doi: 10.4183/aeb.2022.40

NUTRITIONAL HABITS, COMPLIANCE WITH HEALTHY DIET AND INSULIN THERAPY, DEPRESSION AND FAMILY FUNCTIONALITY IN CHILDREN WITH TYPE 1 DIABETES MELLITUS DURING THE COVID-19 PANDEMIC PERIOD

S.B. Koca[1,*], A. Bükülmez[2], A.T. Oflu[2], E.G. Tahta[2], H. Demirbilek[3]

[1]Health Sciences University, Kayseri City Hospital, Department of Pediatrics, Division of Pediatric Endocrinology, Kayseri, [2]Afyonkarahisar Health Sciences University, Faculty of Medicine, Department of Pediatrics, Afyonkarahisar, [3]Hacettepe University, Faculty of Medicine, Department of Pediatrics, Division of Pediatric Endocrinology, Ankara, Turkey

Abstract

Context. The relationship between life changes and glycemic control in children with type 1 diabetes during the pandemic period was examined.

Objective. We aimed to investigate the effect of the pandemic period on 66 children (aged 5-18 years) with type 1 diabetes using scales evaluating family functionality, nutritional habits, adherence to treatment and depression status.

Design. It is a cross-sectional clinical and laboratory study using certain scales for its descriptive features.

Subjects and Methods. Demographic characteristics, anthropometric measurements, laboratory investigations were evaluated. Family functionality of the patients were evaluated with Smilkstein's family APGAR scale, motivation and knowledge levels were evaluated with the 6-item Morisky medication adherence scale (MMAS-6), nutritional habits were evaluated with the Mediterranean diet quality index (KIDMED), and depression status was evaluated with the children depression inventory (CDI).

Results. The mean HbA_{1c} level increased significantly in the first year of the pandemic compared to the onset of the pandemic period (8.5% *vs*. 8.9%, p: 0.003). In the responses to these scales, children with diabetes have high family functionality (89.4%), high motivation (90.9%) and high knowledge level about adherence to treatment (97%). Furthermore, healthy eating habits (high KIDMED index scores 92.4%), and low degree of depression score (95.5%) have been observed. We detected a statistically significant positive correlation between HbA_{1c} and CDI scores (r: 0.27; p: 0.02), and a negative correlation between HbA_{1c} and MMAS-6 motivation score (r: -0.30; p: 0.01).

Conclusions. In this study, the effect of motivation and mood changes on glycemic control was more clearly demonstrated.

Keywords: Children's depression inventory, COVID-19 pandemic, Mediterranean diet quality index, Smilkstein's family APGAR scale, Type 1 diabetes mellitus, 6-item Morisky medication adherence scale.

INTRODUCTION

In the last months of 2019, a coronavirus disease (COVID-19), which was encountered for the first time in the largest city of China's Hubei province, Wuhan, was identified. The World Health Organization (WHO) declared a pandemic on March 11, 2020, due to its rapid spread around the world, and has become a public health problem since then. Changes have emerged in daily activities and lifestyle habits, as country administrations have imposed regional and international restrictions in order to reduce human mobility and prevent transmission routes of the virus. There has been a change in the frequency of admissions to the hospital which led to difficulties in the management of chronic diseases. After 11 March 2020 when the first case was seen in Turkey, government released some preventive measures including hygiene, mask and social distance rules, regulations of international borders and flights (1). These precautions resulted in decreased hospital admissions due to measures such as banning public transportation vehicles, postponing elective surgery and medical interventions, banning public events. In addition, due to the increase in the number of COVID-19 cases and their admission, some hospitals serve as pandemic hospitals and people did not go to the hospitals due to the fear of infection. In that devastating situation health professionals developed alternative strategies in the management

