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Retrospective study on the impact of COVID-19 lockdown on patients with type 2 diabetes in Northern Jordan

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ABSTRACT

Objective During COVID-19 pandemic, complete lockdown of cities was one of the measures implemented by governments worldwide. Lockdown had a significant impact on people's lifestyles and access and utilisation of health services. This study aimed to assess the impact of the lockdown on glycaemic control among patients with type 2 diabetes mellitus (T2DM).

Design and setting This was a retrospective study, electronic medical records at a leading University Hospital in Northern Jordan were used to extract study data.

Participants All outpatients with T2DM.

Primary and secondary outcome measures Glycated haemoglobin (HbA1c), blood glucose and lipid profile for patients with T2DM, 6 months before and 6 months after the full COVID-19 lockdown.

Results A total of 639 patients (289 (45.2%) males and 350 (54.8%) females) were included in this study. Their age ranged from 18 to 91 years, with a mean (SD) of 59.9 (13.8) years. The overall means of HbA1c (8.41 vs 8.20, <0.001), high-density lipoprotein (1.16 vs 1.12, <0.001), low-density lipoprotein (2.81 vs 2.49, <0.001) and total cholesterol (4.45 vs 4.25, p<0.001) levels were significantly higher in the period before lockdown compared with the period after the lockdown. However, triglyceride and fasting blood glucose levels were not affected significantly after the lockdown.

Conclusions The glycaemic control and lipid profile had significantly improved after COVID-19 pandemic lockdown. The availability of medication and medical advice delivery systems (monthly medicine deliveries) during the lockdown in Jordan might have positive impact on patients with diabetes.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The sample used was limited to diabetic outpatients at a single centre due to the pandemic lockdown and challenges in obtaining data from electronic medical records in other hospitals.
- ⇒ Having more measurement before and after (interrupted time-series design) is superior to pre–post test design, which we used without having a control group.
- ⇒ There was a lack of data that could be gathered/extracted from patients' electronic files such as certain sociodemographic variables, medication, dietary and exercise regiments and change in patterns during the data collection period.
- ⇒ The study was conducted in one of the largest hospitals in the north of Jordan that was open even during the pandemic lockdown.
- ⇒ The data collection extended to several months before and after the lockdown period. Therefore, lifestyle and medication may have changed during the periods before or after the lockdown.

INTRODUCTION

Diabetes mellitus (DM) is a lifelong disease that contributes to high morbidity and mortality rates.[1 2] The global prevalence has quadrupled during the last three decades, and it is now the ninth-leading cause of mortality.[3] Individual susceptibility to type 2 diabetes (T2DM) is partly determined by genetic predisposition,[4] but a poor diet and sedentary lifestyle are significant drivers of T2DM.[3 5]

Uncontrolled diabetes has emerged as one of the leading root causes of death in COVID-19 patients, as well as the second most common comorbidity of COVID-19.[6–8] It has been known that people with diabetes are more susceptible to infections and have a worse prognosis once infected than patients with no diabetes.[9–11] Furthermore, when diabetic people infected with respiratory viruses, they tend to get a severe illness and are more likely to be hospitalised.[12 13]

One of the key steps taken by governments around the world, particularly those most afflicted by the COVID-19 pandemic, was the complete or partial lockdown of cities. As part of the global response to COVID-19 pandemic, Jordan declared a state of emergency and imposed a national lockdown in 17 March, 2020 to May 2020. The lockdown was extended to include limiting healthcare services to emergency care only, and patients were also advised to avoid attending hospitals unless strictly essential. Then, the Jordanian government started to ease the lockdown.[14 15] However, strict adherence to prescriptions and reinforcement of the need of preventive actions were emphasised, especially for patients with chronic diseases.[14 16]

The closure of many healthcare services and the curfew that limited people's movement could have affected people's accessibility to medications and continuity of care.[17–19] Poor management of T2DM and any disruptions could result in significant health implications and a deterioration of their metabolic control.[20] Furthermore, the lockdown and other restrictions (ie, social isolation) has affected DM patient's feelings of stress or anxiety.[21 22] A recent study found an increase in carbohydrate intake, disruption of meal schedules, increased snacking, decrease in exercise, decreased self-monitoring of blood glucose and widespread mental stress in patients with T2DM but positive changes such as increased fruit consumption were also reported.[23] Another study showed that although 80% of the participants reported that they exercised regularly and managed to maintain a healthy diet, but only 28% regularly checked their blood glucose levels.[24]

