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Research

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Effects of COVID-19 lockdown on metabolic control in patients with Type 2 Diabetes in Sri Lanka

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ABSTRACT

Introduction: The COVID-19 pandemic has led to an island-wide lockdown in Sri Lanka, leading to restrictions in daily routines. The ensuing lifestyle changes have drastically influenced the prevalence and worsening of chronic diseases like diabetes with poor metabolic control of the disease.

Objectives: To evaluate the immediate impact of the lockdown on the metabolic parameters associated with diabetes control in individuals with type-2 diabetes mellitus (T2DM).

Methodology: A single center cross-sectional descriptive study was conducted on 157 T2DM patients attending a diabetes clinic in the private sector. Pre- and post-lockdown data on metabolic control of the study population was collected from patient records. Patients' perceptions of diet/exercise and access to medication/medical care during the lockdown were collected through a telephone interview.

Results: Pre- and post-lockdown data of 157 male (Females 88; mean age-58.68±SD 13.44 years) patients belonging to the age group 48-72 were evaluated. Of the patients who had a HbA1c of ≤ 7% pre-lockdown, 80% had shown to maintain their HbA1c. Of the patients with HbA1c > 7% pre-lockdown, 27.9% showed a reduction of their HbA1c below 7%.

The majority of the responders had no difference in their diet (69.2%) and exercise (65.4%) during the lockdown. Among those with improved HbA1c (n=101;63% of cohort), 16.9% and 13% had better diet and exercise respectively while none in worsened HbA1c group had improved diet or exercise.

Conclusions: Lockdown in Sri Lanka has not been associated with worsening of glycaemic control in the studied cohort of patients with type 2 diabetes. Adherence to the recommended diet and exercise regime during lockdown is associated with better glycaemic control in patients with type 2 diabetes.

Keywords: COVID-19; Lockdown; Metabolic control; Sri Lanka; Diabetes



INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic due to the SARS-CoV-2 virus has resulted in a significant rise in mortality and morbidity worldwide (1). As there is no effective treatment to date, prevention, including contact tracing and quarantine, adherence to hygienic measures (wearing face masks, hand sanitization, and maintaining social distancing), and community vaccination have played a major part in disease control. During the initial phases of the disease when vaccines were still under development, most countries had mandated population-wide movement control as a measure to successfully control the disease transmission (2, 3).

On the medical front, the pandemic has resulted in temporary disruptions in access to routine, non-emergency medical care access and routine medical clinics, and diagnostic centres, availing contacts with physicians and interruptions to medicine (7-11). It has exclusively affected the majority of the population suffering from chronic illnesses such as diabetes which demands regular physical activities, a strict dietary regime, and compliance with medications for disease control. Foreseeing the negative influence of lockdown on glycaemic control, many researchers worldwide noted a decline in glycaemic control during lockdown (4, 12-16) albeit few studies reported favorable outcomes among patients with diabetes (17-19). Having optimal control of chronic diseases is very important especially during the COVID-19 pandemic as co-morbid conditions including diabetes can worsen the prognosis of COVID-19 infection (20-25). Additionally, a suboptimal glycaemic control that could pave the way for diabetes-related complications, resulting in a higher healthcare burden, could be detrimental during COVID COVID-related economic crisis.

The conditions of the lockdown varied from country to country. Sri Lanka stood out during the first wave of COVID-19 due to early strategies including declaring an island-wide lockdown from 20th March to 11th May 2020 to contain the epidemic by restricting social contacts. Outdoor activities were restricted, educational institutions/public facilities were closed, and working from home was encouraged where applicable. Although routine outpatient healthcare provision was halted

except for emergencies, community programs were established to provide limited health services. Furthermore, lockdown was not strictly imposed on people who wanted to access healthcare facilities. Some pharmacies delivered the medication to the homes of patients when the prescriptions were sent to them online. The government had also introduced certain stimulus packages to prevent financial crises.