*Correspondence to: Serkan Bilge Koca MD, Kayseri City Education and Research Hospital, Pediatric Endocrinology, Health Sciences University, Kayseri City Hospital, Kayseri, 38080, Turkey, E-mail: kocaserkanbilge@yahoo.com.tr

of their patients. Telemedicine is one of the mostly used methods to keep close contact with families and manage the pediatric patients. Nevertheless, there have been mandatory changes in the workplace, social and home environment and life outside the home. A curfew has been imposed on children under the age of 18 without supervision of their parents. Schools were closed. The web-based online educational activities were taken into account. Therefore, changes in daily activities including sleep patterns, eating habits and physical activities were observed. It has been reported that behavioral disorders were more common in children with low income and special education needs, especially in pre-adolescent period, compared to healthy children (2). The frequency of depression in children and adolescents was reported as 2.22-63.8%, and the frequency of anxiety was observed as 7.5-49.5% during the COVID-19 pandemic. In addition, an increase in internet use, sleep duration and obesity which was attributed to inactivity in children has been reported (3). During the pandemic period, changes were observed in the follow-up of children with type 1 diabetes and in the hospital admission characteristics of newly diagnosed diabetics (4). Therefore, metabolic control of patients with type 1 diabetes has been the area of interest for the studies undertaken during pandemic. In present study, we aimed to compare the glycemic control before the pandemic and in the first year of pandemic. We also evaluated lifestyle changes and its impact on the glycemic control using a number of scales that have been proven to be universally valid and reliable.

MATERIALS AND METHODS

Participants

The study was carried out in Afyonkarahisar Health Sciences University Pediatric Endocrinology outpatient clinic, a tertiary-care university health practice and research center, Afyonkarahisar, Turkey. The study was approved by the local ethics committee of the Afyonkarahisar Health Sciences University (Document number: 2011-KAEK-2, 2021/190). The study was carried out on children with type 1 diabetes mellitus, who were followed regularly (every 3-4 months) in our center between the March 2020 and March 2021, during the first year of the COVID-19 pandemic in Turkey. Informed consent was obtained from the parents or legal guardians of the participants. The diagnosis of type 1 diabetes was considered according to the International Society for Pediatric and Adolescent Diabetes (ISPAD) Clinical Practice Consensus Guidelines 2018(5). The inclusion criteria were the following: a duration of diabetes of 12 months or longer and being out of the honeymoon period, using basal/bolus insulin or subcutaneous insulin pump therapy and admission for ≥3 follow-up visits during the last 12 months. Patients who had celiac or any other accompanying systemic diseases, received treatment for dyslipidemia, hypertension or autoimmune thyroid diseases, admitted less than 3 follow-up visits per year and those with intellectual disability were excluded from the study. Out of 103 patients with type 1 diabetes who underwent at least 3 clinical visits per year during the pandemic period; 66 children were included in the study, whose metabolic tests were fully evaluated, the questionnaires were fully applied, and the consent to participate in the study was obtained.

Study design

Data were obtained retrospectively, from the medical records of the patients. The information including patients' age, gender, duration of diabetes, body weight and standard deviation score (SDS), height and height SDS, body mass index and BMI SDS, puberty status, blood pressure measurements, mean hemoglobin A1c (HbA_{1c}) before COVID-19 and mean HbA_{1c} during COVID-19 (arithmetic mean of all HbA_{1c} levels except at the time of or within the first 3 months of diagnosis), fasting lipid parameters (triglyceride, total cholesterol, LDL-cholesterol, HDL-cholesterol) and, daily insulin doses was recorded. The patients' weight, height, body mass index, standard deviation scores of anthropometric measurements were evaluated with an online calculation program (6). (www.childmetrics.org). This evaluation was based on CDC reference values for age and gender. For biochemical and hormonal measurements, blood samples were taken in the early morning after a 10-hour overnight fasting. Children with type 1 diabetes with normal hemogram, biochemistry, vitamin B12, folic acid, ferritin, thyroid functions tests anc celiac serology were included in this study. Biochemical and hormonal tests were measured using an automated biochemical analyser (Cobas 8000 c502-c702 and Cobas 6000 c501-e601, Roche Diagnostics, Mannheim, Germany). Plasma glycosylated hemoglobin A1c (HbA_{1c}) was measured by electrochemiluminescence immunological method (ECLIA) on the Cobas 8000 e602 analyzer (Roche Diagnostics, Mannheim, Germany). Puberty status was evaluated according to Marshall and Tanner staging (7,8). Girls with no breast development and boys with

testicular volume of less than 4 ml were defined as prepubertal; while those with breast development and testicular volume of 4 mL or more were defined as pubertal. At their final follow-up visit, patients and their guardians were asked to respond to the scale questions providing face-to-face support via an online form. An experienced diabetes nurse also provided online support, keeping families informed of their needs and questions.