Relevant studies found improved glycaemic control in patients with diabetes during lockdown,[21 25] while others reported deterioration of glycaemic control or no difference.[26–33] Reviews of the current literature revealed a lack of regional studies investigating the effect of COVID-19 lockdown on patients with T2DM.[26 34] Therefore, this study aimed to assess the impact of COVID-19 lockdown on glycaemic control among patients with T2DM in Jordan. Specifically, the study was conducted to compare glycated haemoglobin (HbA1c) levels, blood glucose levels, and lipid profile measures as reflected by the low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol and triglycerides (TG) among Jordanian patients with T2DM before and after lockdown.

MATERIALS AND METHODS

Data source

This was a retrospective study conducted at a leading tertiary university hospital serving more than 1.6 million populations in Northern Jordan. The current study used data from electronic medical records for outpatients with T2DM 6 months before (mid of September 2019 to mid of March 2020) and 6 months after the lockdown (end of May 2020 to end of November 2020). The sample size was calculated using G*Power V.3.1.9.2. The minimum sample size needed to detect a small effect size in the change of HBA1c (effect size d=0.3) at a power of 80% and alpha level of 0.05 was calculated at 145 subjects. Our sample size was increased to have an adequate power for subgroup analysis.

The HbA1c, fasting blood glucose (FBG) and lipid profile of T2DM individuals were retrieved and compared prelockdown and postlockdown to examine the potential impact of lockdown on glycaemic control and lipid profile. Available sociodemographic data including age, gender and marital status were also obtained. We made sure that data extracted about fasting blood sugar through patients' electronic medical files was accurate. Nurses and doctors usually ask patients about their fasting status before a blood sample is taken. If the patients are not fasting at that time, then blood samples are delayed to another day.

All collected data were processed and analysed anonymously.

Patient and public involvement

No patient involved.

Data analysis

Collected data were entered and encoded into IBM SPSS Statistics software (IBM SPSS Statistics for Windows, V.26.0., IBM). Data were tested for normality and found to be normally distributed except for HbA1C and TG. Thus, differences between males and females were tested using an independent sample t-test in normally distributed data and Mann-Whitney non-parametric tests for non-normally distributed data. Similarly, differences between levels of variables before and after the COVID-19 lockdown were compared using paired samples t-test for normally distributed data and using the Wilcoxon signed ranks test for data that are not normally distributed. Finally, repeated measures multivariate analysis was conducted to compare the means of parameters between the two time intervals after adjusting for gender and age. A $p<0.05$ was considered statistically significant.

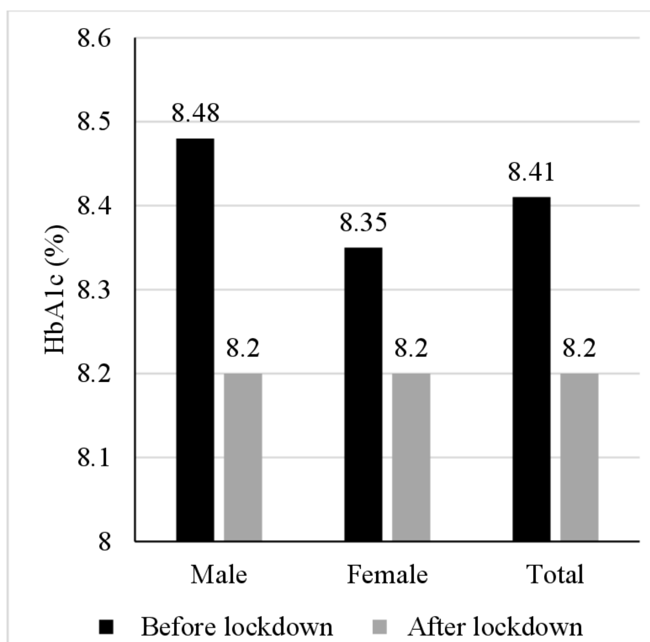

Figure 1 The mean HbA1c (%) in males and females before and after the lockdown. HbA1c, glycated haemoglobin.

