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Type 1 Diabetes and COVID-19: the level of anxiety, stress and the general mental health in comparison to healthy control

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Summary

Aim. Assessment of mental state of patients with T1DM – the level of anxiety, stress and general mental health in the stressful conditions of an epidemic. Moreover, it was checked whether the stress response to the epidemic in the T1DM group differed from that in the control group. This is the first study to address these questions in the type 1 diabetes population in Poland.Method. An e-mail was sent to all T1DM patients under the care of a diabetes clinic with information about the possibility of online consultation with a psychologist / psychiatrist, with a set of psychological tests attached. The study included 49 patients with T1DM who responded within the first month and agreed to participate in the study. 38 people from the control group were randomly recruited. Each person completed a set of psychological tools.

Results. In both groups, the level of stress was higher than typical for the general population in the situation without stressor. T1DM patients who have been ill for over 10 years more often cope with stress through a task-oriented approach. Patients who have been ill for less than 10 years use avoidance strategies. In the first phase of the epidemic, women with T1DM used avoidance strategies. Patients with diabetes and mental disorders react more anxiously and thus require special care in coping with diabetes.

Conclusions. In a situation of stress such as a epidemic, patients suffering from T1DM require optimization of treatment and cooperation of specialists in the field of diabetes and psychology / psychiatry.

Key words: Type 1 Diabetes Mellitus, stress, COVID-19

Introduction

On 30 January 2020, the World Health Organization (WHO) declared the COVID-19 outbreak to be a public health emergency of international concern, and on March 11, the epidemic was upgraded to pandemic [1-3]. The Centers for Disease Control and Prevention states that individuals with diabetes are at higher risk for severe illness with coronavirus disease 2019 (COVID-19) and poorer health outcomes [3-5]. Research suggests the underlying reason for an increased risk of COVID-19 complications in individuals with diabetes may be poor glycemic control or hyperglycemia [4]. Information on clinical outcomes for patients with type 1 diabetes who have confirmed cases of COVID-19 is limited [5].

For instance, it was shown that the most prevalent comorbidity among patients with a confirmed case of COVID-19 was obesity (39.4%), followed by hypertension or cardiovascular disease (12.1%). The most prevalent adverse outcome within COVID-19–positive patients was diabetic ketoacidosis (DKA) (45.5%). Despite many uncertainties, the COVID-19 pandemic recommendations in most countries include people with diabetes within the „at risk" population [5]. Some practical recommendations for diabetes management have been described [6]. In summary it is suggested that people with diabetes stay hydrated, and constantly check Blood glucose (BG) and check for ketones in the event of high BGs [7].

Lockdowns caused by the coronavirus disease 2019 (COVID-19) have turned the lives of people around the world upside down. Yet, for those living with diabetes, the movement restrictions have raised a whole series of extra questions: how can they seek medical advice; how can their health be monitored; and how can they continue to manage their condition? Healthcare professionals and those who support people with diabetes have rallied during the lockdown to find innovative ways to help [8-11].

The data concerning the impact of COVID-19 pandemic on diabetes course among T1DM individuals are conflicting, some studies suggest the crucial role of advanced technologies in maintaining glycemic control [12, 13]. For patients with T1DM and COVID-19 infection it has been shown that they often present with hyperglycemia and/or diabetic ketoacidosis (DKA). The risk of in-hospital mortality may be increased [14].

Patients with type 1 diabetes (T1DM) from the University hospital in Krakow also were confronted with difficulties connected with epidemic situation. About 700 patients aged 18-85 were forced to face situation where their regular visits with specialists in diabetology were first temporarily canceled and then shifted into online consultations. The university hospital in Krakow was changed into infectious diseases hospital and some specialists were engaged to work with patients with coronavirus. The patients had few stressors active at the same time – the threat connected with the possibility of getting COVID-19, and/or complications connected with it in the course of diabetes, the insecurity connected with their further treatment, insecurity connected with lack of access to their diabetologist as well as general stress connected with lockdown. In this case a crisis intervention team for T1DM patients was established. The goal

of the team was to provide psychological support for the patients if needed and to present information concerning how the patients may obtain medical consultations/ prescriptions. Every patient with type 1 diabetes from the outpatient clinic received an email with information about the current situation and details concerning ways of contact. Also, each of the patients received an interactive questionnaire, including set of psychological tests. The study received the consent of Bioethical Committee of Jagiellonian University.

Aim of the study

In the current study, we aimed to evaluate the mental condition of the patients with type 1 diabetes – the level of anxiety, stress and the general mental health in the stressful conditions of epidemic s. Furthermore, we aimed at observing whether the stress reaction to epidemic was higher in T1DM than in a control group tested at the same time of lock down.

