

## Research Article

# Covid-19 Pandemic and Diabetes - Pandemic Effects on Blood Glucose Regulation

Muhammed Tunç<sup>1\*</sup>; Aslihan Türkmen Tunc<sup>2</sup>; Fayzanur Erdem<sup>3</sup>

<sup>1</sup>Department of Internal Medicine, Vakıf University, Bezmialem, Istanbul

<sup>2</sup>Department of Family Medicine, Plevne Family Health Center, Gaziosmanpaşa, Istanbul

<sup>3</sup>Department of Family Medicine, Health Sciences University, Okmeydanı Education and Research Hospital, Istanbul

\*Corresponding author: Muhammed Tunç

Department of Internal Medicine, Vakıf University, Bezmialem, Istanbul

Email: mtunc@bezmialem.edu.tr

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## Abstract

**Background:** COVID-19 (Novel Coronavirus Disease) pandemic has led to quarantines and restrictions sometimes partly and sometimes throughout the country in Turkey and as well as many other countries. Many people remained inactive since they could not go out, and follow-up of chronic diseases has become difficult because of the inability to access hospital due to the pandemic.

**Aim:** In this study we aimed to investigate the effects of COVID-19 pandemic, which occasionally causes lockdown and partial quarantine implementations, on blood glucose regulation in patients with Type 2 Diabetes Mellitus (DM).

**Study Design:** Single-center, Retrospective, Observational study

**Methods:** The laboratory findings of type 2 DM patients who had been followed-up by our clinic for at least 2 years before the pandemic and who also came for control after the 3-months nationwide lockdown in Turkey (June 2020). Data were obtained from the hospital information system and examined. The values before pandemic and after lockdown were compared.

**Results:** The study included a total of 169 patients. Of the participants 49.7% were female and 50.3% were male. The mean age was 57.7 years in female patients and 54.8 years in male patients. Triglyceride level was significantly increased after the lockdown compared to before the pandemic in all patients ( $p < 0.005$ ). The levels of Fasting Blood Glucose (FBG) and glycated Hemoglobin (HbA1c) were significantly lower after the lockdown in the patients aged over 65 years, while these values were increased in the other age group, but the difference was not statistically significant.

**Conclusion:** COVID-19 pandemic led to statistically insignificant disruption in glucose regulation especially in young type 2 DM patients, while glucose regulation improved in the elderly population under quarantine conditions. Our study was conducted in a short-term and limited population and therefore, further studies with larger populations are needed.

**Keywords:** COVID-19; Pandemic; Type 2 diabetes mellitus; Fasting blood glucose; Glucose regulation

## Introduction

COVID-19 infection has spread to all over the world from China at the end of December 2019, and the World Health Organization (WHO) declared it as a global pandemic as of March 2020 [1]. Since the outbreak first emerged, numerous studies have been performed about COVID-19 infection, which is new to the world.

Pathological alterations cause susceptibility to any type of infection in diabetic patients. Increase in morbidity and mortality is inevitable in the case of hyperglycemia, decreased immunity, damage to pulmonary functions and renal failure, cardiovascular disease and complications such as pulmonary microangiopathy [2].

Studies conducted from the beginning of the pandemic have found that diabetes is an important risk factor in mortality. Studies from Wuhan have found high prevalence of diabetes in COVID-19 patients, and similarly studies conducted in Italy have reported high prevalence of diabetes in hospitalized patients due to COVID-19 [3-7]. According to the 72.314 COVID-19 case report published by the China Center for Disease Control and Prevention, mortality was reported as approximately 3 folds higher in diabetic patients compared to the persons without diabetes [8]. Whereas in the majority of the initial studies performed in the beginning of the pandemic no distinction has been made between Type 1 and Type 2 DM, according to the recent studies clinical course of COVID-19 is negatively affected by Type 1 DM, but it was still better compared to Type 2 DM [9].

Besides increased risk of COVID-19 infection and mortality in diabetic patients, clinical course of diabetes itself has also been affected by the pandemic conditions. Physical activity and healthy diet that are among the indispensable lifestyle changes in follow-up of diabetes have been interrupted by pandemic and quarantine conditions, and have negatively affected blood glucose regulation in people with diabetes mellitus [10]. Since the beginning of the outbreak, the World Health Organization and national healthcare authorities have called for social isolation and "staying at home and not leaving home except when necessary" in order to reduce the spread rate of the disease. Also in our country lockdowns have been imposed sometimes in certain provinces, and sometimes in the whole country. Almost all hospitals at the beginning, and some hospitals after progression of the pandemic have been declared pandemic hospitals and these hospitals could not accept patients except for COVID-19. At beginning of pandemic, nationwide restrictions imposed at our country for 3 months, and at 1 June 2020 normalization process started, restrictions have begun to be reduced.