Table 1 Changes in glucose level, HbA1c and lipid parameters before COVID-19 lockdown and the period after lockdown

		Before lockdown		After lockdown		Change (before–after)		P value
	N	Mean	SD	Mean	SD	Mean	SD	
Total								
HbA1c (%)	637	8.41	1.59	8.20	1.59	0.21	1.40	**<0.001**
Fasting blood glucose (FBG) (mmol/L)	254	10.89	4.68	11.19	5.30	−0.31	5.86	0.407
High-density lipoprotein (HDL) (mmol/L)	423	1.16	0.30	1.12	0.30	0.04	0.17	**<0.001**
Low-density lipoprotein (LDL) (mmol/L)	414	2.81	0.99	2.49	0.88	0.32	0.85	**<0.001**
Total cholesterol (mmol/L)	424	4.45	1.13	4.25	1.06	0.20	0.91	**<0.001**
Triglyceride (TG) (mmol/L)	416	2.22	1.59	2.20	1.24	0.02	1.26	0.713
Male								
HbA1c (%)	287	8.48	1.66	8.20	1.57	0.29	286	**0.001**
FBG (mmol/L)	126	11.28	4.85	11.17	5.48	0.11	125	0.847
HDL (mmol/L)	202	1.05	0.24	1.01	0.25	0.04	201	**<0.001**
LDL (mmol/L)	197	2.78	0.97	2.36	0.80	0.43	196	**<0.001**
Total cholesterol (mmol/L)	203	4.34	1.08	4.04	0.96	0.30	202	**<0.001**
TG (mmol/L)	198	2.35	1.66	2.31	1.38	0.04	197	0.718
Female								
HbA1c (%)	350	8.35	1.53	8.20	1.62	0.15	349	**0.048**
FBG (mmol/L)	128	10.50	4.49	11.22	5.15	−0.72	127	0.123
HDL (mmol/L)	221	1.26	0.31	1.22	0.32	0.04	220	**0.002**
LDL (mmol/L)	217	2.84	1.01	2.61	0.94	0.23	216	**<0.001**
Total cholesterol (mmol/L)	221	4.54	1.18	4.44	1.11	0.11	220	0.065
TG (mmol/L)	218	2.11	1.51	2.10	1.08	0.01	217	0.890

All bold values refer to significant P values.
HbA1c, glycated haemoglobin.

RESULTS

A total of 639 patients (289 (45.2%) males and 350 (54.8%) females) were included in this study. Their age ranged from 18 to 91 years, with a mean (SD) of 59.9 (13.8) years. There was no significant difference in mean age between males (60.1±13.79) and females (59.7±13.78), p=0.745. One-tenth (10.3%) of patients were singles.

Figure 1 shows the mean HbA1c (%) in males and females before and after the lockdown. The mean HbA1c decreased significantly in the period after the lockdown compared with the period before lockdown among males and females.

Table 1 shows the changes in glucose level, HbA1C and lipid parameters between the period of before COVID-19 lockdown and the period after lockdown. The overall means of HbA1c (8.41 vs 8.20, <0.001), HDL (1.16 vs 1.12, <0.001), LDL (2.81 vs 2.49, <0.001) and total cholesterol (4.45 vs 4.25, p<0.001) levels were significantly higher in the period before lockdown compared with the period after the lockdown. However, TG and FBG levels were not affected significantly after the lockdown. The same findings were seen in males and females, except that the change in total cholesterol was not significant among females.

In the multivariate analysis, the changes (before–after) in HbA1C (B 0.25%, 95% CI 0.12% to 0.38%; p=0.081), HDL (B=0.05 mmol/L, 95% CI 0.02 to 0.08; p=0.019), LDL (B=0.34 mmol/L, 95% CI 0.22 to 0.46; p<0.001) and total cholesterol (B 0.21 mmol/L, 95% CI 0.08 to 0.35; p=0.002) were statistically significant after adjusting for age and gender. However, the changes in FBG level (p=0.72) and TG (p=0.85) were not statistically significant.

DISCUSSION

Our findings showed that HbA1C levels were high for all patients of all groups, both before and after the lockdown. Unlike previous research that assumed a significant worsening of glycaemic control among patients with T2DM,[26–29] this study showed significant improvement in HbA1c after the lockdown, and no significant changes have been observed in glucose levels. However, the small decrease of HbA1c was not associated with a decrease in FBG levels. Thus, the clinical benefit of the changes in glycaemic control was modest at best.

