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Patient reported changes in metabolic health during lockdown: A
cross sectional digital connect survey in people with type 2 diabetes

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1. Introduction

COVID-19 is a global pandemic affecting over 200 countries. The morbidity and mortality associated with COVID-19 has impacted the social, political, and cultural landscapes of the world. Several studies have shown type 2 diabetes as an important and commonly occurring comorbidity with COVID-19 [1–3]. In a study from USA across 1122 patients across 88 centres; it has been reported that diabetes in COVID-19 was associated with more than a fourfold increase in mortality [4].
In China, a meta-analysis of nine studies including 1936 patients of COVID-19, found a significant correlation between severity of COVID-19 and diabetes [5], while another study in 44672 patients of COVID-19 in China reported a case fatality rate of 7.3% in patients with diabetes as opposed to 2.3% in those without diabetes [6]. Even though it appears that people with diabetes may not be more prone to acquiring COVID-19, the prognosis of the same is worse in these patients with a higher mortality.

The high prevalence of diabetes in India makes the population highly susceptible not just contracting the disease but also makes the T2DM population vulnerable to COVID 19 related complications with increased morbidity and mortality [7]. Therefore, it is important for the patients to be aware, disciplined, and sensitive to achieve glycemic control to mitigate the risks of COVID 19. This is even more important for patients with co-morbidity of hypertension and cardiovascular disease [8].

It is well postulated that it takes 21 days to formulate a new habit as it is a function of the formation of the new neurological pathways in the human brain. This principle is based on the findings of research by Maxwell Maltz way back in 1950’s [9,10]. Hence, we hypothesise that COVID 19 imposed lockdown could be an unprecedented model to evaluate for the acute changes in the lifestyle that would affect the glycemic and the metabolic health.

2. Objectives

We evaluated the change in healthful behaviour patterns in people with T2DM and the impact of situational strategies developed by the patients by themselves, to cope with the nationwide lockdown on the metabolic parameters, including the self-reported glycemic measures. The aim of this survey was to map the overall short-term impact of the nationwide lockdown on the metabolic parameters in people with type 2 diabetes and explore the characteristics of the people with respect to gender and age. We evaluated the direct glycemic parameters and the indirect markers that would have affected the diabetes control. The survey was done to capture the short-term impact over three weeks on the metabolic health of people with diabetes as an assessment of acute changes due to COVID 19 pandemic imposed nationwide lockdown.

3. Methods

3.1. Participants

The survey was conducted and included people with T2DM who had visited their diabetologists for an in-person in-clinic consultation at least once during the last three months before initiation of nationwide lockdown (March 22, 2020) were randomly selected from the electronic patient database. The data was collected using the electronic form, created as a Google form and the responses were directly downloaded as an Excel file.

A cross sectional survey of patients from pooled practices of 23 diabetologists who are members of United Diabetes Forum (UDF) across the country was conducted for a period of one week from April 10 to April 16, encompassing the later part of the first phase of the nationwide lockdown (March 25th – April 14th) and the initial part of the second phase of the lockdown (April 15th – May 3rd).

3.2. Recruitment methodology

The people were informed for the objectives of the survey through a whatsapp message and were asked for the electronic consent through a reply to the initial whatsapp message. The people who consented were provided the online link of the Google form. A reminder was sent out on Whatsapp on the third day and sixth day, if the response was not recorded on the second day and fifth day, respectively.

3.3. Development of the questionnaire

The questionnaire was developed by UDF members, directly involved in the delivery of diabetes care. The questionnaire comprised a total of 30 questions designed to assess the current health status, perceived health status and the behaviour before the lockdown and the change observed in the health status after 21 days of lockdown. The questionnaire incorporated measures to assess the behaviour changes due to the COVID-19 pandemic-driven lockdown including changes in physical activity levels, medication adherence, food habit changes, glycemic monitoring, tobacco, alcohol consumption and duration of sleep.

