The effect of COVID-19 lockdown on glycemic control in patients with type 2 diabetes mellitus in Turkey

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ABSTRACT

Background and aims: A national lockdown to prevent the spread of coronavirus disease (COVID-19) in Turkey was introduced in March 2020. We think that lockdowns may lead to weight gain and worsening of glycemic parameters in patients with type 2 diabetes mellitus (DM). The purpose of this study was to investigate how type 2 DM patients were affected by the lockdown.
Method: Type 2 DM patients unable to attend regular follow-ups due to lockdown over a 75-day period between March and June 2020 and who again attended polyclinic follow-up when the lockdown was lifted were included in the study. These patients' glycemic control and weight status were compared with the pre-lockdown period. In addition, patients' general habits, and adherence to diet and exercise were evaluated, while their general health was assessed using the Short-Form 36-item survey.
Result: The research involved 101 type 2 DM patients, 57 men (56.5%) and 44 women (44.5%), with a mean age of 55 ± 13. Patients' mean pre-lockdown weight was 84.7 ± 16.4 kg, rising to 85.5 ± 16.8 kg post-lockdown, although the increase was not statistically significant (p = 0.781). In terms of glycemic parameters, Hba1c rose from 7.67 ± 1.76 to 8.11 ± 2.48, and fasting glucose from 157.9 (83—645) mg/dl to 163.2 (84—550) mg/dl, none of which were statistically significant (p = 0.253, p = 0.079, respectively).
Conclusion: In addition to weight gain among type 2 DM patients during the Covid 19 lockdown, statistically insignificant increases were also observed in such glycemic parameters. This was a small sample and further studies with larger sample are needed.

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1. Introduction

Novel coronavirus disease (COVID-19), a global pandemic affecting millions and costing the lives of hundreds of thousands, is still wreaking devastation [1]. The majority of fatalities occur in the elderly and/or in the presence of chronic diseases such as diabetes mellitus (DM), hypertension, obesity, chronic kidney disease, cardiovascular disease, and cancer [2]. DM is responsible for a significant increase in COVID-19-related mortality associated with acute respiratory distress syndrome [3]. Good blood sugar regulation can result in strengthening of the immune system and reduce the severity of disease [4,5]. However, follow-ups and glycemic controls in patients with diabetes have been interrupted due to the lockdown imposed to prevent the spread of the pandemic. Impaired blood sugar regulation is therefore predicted as a result, due to such factors as inactivity, poor dietary adherence, and lack of follow-up.

A study from China showed a worsening in glycemic control and high fasting blood sugar during the COVID-19 outbreak [6]. However, other research involving patients with type 1 DM reported no worsening of glycemic control during COVID-19 quarantine [7].

Following the first officially notified case in Turkey on 11 March 2020, schools and universities were closed on March 16, 2020. Various nationwide restrictions were imposed throughout the month of March, such as the closure of public facilities including cinemas, theaters, cafes, sports arenas, and places of entertainment,

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limitations on domestic and international travel, and lockdowns on under-18s and over-65s. These restrictions began being gradually lifted from 1 June 2020. Clinical services were subjected to modification during this process, and DM patients' follow-ups were affected by interruptions as a result.

While several studies have examined the effects on patients with type 1 DM of the lockdown measures aimed at halting the spread of the global pandemic [7,8], there has been insufficient research into the effects on patients with type 2 DM. The purpose of this study was therefore to investigate how the blood sugar levels, weight, diet and exercise patterns of our type 2 DM patients were affected by the lockdown.

2. Material and method

2.1. Study design and population

This single-center, retrospective, observational study was conducted at the Düzce University Medical Faculty internal diseases and diabetology clinic, Turkey. Type 2 DM patients aged 18–80 years unable to attend follow-ups due to the 75-day lockdown between 16 March and 1 June 2020, but who attended follow-ups in July and August once the restriction had been lifted, were included in the study. Prediabetics and secondary diabetics, individuals with symptoms such as fever, cough or respiratory difficulty during the lockdown period, patients diagnosed with COVID-19, and individuals with a history of surgery or trauma were excluded.