Similar to our findings, several previous studies found that the lockdown did not negatively affect glycaemic control pattern among patients with T2DM.[30 35] Other studies from Greece, France and India reported improvement in glycaemic and metabolic control during the lockdown periods pertaining to their countries.[25 36 37]

Our findings were not in accordance with those reported by Ghosal *et al* who reported substantial increase in HbA1C and diabetes-related complications in people with diabetes.[38] Another study concluded that overall glycaemic control has worsened during a 3-week lockdown period. The authors suggested that lifestyle changes, psychological stress, difficulty in getting medication and medical advice were possible factors in worsening glycaemic control.[29] Such problems were not seen among patients included in our study. The Jordan government implemented internationally standardised guidelines in crisis management which were all critical to success and progress during critical situations and helped Jordanian to pass the crisis with minimal effect on patients' health.[14 15]

Also, the Ministry of Health healthcare centres and hospitals and in partnership with Jordanian Medical Association and non-governmental organisations played a vital role in delivering medications to patients with chronic diseases to their homes during the pandemic. Contrary to the Jordanian situation, decentralised measures implemented by states in Brazil were reported to have left the majority of patients with diabetes unprotected, thus reported increased glycaemic levels and/or variability.[39]

One explanation for the possible significant improvement in HbA1c and total cholesterol level in some patients with diabetes was that those who had a labour-intensive work schedule prior to the lockdown now had the option of working from home, resulting in better eating habits and a chance for more exercise.[36]

Contrary to previous findings,[34] our findings demonstrated that both LDL and HDL were higher before the lockdown than after the lockdown in both males and females. The lower HDL, LDL and cholesterol after the lockdown may be linked to a change in food patterns during lockdown; low-carbohydrate diets help people lose weight and improve their lipid profiles.[29 30 40] In contrast to the 3-week lockdown period mentioned by Khare and Jindal,[29] difficulty in getting medication and medical advice were not a major problem throughout the Jordanian population, as the governmental protocols and medication services for chronic diseases patients did not diminish at all. Finally, as this is a retrospective study, where data were extracted from patients' electronic medical records, we relied on what was documented in these records with limited accessibility to patients because of the COVID-19 curfew at the time of data collection. However, if there were any changes in medications, the doctor should have included this in the patients' electronic files. We did not see any medication changes documented in any of the data that we extracted.

Limitations

This study has some limitations that need to be acknowledged by the authors. First, the sample used was limited to diabetic outpatients at a single centre due to the pandemic lockdown and challenges in obtaining data from electronic medical records in other hospitals. Second, our study lacks a control group thus having more measurement before and after (interrupted time-series design) is superior to pre–post test design, which we used without having a control group. Third, there was a lack of data that could be gathered/extracted from patients' electronic files such as certain sociodemographic variables, medication, dietary and exercise regiments and change in patterns during the data collection period. The study was conducted in one of the largest hospitals in the north of Jordan that was open even during the pandemic lockdown. Finally, the data collection extended to several months before and after the lockdown period. Therefore, lifestyle and medication may have changed during the periods before or after the lockdown.

CONCLUSIONS

Our study showed that the glycaemic control and lipid profile had significantly improved after lockdown. The availability of medication delivery systems (monthly medicine deliveries) during the lockdown in Jordan might have had a positive impact on patients with diabetes. Delivering medicines to patients' homes initiative was part of the Jordanian's health system precautionary measures to prevent the arising coronavirus pandemic, limit its spread, reduce hospital/health centres visits and encourage citizens to stay at home and provide services using available technology.

Contributors MSA, NSO and YK conceived the ideas of this study, participated in the studydesign, analysis and interpretation, as well as drafted and amended for themanuscripts. NSO and NA-S were involved in data collection. Data analysis and interpretation was done by YK. MSA, YK and NA-S critically reviewed the manuscript. All authors had final responsibility for the decision to submit for publication. MSA is the guarantor for the study.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Prior to data collection, ethical approvals were obtained from the Institutional Review Board (IRB) of the Jordan University of Science and Technology (JUST) and from the participating hospital. The consent form administration was waived and approved by the IRB at JUST (2021/144/35).

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Data availability statement Data are available on reasonable request.

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