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Research Article

Incidence of Diabetes and Ischemic Heart Disease in COVID-19 Post Pandemic

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Abstract

Background: The long-term effects of COVID-19 Pandemic are currently getting more attention. The majority of individuals with COVID-19 report having symptoms for duration greater than four weeks following their initial appearance. After COVID-19 infection, there is worry that cardiovascular conditions and metabolic conditions may be harmed. The severity of the sickness and COVID-19 vulnerability, meanwhile, are known to be linked to cardiometabolic risk.

Aim: To study the incidence of ischemic heart disease and diabetes mellitus post COVID 19 pandemic

Methods and Materials: Information for all individuals diagnosed as suffering of COVID-19 were taken at the beginning of the investigation from the health department's release of electronic medical records in February 2021. The main outcomes analyzed were first ever documented CVD as well as DM diagnoses. The data were then collected at different time periods. They were as follows: Before date of indexing. Acute: Follow up till four weeks from index. Post-acute: Five to twelve weeks from date of indexing. Long: Thirteen weeks to fifty-two weeks from date of indexing. Poisson confidence intervals (CIs) were computed.

Results: CVD events was 1362 in COVID -19 study group while it was 131 in control study group at phase corresponding to four weeks after the indexed date. CVD events was 781 in COVID -19 study group while it was 298 in control study group at phase corresponding to five to twelve weeks since the date of indexing. CVD events was 781 in COVID -19 study group while it was 298 in control study group at phase corresponding to five to twelve weeks since the date of indexing. CVD events was 2,134 in COVID -19 study group while it was 298 in control study group at phase corresponding to 13 to 52 weeks since the date of indexing.

Conclusion: Early on after COVID-19 infection, the risk of CVD is elevated, and this risk is elevated for up to three months. However, it was not observed that there was a long-term rise in the prevalence of CVD or DM in COVID-19 patients who do not already have these illnesses

Keywords: Prevalence, Cardiovascular disorders, diabetes mellitus, post COVID-19

Introduction

The multiple organ systems illness known as Coronavirus Disease of 2019 (COVID-19) more universally acknowledged [1]. The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus infects the respiratory system and causes host immune reactions that could have systemic implications by activating inflammatory mediators [2,3]. With downregulated response of immune system, irregular platelet aggregation, coagulopathy, endothelial cell malfunction, and thrombosis affecting different methods with a risk of end-organ harm, COVID-19 may cause an inflammatory "cytokine storm" [4]. While fresh cardiovascular disorders (CVD) and fresh cases of diabetes mellitus (DM) have been linked to initial COVID-19 contamination [5], longer-term consequences after the contamination have not been extensively described.

Cardiac arrest, cardiac damage with raised troponin levels, and an increased morbidity and mortality probability among COVID-19-positive individuals who get hospitalized are some of the cardiac symptoms of COVID-19 [6,7]. In the first four weeks, COVID-19 can be additionally linked to sudden myocardial infarction and ischemic stroke [8-10]. Patients with COVID-19 have witnessed new-onset hyperglycaemia, frequently referred to as "stress hyperglycaemia," which has been linked with a poorer outcome [5,11]. Both existent and newly developed DM might have sequelae, such as hyperosmolarity condition and diabetic ketoacidosis condition [12–14]. Elevated concentrations of cytokine interleukin-6 (IL-6) and cytokine tumour necrosis factor alpha (TNF) are indicative of direct pancreatic injury by SARS-CoV-2 and accompanying general inflammatory condition seen in chronic post COVID-19, which results in decreased pancreatic insulin production and insulin resistance [15,16].

The long-term effects of COVID-19 are currently getting more attention. The majority of individuals with COVID-19 report having symptoms for longer than 4 weeks following their initial appearance [17-19]. After COVID-19 infection, there is worry that cardiovascular conditions and metabolic conditions may be harmed. The severity of the sickness and COVID-19 vulnerability, meanwhile, are known to be linked to cardiometabolic risk.