3.4. Statistical methods

Results on continuous measurements are presented as mean ± SD and results on categorical measurements are presented in Number (%). Normality of data was tested by Shapiro-Wilk, Kolmogorov-Smirnoff test. Paired t-test was used to find the significance of study parameters within groups measured on two occasions. Chi-square/Fisher Exact test was used to find the significance of study parameters on categorical scale between two or more groups. Significance is assessed at a level of 5%.

4. Results

4.1. Patient characteristics

The span of the participants per diabetologist varied with five, three and single diabetologist accounted for 68.5% (235), 53% (181) and 27.4% (94) participants, respectively. All patients surveyed in this study were pooled from independent practices.

Table 1 shows the baseline sociodemographic characteristics of participants. The mean age of the 343 participants was 55 ± 13 years (minimum 18, maximum 89, range 71, 95%; CI 52 to 55). 15.3% (58) of participants was female and 84.7% (295) were male. Similarly, the mean age of patients with diabetes was 55 ± 13 years (minimum 18, maximum 89, range 71, 95%; CI 52 to 55) with females being 15.3% (58) and males being 84.7% (295). The mean age of the patients with diabetes who consented was 55 ± 13 years (minimum 18, maximum 89, range 71, 95%; CI 52 to 55) with females being 15.3% (58) and males being 84.7% (295).

Table 1 shows the baseline sociodemographic characteristics of participants.

| Variable                | Parameter           | No. of participants (%) |
|-------------------------|---------------------|-------------------------|
| Type of therapy         | Insulin             | 116 (33.8)              |
|                         | Oral medications    | 202 (58.8)              |
|                         | Lifestyle Management| 25 (7.2)                |
| Hypertension duration   | Non hypertensive    | 185 (53.9)              |
|                         | <5 years            | 50 (14.5)               |
|                         | 5–10 years          | 39 (11.3)               |
|                         | >10 years           | 69 (20.1)               |
participants surveyed had diabetes for over 10 years while one-third of the studied participants were on insulin therapy.

Almost half of the participants \( (n = 158) \) were hypertensives, with almost all \( (n = 151) \) were strictly compliant to the prescribed anti-hypertensive therapy. There were 54 \( (15.7\%) \) participants who had both the co-morbidities of hypertension and diabetes.

4.2. Change during the lockdown

Table 2 shows the change in the parameters during the lockdown. Even before the lockdown, almost half of the participants had adequate sleep of more than 8 h, with substantially higher number of people; more than double the number of people reporting adequate sleep, during the lockdown. The tobacco consumption decreased by almost one-third. Almost, half of the participants, even before the lockdown, during recall for last one week reported to be fully compliant, to the anti-diabetic drugs with compliance, to the therapy further increased marginally. Fasting glucose reported by SMBG of more than 140 mg/dl, was reported by almost one-third of the participants before the lockdown, was reported by less than one fifth of participants, during the lockdown. Post prandial glucose of more than 180 mg/dl initially reported by almost one-third of the participants changed to almost 6% during the lockdown. Before the lockdown, there were less than 5% people who were not regularly monitoring their fasting and post prandial glucose, which increased substantially by almost five times during the lockdown. The participants who reported decrease in the weight were marginally more than those who reported increase in the weight. However, more than half reported that the body weight almost remained the same during lockdown. This was despite the finding that there was 7.7\% (22) less participants reporting daily physical exercise during the lockdown.

Table 3 shows association between the sociodemographic characteristics of participants and the age. Almost half of the participants were in the age group of 41–60 years followed by almost one-third in the age group of more than 60 years. The participants in the age group 18–60 years were more often the primary earning members as compared to the people in the age group more than 60 years \( (OR \ 2.48, 95\% CI \ 1.53 \ to \ 4.02; \ p < 0.0003) \) and also the participants in the same age group were less likely to have duration of diabetes which was more than 10 years \( (OR \ 0.10 95\% CI \ 0.06 \ to \ 0.17, \ p < 0.0001) \). Almost three-fourth of the participants were less than 60 years of age with duration of diabetes less than 10 years. Almost half of the participants were non-hypertensives between the age group of 18–60 years \( (OR \ 5.46 95\% CI \ 3.28 \ to \ 9.06, \ p < 0.0001) \). There was not much change in the number of participants in the age group more than 60 years, that had adequate sleep duration even during the lockdown \( (OR \ 0.32 95\% CI \ 0.17 \ to \ 0.62, \ p < 0.0009) \), whereas almost one-fourth of the participants who had adequate sleep duration during the lockdown was between the age group 18–60 years.

