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Observational study on Effect of Lock Down due to COVID 19 on glycemic control in patients with Diabetes: Experience from Central India

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ABSTRACT

Background and aims: Diabetes is a chronic metabolic condition characterized with hyperglycemia and associated with several complications. Glycemic control is important factor in preventing the complications associated with diabetes. Pillars for good glycemic control are good life style modification with proper medication under medical guidance. The aim of this study was to study the effect of lock down on glycemic control in diabetic patients and possible factor responsible for this.

Material and methods: – Out of 407 only 143 diabetic patients who attended the our endocrine OPD in last 3 months who had good glycemic control in past without any chronic complication and willing to participate were included in study. They were advised for the self-monitoring of blood glucose for identifying the glycemic control and with questionnaire designed possible factor was identified during the lockdown period.

Results: – The patients were aged between 18 and 65 years with mean age of 54.68 years and male to female ratio was 91:52.56 (39.16%) patients reported worsening of hyperglycemia and requiring addition of medications for control of blood glucose and 3 (2.09%) patients reported hypoglycemic events and medications were stepped down. Psychological stress was most common factor worsening of hyperglycemia followed by change in diet and exercise.

1. Introduction –

As world is facing the pandemic due to COVID-19 (Corona Virus Disease 2019) which has high infection rate and associated morbidity & mortality. Thus, several measures are being taken to prevent its spread. And a major step taken by government of India in order to prevent its spread is temporary lock down of country along with all precautions advised like social distancing and social isolation [1].

People with diabetes and other co-morbid conditions like asthma, heart failure, raised serum creatinine and elderly people above the age of 65 years may be at higher risk. The Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) study estimates that approximately 62 million people in India have diabetes [2,3]. A recent survey by World health organization estimated that India have 72.96 million cases of diabetes in adult population [4].

Diabetes is a chronic metabolic condition characterized with hyperglycemia and associated with metabolic complications. It is not uncommon endocrine disorder and prevalence in India ranges from 10.9 to 14.2% in urban area and 3.0–7.8% in rural area [2,3]. Good glycemic control is important factor in preventing the complications associated with diabetes. Adaption of good life style modification which includes balanced diet, exercise, proper sleep & psychological wellbeing with proper medication under medical guidance are the pillars for good glycemic control. All these pillars may be shaken in the lock down period. Hence aim of our study was to study the effect of lock down on glycemic control in diabetic patients and possible factor responsible for this [3,5,6].

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2. Material and methods

This was the observational cohort study performed at our Endocrine department. Duration of study was 3 weeks during the first phase lock down period.

Out of 407, 143 type 2 diabetic patients who had attended our endocrine OPD in the last 3 months and had good glycemic control in the past without any chronic complications, and willing to participate were included. This was identified based on previous follow up clinical records. The inclusion criteria for enrollment into the study included the following: (1) adult patients with previously diagnosed with T2DM on treatment, and (2) willing to participate in the study. Exclusion criteria included (1) Sick patients, (2) Patient with established microvascular or macrovascular complication of diabetes, (3) pregnancy, (4) Not willing to participate in study.

Patients who met the above criteria were included and advised for SMBG (self-monitoring of blood glucose) for minimum 2 readings which included Fasting Blood Glucose (FBG) and Post Prandial Blood Glucose (PPBG) which is two hours after taking breakfast to maximum as many patient wanted or as and when required if patient had any symptom suggesting of change in blood sugars. Patients were reminded through automated messaging services and minimum 5 days readings were recorded and patients were asked to report the blood sugars charting regularly through telemedicine which was regularly used earlier too through mobile applications. Then with paired T – test, statistical analysis was done and blood sugars during lock down and pre-lock down were compared.

Though Ideal targets for glycemic control are based on age and associated co-morbid condition but for our study the FBG (before breakfast blood glucose) below 140 mg/dl and any other blood glucose below 180 mg/dl and above 70 mg/dl were considered for good glycemic control, Stepping up of medications was done if FBS was persistently higher than 140 mg/dl and any other blood sugars more than 180 mg/dl. And even a single episode of hypoglycemia was entertained with stepping down of medications.