Questionnaires

Questionnaires were filled in by parents for individuals under the age of 7, by children under parental supervision between the ages of 7 and 13, and by children over the age of 13. The scales were applied to patients who were followed up regularly and had sufficient laboratory records. Since some of the patients who had been applied questionnaire during their first admission could not continue their follow-ups regularly, only the questionnaires of those with complete follow-ups in the last visit were included in the study.

The first scale is the family APGAR scale, developed by Smilkstein, which is used to evaluate family functioning. The Turkish adaptation of this scale, and its validity and reliability analyses were performed (Cronbach's alpha 0.79), (9,10). APGAR acronym consists of the first letter of each parameter. Adaptation, using the resources to solve the problem in a crisis environment; Partnership, sharing the decisions and responsibilities; Growth, physical and emotional maturation provided by family members; Affection, the love and cooperation between family members, sharing feelings; Resolve, allocating time to other family members for their physical and spiritual development, sharing time and property. The scale consists of five items. In each item, there are three options to measure the feeling of satisfaction. Scores for these options are 0 (hardly ever), 1 (some of the time) and 2 (almost always). The total score ranges from 0 to 10. A high score indicates satisfaction with family functioning. According to the total score, 7-10 was considered as high, 4-6 moderate, and 0-3 as low. The items in the family APGAR scale were shown in Supplementary Table 1.

Children's depression inventory (CDI), developed by Kovacs, was used to measure children's depression scores (11). The validity and reliability analyses of the Turkish adaptation were made (Cronbach's alpha 0.80) (12). It is a 27-item self-assessment scale that can be applied to children aged 6-17. Each item gets 0, 1 or 2 points depending on the severity of the symptoms. The maximum score is 54. A score of 19 or less is considered normal. The higher the score, the more severe the depression. The items in the CDI were shown in Supplementary Table 2.

Morisky medication adherence scale (MMAS) is a scale used to evaluate adherence to treatment in chronic diseases (13). MMAS-6 is a scale consisting of 6 items, adapted to Turkish, and validity and reliability analyses have been made (14). It is an easy-to-apply test that can evaluate motivation and knowledge level separately. The questions were answered as Yes/No and in the evaluation; In questions 2 and 5 yes 1 point, no 0 points; other yes is 0 points, no is 1 point. From questions 1, 2 and 6 low motivation if the patient's total score is 0 or 1 level, and >1 indicates high motivation level. If the total score received from questions 3, 4 and 5 is 0 or 1 indicates low level of knowledge, and >1 indicates high level of knowledge. The questions in MMAS-6 were shown in Supplementary Table 3.

The Mediterranean Diet Quality Index for Children and Adolescents (KIDMED) is a test that evaluates adherence to the Mediterranean diet in individuals between the ages of 2-24 and is valid in many societies around the world (15). The validity and reliability analyses of the Turkish adaptation were made (Cronbach's alpha 0.72) (16,17). It is a scale consisting of 16 items in total that can be answered simply as "Yes" or "No" by evaluating different food groups and eating habits consumed in the diet. In scoring, +1 and -1 points are given according to the item that fits the habits of the individual. The sum of all scores forms a classification for adherence to the Mediterranean diet. According to the Mediterranean diet adherence index total score: 1) high >8, 2) moderate 4–7, and 3) poor ≤3. The items in KIDMED were shown in Supplementary Table 4.

Statistical analysis

SPSS version 24.0 (IBM Corporation, Armonk, NY, USA) software program was used in the statistical analysis of the data. Mean, standard deviation (SD), minimum, maximum and median values, first (Q1) and third (Q3) quartiles and interquartile range (IQR) of numerical variables were calculated. Categorical variables were shown as frequency and percentage values. Shapiro-Wilk test was used to evaluate the normal distribution of data. In addition, those whose kurtosis and skewness ranges were between -2 and +2 were considered to have a normal distribution. Student's T test was used to compare the means of two independent numerical variables. Paired samples T test

was used to compare the means of hemoglobin A1c value before and after COVID 19. Spearman correlation analysis was used to evaluate the relationship between demographic data and HbA_{1c} and the answers given on the scale. A $p<0.05$ was considered for statistical significance.