Declaration of pandemic and partial quarantine have changed people's approach to food, causing and resulted in more "unhealthy" diets for most people. As a result of the combination of all these factors, people have remained physically inactive, many people have eaten unhealthy diets and presentation to hospitals for chronic disease follow-up has become difficult. Given the importance of diabetic patients to be physically active, to have a healthy diet and to be under physician control constantly, it seems inevitable that COVID-19 pandemic will adversely affect the clinical course of diabetic patients. In this study, we aimed to investigate the effects of COVID-19 pandemic in diabetic patients followed-up by our clinic.

## Material and Methods

### Study Design and Population

This study was designed as a single-center, retrospective, observational study and conducted in the internal diseases clinic of the Eyup Bezmialem Vakif University. A total of 160 patients with type 2 diabetes mellitus who had been followed-up by the internal diseases clinic of the Eyup Bezmialem Vakif University since 2 years before pandemic, and then presented to our clinic after lockdown and whose information, blood analysis outcomes were complete on the hospital information system were included in the study. Patients with missing information were excluded from the study. Patients' causes of presentation, hospital files and biochemical data existing on the system were retrospectively examined. The values before pandemic and after lockdown were compared and statistically analyzed.

## Ethical Considerations

Ethics approval of the study was received from the local ethics committee of the Eyup Bezmialem Vakif University with the 08/09/2020 dated and 15/309 numbered decision, and also the necessary permission was obtained from the TR Ministry of Health (2020-08-07T09\_36\_35).

## Statistical Analysis

Statistical analysis was performed using SPSS version 20.0 for Windows statistical package software (IBM SPSS) at %95 confidence level. Kolmogorov Smirnov and Shapiro Wilks tests are used to determine normality of data, and data were found to be distributed normally. The measurement averages obtained before pandemic and after the lockdown in women and men and whether there is a significant difference between these averages were examined by t-test in dependent groups. The averages of the first and last measurements by gender, age group and whether the difference between these averages differ significantly was examined by independent t-test and one-way analysis of variance.

## Results

Our study included a total of 169 patients. Of the participants 49.7% were female and 50.3% were male. The mean age was 57.7 years in female patients and 54.8 years in male patients. All participants were patients with Type 2 diabetes who had been followed up by our internal diseases clinic for at least 2 years before the pandemic and who presented to our clinic after the lockdown.

Biochemical analysis outcomes were evaluated in all patients as before the pandemic and after the lockdown. The mean triglyceride value from the cholesterol panel was significantly higher after the pandemic than before the pandemic in all patients ( $p < 0.005$ ). No statistically significant difference was found in the levels of Fasting Blood Glucose (FBG), glycated Hemoglobin (HbA1c) and urinary microalbumin between the mean values before pandemic and after the lockdown ( $p > 0.005$ ). Evaluation of the all patients' investigations before pandemic and after lockdown is shown in Table 1.

**Table 1:** Evaluation of the patients' investigations before and after the pandemic.

	N	Before		After		P
		Mean	SD	Mean	SD	
HbA1c	169	6,76	0,95	6,77	0,96	0,951
FBG	168	134,59	36,45	139,17	38,93	0,061
Creatinine	168	0,82	0,21	0,83	0,22	0,197
Triglyceride	167	163,80	82,52	181,94	93,11	0,000*
LDL	168	131,35	34,02	129,45	34,52	0,319
AST	164	21,55	10,51	21,00	10,40	0,209
ALT	163	27,15	21,95	26,13	23,27	0,329
Calcium	101	9,61	0,45	9,59	0,30	0,594
Sodium	9	137,22	2,17	136,89	2,47	0,438
Potassium	9	4,46	0,17	4,52	0,26	0,332
Iron	19	57,26	24,99	62,05	30,45	0,454
UMA	152	87,46	248,96	81,21	216,03	0,633
TSH	157	1,93	1,48	1,91	1,22	0,869
Vitamin B12	155	316,81	142,68	307,82	166,00	0,336

\* $p < 0,05$

HbA1c: Glycated Hemoglobin; FBG: Fasting Blood Glucose; LDL: Low-Density Lipoprotein; AST: Aspartate Transaminase; ALT: Alanine Transferase; UMA: Urine Microalbumin; TSH: Thyroid-Stimulating Hormone