Available limited studies on lockdown in Sri Lanka had indicated the impact on mental health; Patabendige et al. showed an increase in the prevalence of perinatal anxiety and depression among Sri Lankan pregnant women with no proven/known COVID-19 infection (26). However, the impact on other chronic illnesses that undermine the control of the prevailing disorder has not yet studied. It is important to explore and understand the impact of being under lockdown on metabolic health, especially during the pandemic of COVID-19. The aim of this study is to investigate the effect of lockdown on metabolic control of type-2 diabetes mellitus and to identify factors contributing to glycaemic control under lockdown during the COVID-19 pandemic in Sri Lankan background. Knowledge from this study would provide new insights into managing patients with diabetes during challenging situations like regional/island-wide lockdowns.

METHODOLOGY

Patient selection

A single-center observational cross-sectional study was carried out on all consecutive patients with type 2 diabetes who were followed up at a private Diabetes and Endocrine Consultation Practice in Kandy district, Central Province of Sri Lanka between January 2020 to July 2020. All consultations and medication adjustments were done by a single qualified Endocrinologist. Patients with other types of diabetes except type 2 diabetes mellitus and those who did not consent to participate were excluded. 157 patients who attended the consultation both before and after the island-wide lockdown period (20th March to 11th May 2020) were identified.

Ethical considerations

Ethical approval was obtained from the human research ethics committee of the National Hospital, Kandy, Sri Lanka (NHK/ERC/38/2020). All participants provided oral informed consent.

Data collection

Data on age, gender, height, pre- and post-lockdown weight, HbA1c, and lipid profile were collected on review of medical records. Data from the last consultation visit which occurred between 1st January to 20th of March 2020 were obtained as pre-lockdown metabolic parameters while the same parameters from the first-ever consultation visit after lifting the lockdown on 11th May to July 2020 were collected. A telephone interview was carried out by two trained research assistants using a questionnaire to collect details on patient perception of diet (better/same/worse), physical activity (better/same/worse), and access to medication (better/same/worse). Perception of reasons for the above responses during the lockdown compared to the pre-lockdown period

was also obtained through an open-ended question.

Statistical methods

An independent-sample t-test was run to determine if there were differences between groups at baseline. Pre- and post-lockdown data were analysed using paired sample t-test for continuous and Chi-square (Fisher's exact test) test for categorical data. A $p < 0.05$ was considered indicative of a statistically significant difference. Statistical analyses were performed using the SPSS (version 24, Chicago, IL, USA) software package.

RESULTS

Patient characteristics

The baseline characteristics of 157 patients are summarized in Table 1. The interval between the 2 visits was above 75 days for all the participants.

Table 1: Baseline characteristics of the patient study sample before COVID-19 lockdown

Variable		N (%)	(mean \pm SD)
Age in Years		157 (100)	58.68 \pm 13.44
Duration of Diabetes in years (mean \pm SD)		157 (100)	12.56 \pm 9.6
Sex	Male	69 (43.9)	
	Female	88 (56.1)	
Type of Diabetes,	Type 2 Diabetes	157 (100)	
	Type 1 Diabetes	0 (0)	
HbA1c (%)	Male	57 (41.9)	8.51 \pm 1.77
	Female	79 (58.1)	8.98 \pm 1.99
	Total	136 (100)	8.78 \pm 1.91
BMI (kg/m ²)	Male	43 (38.7)	25.49 \pm 3.38
	Female	68 (61.2)	28.15 \pm 4.39
	Total	111 (100)	27.11 \pm 4.21

HbA1c- Glycated haemoglobin A1c; BMI- body mass index

Glycaemic and metabolic parameters

The mean post-lockdown HbA1c (7.93 ± 1.58) value was statistically significantly lower compared to the mean pre-lockdown HbA1c (8.78 ± 1.91) level (Table 2). HbA1c improvement was not associated with age, gender, duration of diabetes, pre-lockdown BMI, or Δ BMI. During the sub-group analysis, of the 25 patients who had a HbA1c of $\leq 7\%$ before lockdown, 80% had shown to maintain their HbA1c $\leq 7\%$ whereas 27.9% of 111 patients with HbA1c $> 7\%$ pre-lockdown showed a reduction of their HbA1c below 7%.