RESULTS

Of the patients, 37 (56.1%) were female and 29 (43.9%) were male. While 13 (19.7%) children were in the prepubertal period, 53 (80.3%) children were pubertal. One of these children was 5 years 6 months old, the others were 7 years old and over. Three of our patients

Table 1. Characteristic baseline clinical and laboratory data

Characteristic	Mean	SD	Median	Q1-Q3	Minimum	Maximum
Age (years)	13.1	3,2	14	10 - 16	5	18
Diabetes duration (years)	5.6	3.1	5	3 - 8	2	14
Daily insulin dose before COVID-19 (unit/kg)	**0.99**	**0.23**	**1.01**	**0.81 – 1.12**	**0.51**	**1.72**
Daily insulin dose (unit/kg)	1.08	0.25	1.04	0.88 - 1.22	0.59	1.82
Systolic blood pressure (mmHg)	100	11.5	90	100 - 110	80	120
Diasystolic blood pressure (mmHg)	62.5	8.4	60	60 - 70	50	80
Weight (kg)	49.7	15.8	51.2	36.9 - 60.7	23	96
Height (cm)	153.9	15.6	156.2	145.7 - 166.3	121.8	186.7
BMI before COVID-19 (kg/m^2)	**19.5**	**4.1**	**18.9**	**16.6 - 21.4**	**13**	**35.3**
BMI (kg/m^2)	20.4	4.2	19.6	17.5 - 22.4	13.8	37
Weight SDS	0.18	0.98	0.07	-0,42 - 0.93	-1.89	2.14
Height SDS	-0.16	1.06	-0.23	-0.88 - 0.59	-2.45	3.06
BMI SDS before COVID-19	**0.2**	**1.02**	**0.16**	**-0.39 - 0.16**	**-2.8**	**2.1**
BMI SDS	0.28	0.97	0.28	-0.29 - 1.06	-2.0	2.1
Mean HbA_{1c} before COVID-19 (%)	8.5	1.41	8.3	7.4 - 9.3	6.2	12.2
Mean HbA_{1c} during COVID-19 (%)	8.9	2.1	8.5	7.4 - 10.5	5.7	15.5
Total cholesterol (mg/dL)	155.1	34.5	149.5	133.7 - 169.7	67	291
HDL-cholesterol (mg/dL)	53.9	10.8	53	46.7 - 61.2	30	80
LDL-cholesterol (mg/dL)	99.6	32	92.5	80 - 114.7	28	247
Triglyceride (mg/dL)	124.9	102.3	94.5	70.7 - 142.5	26	590

Table 2. Scores of the scales applied during the examination at the last visit

Scale	Mean	SD	Median	Q1 - Q3	Minimum	Maksimum
APGAR score	8.41	1.76	9	7.7 - 10	3	10
MMAS-6 Motivation score	2.48	0.66	3	2 - 3	1	3
MMAS-6 Knowledge score	2.55	0.56	3	2 - 3	1	3
KIDMED score	11.1	2.2	12	10 - 13	6	15
CDI score	7.9	5.5	7.5	3.7 - 11	0	26

Table 3. Evaluation of the scales applied during the examination at the last visit

Scale	APGAR n, (%)	MMAS-6 Motivation n, (%)	MMAS-6 Knowledge n, (%)	KIDMED index n, (%)	CDI n, (%)
Interpretation	Low 2, (3%) Moderate 5, (7.6%) High 59, (89.4%)	Low 6, (9.1%) High 60, (90.9%)	Low 2, (3%) High 64, (97%)	Poor (0%) Moderate 5, (7.6%) High 61, (92.4%)	Normal 63, (95.5%) High 3, (4.5%)

Table 4. Correlations between scale interpretation and demographic data and HbA_{1c}

Characteristic	APGAR		MMAS-6 Motivation		MMAS-6 Knowledge		KIDMED index		CDI	
	r	p	r	p	r	p	r	p	r	p
Age	-0.08	0.50	-0.17	0.16	-0.24	**0.04***	-0.07	0.53	0.15	0.20
Sex	0.00	0.96	-0.03	0.75	-0.02	0.86	0.02	0.85	-0.04	0.71
Puberty status	-0.05	0.68	-0.15	0.20	-0.08	0.48	-0.14	0.25	0.10	0.38
Diabetes duration	-0.02	0.82	-0.02	0.86	-0.10	0.39	-0.20	0.10	-0.06	0.61
Mean HbA_{1c} during COVID-19	-0.05	0.67	-0.30	**0.01***	-0.12	0.32	0.07	0.54	0.27	**0.02***