Table 4 shows association between the sociodemographic characteristics of participants and the gender. There were a greater number of males \( (68\%) \) as compared to 32\% of the participants were female. Men more often than women are the primary earning members \( (OR \ 9.72 95\% CI \ 5.81 \ to \ 16.47, \ p < 0.0001) \). There were relatively less proportion of males who were on insulin as compared to females. \( (OR \ 0.44 95\% CI \ 0.28 \ to \ 0.71, \ p < 0.0009) \). There was a dramatic drop in females ordering food from eatery as compared to males \( (OR \ 0.34 95\% CI \ 0.14 \ to \ 0.9) \). The increase in the adequate sleep by a greater number of participants during the lockdown was not statistically different between the males and females. However, there were numerically higher number of males as compared to females who achieved adequate sleep during lockdown.

4.3. Changes in the diabetes management due to lockdown imposed by COVID-19

The compliance to therapy, SMBG fasting and post prandial glucose control, SMBG monitoring did not differ significantly neither in the age groups, nor in the gender groups. However, there was a superior change in the glycemic variables in the male participants. The change in the body weight was not significant between the genders. However, there were more males reporting decrease in body weight, and vice versa by the females.

5. Discussion

This study across 343 patients from 23 diabetologists demonstrated that the short-term impact of the lockdown on the metabolic health of the patients by virtue of the adoption to the new lifestyle and the constrained resources. The fear of death which has perhaps created a panic in T2DM community raising the awareness for the COVID-19 related complications including mortality,

| Table 2 | Changes reported during lockdown. |
|----------|----------------------------------|
| **Variable** | **Change with reference to Lockdown** | **No. of participants (%)** |
| Adequate sleep > 8 h | Before | 54 (15.7) |
| Tobacco | Before | 127 (37) |
| Compliance to Therapy | Before | 42 (12.2) |
| 100% compliance in last one week | During | 29 (8.4) |
| SMBG Fasting Glucose > 140 mg/dl | Before | 176 (51.3) |
| SMBG Postprandial Glucose > 180 mg/dl | During | 188 (54.8) |
| SMBG Fasting Glucose — Did not check | Before | 112 (32.6) |
| SMBG Postprandial Glucose — Did not check | During | 62 (18) |
| Habitual Food from Eatery | Before | 104 (30.3) |
| Daily Physical Exercise | During | 20 (5.8) |
| Body weight — Change during lockdown | Before | 12 (3.4) |
| | During Lockdown | 66 (19.2) |
| | Before | 17 (4.9) |
| | During | 67 (19.5) |
| | Before | 310 (90.3) |
| | During | 33 (9.6) |
| | Before | 285 (83) |
| | During | 263 (76.6) |
| | Decreased | 56 (16.3) |
| | Increased | 51 (14.8) |
| | Same no change | 178 (51.8) |
through consistent television and social media driven communications, could be attributed as one of the important reasons for enhanced compliance to the ant-diabetic therapy. Moreover, the restrictions imposed by the health authorities because of the higher risk of being infected and to experience more severe symptoms of the contract COVID 19, reinforced the awareness to maintain social distancing, hand hygiene and restrain to the home [11]. Although, there was a minimal change for the enhanced compliance to therapy, but is nothing less than a remarkable drift in habit, since despite several logistics and financial constraints, there has been a social and behavioral change, to be adherent to the therapy, in a short span of time. The panic buying of the chronic medications has been well reported, just as the lockdown was announced. This was evidenced by a considerable increase in the price of ambulatory glucose strips, the increase in the price of the glucometers, unavailability of the battery, would have limited the utilisation of SMBG, even in highly disciplined and complaint patients [13].