Questionnaire was self-designed as described in Table 7 to identify the possible cause for loss of glycemic control by patient's subjective response.

3. Results

The patients were aged between 18 and 65 years with mean age of 54.68 years and male to female ratio was 91:52. Mean fasting and post prandial blood glucose before lock down in our patients was 115.9 mg/dl and 124.9 mg/dl respectively. The summary of baseline characteristics is described in Table 1.

Mean Fasting Blood Glucose and post prandial blood glucose during the COVID 19 lockdown in male patients was 118.3 mg/dl and 157.7 mg/dl respectively. Results in details is explained in Table 2.

Mean Fasting Blood Glucose and post prandial blood glucose during the COVID 19 lockdown in female patients was 121.2 mg/dl and 161.37 mg/dl respectively. Results in details is explained in Table 3.

Overall Mean Fasting Blood Glucose and post prandial blood glucose during the COVID 19 lockdown in patients was 119.4 mg/dl and 159.0 mg/dl respectively. Results in details is explained in Table 4.

Thus, both fasting and post prandial blood glucose in lock down period were higher than prior to lock down but statistically significant difference was seen with post prandial blood glucose only as described in Table 5.

Overall, 56 (39.16%) patients reported worsening of hyperglycemia and requiring addition of medications for control of blood sugars. 11 patients reported only fasting hyperglycemia, 24 patients reported only post prandial hyperglycemia and 21 patients reported both fasting and post prandial hyperglycemia. 3 (2.09%) patients which included 2 males and 1 female patient reported hypoglycemic events and medications were stepped down. Results in details is explained in Table 6.

Psychological stress was most common factor worsening of hyperglycemia and was observed as financial stress, stress of disease (COVID 19), stress due loss of social networking or any other form of stress in 117 (81.82%), 99 (69.23%), 70 (48.95%), 75 (52.45%) patients respectively. This was followed by change in exercise which was observed as change in type of exercise, change in timing of exercise and change in duration of exercise in 115 (80.42%), 104 (72.72%) and 87 (60.84%) patients respectively. Dietary changes were observed as change in type of diet, change in timings of meals, change in frequency of meals, change in amount of diet in 57 (39.86%), 86 (60.14%), 86 (60.14%) and 98 (68.53%) patients respectively. Prevalence of various causes for loss of glycemic control are described in Table 7.

4. Discussion

Lockdown being a significantly important step in order to stop and prevent the spread of COVID 19 infection was taken by government of India but it may have affected the glycemic control in diabetic patients. Good glycemic control is important have good immunity and to prevent complications related diabetes. Hence in our study we tried to identify the effect of lock down on glycemic control.

In our study we have included the patients who had good glycemic control and were on regular follow up.

In our study mean FBG was numerically higher in lock down period but was not statistically significant, while PPBG was significantly higher in lock down period as compared to previous non lock down period. Possible reason for it may be the change in amount and type of diet due to being at home with lack of exercise due to lock down which majorly affects the PPBG. Stress alters the hormonal homeostasis and lead may to hyperglycemia but as with sleep sympathetic activity reduces, effect of stress on FBG may be less as compared to PPBG [7,8]. Secondly hypothesis for it may be that in our study we included patients who had good glycemic

Table 1
Baseline characteristics of our Patients.

Parameter	Male (N = 91)		Female (N = 52)		Overall (N = 143)	
	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range
Age (Years)	55.18 ± 9.12	27–63	53.81 ± 7.1	31–61	54.68 ± 9.22	27–63
BMI (Kg/m^2)	28.33 ± 3.12	22.6–35.7	31.25 ± 2.13	24.7–36.2	29.39 ± 2.21	22.6–36.2
Duration of DM (Years)	7.48 ± 5.89	2–23	8.76 ± 3.67	1–19	7.95 ± 4.91	1–23
FBG (mg/dl)	115.7 ± 6.81	91–132	116.4 ± 5.76	102–134	115.9 ± 8.09	91–134
PPBG (mg/dl)	121.4 ± 7.12	114–143	131.1 ± 8.37	106–157	124.9 ± 10.49	106–157
HBA1c	6.6 ± 0.2	6.4–7.2	6.9 ± 0.14	6.6–7.4	6.7 ± 0.21	6.4–7.4

Table 2
Mean Blood Glucose levels during Lock down due to COVID 19 in male patients.