*Pearson correlation was used.

were using a flash glucose measurement system in addition to blood glucose monitoring with a glucometer. Anthropometric measurements, demographic data and laboratory results obtained at the last visit were shown in Table 1. Although metabolic controls and lipid profiles of the patients were evaluated at the time the scales were applied, lipid analyzes of some of these cases were not performed at the beginning of the pandemic. The daily insulin doses and body mass index values at the beginning of the pandemic and in the first year of the pandemic are also included in Table 1. The results of the scales administered to children with diabetes and their parents by face-to-face and online interviews at the last visit and the interpretation of these scales were shown in Table 2 and Table 3, respectively. The mean HbA_{1c} level of the period until the onset of the pandemic (except for the first HbA_{1c} at the time of diagnosis of diabetes) and the mean HbA_{1c} level at the end of the first year of the pandemic period (only the mean of the pandemic period) were measured. HbA_{1c} level increased significantly in the first year of the pandemic compared to the onset of the pandemic period (8.5% *vs.* 8.9%, p: 0.003). In the responses to these scales; children with diabetes have high family functionality (89.4%), high motivation level for adherence to treatment (90.9%), high level of knowledge about adherence to treatment (97%), healthy eating habits (high KIDMED index scores 92.4%), and low degree of depression score (95.5%) has been

Supplementary Table 1. Family APGAR scale

	Items	Almost always	Some of the time	Hardly ever
1.	I am satisfied that I can turn my family for help when something is troubling me	2	1	0
2.	I am satisfied with the way my family talks on things with me and shares problems with me	2	1	0
3.	I am satisfied that my family accepts and supports my wishes to take on new activities or directions	2	1	0
4.	I am satisfied with the way my family expresses affection and responds to emotion such as anger, sorrow and love	2	1	0
5.	I am satisfied with the way my family and I share time together	2	1	0

Supplementary Table 2. Children depression inventory

	Items	Not at all	Sometimes	Always
1.	I am sad all the time	0	1	2
2.	I am sure that terrible things will happen to me	0	1	2
3.	I feel like crying everyday	0	1	2
4.	Things bother me all the time	0	1	2
5.	I sleep pretty well	0	1	2
6.	I am tired all the time	0	1	2
7.	Most days I don't feel like eating	0	1	2
8.	I don't worry about aches and pains	0	1	2
9.	I get into fights all the time	0	1	2
10.	Nothing will ever work for me	0	1	2
11.	I like myself	0	1	2
12.	All bad things are my fault	0	1	2
13.	I want to kill myself	0	1	2
14.	I look ugly	0	1	2
15.	Nobody really loves me	0	1	2
16.	I do everyhing wrong	0	1	2
17.	Nothing is fun at all	0	1	2
18.	I am bad all the time	0	1	2
19.	I cannot make up my mind about things	0	1	2
20.	Doing school work is not a big problem	0	1	2
21.	I never have fun at school	0	1	2
22.	My school work is alright	0	1	2
23.	I can never be as good as other kids	0	1	2
24.	I like being with people	0	1	2
25.	I do not feel alone	0	1	2
26.	I have plenty of friends	0	1	2
27.	I never do what I am told	0	1	2

observed. The relationship between age, gender, duration of diabetes, mean HbA_{1c} level during the pandemic period, and the direction of the relationship were shown in the correlation analysis table (Table 4). We detected a statistically significant positive correlation between HbA_{1c} and CDI scores (r: 0.27; p: 0.02), and a negative correlation between HbA_{1c} and MMAS-6 motivation score (r: -0.30; p: 0.01) (Fig. 1).

