Blood Glucose Control During Lockdown for COVID-19: CGM Metrics in Italian Adults With Type 1 Diabetes

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DIABETES AND COVID-19

To prevent the spread of COVID-19, lockdown was imposed in many countries with rigid restrictions on all outdoor activities, also limiting attendance at diabetes clinics. In patients with diabetes, lockdown implies lifestyle changes related to physical activity, stress, and nutrition that are likely to adversely affect glycemic control (1). Conversely, during lockdown, individuals with type 1 diabetes (T1D) are to be expected to have a more regular lifestyle, more closely respecting time schedules and insulin administration timing.

We evaluated the impact of lockdown on glucose control in 207 Italian adults with T1D attending the Diabetes Outpatient Clinic of the Federico II University Hospital, Naples: 96 females/111 males, mean ± SD age 38.4 ± 12.7 years, 104 on multiple daily insulin injections (MDI), and 103 on insulin pump (continuous subcutaneous insulin infusion [CSII]). Inclusion criteria were continuous glucose monitoring (CGM) for at least 6 months, including a 2-week period with CGM use >70% before (January–February) and during (March–April 2020) lockdown, while maintaining the same device: FreeStyle (n = 130), Guardian 3 (n = 47), Dexcom G6 (n = 18), and Eversense (n = 12). Each participant gave informed consent for the use of her or his data. No participant reported COVID-19 infection during the study.

Time in target range (TIR) (3.9–10.0 mmol/L), time above target range (TAR) (>10.0 mmol/L and >13.9 mmol/L), and time below target range (TBR) (<3.9 mmol/L and <3.0 mmol/L) expressed as percentage of all CGM readings, mean glucose, and glycemic variability (coefficient of variation [CV%]) were analyzed (2). An online questionnaire provided data on physical activity, dietary habits, and sleeping pattern. The primary outcome was change in TIR (%) from prelockdown to lockdown period. Secondary end points were changes in TAR, TBR, and CV%.

Results are shown in Tables 1 and 2. During lockdown, TIR increased significantly (P = 0.002) in the whole cohort and subgroups of sex, age (<35 or ≥35 years), and insulin regimen (MDI or CSII). Glycemic variability (CV%) decreased significantly (P = 0.001), with the change being more relevant in relation to lower age (P < 0.001 vs. ≥35 years), male sex (P < 0.001 vs. female), and MDI use (P < 0.001 vs. CSII). This improvement was due to reduction of hypoglycemia <3.0 mmol/L (P < 0.001)—more evident in MDI participants (P = 0.025 vs. CSII)—and hyperglycemia >13.9 mmol/L (P = 0.052). During lockdown, participants reduced their physical activity, had a

Table 1—CGM metrics before and during lockdown in the study participants

CGM metrics (n = 207)	Before lockdown	During lockdown	P value*
CGM use (%)	91.2 ± 9.1	90.1 ± 8.6	0.081
Mean glucose (mmol/L)	9.6 ± 2.0	9.5 ± 1.9	0.165
Estimated HbA_{1c} (%)	7.7 ± 1.3	7.6 ± 1.1	0.098
Estimated HbA_{1c} (mmol/mol)	60 ± 10	59 ± 9	0.098
TAR (%)			
>180 mg/dL (10.0 mmol/L)	26.8 ± 11.2	26.3 ± 11.2	0.414
>250 mg/dL (13.9 mmol/L)	14.7 ± 15.3	13.2 ± 13.7	0.052
TIR (%)	55.6 ± 17.6	58.2 ± 18.1	0.002
TBR (%)			
<70 mg/dL (3.9 mmol/L)	2.95 ± 3.05	2.71 ± 3.08	0.192
<54 mg/dL (3.0 mmol/L)	1.42 ± 2.39	0.58 ± 1.17	<0.001
Glycemic variability (CV%)	35.9 ± 7.0	34.7 ± 6.3	0.001

Data are expressed as mean ± SD. *Paired sample t test.

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Table 2—Questionnaire-derived lifestyle data before and during lockdown in the study participants

Lifestyle changes compared with prelockdown (n = 182)	More	Less	Same	P value§
Total physical activity#	25 (14)	127 (70)	30 (16)	<0.001
Food amount	76 (42)	16 (9)	90 (49)	<0.001
Regularity of mealtimes	47 (26)	40 (22)	95 (52)	<0.001
Number of snacks	46 (25)	16 (9)	120 (66)	<0.001
Sleep duration	63 (35)	53 (29)	66 (36)	0.318
	Later	Earlier	Same	
Bedtime	105 (57)	11 (6)	66 (36)	<0.001
Waking time	96 (53)	32 (17)	54 (30)	<0.001

Data are expressed as number of participants (%). §χ^2 test. #Score based on type and frequency of physical activity.

more regular meal pattern with a higher food intake and more frequent snacking, and went to bed later and woke up later. Participants who increased sleep duration (n = 63) showed a greater, although not statistically significant, increase in TIR than those who decreased it (n = 53) (4.1 ± 13.2% vs. 0.17 ± 11.5%, P = 0.088). Changes in physical activity during lockdown were significantly positively associated with changes in glucose CV% (Pearson correlation, r = 0.155, P = 0.038) but not with changes in TIR (r = 0.019, P = 0.800).

This study shows that during lockdown for COVID-19, patients with T1D had improved glucose control indicated by increased TIR, reduced glucose variability, and reduced hyperglycemia and severe hypoglycemia. These findings are somewhat unexpected considering that, because of home confinement, patients had no access to outpatient diabetes clinics—although interacting with their diabetes team by teleconsulting—and less opportunity to perform physical activities. We can hypothesize that the improved glucose control observed in our patients could result from a more regular lifestyle, including reproducible mealtimes and more time for self-care, as also supported by the increased TIR associated with increased sleep duration (3,4). The reduction in physical activity may have also played a role, considering the well-known difficulties to appropriately modulate carbohydrate intake and insulin doses in relation to exercise. In fact, in our study, the reduction in physical activity was associated with reduced glucose variability but unchanged TIR, in line with the evidence that physical activity, while exerting favorable effects on weight, cardiovascular fitness, lipid profile, and psychological well-being (5) in people with T1D, does not clearly associate with improved glycemic control.

A strength of our study is that COVID-19 restrictions represented an unprecedented, hopefully unique condition in which to evaluate the effects of home confinement in a free-living T1D population. Moreover, CGM cloud platforms provide new metrics of glucose control including glycemic variability. A limitation is that lifestyle data were mainly qualitative. Moreover, the lack of a control group does not allow assignment of the observed changes to lockdown. However, because of the extraordinary condition patients were facing, these changes were very unlikely due to general trends or other unmeasured factors.

In conclusion, in adults with T1D, glucose control improved during lockdown, highlighting the importance of a more stable rhythm of life, including more regular mealtimes. Lifestyle changes in patients with T1D should take into consideration not only diet and physical activity but also a more regular and less stressful life.

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