Parameter	Male (N = 91)	
	Mean ± SD (mg/dl)	Range
Fasting Blood Glucose (mg/dl) (n = 91 X 5 = 455)	118.3 ± 12.43	88–164
Post Prandial 2 h Breakfast Blood Glucose (mg/dl) (n = 91 X 5 = 455)	157.7 ± 18.23	110–213
Before Lunch Blood Glucose (mg/dl) (n = 302)	139.5 ± 17.69	64–190
Before Dinner Blood Glucose (mg/dl) (n = 356)	166.3 ± 18.75	132–234
Random any other blood Glucose (mg/dl) (n = 203)	127.5 ± 19.11	56–181

Table 3
-Mean Blood Glucose levels during Lock down due to COVID 19 in female patients.

Parameter	Female (N = 52)	
	Mean ± SD (mg/dl)	Range
Fasting Blood Glucose (mg/dl) (n = 52 X 5 = 260)	121.2 ± 11.76	105–161
Post Prandial 2 h Breakfast Blood Glucose (mg/dl) (N = 52 X 5 = 260)	161.3 ± 18.45	118–227
Before Lunch Blood Glucose (mg/dl) (n = 121)	163.3 ± 12.12	144–201
Before Dinner Blood Glucose (mg/dl) (n = 138)	154.7 ± 22.32	51–246
Random any other blood Glucose (mg/dl) (n = 103)	147.3 ± 11.78	136–187

Table 4
Overall Mean Blood Glucose levels during Lock down due to COVID 19 diabetic patients.

Parameter	Overall (N = 143)	
	Mean ± SD	Range
Fasting Blood Glucose (mg/dl) (n = 715)	119.4 ± 11.67	88–164
Post Prandial 2 h Breakfast Blood Glucose (mg/dl) (n = 715)	159.0 ± 16.38	110–227
Before Lunch Blood Glucose (mg/dl) (n = 423)	146.3 ± 18.65	64–201
Before Dinner Blood Glucose (mg/dl) (n = 494)	163.1 ± 25.16	51–246
Random any other blood Glucose (mg/dl) (n = 306)	134.2 ± 18.12	56–187

Table 5
Comparison of Mean Blood Glucose before and during lock down.

	Fasting Blood Glucose (Mean + SD)		P Value	Post Prandial Blood Glucose (Mean + SD)		P Value
	Before	During lockdown		Before	During lockdown	
Male	115.7 + 6.81	118.3 ± 12.43	0.45	121.4 ± 7.12	157.7 ± 18.23	0.02
Female	116.4 ± 5.76	121.2 ± 11.76	0.31	131.1 ± 8.37	161.3 ± 18.45	0.01
Over all	115.9 + 8.09	119.4 ± 11.67	0.25	124.9 ± 10.49	159.0 ± 16.38	0.02

Table 6
Number of patients who reported of loss of glycemic control.

	Male	Female	Total
Only Fasting (>140 mg/dl)	7	4	11
Only Post Prandial (>180 mg/dl)	11	13	24
Both Fasting and Post Prandial	9	12	21
Total	27	29	56
Hypoglycemia events recorded (<70 mg/dl)	2	1	3

control with mean HBA1c of 6.7 and in such patients post prandial is major contributor for HBA1c [9].

In our study 56 (39.16%) patients experienced hyperglycemia. 11 patients reported only fasting hyperglycemia. These patients majorly reported of psychological stress and decreased sleep and only 4 patients reported of missing medication. 24 patients reported only post prandial hyperglycemia. These patients also reported of psychological stress due to financial reason and dooms day feeling due to COVID 19, while 18 patients also reported of missing medication due to difficulty in availability and being pre occupied with household activities. 21 patients reported both fasting and post prandial hyperglycemia psychological stress with irregular sleep being most common factor.