The recovery period following COVID-19 is still inadequately understood, though. With longitudinal data from digital medical records, it is possible to analyse COVID-19 results over a longer period of time. In order to compare a group of patients with COVID-19 exposure to a matched cohort of patients without a COVID-19 diagnosis, we conducted study. We sought to determine the overall impact of COVID-19 contamination on cardiovascular consequences and metabolic consequences over intervals of four weeks, three months, and twelve months in order to identify areas for future research that may be most important and to guide clinical care and public health initiatives.

Methods and Materials

Data source and participant selection

Information for all individuals diagnosed as suffering of COVID-19 were taken at the beginning of the investigation from the health department's release of electronic medical records in February 2021. The index deadline for COVID-19 contamination was the day of the first coding. We considered individuals with medical assessment of "confirmed" or "suspected" COVID-19 since conclusive testing was not generally accessible during the early stages of the epidemic. However, we performed a risk assessment using just patients who had a polymerase chain reaction (PCR) test validated COVID-19 medical coding documented. A subset of normal control patients without a history of contamination of COVID-19 reported till the date of indexing was contrasted to the COVID-19 group.

Control participants were randomly selected from the March 2021 version registered populace, which at the moment of sampling offered the most recent data available in the database. The records of controls were evaluated till eighteen months before the

beginning of the research and they had to be compared for age, gender, and family practice. Patients who had widespread CVD or DM reported more than a year or within a year of the commencement of their record were not eligible to serve as controls.

Outcome measures

The main outcomes analysed were first ever documented CVD as well as DM diagnoses. Stroke, venous thrombosis, pulmonary embolism, cardiomyopathy and myocarditis, heart failure, condition of ischemic heart disease, condition of myocardial infarction, supraventricular tachycardia, atrial arrhythmias, and atrial fibrillation were the subcategories into which CVD diagnoses were divided. Type 1 diabetes and type 2 diabetes mellitus diagnoses were made, and oral hypoglycaemic medications and insulin were started. A subsequent record of HbA1c $\geq$ 48 mmol/mol was deemed definitive of diabetes after reviewing the HbA1c records. When administered insulin during three months of diagnosis and had a diagnostic age of thirty-five years or below, participants were identified as having a type 1 DM profile [22]. The date of death served as the measurement of mortality.

Covariates

Data collected during the research period prior to the index date was used to define variables. body mass index (BMI), status of smoking were covariates chosen because of documented correlations with CVD and DM.

The data were then collected at different time periods. They were as follows:

Before date of indexing

Acute: Follow up till four weeks from index

Post-acute: Five to twelve weeks from date of indexing

Long: Thirteen weeks to fifty-two weeks from date of indexing

Poisson confidence intervals (CIs) were computed.

We were aware that the prevalence of CVD and diabetes may shift between 13 and 52 weeks after the confirmation of COVID-19. In order to compare each four-week duration after a COVID-19 detection with baseline, we calculated adjusted rate ratios and associated 95% confidence intervals (CIs) in secondary analyses. The loess method was used to fit a smoothed curve to the estimates before they were plotted. We limited our sensitivity analysis to COVID-19 subjects who have tested positive for SARS-CoV-19 infection via PCR.

To assess the variables connected to PCR confirmation, a logistic regression framework was developed. The SPSS programme, version 2021, was used to implement all computations. After the process of peer review, we added a risk assessment to see if accounting for the number of consultations could help to explain the correlation between COVID-19 and diabetes incidence.

Results

It was observed that CVD events was 3,092 in COVID -19 study group while it was 1,761 in control study group at phase before the index date. CVD events was 1,362 in COVID -19 study group while it was 131 in control study group at phase corresponding to four weeks after the indexed date. CVD events was 781 in COVID -19 study group while it was 298 in control study group at phase corresponding to five to twelve weeks since the date of indexing. CVD events was 781 in COVID -19 study group while it was 298 in control study group at phase corresponding to five to twelve weeks since the date of indexing. CVD events was 2,134 in COVID -19 study group while it was 298 in control study group at phase corresponding to 13 to 52 weeks since the date of indexing.