Demographic data, anthropometric measurements, dietary and exercise habits, anti-diabetic treatments, blood sugar measurement frequencies, frequencies of acute diabetic complications, and fasting glucose, postprandial glucose, HbA1c, and other laboratory parameters were recorded for all presenting patients. Data for the evaluation of patients' daily living activities during the lockdown period, changes in working and social life, and emotional and mental health were collected from clinical records and the Short-Form 36-item survey (SF-36) scale. SF-36 is a measurement tool capable of determining patients' general health status, and daily activity and working dynamics in the previous four weeks, and also capable of evaluating their emotional status. It was first developed by Ware and Sherbourne in 1992 [9], and was adapted into Turkish by Koçyiğit et al. [10]. SF-36 generates eight subscales - general health (GH), physical functioning (PF), role limitations due to physical health (RP), role limitations due to emotional problems (RE), social functioning (SF), body pain (BP), vitality (VT), and mental health (MH). These were all scored between 0 and 100 and were subjected to statistical analysis.

2.2. Ethical considerations

Ethical approval was obtained from the human research ethics committee of the Düzce University Faculty of Medicine (2020/148), and permission for the research was obtained from the Turkish Republic Ministry of Health (2020-06-26T10-38-54). All the procedures complied with the provisions of the Declaration of Helsinki. All participants provided oral informed consent.

2.3. Statistical analysis

Study data were analyzed on SPSS version 20.0 software (IBM Corp., USA). Quantitative parametric data were expressed as mean plus standard deviation (SD), and quantitative non-parametric data as median values plus minimum and maximum. The Kolmogorov−Smirnov test was used to analyze the distribution of variables. For non-parametric data, comparisons between different groups were performed using the Mann-Whitney *U* test, while the independent-t test was used to compare parametric data between the groups.

3. Results

This study involved 101 type 2 DM patients, 57 men (56.5%) and 44 women (44.5%), with a mean age of 55 ± 13 years. Median duration of DM was 7.5 (1−35) years, and patients' mean body mass index (BMI) was 30.3 ± 5.5. The most frequent accompanying co-morbidity was hypertension, observed in 51 (50%) cases, and the most frequent microvascular complication was diabetic neuropathy, seen in 34 (33.6%) cases. Patients' basic demographic characteristics are summarized in Table 1.

Forty (39.6%) patients gained weight during the three-month lockdown, 39 (38.6%) lost weight, and 22 (21.7%) remained unchanged. The numbers of patients who exercised regularly and dieted were low. The highest SF-36 subscale scores were observed for PF (59.5 ± 26.9) and RE (59.8 ± 31.5), while the lowest score was determined on the BP subscale (36.8 ± 29.2). Patients' basic characteristics during the lockdown period are summarized in Table 2, and the SF-36 results in Table 3.

Examination of anthropometric and laboratory parameters before and after the lockdown revealed a pre-lockdown weight of 84.7 ± 16.4 kg and a post-lockdown weight of 85.5 ± 16.8 kg. This increase was not statistically significant (p = 0.781). Mean pre-lockdown waist circumference was 105 ± 23 cm, compared to 107 ± 32 cm post-lockdown, and this increase was also not significant (p = 0.639). In terms of glycemic parameters, Hba1c

Table 1
Basic patient characteristics.

Parameters	n (%)
Male	57 (56.5)
Female	44 (43.5)
Age, years, (mean ± SD)	55 ± 13
Active smokers	32 (31)
Duration of diabetes, years, median (min-max)	7.5 (1−35)
BMI, kg/m^2	30.3 ± 5.5
Weight, kg	84.8 ± 16.4
Co-morbidity	
Hypertension	51 (50)
Hyperlipidemia	38 (37.6)
Coronary artery disease	22 (21.7)
Cerebrovascular disease	1 (0.9)
COPD	4 (3.9)
Diabetic microvascular complications	
Neuropathy	34 (33.6)
Retinopathy	24 (23.7)
Nephropathy	12 (11.8)
Diabetic foot	2 (1.9)
Type of treatment	
OAD Only	57 (56.4)
Insulin Only	16 (15.8)
OAD and Insulin	28 (27.7)
Type of Insulin	
Basal	23 (52.3)
Premix	10 (22.7)
Intensive	11 (25)
Type of OAD, n	
Metformin	69
Sulfonylurea	15
DPP-IV	54
Thiazolidinedione	12
SGLT-2 inh.	22

SD, standard deviation; BMI, body mass index; COPD, chronic obstructive pulmonary disease.
OAD, oral antidiabetic; DPP-IV, dipeptidyl peptidase-iv; SGLT-2, sodium-glucose cotransporter-2.