To our knowledge, this is the first study that addresses these questions in a population with type 1 diabetes.

Materials and Methods

We included 49 young adult T1DM patients (75.5% women) who responded to the email within the first month and who approved their participation in the study. The 38 controls (71.2% women) who filled interactive questionnaire between (March 2020 – May 2020) were recruited randomly – it was a group of persons from general population who on averaged matched the studied group in terms of age and gender. All but one T1DM patients were treated with a personal insulin pump. They were on average 29.8 ± 8.9 years with a mean body mass index (BMI) of 23.8 ± 3.6 kg · m^{-2}. The control group included healthy with BMI matched to those in the T1DM group. In the control group, the mean age was 37.6 ± 11.8 years (p=0.0004), and mean BMI of 24.2 ± 4.4 kg m^{-2} (p=0.76). All patients were free from advanced micro and macrovascular complications of diabetes. A detailed description of the group is presented in Table 1. None of the participants suffered from COVID-19 at the time of the study.

Table 1. **Clinical characteristics of the studies group.**

Variables	T1DM Mean ± SD	Control Mean ± SD	p-value
Age [years]	29.8 ± 8.9	37.6 ± 11.8	0.0004
BMI [kg/m2]	23.8 ± 3.6	24.2 ± 4.4	0.76
Household with more than 2 persons/less and equal 2	30/19	8/12*	0.1798
Diabetes duration [years]	16.2 ± 7.3	N/A	N/A
Time of CSII [years]	8.7 ± 4.2	N/A	N/A

table continued on the next page

HbA1c [%] [mmol/mol]	6.4 ± 0.7 46	N/A	N/A
Mean glycemia from glucometer [mg · dL^{-1}]	146.8 ± 25.8	N/A	N/A

CSII – continuous subcutaneous insulin infusion (treatment with a personal insulin pump)
*lack of sociodemographic data from 18 persons from the control group

Research tools included:

1. Demographic survey – including inter alia basic information about gender, age, occupation, education, place of residence, the method of DM treatment, occurrence of other illnesses, including mental illnesses, addictions;
2. CISS (Coping Inventory for Stressful Situations) – a four-factor model of human coping with adversity developed by Endler and Parker. Their construct differentiates three types of coping: Task-oriented coping; Emotion-oriented coping; Avoidant-oriented coping [15];
3. STAI (State-Trait Anxiety Inventory) – by Spielberger et al, a commonly used measure of trait and state anxiety [16];
4. PSS-10 (Perceived Stress Scale) – designed by Sheldon Cohen et al, the most widely used psychological instrument for measuring the perception of stress [17];
5. GHQ-30 (General Health Questionnaire-30) – a screening device for identifying minor psychiatric disorders in the general population and within community or non-psychiatric clinical settings such as primary care or general medical outpatients' it assesses the respondent's current state and asks if that differs from his or her usual state [18].

Statistical Analysis

The normality of continuous variable distribution was assessed by the Shapiro-Wilk test. Differences between groups were analyzed with Student's t test or nonparametric tests, as appropriate. The study results are presented as arithmetic means ($\bar{x}$) ± standard deviations (SD). All statistical analyses were performed using R ver. 4.0.2 statistical software (http://www.r-project.org/). The results were considered significant at the significance level of $p < 0.05$.

Results

The first analyses aimed at comparing results in study group versus control group [Tab. 2].

Table 2. **The level of the psychological parameters (anxiety, stress, coping strategies and general psychopathology) in the examined groups.**

Indices	T1DM group	Control group	*P*
Coping Inventory For Stressful Situations			
CISS SSZ Score	56 ± 9.3	58.7 ±8.8	0.2688
CISS SSZ Sten	5.4 ± 1.9	5.9 ± 2.0	0.3935
CISS SSE Score	40.5 ±10.8	43.4 ± 9.6	0.1944
CISS SSE Sten	4.7 ± 2.1	5.2 ± 1.9	0.1434
CISS SSU Score	42 ±8.2	39.8 ± 6.3	0.1772
CISS SSU Sten	4.8 ± 1.8	4.7 ± 1.5	0.8990
CISS ACZ Score	17.7 ± 5.3	16.2 ± 5.3	0.1739
CISS ACZ Sten	4.7 ± 2.0	4.3 ± 2.0	0.2111
CISS PKT Score	16.3 ± 4.1	16.8 ± 5.0	0.6213
CISS PKT Sten	5.1 ± 2.0	5.6 ± 2.7	0.3568
Perceived Stress Scale			
PSS10 Score	21.0 ± 4.1	22.2 ±3.0	0.1101
PSS10 Sten	6.9 ± 1.3	7.3 ± 0.9	0.2503
State-Trait Anxiety Inventory			
STAI Score	39.7 ± 11.0	40.3 ± 10.2	0.5068
STAI Sten	5.3 ± 2.1	5.6 ± 2.1	0.4386
STAI2 Score	39.1 ± 8.8	43.3 ± 8.2	0.0145
STAI2 Sten	4.4 ± 2.3	5.3 ± 2.2	0.0578
General Health Questionnaire			
GHQ Score	7.4 ± 5.2	7.6 ± 7.7	0.3239