It was found that CVD events was greater in CIVID -19 group as compared to control group at all the phases of observations. It was further observed that cases of CVD decreased at four weeks after date of indexing. It further decreased after five weeks to twelve weeks after date of indexing. However, it increased after 13 to 52 weeks from date of indexing. The findings were significant statistically. ($p \leq 0.001$). (table 1,2).

It was observed that Diabetes mellitus events was 3,474 in COVID -19 study group while it was 2,547 in control study group at phase before the index date. Diabetes mellitus events was 424 in COVID -19 study group while it was 168 in control study group at phase corresponding to four weeks after the indexed date. Diabetes mellitus events was 690 in COVID -19 study group while it was 386 in control study group at phase corresponding to five to twelve weeks since the date of indexing. CVD events was 690 in COVID -19 study group while it was 386 in control study group at phase corresponding to five to twelve weeks since the date of indexing. Diabetes mellitus events was 3,263 in COVID -19 study group while it was 2,164 in control study group at phase corresponding to 13 to 52 weeks since the date of indexing.

It was found that Diabetes mellitus events was greater in COVID -19 group as compared to control group at all the phases of observations. It was further observed that cases of diabetes mellitus decreased at four weeks after date of indexing. It increased after five weeks to twelve weeks after date of indexing. Again it increased after 13 to 52 weeks from date of indexing.The findings were significant statistically. ($p \leq 0.01$). (table 1,2).

Table 1: Prevalence of CVDs and DM at different periods of time of follow up of COVID-19

Phase	**Before date of indexing**		**Acute: Follow up till four weeks from index**		**Post-acute: Five to twelve weeks from date of indexing**		**Long: Thirteen weeks to fifty-two weeks from date of indexing**	
	COVID-19 subjects	Control subjects	COVID-19 subjects	Control subjects	COVID-19 subjects	Control subjects	COVID-19 subjects	Control subjects
Patient weeks	21,894,812	22,462,512	1,765,413	1,750,536	3,485,891	3,461,146	16,635,311	16,351,221
CVD events	3,092	1,761	1,362	131	781	298	2,134	1,567
CVD incidence every one lakh patient weeks (95% CI)	14.21 (13.59 to 14.67)	7.59 (7.31 to 8.01)	77.06 (73.86 to 84.12)	7.42 (6.21 to 8.73)	23.14 (20.64 to 24.79)	8.52 (7.58 to 9.57)	12.76 (12.24 to 13.19)	9.11 (8.78 to 9.69)
Diabetes diagnoses	3,474	2,547	424	168	690	386	3,263	2,164
DM incidence every one lakh patient weeks (95% CI)	15.93 (15.31 to 16.51)	11.45 (10.91 to 11.81)	23.84 (21.61 to 26.21)	9.57 (8.21 to 11.52)	19.61 (19.21 to 22.07)	11.21 (10.13 to 12.42)	19.57 (18.13 to 20.37)	13.18 (12.73 to 13.85)

Table 2: Results of analysis in difference in incidences of DM and CVD at different periods of observations.

	DM		All CVD outcomes	
	Unadjusted	Adjusted	Unadjusted	Adjusted
"Acute COVID-19" up to four weeks	1.82 (1.56 to 2.29)	1.83 (1.56 to 2.23)	5.71 (4.81 to 6.91)	5.72 (4.84 to 7.21)
RR (95% CI)				
P value	< 0.031	< 0.021	< 0.041	< 0.031
"Post-acute COVID-19" five to twelve weeks	1.29 (1.13 to 1.51)	1.31 (1.32 to 1.51)	1.46 (1.33 to 1.76)	1.51 (1.32 to 1.82)
RR (95% CI)				
P value	< 0.011	< 0.041	< 0.021	< 0.05
"Long COVID-19" 13 to 52 weeks	1.08 (0.99 to 1.16)	1.08 (0.99 to 1.17)	0.79 (0.71 to 0.87)	0.91 (0.76 to 0.91)
RR (95% CI)				
P value				