**Table 2:** Evaluation of the mean investigation values before and after the pandemic in the female patients.

	N	Before		After		P
		Mean	SD	Mean	SD	
HbA1c	84	6,59	0,83	6,67	0,90	0,206
FBG	84	132,27	37,34	135,00	36,04	0,423
Creatinine	83	0,76	0,18	0,78	0,20	0,300
Triglyceride	82	160,96	79,02	174,95	90,76	0,026*
LDL	83	135,05	35,44	133,01	33,33	0,464
AST	80	19,48	7,30	20,21	7,12	0,125
ALT	80	20,95	10,23	21,35	10,10	0,507
Calcium	55	9,60	0,54	9,59	0,28	0,941
Potassium	6	4,45	0,08	4,58	0,25	0,175
Iron	14	48,79	20,09	52,86	24,54	0,550
UMA	75	44,21	86,72	42,76	77,06	0,822
TSH	77	2,16	1,14	2,07	1,18	0,492
Vitamin B12	77	323,12	150,58	332,99	208,18	0,545

\*p<0,05

HbA1c: Glycated Hemoglobin; FBG: Fasting Blood Glucose; LDL: Low-Density Lipoprotein; AST: Aspartate Transaminase; ALT: Alanine Transferase; UMA: Urine Microalbumin; TSH: Thyroid-Stimulating Hormone

When biochemical outcomes were compared between before the pandemic and after the lockdown, no significant difference was found in HbA1c and FBG values of the female patients (p>0.005). The mean triglyceride value from the cholesterol panel was significantly higher after the lockdown than before the pandemic (p=0.026) (Table 2).

No significant difference was found in the mean HbA1c, FBG and urinary microalbumin values of the male patients before the pandemic and after the lockdown. The mean triglyceride value from the cholesterol panel was significantly higher after the lockdown than before the pandemic in the male patients (p=0.002). Vitamin B12 level was significantly lower after the lockdown compared to before the pandemic in the male patients (Table 3).

When we evaluated our results according to the age groups; the mean values of FBG, creatinine and triglycerides were significantly higher after the lockdown compared to before the pandemic in <65 years old age group (p<0.005). The mean values of FBG and HbA1c were significantly lower after the lockdown compared to before the pandemic in ≥65 years old age group (p<0.005) (Tables 4 & 5).

**Table 3:** Evaluation of the mean investigation values before and after the pandemic in the male patients.

	N	Before		After		P
		Mean	SD	Mean	SD	
HbA1c	85	6,94	1,03	6,87	1,01	0,397
FBG	84	136,90	35,61	143,33	41,42	0,069
Creatinine	85	0,88	0,22	0,88	0,23	0,448
Triglyceride	85	166,54	86,14	188,68	95,37	0,002*
LDL	85	127,74	32,38	125,96	35,49	0,503
AST	84	23,54	12,56	21,75	12,76	0,014*
ALT	83	33,12	27,87	30,75	30,46	0,225
Calcium	46	9,63	0,33	9,59	0,32	0,283
Potassium	3	4,47	0,31	4,40	0,30	0,184
Iron	5	81,00	23,31	87,80	33,04	0,700
UMA	77	129,58	334,93	118,66	289,94	0,664
B12	78	310,59	135,12	282,97	105,26	0,003*

\*p<0,05

HbA1c: Glycated Hemoglobin; FBG: Fasting Blood Glucose; LDL: Low-Density Lipoprotein; AST: Aspartate Transaminase; ALT: Alanine Transferase; UMA: Urine Microalbumin; TSH: Thyroid-Stimulating Hormone

**Table 4:** Evaluation of the investigations before and after the pandemic in patients <65 years old.

	N	Before		After		p
		Mean	SD	Mean	SD	
HbA1c	140	6,75	0,94	6,82	1,00	0,257
FBG	139	134,62	36,41	142,45	40,26	0,004*
Creatinine	140	0,80	0,17	0,82	0,21	0,035*
Triglyceride	139	164,73	85,30	184,47	94,28	0,000*
LDL	140	132,44	33,24	129,24	34,16	0,112
AST	137	21,61	10,77	21,09	10,74	0,296
ALT	138	27,75	23,13	26,81	24,52	0,441
Calcium	81	9,60	0,48	9,58	0,30	0,817
Potassium	7	4,40	0,12	4,53	0,28	0,093
Iron	16	55,88	26,73	59,75	32,66	0,597
UMA	127	85,50	247,41	68,22	185,57	0,090
TSH	131	1,87	1,23	1,93	1,26	0,656
Vitamin B12	130	316,76	139,99	307,62	158,53	0,277