List of abbreviations for the tables: CISS – Coping Inventory For Stressful Situations; CISS SSZ task-oriented style; CISS SSE emotion-oriented style; CISS ACZ distraction seeking,; CISS PKT social diversion, PSS10 – Perceived Stress Scale; STAI – State-Trait Anxiety Inventory; GHQ ¬ General Health Questionnaire

What seems to be essential observation is that the level of stress in both groups was higher than typical for population in non-stressful condition, as indicated by validation studies [17].

This shows that the lockdown situation is a source of stress regardless of the presence of the chronic disease. Interestingly, there were no statistically significant differences between the studied and control groups, apart from state anxiety. Interestingly, the general level of state anxiety was higher in the control group. This may suggest that T1DM patients have learned to deal with anxiety on a regular basis.

The next analyses were focused on verifying various parameters within the T1DM group

First we compared patients with diabetes duration >10 years vs ≤10 years [Tab. 3].

Table 3. **Comparison between patients with diabetes duration >10 years vs ≤10 years**

Indices	≤ 10 years	>10 years	P-value
BMI [kg/m^2]	22.4±3.2	24.3±3.7	0.129
HbA1c [%] Mmol/mol	6.9±1.0 52	6.3±0.6 45	0.108
Mean glycemia from glucometer [mg/dL]	156±25	144±25	0.122
Coping Inventory For Stressful Situations			
CISS SSZ Score	51.5±9.1	57.3±9.1	0.052
CISS SSZ Sten	4.4±1.8	5.7±1.8	0.029
CISS SSE Score	41.9±15.7	40.1±9.2	0.719
CISS SSE Sten	5.1±2.7	4.5±1.9	0.435
CISS SSU Score	45.2±10.8	41.1±7.2	0.146
CISS SSU Sten	5.0±2.2	4.8±1.7	0.741
CISS ACZ Score	18.9±6.3	17.4±5.1	0.404
CISS ACZ Sten	4.8±2.3	4.7±1.9	0.676
CISS PKT Score	18.6±3.6	15.6±4.0	0.031
CISS PKT Sten	5.9±2.0	4.9±2.0	0.235
Perceived Stress Scale			
PSS10 Score	22.5±5.9	20.5±3.4	0.301
PSS10 Sten	7.3±1.8	6.8±1.1	0.194
State-Trait Anxiety Inventory			
STAI Score	39.4±10.7	39.8±11.3	0.990
STAI Sten (Cecha)	4.9±2.7	4.3±2.2	0.549
STAI2 Score	40.2±9.2	38.7±8.8	0.674
STAI2 Sten (Stan)	5.4±2.4	5.3±2.0	0.913
General Health Questionnaire			
GHQ Score	8.7±6.8	7.0±4.7	0.524

The statistically significant difference concerns stress coping strategies. The analysis revealed that patients with longer than 10 years history of DM are statistically more often task oriented – they deal with stress by finding solutions and trying to resolve stressful situation. On the other hand patients who have shorter than 10 years history of DM tend to use avoidance strategy – they search for the support of others, which temporarily may be effective but also it may suggest some level of helplessness and lack of self-efficacy.

The analysis including gender differences indicated that women with T1DM in the first stage of epidemic more often used avoidance strategies than men. They searched

for contacts with others, tried to distract their attention by being engaged in various activities not connected with epidemic [Tab. 4].