In a study from Italy, there were no significant changes in the ambulatory glucose profile of insulin treated people during the initial 14 days of lockdown [14]. There are emerging evidences from India, that glycemic characteristics have indeed improved during the lockdown [13,15]. However, our results contrast with a simulation modelling study that theoretically suggests that the duration of the lockdown is linked with worsened glycemic control [16]. The highly motivated patients continued their physical activity despite being indoors in the houses or with limited walk with the limited geography such as residential compound or terraces. The perceived decrease in the body weight. The change in the body weight although reported to decrease in a small number of participants has been shown to decrease in a small-time frame of 21 days. The weight reduction in short period of time could be the

| Variables                                      | Age (n = 343)                                                                                                                                                                                                 |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                | 18–60 years (n = 237)                                                                                                                  | >60 years (n = 106)                                                                 | p value | Odds Ratio (OR) |
| No of Participants (%)                         |                                                                                                                                                                                                           |
| Earning Status                                 |                                                                                                                                                                                                           |
| Primary earning member                         | 176 (51.3)                                                                                                                                   | 57 (16.6)                                                                       | <0.0003  | 2.48 (1.53–4.02) |
| Dependant 110 (32)                             | 61 (17.7)                                                                                                                                   | 49 (14.2)                                                                       |         |                |
| Duration of Diabetes                           |                                                                                                                                                                                                           |
| >10 years                                      | 80 (23.3)                                                                                                                                   | 78 (22.7)                                                                       | <0.0001  | 0.10 (0.06–0.17) |
| <10 years                                      | 263 (76.6)                                                                                                                                  | 28 (8.1)                                                                        |         |                |
| Hypertension status                            |                                                                                                                                                                                                           |
| No Hypertension                                | 157 (45.7)                                                                                                                                  | 28 (8.16)                                                                       | <0.0001  | 5.46 (3.28–9.06) |
| Hypertensive                                   | 80 (23.3)                                                                                                                                   | 78 (22.7)                                                                       |         |                |
| Change in Bodyweight during Lockdown           |                                                                                                                                                                                                           |
| Decreased 56 (16.3)                            | 44 (12.8)                                                                                                                                   | 12 (3.4)                                                                        | 0.82 ns  | 1.12 (0.46–2.73) |
| Increased 31 (14.8)                            | 39 (11.3)                                                                                                                                   | 12 (3.4)                                                                        |         |                |
| Sleep Duration > 8 h                           |                                                                                                                                                                                                           |
| Before 60 (17.4)                                | 28 (8.16)                                                                                                                                   | 32 (9.3)                                                                        | 0.0009   | 0.32 (0.17–0.62) |
| During 121 (35.5)                               | 88 (25.6)                                                                                                                                   | 33 (9.6)                                                                        | ***      |                |
| Habitual Food from Eatery                      |                                                                                                                                                                                                           |
| Before 310 (90.3)                               | 202 (58.8)                                                                                                                                  | 108 (31.4)                                                                      | 0.70 ns  | 1.21 (0.60–2.58) |
| During 33 (9.6)                                 | 20 (5.8)                                                                                                                                    | 13 (3.7)                                                                        |         |                |
| Daily Physical Exercise                        |                                                                                                                                                                                                           |
| Before 285 (83)                                 | 196 (57.1)                                                                                                                                  | 89 (25.9)                                                                       | 0.85 ns  | 0.96 (0.66–1.38) |
| During 263 (76.6)                               | 183 (53.3)                                                                                                                                  | 80 (23.3)                                                                       |         |                |
| Tobacco Consumption                            |                                                                                                                                                                                                           |
| Before 63 (18.3)                                | 51 (14.8)                                                                                                                                   | 12 (3.4)                                                                        | 0.70 ns  | 1.52 (0.40–5.58) |
| During 8 (2.3)                                  | 4 (1.1)                                                                                                                                     | 4 (1.1)                                                                         |         |                |
| Total Compliance to Therapy                    |                                                                                                                                                                                                           |
| Before 176 (51.3)                               | 111 (32.3)                                                                                                                                  | 65 (18.6)                                                                       | 0.07 ns  | 4.25 (1.08–15.91) |
| During 188 (54.8)                               | 122 (39.3)                                                                                                                                  | 66 (15.4)                                                                       |         |                |
| SMBG Fasting Glucose > 140 mg/dl               |                                                                                                                                                                                                           |
| Before 112 (32.6)                               | 56 (16.3)                                                                                                                                   | 56 (16.3)                                                                       | >0.87 ns | 1.06 (0.58–1.95) |
| During 62 (18)                                 | 30 (8.7)                                                                                                                                    | 32 (9.3)                                                                        |         |                |
| SMBG Post Prandial Glucose > 180 mg/dl         |                                                                                                                                                                                                           |
| Before 104 (30.3)                               | 71 (20.1)                                                                                                                                   | 33 (10.2)                                                                       | 0.60 ns  | 1.43 (0.52–3.85) |
| During 20 (5.8)                                | 12 (3.4)                                                                                                                                    | 8 (2.3)                                                                         |         |                |
| Not checking FPG at all                        |                                                                                                                                                                                                           |
| Before 12 (3.4)                                 | 10 (2.9)                                                                                                                                    | 2 (0.58)                                                                        | >0.99 ns | 1.25 (0.26–6.25) |
| During 66 (5.8)                                 | 53 (15.4)                                                                                                                                   | 13 (3.7)                                                                        |         |                |