Total cholesterol and LDL cholesterol statistically significantly improved while a significant reduction in the HDL level was observed during lockdown. However, there was no statistically significant association between changes in cholesterol levels (total or LDL) and age, gender, Δ BMI, or Δ HbA1c.

Although it was observed that there was a decrease in BMI from 27.06 kg/m^2 to 26.94 kg/m^2 during lockdown, it failed to achieve statistical significance (Table 2).

Table 2: Comparison of alterations in metabolic parameters pre- and post-lockdown

Parameter		N (%)	Pre-Lockdown (mean \pm SD)	Post-Lockdown (mean \pm SD)	P Value
Body mass index (Kg/m ²)		111 (100)	27.06 ± 4.22	26.94 ± 4.05	0.17
HbA1c (%)	Improved	101 (74.3)	9.09 (1.95)	7.64 (1.46)	<0.01*
	Worsened	35 (25.7)	7.86 (1.43)	8.74 (1.61)	<0.01*
	Total	136 (100)	8.78 ± 1.91	7.93 ± 1.58	<0.01*
Total Cholesterol (mmol/L)		20	201.18 ± 69.39	164.36 ± 54.33	<0.01*
LDL Cholesterol (mmol/L)		20	131.30 ± 78.91	91.31 ± 43.61	<0.01*
HDL Cholesterol (mmol/L)		20	50.47 ± 13.88	43.69 ± 7.99	0.01*
Triglycerides (mmol/L)		20	153.01 ± 108.46	149.74 ± 72.14	0.84

Data are expressed as mean \pm standard deviation.

P values are calculated using paired samples t-tests performed for each parameter

* Signifies statistical significance at $p < 0.05$

Abbreviations: HbA1c, haemoglobin A1c; LDL, low-density lipoprotein; HDL, high-density lipoprotein

Patient's perception of the contributing factors for changes in metabolic profile

The majority of the patients had not perceived any change in their diet or physical activities during lockdown (Diet-69.2%; Physical activities-65.4%) while only 12.1% and 9.3% of patients noted an improvement respectively. Interestingly 85% of the cohort had access to medications while 48.9% had claimed that access to medical care has also been the same or improved (Table 3).

The entire cohort was categorized into two groups: those with improved HbA1c (defined as post-lockdown HbA1c equal to or less than the pre-lockdown HbA1c) and worsened HbA1c. Although an overall reduction in HbA1c was noted in the study population 25% has worsened HbA1c. We compared the perception about diet, physical activity, access to medication, and access to medical care between the improved and worsened groups.

Table 3: Patients' perception on changes in routine lifestyle during lockdown

Component assessed	Response	The number of patients responded		Total N (%)	Chi-squared test
		HbA1c Improved N (%)	HbA1c worsened N (%)		
Diet	Better	13 (16.9)	0 (0)	13 (12.1)	Value -7.9 Df 2 P <0.01
	Same	53 (68.8)	21 (70.0)	74 (69.2)	
	Worse	11 (14.3)	9 (30.0)	20 (18.7)	
Physical activities	Better	10 (13.0)	0 (0)	10 (9.3)	Value 9.7 Df 2 P <0.01
	Same	53 (68.8)	17 (56.7)	70 (65.4)	
	Worse	14 (18.2)	13 (43.3)	27 (25.2)	
Access to medications	Same/Improved	64 (83.1)	27 (90.0)	91 (85.0)	Value 0.8 Df 1 P 0.36
	Worse	13 (16.9)	3 (10.0)	16 (15.0)	
Access to medical care	Same/Improved	36 (46.8)	16 (53.3)	52 (48.6)	Value 2.0 Df 2 P 0.37
	Worse	20 (26.0)	4 (13.3)	24 (22.4)	
	Not required	21 (27.3)	10 (33.3)	31 (29.0)	

Better, Improved, Same, and Worse represent the subjective feelings of participants on how each parameter assessed had been changed during lockdown.