DISCUSSION

During the COVID-19 pandemic period, children and adolescents with type 1 diabetes had to manage their diabetes themselves and with the support of their parents in some periods when restrictions were applied intensely. In some studies evaluating glycemic control in children and adults with type 1 diabetes, no deteroration of glycemic control was reported in the early stages of restrictions. In such studies, compliance with stay-at-home warnings, regular meal times, parental support, lack of school and after-school activities in adolescents, and a more regular lifestyle and physical activity at home were reported to be effective on good glycemic control (18-21). During the pandemic period; fear of getting sick, fear of losing parents or relatives, increased stress levels, anxiety and depression have been reported (22). Therefore, studies evaluating the short-term effects of pandemic on the pediatric type 1 diabetes patients have reported variable impact on the glycemic control and psychosocial statues of families and patients. This, heterogeniety can be attributed to the availability of telemedicine practices, regional and ethnic differences, age range and number of patients in the samples.

In a study evaluating the glycemic control of children with type 1 diabetes at the first lockdown period, glycemic control has been shown as improved with lower hypoglycemia episodes (23). They also showed that symptoms of depression and anxiety were associated with worse glycemic control. In our study we did not evaluate the hypoglycemia but glycemic control was worse compared to the pre-pandemic period. This was attributed to the prolongation of the pandemic therefore loss of motivation of the children and their caregiver who were involved in the management of their diabetes. Indeed, we also showed that increased CDI score was positively related with HbA_{1c} level, namely poorer glycemic control.

Family functionality have been shown to positively affect metabolic control in children with type 1 diabetes (24-27). Although there are different scales in this respect, we used the family APGAR

Supplementary Table 3. Morisky Medication Adherence Scale-6 (MMAS-6)

	Questions	No	Yes
1.	Do you ever forget to take your medicine(s)?	1	0
2.	Do you take care to take your medicine(s) on time?	0	1
3.	Have you ever stopped taking your medication when you felt better?	1	0
4.	Have you ever stopped taking the medicine when you felt unwell, thinking it was due to the medicine?	1	0
5.	Do you know the long-term benefits of taking medication?	0	1
6.	Do you sometimes forget to prescribe your medication when the time has come?	1	0

Supplementary Table 4. The Mediterranean Diet Quality Index for Children and Adolescents

	KIDMED test criteria	Scoring
1.	Takes a fruit or fruit juice every day	+1
2.	Has a second fruit every day	+1
3.	Has fresh or cooked vegetables regularly once a day	+1
4.	Has fresh or cooked vegetables more than once a day	+1
5.	Consumes fish regularly (at least 2–3/week)	+1
6.	Goes >1/week to a fast food restaurant?	-1
7.	Likes pulses and eats them >1/week	+1
8.	Consumes pasta or rice almost every day (5 or more per week)	+1
9.	Has cereals or grains (bread, etc.) for breakfast	+1
10.	Consumes nuts regularly (at least 2–3/week)	+1
11.	Uses olive oil at home	+1
12.	Skips breakfast	-1
13.	Has a dairy product for breakfast (yogurt, milk…)	+1
14.	Has commercially baked goods or pastries for breakfast	-1
15.	Takes two yogurts and/or some cheese (40 g) daily	+1
16.	Takes sweets and candy several times every day	-1

scale to evaluate family functioning. We observed that family functionality and participation were at a good level in our diabetes group during the pandemic period, and we found that it was not related with deterioration in the final HbA_{1c} measurement. There were studies showing that family functionality was more effective in regulating meal times and glycemic control, especially in young diabetics (28).

In our study, we examined the relationship between adherence to treatment and metabolic control. We used the MMAS-6 scale, which allows to separately evaluate the two components of adherence to treatment, motivation and knowledge. External parameters affecting compliance with treatment were not questioned. The studies conducted in adults have shown that metabolic control is impaired and treatment expenditures increase with the deterioration of adherence to treatment (29). In our study, although HbA_{1c} levels increased in the first year of the pandemic period, motivation and knowledge level scores were high in children with diabetes. In our study, we observed in the pandemic period that the issues such as busy life style, forgetfulness, changes in daily lives and variable moods which could impair the adherence to treatment did not have an apparent impact on the metabolic control in our study.

The Mediterranean diet, which has a nutritious content includes plenty of fresh vegetables, some fruit, plant-fats such as olive oil, nuts, fish such as sardines, and occasionally meat and dairy products, specified by the World Health Organization as a healthy diet for children and adults (30). Considering that this diet provides physical and mental well-being to the child, protects against overweight and obesity, and prevents cardiovascular diseases, in a period of low physical activity due to restrictions, an ideal diet may be considered. A higher KIDMED score was associated with better glycemic control and lipid profile (31). Similar to our study, Mediterranean type diet was being applied at a very high rate. There was no considerable deterioration in eating habits during the pandemic period. In a study conducted in a region where home confinement was practiced during the pandemic period in Italy, it was observed that there was no significant increase in disordered eating behaviors (DEB) in children with diabetes compared to healthy children (32).