*p ≤ 0.10, **p < 0.05, ***p < 0.01, ****p < 0.0001, ns Non Significant.
function of enhanced mobility due to the increased demand of the household chores, due to the lack of the domestic help, which otherwise has not been consciously been attributed to the increase in the physical activity. The dramatic decrease in the consumption of the outside eatery food along with the travel restrictions with predominantly the home cooked food resulted in a dietary calorie discipline, which could have further added to the perceived decrease in the weight, by the participants. Also, the lack and the ease of availability of the non-vegetarian food would also have resulted in the direct perception of decrease in the weight. Since, many of the participants were from Mumbai, the work from home eliminated the long, stressful commute time, slowed down the hectic routine, enabling more time to rest, relax and have an adequate sleep of more than 8 h daily. Perhaps, this enabled enhanced time to cope with the challenges of diabetes management. The impact of the behavioral change would need more time to be assessed by a difficult to achieve point parameter. Our results provide insights that people with T2DM may be able to face the ongoing restrictions, in a safe manner, which is important as diabetes itself may worsen the prognosis of COVID 19.

The strengths of the study include the timeliness of the study, which was initiated appropriately overlapping the end of first phase of lockdown and the beginning of the second, during which the participants had well adapted and learned to cope with the new normal for the self-management of diabetes. The predominant representation of the patients from the western part of the country which has been the hot bed of the COVID 19 pandemic in India could be the representative picture for the rest of the country, for how the patients with T2DM would be coping as the disease has spread across the country.

5.1. Limitations of the study

The variability for the participants that responded per
diabetologist in the study was a function of the motivation of the individual participant to timely respond to the questionnaire. This could be accounted to be driven by the external variables driven by the diabetologist-patient relationship and the current situation under which the participant would have desired to respond. The results represent the patient reported parameters which need to corroborated post lockdown with regular in person-in clinic monitoring of FPG, PPG and HbA1c and compare with the investigations conducted before the lockdown. We did not categorically investigate the reasons to decline the study invitation. The parameters reported are based on the perception mapping capabilities of the individual participant.

6. Conclusions

The lockdown imposed as a measure to combat the spread of COVID 19 resulted in improved metabolic health in people with T2DM. The enhanced compliance to the therapy is attributed to greater societal awareness about association for the risk of COVID 19 in patients with diabetes and hypertension. This contrasts with the decrease in the SMBG due to the unavailability of the point of care resources. Our study highlights the dynamic impact of the lockdown which enabled situational, self-automated patient empowerment despite the limited resources, to take control of their diabetes. Self-imposed adoption towards healthful modifications in the short term may be self-adapted in long term that would be sustainable. The results need corroboration with a longer follow up to evaluate the changes with the evolving COVID 19 situation.

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