In our study 3 patients had episodes of hypoglycemia which included 2 male and 1 female.

First male patient noted hypoglycemic event before lunch and on enquiry cause was identified as delay in timing of lunch because all were busy doing household routine activity. Second male patient noted hypoglycemic event at evening after doing strenuous house hold work.

Only female patient noted hypoglycemic event before dinner because of increased gap between medication taken and delayed dinner.

In our study psychological stress was identified as the most common factor for loss of good glycemic control. Similar observations were made during previous stressful situations which mimics lock down situation like earthquakes, hurricane, war [10–12]. D Dubey et al. in their article described that COVID 19 itself in association with forced quarantine by nationwide lockdowns can produce acute panic, anxiety, obsessive behaviors, hoarding, paranoia, and depression, and post-traumatic stress disorder (PTSD) and several psychological disorder [13]. Similar finding was reported by

Table 7
Prevalence of multiple causes for loss of glycemic control during lockdown due to COVID 19 based on questionnaire.

Question	Sub- questions	Male n = 91 (%)	Female n = 52 (%)	Total n = 143 (%)
Stress	1. Financial Stress	74 (81.32%)	43 (82.69%)	117 (81.82%)
	2. Stress of Disease (COVID 19)	66 (72.53%)	33 (63.46%)	99 (69.23%)
	3. Stress due loss of social networking	41 (45.05%)	29 (55.77%)	70 (48.95%)
	4. Other	37 (40.66%)	38 (73.08%)	75 (52.45%)
Diet	1. Change in type	36 (39.56%)	21 (40.38%)	57 (39.86%)
	2. Change in timing	54 (59.34%)	32 (61.54%)	86 (60.14%)
	3. Change in frequency	51 (56.04%)	35 (67.31%)	86 (60.14%)
	4. Change in Amount	61 (67.03%)	37 (71.15%)	98 (68.53%)
Exercise	1. Change in Type	74 (81.32%)	41 (78.85%)	115 (80.42%)
	2. Change in timing	67 (73.63%)	37 (71.15%)	104 (72.72%)
	3. Change in duration	51 (56.04%)	36 (69.23%)	87 (60.84%)
Sleep	1. Change in timing	75 (82.42%)	31 (59.62%)	106 (74.13%)
	2. Change in duration	54 (59.34%)	29 (55.77%)	83 (58.04%)
	3. Change in frequency	68 (74.23%)	33 (63.46%)	101 (70.63%)
Medication	1. Change in timing	59 (64.84%)	24 (46.15%)	83 (58.04%)
	2. Difficulty in availability	29 (31.87%)	17 (32.69%)	46 (32.17%)
	3. Missing of medication	31 (34.07%)	19 (36.54%)	50 (34.97%)

Zandifar A et al. in their study at Iran [14].

Other factors possibly responsible for loss of good glycemic control included unfavorable change in diet, exercise and sleep pattern with difficulty in obtaining physician guidance and medications. This was in corroboration with other study from India by Ghosh A et al. which concluded that during lockdown there was increase in carbohydrate intake, decrease in exercise, decreased SMBG and widespread mental stress in patients with T2DM which resulted in exacerbation of hyperglycemia and hypertension [15].

Thus, overall glycemic control in our patients got deranged during lock-down period which is in corroboration with the study by S Ghosal et al. which concluded that duration of lockdown is directly proportional to the worsening of glycemic control and diabetes-related complications. Thus, worsening of glycemic control will put additional load on already overloaded healthcare system due to complications of diabetes. Also uncontrolled glycemic control may also increase COVID19 infection rate and worsen outcome in patients with diabetes [16].

5. Conclusion

Our study showed that overall glycemic control got deranged during the 3-week lockdown period. Lifestyle changes, psychological stress, difficulty in getting medication and medical advice were identified as possible factors responsible for derangement of glycemic control. Thus, multidisciplinary approach is required which is patient centric and addresses the various issues like psychological stress, diet exercise along with proper medication is required for achieving good glycemic control.