The CDI is a scale that rates the severity of symptoms associated with dysthymic disorder and depression in children and adolescents. In a longitudinal study conducted in the United Kingdom, a significant increase in depression symptoms was found in children under lockdown measures (33). In our study, the CDI scores of 95.5% of children with type 1 diabetes were below the cut-off range of 19 points. In a study evaluating the relationship of lock-down in the COVID-19 pandemic in adults with type 1 diabetes, glycemic control was shown not to be impaired in adults with diabetes, even a modest improvement was observed, which was attributed to regular daily life activities and reduced work related stress (34). In a study conducted in non-pandemic period in Turkish children with type 1 diabetes, CDI scores have been reported to be varied according to the socioeconomic development level of the two cities where patients were recruited from (35).

In our study, we found a weak positive correlation between HbA_{1c} and CDI scores, and a weak negative correlation between MMAS-6 motivation score and HbA_{1c}. As we are still not yet aware of how long the pandemic will remain as a problem in our life, these findings suggests a need for a special care to the type 1 diabetes patients and their families to increase their motivation levels and prevent depression thus improve glycemic control during the pandemic period. Prolongation of the quarantine period, fear of infection, monotony, frustration, insufficient support and financial losses are strong stressors and long-term effects of restrictions (36). The strength of our study was the comprehensive examination of psychosocial factors in children with type 1 diabetes and their relationship with glycemic control during the pandemic. In addition, the patients were evaluated face-to-face at all visits, and the scales were recorded at the last visit.

Another strength of our study is that the extent of parental support and functionality, the knowledge and motivation of patients about diabetes, the type of nutrition and adherence to treatment were evaluated, and the possible effects of these variables on HbA_{1c} were also investigated. There were some limitations in our study. Firstly, in the answers given to the scales, the guidance of the family in the younger age group may be effective in changing results as well as the individual's own ideas. Secondly, since this research was conducted in a single center, different results may emerge with the effect of some educational and socioeconomic status throughout the country. Third, our sample size was a small group and a healthy control group was lacking. Therefore, the outputs from the scales could not be a trustworthy representative for all diabetic children accross the country.

In the present study evaluating long-term

impact of Covid-19 pandemic on the psychosocial and disease burden of type 1 diabetes and its effects on the glycemic control in children, CDI score was found negatively related with glycemic outcome while increased familial motivation scores were positively correlated. Our results suggest that to improve the glycemic control of pediatric type 1 diabetes patients during pandemic, it is paramount to develop appropriate management strategies improving the mood of children and keeping the motivation of family at highest level.

The city we live in is described as a city of gastronomy; in terms of its income, it is in an average place in Turkey at the level of national income per province. Although the average income level of families with diabetes was not specifically questioned, it was considered to evaluate food choices by choosing a standard scale in terms of healthy nutrition. The type of diet recommended for individuals with type 1 diabetes is the Mediterranean diet, as it is healthy and balanced. For this reason, we recommend this type of nutrition to our patients and their families from the moment of the first diagnosis of diabetes. As an inquiry scale, their compliance with this diet was investigated.

To the best of our knowledge, we have not seen a study that examined metabolic control, nutritional habits, adherence to treatment and mood levels in children with type 1 diabetes during the pandemic period. In addition, the use of a scale that supervises the responsibilities of parents reveals the strength of the study.

Conflict of interest

The authors declare that they have no conflict of interest.

Funding

The authors did not receive any financial support from any public or private source. The authors have no financial or proprietary interest in a product, method, or material described here.

