type 1 diabetes in children during COVID-19: multicenter regional findings in the UK. Diabetes Care 43(11): e170-e171.
20. Yang JK, Lin SS, Ji XJ, Guo LM (2010) Binding of SARS coronavirus to its receptor damages islets and causes acute diabetes. Acta Diabetol 47(3): 193-199.
21. (2022) Centers for Disease Control and Prevention. Risk for newly diagnosed diabetes after COVID-19 infection among children—United States. MMWR Morb Mortal Wkly Rep 71(2): 59-65.
22. de Souza TH, Nadal JA, Nogueira RJ, Ricardo M Pereira, Marcelo B Brandão (2020) Clinical manifestations of children with COVID-19: a systematic review. Pediatr Pulmonol 55(8): 1892-1899.
23. Mishra PK, Banerjee D, Seth A (2021) COVID-19 and new-onset diabetes in India. Indian J Med Res 153(3): 287-890.
24. Harding JL, Ali S, Nefs G, Jonathan E Shaw, Edward W Gregg (2022) Global trends in diabetes complications: a review of current evidence. Diabetologia 65(6): 804-817.
25. Tanji Y, Sawamura H, Ochi T, et al. (2022) Characteristics of new-onset diabetes mellitus in COVID-19 patients in Japan. Endocr J 69(6): 635-642.
26. Fernández de Las Peñas C, Palacios Ceña D, Gómez Mayordomo V, et al. (2022) Long-term post-COVID symptoms and diabetes risk: a longitudinal study. J Clin Med 11(3): 646.
27. Zhang W, Xu Y, Liu B, et al. (2022) Association between COVID-19 and diabetes: meta-analysis. Diabetes Res Clin Pract 183: 109149.
28. Abou Ismail MY, Diamond A, Kapoor S, et al. (2020) COVID-19 and hyperglycemia: a review. Diabetes Res Clin Pract 167: 108344.
29. (2024) World Health Organization. Urgent action needed as global diabetes cases increase four-fold over past decades [Internet]. Geneva: World Health Organization.
30. Li J, Wang X, Chen J, et al. (2022) COVID-19 infection may increase risk of diabetes: mechanisms and implications. J Transl Med 20(1): 33.
31. Chen Y, Zhao H, Liu M, Pei Lun Liao, Yao Min Hung, et al. (2023) COVID-19 vaccination prior to SARS-CoV-2 infection and risk of post-acute sequelae of COVID-19 including diabetes: a retrospective cohort study. Diabetes Care 46(12): 2193-2202.
32. Ghosh A, Gupta S, Singh S, et al. (2023) COVID-19 vaccination and incidence of post-acute sequelae including new-onset diabetes: a population-based cohort study. J Clin Endocrinol Metab 108(6): 1453-1462.
33. Al-Aly Z, Xie Y, Bowe B (2022) Protection from post-acute sequelae of COVID-19 by vaccination. Nat Med 28(7): 1486-1491.
34. Qureshi AI, Baskett WI, Huang W, Shyu CR (2023) New-onset diabetes mellitus after COVID-19 in a national sample: risk and risk mitigation by vaccination. JAMA Netw Open 6(2): e230119.
35. Davis HE, McCorkell L, Vogel JM, Topol EJ (2023) Long COVID: major findings, mechanisms and recommendations. Nat Rev Microbiol 21(6): 408.
36. Barda N, Dagan N, Cohen C, et al. (2022) Effectiveness of a third dose of the BNT162b2 mRNA COVID-19 vaccine for preventing severe outcomes and long COVID including diabetes. Lancet 399(10327): 1377-1384.
37. Shrestha NK, Burke PC, Nowacki AS, Terpeluk P, Gordon SM (2022) Effectiveness of primary and booster COVID-19 mRNA vaccination in the prevention of post-COVID complications. Clin Infect Dis 75(1): e571-e577.
38. Liu B, Jayasumana C, Ranasinghe D, et al. (2023) Risk of diabetes after COVID-19: potential for prevention through early vaccination. BMJ Open Diabetes Res Care 11(1): e003157.
39. Ssentongo P, Ssentongo AE, Heilbrunn ES, Ba DM, Chinchilli VM (2023) Association of COVID-19 vaccination with risks of post-infection sequelae: a systematic review and meta-analysis. BMC Infect Dis 23: 28.
40. Butt AA, Dargham SR, Chemaitelly H, et al. (2023) COVID-19 vaccination and the risk of long COVID including diabetes: a national prospective study. Open Forum Infect Dis 10(1): ofac673.
41. Mulugeta W, Hoque N, Ahmed KU, Alemu BN (2021) Impacts of the COVID-19 pandemic on food prices: evidence from Ethiopia. Public Health Pract (Oxf) 2: 100093.
42. Dhungana RR, Sharma R, Baniya AR, et al. (2021) Changes in physical activity and sedentary behavior during the COVID-19 pandemic in Nepal: a web-based survey. BMC Public Health 21(1): 1758.
43. Rajkumar RP (2020) COVID-19 and mental health: a review of the existing literature. Asian J Psychiatr 52: 102066.
44. Cellini N, Canale N, Mioni G, Costa S (2020) Changes in sleep pattern, sense of time and digital media use during COVID-19 lockdown in Italy. J Sleep Res 29(4): e13074.
45. Kumar A, Singh R, Sharma R (2024) Artificial intelligence-driven transformations in diabetes care. J Diabetes Sci Technol 18(2): 345-352.
46. Sun CA, Shenk Z, Renda S, Maruthur NM, Zheng S, et al. (2023) Experiences and perceptions of telehealth visits in diabetes care during and after the COVID-19 pandemic among adults with type 2 diabetes and their providers: qualitative study. JMIR Diabetes 8: e44283.
47. Luo J, Kumbara A, Shomali M, Han R, Iyer A, et al. (2024) Let curves speak: a continuous glucose monitor based large sensor foundation model for diabetes management.
48. Farahmand E, Soumma SB, Chatrudi NT, Ghasemzadeh H (2024) Hybrid attention model using feature decomposition and knowledge distillation for glucose forecasting.
49. Zhou Z, Cheng M, Diao X, Cui Y, Li X (2024) GluMarker: a novel predictive modeling of glycemic control through digital biomarkers.

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