Table 4. **Comparison between male and female in T1DM group**

Indices	Female	Male	P-value
BMI [kg/m^2]	23.8±4.0	24.0±2.2	0.824
HbA1c [%]	6.5±0.8	6.3±0.5	0.584
Mean glycemia from glucometer [mg/dL]	147±22	147±33	0.549
Coping Inventory For Stressful Situations			
CISS SSZ Score	54.8±9.8	59.7±6.7	0.273
CISS SSZ Sten	5.2±1.9	6.2±1.8	0.241
CISS SSE Score	40.9±10.5	39.1±12.1	0.601
CISS SSE Sten	4.7±2.1	4.4±2.3	0.656
CISS SSU Score	43.8±8.2	36.7±5.1	0.007
CISS SSU Sten	5.2±1.9	3.8±1.3	0.032
CISS ACZ Score	18.5±5.6	15.3±3.7	0.075
CISS ACZ Sten	5.0±2.0	4.0±1.5	0.136
CISS PKT Score	17.0±4.2	14.1±3.1	0.029
CISS PKT Sten	5.5±2.0	4.2±1.6	0.049
Perceived Stress Scale			
PSS10 Score	21.4±4.1	19.6±4.0	0.181
PSS10 Sten	7.1±1.3	6.5±1.3	0.137
State-Trait Anxiety Inventory			
STAI Score	39.7±11.1	39.6±11.4	0.907
STAI Sten (Cecha)	4.3±2.2	4.9±2.6	0.577
STAI2 Score	39.2±8.9	38.6±9.1	0.789
STAI2 Sten (Stan)	5.2±1.8	5.8±2.7	0.429
General Health Questionnaire			
GHQ Score	7.4±5.2	7.5±5.4	1.0

Further analysis showed that patients who life alone or only with one person used more task oriented style [Tab. 5]. We may expect that people living in groups could more easily support each other and distribute their tasks, while those living alone had to mobilize their own resources and focus on the most important goals – organizing food, medications etc.

Table 5. **Comparison between T1DM household with >2 person vs <=2 person**

Indices	<=2 person	>2 person	P-value
BMI [kg/m^2]	23.1±3.1	24.3±3.9	0.266
HbA1c [%]	6.4±0.5	6.5±0.9	0.617
Mean glycemia from glucometer [mg/dL]	136±19	155±27	0.015
Coping Inventory For Stressful Situations			
CISS SSZ Score	59.7±7.7	54.0±9.8	0.028
CISS SSZ Sten	6.1±1.8	5.0±1.9	0.052
CISS SSE Score	39.5±9.1	41.1±11.8	0.624
CISS SSE Sten	4.4±1.8	4.8±2.2	0.453
CISS SSU Score	41.7±7.5	42.2±8.7	0.849
CISS SSU Sten	4.8±1.8	4.8±1.9	0.987
CISS ACZ Score	16.6±4.7	18.4±5.7	0.262
CISS ACZ Sten	4.4±1.7	5.0±2.1	0.302
CISS PKT Score	17.1±3.5	15.8±4.4	0.283
CISS PKT Sten	5.6±1.8	4.9±2.1	0.226
Perceived Stress Scale			
PSS10 Score	21.6±3.8	20.6±4.4	0.425
PSS10 Sten	7.2±1.2	6.8±1.4	0.262
State-Trait Anxiety Inventory			
STAI Score	38.4±13.5	40.5±9.3	0.169
STAI Sten (Cecha)	4.1±2.2	4.6±2.4	0.380
STAI2 Score	37.7±8.4	39.9±9.1	0.405
STAI2 Sten (Stan)	5.0±2.3	5.5±1.9	0.382
General Health Questionnaire			
GHQ Score	6.9±3.6	7.7±6.0	0.992

The analysis showed that the global level of psychopathology measured by GHQ-30 was higher in patients who had the levels of anxiety – both state and trait anxiety – higher than in the general population. Patients with exaggerated level of GHQ (score ≥12) use more often emotion oriented coping strategies and their general level of anxiety is higher [Tab. 6]. The group of patients with elevated GHQ levels deserves special attention of specialists. These are the persons who already prior epidemic had emotional difficulties. Now, in the lockdown situation, they revealed high level of anxiety and stress and it is probable that they will have difficulties in dealing with the stressor.

Tab. 6. Comparison between patients with GHQ score ≥12 vs <12.

Indices	GHQ ≥12	GHQ< 12	P-value
BMI [kg/m^2]	23.7±4.0	23.9±3.6	0.708
HbA1c [%]	6.8±0.5	6.4±0.7	0.283
Mean glycemia from glucometer [mg/dL]	149.7±23.0	146.0±26.0	0.705
Coping Inventory For Stressful Situations			
CISS SSZ Score	53.8±11.8	56.5±8.8	0.493
CISS SSZ Sten	5.1 ±2.5	5.5±1.8	0.700
CISS SSE Score	49.6±9.3	38.5±10.1	0.004
CISS SSE Sten	6.4±1.5	4.2±2.0	0.003
CISS SSU Score	41.0±6.0	42.2±8.6	0.682
CISS SSU Sten	4.1±1.7	5.0±1.8	0.096
CISS ACZ Score	17.6±4.5	17.8±5.5	0.922
CISS ACZ Sten	4.3±2.1	4.8±1.9	0.501
CISS PKT Score	15.6±3.3	16.5±4.3	0.550
CISS PKT Sten	4.4±1.7	5.3±2.0	0.248
Perceived Stress Scale			
PSS10 Score	22.3±4.7	20.7±4.0	0.282
PSS10 Sten	7.3±1.5	6.8±1.3	0.201
State-Trait Anxiety Inventory			
STAI Score	50.4±9.9	37.2±9.9	0.001
STAI Sten (Cecha)	6.1±2.2	4.0±2.2	0.019
STAI2 Score	46.1±9.5	37.5±7.9	0.013
STAI2 Sten (Stan)	7.4±1.4	4.8±1.9	<0.001