Table 2
Basic patient characteristics during lockdown.

Parameters	n (%)
Weight status during lockdown	
Gained weight	40 (39.6)
Lost weight	39 (38.6)
Same weight	22 (21.7)
Frequency of blood sugar testing during the lockdown	
Never	14 (13.8)
Rarely	37 (36.6)
Occasionally	24 (23.7)
Regularly	26 (25.7)
Frequency of exercise during the lockdown	
Never	35 (34.6)
Rarely	35 (34.6)
Occasionally	17 (16.8)
Regularly	14 (13.9)
Frequency of dieting during the lockdown	
Never	27 (26.7)
Rarely	29 (28.7)
Occasionally	37 (36.6)
Regularly	8 (7.9)
Acute diabetic complications during lockdown	
Severe hypoglycemia	1 (0.9)
Diabetic ketoacidosis	0 (0)
Hyperosmolar non-ketotic hyperglycemia	1 (0.9)

Table 3
Health-related quality of life scores (Short-Form 36-Item Survey).

GH 2	48.1 ± 18.4
PF 10	59.5 ± 26.9
RP 4	54.9 ± 27.6
RE 3	59.8 ± 31.5
SF 2	47.2 ± 13.8
BP 2	36.8 ± 29.2
VT 9	50.5 ± 10.2
MH 4	52.2 ± 16.6

GH, General Health; PF, Physical functioning; RP, Role limitations due to physical health; RE, Role limitations due to emotional problems; SF, Social functioning; BP, Body Pain; VT, Vitality; MH, Mental Health.

increased from 7.67 ± 1.76 to 8.11 ± 2.48, fasting glucose from 157.9 (83–645) mg/dl to 163.2 (84–550) mg/dl, and postprandial glucose from 228.8 ± 72.9 mg/dl to 260.3 ± 90.8 mg/dl, and these changes were also not statistically significant (p = 0.253, p = 0.678, and p = 0.079, respectively). A comparison of other pre- and post-lockdown parameters is summarized in Table 4.

Table 4
Pre- and post-lockdown laboratory parameters.

Parameters	Before lockdown	After lockdown	p value
Weight, kg	84.7 ± 16.4	85.5 ± 16.8	0.781
BMI, kg/m^2	29.8 ± 3.4	30.3 ± 5.5	0.486
Waist circumference, cm	105 ± 23	107 ± 32	0.639
Hba1c, %	7.67 ± 1.76	8.11 ± 2.48	0.253
Fasting glucose, mg/dl	157.9 (83–645)	163.2 (84–550)	0.678
Postprandial glucose, mg/dl	228.8 ± 72.9	260.3 ± 90.8	0.079
Urea, mg/dl	31.7 ± 10.7	32.1 ± 13.9	0.860
Creatinine, mg/dl	0.84 ± 0.34	0.87 ± 0.32	0.605
ALT, mU/L	23.93 ± 10.6	23.81 ± 9.4	0.871
Urine MA/creatinine	1.02 (0–73)	0.63 (0–83)	0.342
TSH, U/L	1.51 (0.04–18)	1.52 (0.1–12)	0.342

BMI, body mass index; Hba1c, hemoglobin a1c; ALT, alanine transaminase; MA, microalbumin; TSH, thyroid-stimulating hormone.

4. Discussion

This study investigated the effects on type 2 DM patients of the national lockdown in Turkey during the global COVID-19 pandemic. Increases were observed in weight and waist circumference values, and in glycemic parameters such as fasting and postprandial glucose, although these did not attain statistical significance.

The course of the disease and glycemic control in patients with DM are adversely affected by changes in lifestyles caused by the COVID-19 lockdown [11]. The most important underlying factors among DM patients are restriction of activity and dietary changes during the lockdown. Other factors may include the inability to visit hospitals or pharmacies and interruption of treatment due to anxiety over infection, critical interventions under physician control not being performed, and increasing anxiety and stress in DM patients already predisposed to depression [12].