Limitation of study

Possibility of sample Bias cannot be ruled out as patients were from one center with small sample size. The study findings were dependent on honesty of patient or attendant and reliability of glucometer used for recording the blood sugar reading. It was an unblinded study and intervention were taken if very high fluctuation in blood sugars noted.

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References

[1] India Covid-19 Tracker [Online] Available at, https://www.covid19india.org/; 2020.
[2] Anjana RM, Pradeepa R, Deepa M, Datta M, Sudha V, Unnikrishnan R, et al. Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: phase I results of the Indian Council of Medical Research-India DIABetes (ICMR-INDIAB) study. Diabetologia 2011;54:3022–7.
[3] Mohan V, Shah SN, Joshi SR, Seshiah V, Sahay BK, Banerjee S, et al. Current status of management, control, complications and psychosocial aspects of patients with diabetes in India: results from the DiabCare India 2011 Study. Indian Journal of Endocrinology and Metabolism 2014;18(3):370–8.
[4] Government survey found 11.8% prevalence of diabetes in India. ONLINE, https://www.livemint.com/science/health/government-survey-found-11-8-prevalence-of-diabetes-in-india-11570702665713.html; 2019.
[5] Standards of medical care in diabetes—2019. Diabetes Care Jan 2019;42(Supplement 1). https://doi.org/10.2337/dc19-Sint01.
[6] Kalra S, Jena BN, Yeravdekar R. Emotional and psychological needs of people with diabetes. Indian J Endocr Metab 2018;22:696–704.
[7] Zoccoli G& Amici R. Sleep and autonomic nervous system. Current Opinion in Physiology June 2020;15:128–33.
[8] Bruce DG, Chisholm DJ, Storlien LH, Kraegen EW, Smythe GA. The effects of sympathetic nervous system activation and psychological stress on glucose metabolism and blood pressure in subjects with type 2 (non-insulin-dependent) diabetes mellitus. Diabetologia 1992;35(9):835–43.
[9] Monnier Louis, Claude Colette, Monnier Louis, Claude Colette. Contributions of fasting and postprandial glucose to hemoglobin a1c. Endocr Pract 2006;12(Supplement 1):42–6. January 2006.
[10] Fonseca VA, Smith H, Kuhadiya N, Leger SM, Yau CL, Reynolds K, et al. Impact of a natural disaster on diabetes. Diabetes Care 2009;32:1632–8.
[11] Fujihara K, Saito A, Heianza Y, Gibo H, Suzuki H, Shimano H, et al. Impact of psychological stress caused by the great east Japan earthquake on glycemic control in patients with diabetes. Exp Clin Endocrinol Diabetes 2012;120(9):560–3.
[12] Rubinstein A, Koffler M, Villa Y, Graff E. The Gulf War and diabetes mellitus. Diabet Med 1993;10:774–6.
[13] Dubey S, Biswas P, Ghosh R, et al. Psychosocial impact of COVID-19 [published online ahead of print, 2020 May 27]. Diabetes Metab Syndr 2020;14(5):779–88. https://doi.org/10.1016/j.dsx.2020.05.035.
[14] Zandifar A, Badrfam R. Iranian mental health during the COVID-19 epidemic [published online ahead of print, 2020 Mar 4]. Asian J Psychiatr 2020;51:101990. https://doi.org/10.1016/j.ajp.2020.101990.
[15] Ghosh A, Arora B, Gupta R, Anoop S, Misra A. Effects of nationwide lockdownduring COVID-19 epidemic on lifestyle and other medical issues of patients with type 2 diabetes in north India, Diabetes & Metabolic Syndrome. Clin Res Rev 2020. https://doi.org/10.1016/j.dsx.2020.05.044.
[16] Ghosal S, Sinha B, Majumder M, Misra A. Estimation of effects of nationwide lockdown for containing coronavirus infection on worsening of glycosylated haemoglobin and increase in diabetes-related complications: a simulation model using multivariate regression analysis. Diabetes & Metabolic Syndrome: Clin Res Rev 2020. https://doi.org/10.1016/j.dsx.2020.03.014.