Discussion

There is currently increasing focus on COVID-19's long-term consequences. The majority of COVID-19 patients claim that their symptoms persisted for more than 4 weeks after they first manifested. There is concern that metabolic and cardiovascular problems may be damaged by COVID-19 infection. Conversely, it is known that the austerity of the illness and COVID-19 vulnerability are related to cardiometabolic risk. [20-21]

Furthermore, during the height of the disease outbreak, restrictions on patients were associated with substantial alterations in eating habits and other health associated activities that may have had an effect on CVD conditions and diabetes conditions in the common people even with no evidence of COVID-19 infection. Hence, controlled trials are necessary to determine the overall impact of COVID-19 contamination on cardiovascular health outcomes and diabetic outcomes after adjusting for premorbid changes between people with and without symptoms as well as variations in time in matched controls. [22-23] Concerns about the potential consequences of "long COVID-19" syndromes are present in COVID-19 patients who are hospitalized, but there are few studies that have established prolonged follow-up for sizable population-based study populations.

It was observed that CVD events was 3,092 in COVID -19 study group while it was 1,761 in control study group at phase before the index date. CVD events was 1,362 in COVID -19 study group while it was 131 in control study group at phase corresponding to four weeks after the indexed date. CVD events was 781 in COVID -19 study group while it was 298 in control study group at phase corresponding to five to twelve weeks since the date of indexing. CVD events was 781 in COVID -19 study group while it

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It was found that CVD events was greater in COVID -19 group as compared to control group at all the phases of observations. It was further observed that cases of CVD decreased at four weeks after date of indexing. It further decreased after five weeks to twelve weeks after date of indexing. However, it increased after 13 to 52 weeks from date of indexing. The findings were significant statistically. ($p \leq 0.001$)

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The 2019 Coronavirus Disease (COVID-19) is a multi-organ system ailment that is becoming well recognized. By activating inflammatory mediators, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus attacks the respiratory system and triggers host immunological reactions that may have systemic effects [24,25]. COVID-19 may result in an inflammatory "cytokine storm" due to the immune system's downregulation, abnormal platelet aggregation, coagulopathy, endothelial cell dysfunction, and thrombosis that may injure end organs. Although the initial COVID-19 contamination has been connected to recent cardiovascular diseases (CVD) and cases of diabetic mellitus (DM), longer-term effects following the contamination have not been thoroughly discussed. [26,27]

Some of the cardiac symptoms of COVID-19 include cardiac arrest, heart damage with elevated troponin levels, and a higher likelihood of morbidity and mortality. Individuals with COVID-19 have had "stress hyperglycemia," or new-onset hyperglycemia, which has been associated with a worse prognosis. [28-30] Existing DM and newly formed DM may both have complications, such as hyperosmolarity and diabetic ketoacidosis. Lowered pancreatic insulin production and insulin resistance are caused by direct pancreatic injury caused by chronic COVID-19 contamination, which is indicated by elevated levels of the cytokine's interleukin-6 (IL-6) and tumour necrosis factor alpha (TNF) [15, 16].

In this study, information was obtained via the health department's release of electronic medical data in February 2021 for all persons who had been diagnosed with COVID-19 at the outset of the investigation. The first day of coding was the COVID-19 contamination index deadline. Although conclusive testing wasn't always available in the early stages of the epidemic, we took into account people having medical assessments of "confirmed" or "suspected" COVID-19.

The primary outcomes were the first-ever documented diagnosis of DM and CVD. The subcategories into which CVD diagnoses were separated included stroke, venous thrombosis, pulmonary embolism, cardiomyopathy and myocarditis, heart failure. Diagnoses for type 1 diabetic mellitus and type 2 diabetes mellitus were made, and insulin and oral hypoglycaemic drugs were started. Reviewing the HbA1c records, a subsequent record of HbA1c values greater or equal to 48 mmol/mol was declared to constitute proof of diabetes. Participants were classified as having a type 1 DM profile when given insulin within three months of diagnosis and had a diagnostic age of 35 years or less [22]. The mortality rate was calculated based on the date of death.