A Spanish study investigating the dietary habits of type 2 DM patients during lockdown reported that patients endeavored to improve their nutritional habits, with increased consumption of vegetables and decreased consumption of fast foods, for example. However, that study also observed an increase in carbohydrate-rich snacking due to boredom and stress and reduced physical activity [13]. Similarly in the present study, the proportion of patients performing regular exercise and exhibiting dietary compliance was comparatively low. A study involving obese patients from Italy determined that patients gained an average of 1.51 kg after one-month quarantine, and that their mean BMI rose by 0.58 kg/m2 [14]. Patients in the present study gained an average 0.81 kg during three-month lockdown, with a 0.5 kg/m2 increase in BMI, although in contrast to the Italian study [14], these increases were not statistically significant. This variation may derive from the lower proportion of obese patients in our study, our DM patients receiving instruction regarding diet and diabetes, or to shorter follow-up times. A study involving type 1 DM patients undergoing continuous glucose monitoring (CGM) reported a significantly longer time at target blood sugar levels (70–180 mg/dl) over a 14-day lockdown period compared to pre-lockdown, although no difference was detected in time remaining hypoglycemic [15]. In a similar study of type 1 DM patients followed-up with CGM, no statistically significant difference was found between pre-lockdown and post-lockdown glucose parameters, although a significant difference was determined between breakfast and dinner [16]. These two studies were consistent with the present research in terms of, contrary to expectation, the lockdown period having no adverse impact on glucose parameters, and in terms on increase in hypoglycemia being observed. Severe hyperglycemia was observed in only one patient in the present study, and hyperosmolar non-ketotic hyperglycemia in another. In another study investigating lockdown in type 1 DM patients, Capaldo et al. [17] reported that glucose parameters were not statistically significantly affected by lockdown, but that physical activities and dietary habits were adversely impacted. These findings were consistent with the present study.

A simulation model study employed multivariate regression analysis to investigate the effects of previous natural disasters in order to predict the effects of the COVID-19 lockdown on patients with DM. Those authors concluded that a linear association existed between the length of lockdown and worsening of lockdown and diabetes-related complications [18]. The duration of lockdown in the present study was 75 days, and although an increase was observed in Hba1c values, this was not statistically significant. In the Gulf War, which severely affected the lives of the inhabitants of the region and resulted in a lockdown of 60 days, worsening of glycemic control and weight gain were observed in patients with both type 1 and type 2 DM, although similarly to the present study,

these increases were not statistically significant [19]. A study investigating the effects on glycemic control of the Marmara earthquake in Turkey in 1999 similarly observed a statistically insignificant increase in Hba1c in DM patients over a three-month period. That study also reported that glycemic control might be expected to worsen if the effects of the earthquakes were prolonged [20].

The SF-36 scores in this study, and particularly those from some of the subscales, were low. Relatively higher scores being reported in studies intended to determine the extent to which diabetic patients experience difficulties in the physical, social, emotional, and mental spheres [21] shows that quality of life declines still further with the addition of an extraordinary factor such as the pandemic. The presence of chronic disease in addition to various disasters with adverse impacts on life is reported to further worsen quality of life, and defenseless groups need to be closely observed in such situations [22].

4.1. Limitations

The first limitation of this study is that although the research compares two different time points it is difficult to establish a definite causal relationship between data and lockdown. Second, our study did not involve a detailed evaluation of factors capable of affecting patients' glycemic values, such as lifestyle changes during lockdown, dietary compliance, the stress factor, and access to medications. Third, the study period was relatively short, and the patient number was low. Another limitation is the absence of pre-lockdown SF-36 measurement. Finally, since this study was performed in a single diabetes center with a homogeneous population, the results may not be representative of other populations.

In conclusion, the increases, albeit statistically insignificant, observed in fasting glucose, postprandial glucose, Hba1c, and weight in the COVID-19 lockdown are noteworthy. We think that this worsening in glycemic parameters during the lockdown is associated with limitations that entered daily life due to an extraordinary phenomenon. At the same time, scores from the SF-36 quality of life scale show that the impact of these factors on patients is associated with more than one parameter. Exposure to extraordinary situations will inevitably result in patients experiencing various physical, mental, and mental problems. Considering that the COVID-19 pandemic is still continuing, in addition to control of biochemical parameters, patients also need to be supported emotionally, mentally, and in terms of social and physical functions at a time of prolonged restriction when restrictions still persist.

Declaration of competing interest

All authors have no conflicts of interest and source of funding.

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