Discussion

Depending on the global region, 20-50% of patients in the coronavirus disease 2019 (COVID-19) epidemic had diabetes [19]. In general, people with all forms of diabetes are at increased risk of infection because of defects in innate immunity affecting phagocytosis, neutrophil chemotaxis, and cell-mediated immunity; however, the high frequency of diabetes in serious cases of COVID-19 could potentially reflect the higher prevalence of type 2 diabetes in older people [6, 19, 20].

Some studies have shown a higher relationship between diabetes and variety of mental health issue which could easily be exacerbated in stressful environment [20, 21]. People with diabetes have COVID-19-specific worries related to their diabetes which is associated with poorer psychosocial health [22, 23]. More than half

were worried about being overly affected due to diabetes if infected with COVID-19, about one-third about being characterized as a risk group due to diabetes and not being able to manage diabetes if infected [24]. Health anxiety, perceived fear of an illness, stress, deficient social support and negative emotions towards any new change in life can all impact on glycemic control [25-27]. Interestingly, psychological insulin resistance is a common reaction in individuals who report anxiety and fear of health-related concerns [28].

However, it was recently shown that glycemic control of T1DM in adolescents using HCL system did not worsen during the restrictions due to COVID-19 epidemic s and further improved in those who continued PA during the quarantine. Maintaining regular PA seems to be an essential strategy for young individuals with T1DM during the COVID-19 crisis [29]

The results of our study indicate that in the lock down stressful situation both T1DM patients and controls use various coping mechanisms, depending on their general mental health condition and imply strategies used on a regular basis. Patients with long time diabetes were more task oriented than others, but their level of stress and anxiety was within the normal range. This may indicate that everyday contact with the challenge of having diabetes results in some level of stress resistance and the ability to apply activities that help the patients focus on the best possible, constructive solutions while facing the challenge of difficult situation.

Patients who live individually or in couples also in the stressful conditions were more task oriented that T1DM who live in bigger groups. Group processes assume that responsibilities are roles are more diverted and spread. Patients who live alone must cope individually with their challenges in stressful situations.

Most of the patients from the examined group were well functioning young adults who can use Internet, which could be a protective factor during the epidemic limitations. It seems important to carry out studies in a group of older people and people with limited access to modern technologies to check their functioning in the changed by coronavirus conditions. Also, an important line of studies would be similar analysis in other group of patients with somatic chronic disease – inter alia with type 2 diabetes.

The results show that T1DM patients and persons in control group in an epidemic situation experience elevated levels of stress and apply various styles and strategies to cope with them. The studies were carried out in the first period of epidemic lock down, when many people expected that the situation would come back to „normal" rather quickly. It would be of crucial importance to analyze the psychological parameters in a long run, when the epidemic situation continues. Such analyses are planned. Also, it would be advisable to observe if the patients develop any symptoms of adjustment disorder or PTSD, which usually do not occur immediately after the stressor occurrence, but within few months from the stressful events.

Professional help in such situations would be essential. With this reflection, University Hospital in Krakow, in cooperation with the Department of Metabolic Diseases and the Chair of Psychiatry of the Jagiellonian University Medical College and the Polish Diabetes Society, decided to offer Psychological Assistance Program for People with Diabetes It is aimed at all people suffering from type 1 diabetes, struggling with

various types of problems and emotional difficulties related to it, especially those connected with reactions to variety of epidemic stressors.

To conclude, T1DM patients can use various coping styles to deal with stress in an demanding situation. Their coping depends on general life situation, duration of diabetes, general mental health. There is a group of patients who in specific situation such as epidemic may need a special attention not only of diabetologists, but also mental health professionals, as the increased levels of stress, anxiety, depression may have especially negative impact on their glycemic control. We hope that cooperation between specialists in diabetology, psychiatry and psychology will provide the most optimal help for T1DM patients confronted with the unexpected and difficult world crisis caused by the global spread of SARS-COV-2.

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