It was observed that Diabetes mellitus events was 3,474 in COVID -19 study group while it was 2,547 in control study group at phase before the index date. Diabetes mellitus events was 424 in COVID -19 study group while it was 168 in control study group at phase corresponding to four weeks after the indexed date. Diabetes mellitus events was 690 in COVID -19 study group while it was 386 in control study group at phase corresponding to five to twelve weeks since the date of indexing. CVD events was 690 in COVID -19 study group while it was 386 in control study group at phase corresponding to five to twelve weeks since the date of indexing. Diabetes mellitus events was 3,263 in COVID -19 study group while it was 2,164 in control study group at phase corresponding to 13 to 52 weeks since the date of indexing.

It was found that Diabetes mellitus events was greater in COVID -19 group as compared to control group at all the phases of observations. It was further observed that cases of diabetes mellitus decreased at four weeks after date of indexing. It increased after five weeks to twelve weeks after date of indexing. Again, it increased after 13 to 52 weeks from date of indexing. The findings were significant statistically. ($p \leq 0.01$).

In early COVID-19 infection a variety of cardiovascular problems, including as palpitations, heart problems, and thrombotic abnormalities, can occur in hospitalized patients [21], yet there aren't many studies that have followed these patients over the long term in the absence of preexisting CVD. Knight et al [20] described the findings of CVDs studied in subpopulation of England in a preprint. According to their findings, CVD outcomes may continue to be worse for up to 49 weeks after COVID-19 infection [20].

More severe COVID-19 sickness is also linked to preexisting DM [22], however other research point to a possible link between COVID-19 and newly developed diabetes. 14.4% of individuals who were hospitalized during the early COVID-19 epidemic, according to a systematic assessment of 8 cases, went on to acquire new-onset diabetes [23]. The observation that the virus penetrates beta cells of pancreas [24], lowers insulin production, and accelerates beta-cell death [25] points to a potential impact of SARS-CoV-2 disease on pancreatic function. Reduced exercise and deconditioning brought on by COVID-19 may potentially increase insulin resistance [26]. Increased chances of discovering diabetes that had not yet been diagnosed may also result from interactions with medical professionals. In earlier studies, hospital-based populations with lower sample size or lower follow-up times were frequently reported. This extensive population-based investigation demonstrates that people with COVID-19 had a somewhat increased baseline risk of developing diabetes.

Al-Aly and colleagues [5] identified an increase in the burden of numerous health concerns 30 days and six months following COVID-19 by using a data mining technique on digital medical data. According to Knight and colleagues [20], venous and arterial issues remained for 49 weeks after COVID-19 at a higher degree. Nonetheless, there is currently a lack of knowledge regarding the recovery phase following COVID-19. A longer length of time can be used to analyze COVID-19 results when using longitudinal data from digital medical records. We conducted a study to contrast a cohort of individuals exposed to COVID-19 to a matched cohort of people undiagnosed with COVID-19. In order to pinpoint the areas for potential future research that may be most crucial and to direct clinical care and public health initiatives, we sought to ascertain the overall impact of COVID-19 contamination on cardiovascular consequences and metabolic consequences over intervals of four weeks, three months, and twelve months. [29,30]

Conclusion

Early on after COVID-19 infection, the risk of CVD is elevated, and this risk is elevated for up to three months. However, it was observed that there was less evidence of long-term rise in the prevalence of CVD or DM in COVID-19 patients who do not already have these illnesses. This study shows that after COVID-19 infection, the incidence of DM is high for at minimum 12 weeks before it starts to decline. Given the elevated baseline risk, COVID-19 patients should be advised to take steps to lower their risk of developing diabetes, including changes to their diet, approach to weight management, and level of physical activity.

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