HbA1c improved (post-lockdown HbA1c \leq pre-lockdown HbA1c; n=77); HbA1c worsened (post-lockdown HbA1c > pre-lockdown HbA1c; n=30)

Association between HbA1c and diet/exercise

Among the patients with improved HbA1c, 16.9% and 13% had a better diet and exercise respectively while the majority had the same diet and exercise levels (68.8% in both) pre- and post-lockdown. The commonest reasons given by those who felt the diet/exercise was better were having ample time to prepare healthy food and to engage in exercise (Figure 1).

Of the worsened HbA1c group, none had improved diet nor exercise while 30% and 43.3% did note worsening of diet and exercise respectively. Having ample time to cook unhealthy food and unavailability of healthy food items during lockdown were a few reasons the participants gave for having a worse diet while inability to go out for walks or gymnasium was the commonest reason for perception of worsened physical activities.

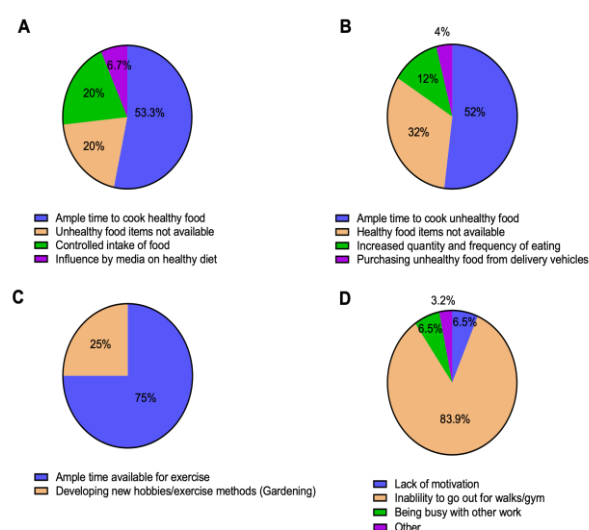


Figure 1: Responses by the study participants on reasons for better/worsening of diet/exercise
A- Diet better during lockdown; B – Diet worse during lockdown; C – Exercise better during lockdown; D – Exercise worse during lockdown. Better / worse responses are the patient perception of change in diet/exercise during lockdown compared to pre-lockdown status.

Association between HbA1c and access to medication and medical care

No association was found between the HbA1c category and access to medication or medical care.

DISCUSSION

The COVID-19 pandemic led to an island-wide lockdown in Sri Lanka, imposing restrictions on routine daily life that impact the lifestyle and the metabolic control of patients with chronic diseases like diabetes. This study evaluated the effect of island-wide lockdown on glycaemic control, metabolic parameters, lifestyle changes (diet/exercise), medication-related changes (access to medications and medical care), and patient perception of possible reasons for any changes in a group of patients with type 2 diabetes. We observed a significant improvement in mean glycaemic level (HbA1c) during the lockdown and a statistically significant association with HbA1c improvement/worsening with diet and exercise. Interestingly, those with glycaemic improvement had a higher pre-lockdown HbA1c value (9.10%) compared with those who did not have glycaemic improvement (7.86%), but there were no other differences between the groups. The impact of the lockdown had positively influenced diabetic patients with poor glycaemic control to achieve better control.

In contrast to the usual expectation of worsening glycaemic control as anticipated from lockdown-mediated lifestyle changes and challenges to accessing medications, our study demonstrates an improvement of glycaemic levels despite strict physical outdoor activity restrictions. Similar findings have been observed in mostly type-1 diabetes and patients with type-2 diabetes. Dalmazi et al. and Bonora et al. noted an improvement in continuous glucose monitoring parameters among patients with type 1 diabetes, possibly due to changes in physical activity and stress (18, 19, 27-30). Stable glycaemic levels were observed among patients with type 2 diabetes, from Turkey and Netherlands, despite changes in stress and weight gain (13, 31).