\*p<0,05

HbA1c: Glycated Hemoglobin; FBG: Fasting Blood Glucose; LDL: Low-Density Lipoprotein; AST: Aspartate Transaminase; ALT: Alanine Transferase; UMA: Urine Microalbumin; TSH: Thyroid-Stimulating Hormone

**Table 5:** Evaluation of the investigations before and after the pandemic in patients ≥65 years old.

	N	Before		After		Before
		Mean	SD	Mean	SD	
HbA1c	29	6,83	1,02	6,52	0,67	0,013*
FBG	29	134,45	37,26	123,41	27,17	0,019*
Creatinine	28	0,91	0,34	0,89	0,29	0,678
Triglyceride	28	159,21	68,19	169,39	87,58	0,232
LDL	28	125,89	37,86	130,50	36,90	0,404
AST	27	21,30	9,19	20,52	8,59	0,463
ALT	25	23,84	13,56	22,40	14,38	0,161
Calcium	20	9,70	0,29	9,63	0,31	0,292
Potassium	2	4,65	0,21	4,50	0,28	0,205
Iron	3	64,67	12,90	74,33	8,96	0,522
UMA	25	97,40	261,69	147,23	327,74	0,416
TSH	26	2,24	2,39	1,84	1,00	0,435
Vitamin B12	25	317,08	159,04	308,88	204,29	0,834

\*p<0,05

HbA1c: Glycated Hemoglobin; FBG: Fasting Blood Glucose; LDL: Low-Density Lipoprotein; AST: Aspartate Transaminase; ALT: Alanine Transferase; UMA: Urine Microalbumin; TSH: Thyroid-Stimulating Hormone

### Discussion

In this study, HbA1c and fasting blood glucose levels that are among the important parameters in the follow-up of diabetes were evaluated. When all age groups evaluated together, no significant difference was found, but the mean values after the lockdown were significantly lower in the patients ≥65 years old. In a study by Onmez et al. from our country [11], HbA1c and fasting blood glucose values worsened in patients with Type 2 diabetes during quarantine, but the difference was not statistically significant. In our study, values indicating glycemic control worsened in <65 years old population at the lockdown period. In a study from India, postprandial blood glucose values were found to significantly increase during quarantine period [12]. In another study evaluating whether eating habits of patients with Type 2 diabetes mellitus was changed during the pandemic, consumption of sugary food and snacks did not change in the population aged 65 years and over, while it increased in persons aged under 65 years [13]. This might be caused by persons ≥65 years old having tried to be more careful about their health, trying to eat more healthy foods and eating a more he-

althy diet because of their ages independently from the quarantine. In addition, this age group is more likely to be inactive and asocial compared to young age groups, and might be affected less from the quarantine than young people that are more active and social. The fact that the young population had to give up their normal active lives under pandemic conditions, triggered psychological stress and caused eating disorders, and the end of their usual activity due to being restricted at home and being in a physically inactive state may also negatively affect the course of diabetes.

In our study, triglyceride value was significantly higher after the lockdown compared to before the pandemic in all age groups; we think this was caused by the increased tendency to a diet rich in carbohydrate and fat [14]. In a study conducted in our country with Type 2 DM patients, a significant increase was found in BMI values of the participants during quarantine period, suggesting that unhealthy eating increased during this period. In a study from Madrid, Spain investigating the effect of the quarantine process on nutrition, Type 2 DM patients were found to be prone to healthy eating [13].

In our study, vitamin B12 levels were found to be significantly decreased in the male patients. We think that this might be resulted from the difficulty in accessing meat products due to lockdown conditions or the tendency of vitamin B12 levels to decrease due to the possibility of metformin use by Type 2 DM patients. People who had attended to hospital controls more easily under normal conditions may have had vitamin B12 deficiency due to not being able to go to the hospital and have investigations during this period [15,16].

It is inevitable that Type 2 diabetes patients, for whom being physically active, a healthy diet and being under physician's control are indispensable, will be negatively affected by the COVID-19 pandemic that surrounds the whole world. The results of our study indicate that the clinical course worsened in certain age groups in the short term; however, this study was conducted in a limited population and with a short duration. Further comprehensive studies with a larger population are needed on these issues.

### Author Statements

### Conflict of Interest

No conflict of interest was declared by the authors.

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