We hypothesize that the expected effects of the lockdown on individuals had been counteracted by the adaptation of regular healthier lifestyle measures at home replacing the otherwise busy stressful work schedule. These include improvement in eating patterns, regular mealtime, less work-related stress, spending more time on self-care and diabetes management, improved sleep quality and spending more quality relaxed time with the family, eating homemade healthy food, and reduced intake of unhealthy food items with high-carbohydrate content (32-34). Also, restraint from the usual outdoor physical activities has enabled a shift towards more household activities like cleaning houses, sweeping, and gardening which contributed to being less sedentary. In addition to these, patient-related factors, policy makers' contribution might have played an important role. Several measures were implemented during the lockdown by the central local authorities in Sri Lanka. These promoted healthy lifestyles, arranged for local food delivery to the doorstep, emphasized the importance of healthy eating and lifestyle through media campaigns, and encouraged home gardening. Our results also show that improvement of the HbA1c category (improve/same) is associated with Diet and Exercise. While most people had no change in their diet, among the HbA1c improved group, 16.9% and 13% thought they had better dietary compliance and exercise during lockdown respectively. The most common attributing factors were having ample time for healthy cooking and physical activities. In alignment with these findings, none of the individuals with worsening HbA1c levels responded that they had improved diet or exercise towards achieving good glycaemic control.

A few key factors in the management of type 2 diabetes, such as timely access to medical care and medication are affected mostly during lockdowns. However, the majority of our cohort reported that access to medication (85%) remained the same or had improved during this period. This was augmented by home delivery of medications facilitated by the authorities and pharmacies. Although access to medical care had been compromised during the lockdown, 48.6% of the individuals did not seem affected by this. They felt an improvement in access to medical care, possibly due to increased usage of telemedicine facilities in

Sri Lanka. However, none of the above showed any direct significant association with the improvement of glycaemic control.

Similar to our findings, Ruissen et al. also noted that people with higher pre-lockdown HbA1c levels had an improvement in HbA1c during lockdown (31). This finding indicates that people with poor glycaemic control would put more emphasis during lockdown to get their glycaemic levels better. Meanwhile, people with very good control of diabetes remain committed to maintaining an optimal HbA1c level despite social restrictions. This is supported by the majority of individuals with HbA1c <7% maintaining a static HbA1c level in our study. Total cholesterol and LDL cholesterol also showed a similar association where patients with target glycaemic levels, HbA1c >7% showed significant improvement in cholesterol levels, possibly owing to practicing the same healthy lifestyle habits.

There are a few limitations to our study. Since the study population is from a single-centre and a private consultation practice, this might impose selection bias and the index sample may not represent the whole Sri Lankan population with type 2 diabetes. Also, the patients who seek private consultation for their disease conditions are generally at middle to higher socio-economic levels. Further, we relied on self-reported changes in diet, exercise, and medication. Also, the duration of the lockdown was 52 days. Despite that, the duration of the two visits was more than 75 days for all the participants. Therefore, we assume the HbA1c level would accurately be indicative of glycaemic level during the lockdown period. Despite these, our study clearly states that the lockdown has not resulted in an adverse impact on glycaemic control and provides a reassurance that, contrary to the expectations, patients can cope successfully during the restrictions.

CONCLUSION

lockdown in Sri Lanka due to the COVID-19 pandemic had not adversely affected the glycaemic control of patients with type 2 diabetes in this study population. Adhering to healthy lifestyle measures is important and may contribute

to the glycaemic and metabolic outcome following a lockdown. Being the first study done on the Sri Lankan population on the effects of lockdown on glycaemic control of a group of patients with type 2 diabetes, this study brings light on the importance of recommendations on healthy lifestyle changes during periods of lockdown and implementation of health policies that improve the care of patients.

Author declaration

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Authors' contributions:

Study concept and design: C.A.; Acquisition of data: A.Z., G.A., and T.K.; Analysis and interpretation of data: S.T; Drafting of the manuscript: P.K., and S.G.; Critical revision of the manuscript for important intellectual content: C.N., and N.K.

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The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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