References

1. Demirbilek Y, Pehlivanturk G, Ozguler ZO, Alp Mese E. COVID-19 outbreak control, example of ministry of health of Turkey. Turk J Med Sci. 2020;50:489-494.
2. Waite P, Pearcey S, Shum A, Raw JAL, Patalay P, Creswell C. How did the mental health symptoms of children and adolescents change over early lockdown during the COVID-19 pandemic in the UK? JCPP Advances. 2021;1:e12009.
3. Gul MK, Demirci E. Psychiatric disorders and symptoms in children and adolescents during the COVID-19 pandemic: A review. Eurasian J Med Oncol. 2021;5:20-36.
4. Zubkiewicz-Kucharska A, Seifert M, Stępkowski M, Noczyńska A. Diagnosis of type 1 diabetes during the SARS-CoV-2 pandemic: Does lockdown affect the incidence and clinical status of patients? Adv Clin Exp Med. 2021;30:127-134.
5. Mayer-Davis EJ, Kahkoska AR, Jefferies C, Dabelea D, Balde N, Gong CX, Aschner P, Craig ME. ISPAD Clinical Practice Consensus Guidelines 2018: Definition, epidemiology, and classification of diabetes in children and adolescents. Pediatr diabetes. 2018;19 Suppl 27:7-19.
6. Demir K, Ozen S, Konakci E, Aydin M, Darendeliler F. A Comprehensive Online Calculator for Pediatric Endocrinologists: CEDD Cozum/TPEDS Metrics. J Clin Res Pediatr Endocrinol. 2017;9:182-184.
7. Marshall WA, Tanner JM. Variations in pattern of pubertal changes in girls. Arch Dis Child. 1969;44:291-303.
8. Marshall WA, Tanner JM. Variations in the pattern of pubertal changes in boys. Arch Dis Child. 1970;45:13-23.
9. Smilkstein G, Ashworth C, Montano D. Validity and reliability of the family APGAR as a test of family function. J Fam Pract. 1982;15:303-311.
10. Ozcan S, Duyan V, Incecik Y. Usage of Family APGAR Scale in Family Medicine: Study of Turkish. Jour Turk Fam Phy. 2011;2:30-37.
11. Kovacs M. The Children's Depression, Inventory (CDI). Psychopharmacol Bull. 1985;21:995-998.
12. Oy B. Children's Depression Inventory: Validity and reliability study. Turk Psikiyatri Derg. 1991;2:132-136.
13. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. Med Care. 1986;24:67-74.
14. Vural B, Acar OT, Topsever P, Alvur TM. Reliability And Validity Of Turkish Version Of Modified Morisky Scale. Jour Turk Fam Phy. 2012;3:17-20.
15. Serra-Majem L, Ribas L, Ngo J, Ortega RM, Garcia A, Perez-Rodrigo C, Aranceta J. Food, youth and the Mediterranean diet in Spain. Development of KIDMED, Mediterranean Diet Quality Index in children and adolescents. Public Health Nutr. 2004;7:931-935.
16. Erol E, Ersoy G, Pulur A, Özdemir G, Bektaş Y. Evaluation of the Mediterranean Diet Quality Index (KIDMED) in adolescents in Turkey. J Hum Sci. 2010;7:647-664.
17. Sahingoz SA, Ozgen L, Yalcın E. Akdeniz Diyet Kalitesi Ölçeğinin (Mediterranean Diet Quality- KIDMED) Geçerlik ve Güvenirlik Çalışması. 5th International Eurasian Congress on Natural Nutrition, Healthy Life Sport. 2019:1078-1088.
18. Bonora BM, Boscari F, Avogaro A, Bruttomesso D, Fadini GP. Glycaemic Control Among People with Type 1 Diabetes During Lockdown for the SARS-CoV-2 Outbreak in Italy. Diabetes Ther. 2020(11); 1369–1379.
19. Schiaffini R, Barbetti F, Rapini N, Inzaghi E, Deodati A, Patera IP, Matteoli MC, Ciampalini P, Carducci C, Lorubbio A, Schiaffini G, Cianfarani S. School and pre-school children with type 1 diabetes during Covid-19 quarantine: The synergic effect of parental care and technology. Diabetes Res Clin Pract. 2020;166:108302.
20. Tornese G, Ceconi V, Monasta L, Carletti C, Faleschini E, Barbi E. Glycemic Control in Type 1 Diabetes Mellitus During COVID-19 Quarantine and the Role of In-Home Physical Activity. Diabetes Technol Ther. 2020;22:462-467.
21. Passanisi S, Pecoraro M, Pira F, Alibrandi A, Donia V, Lonia P, Pajno GB, Salzano G, Lombardo F. Quarantine Due to the COVID-19 Pandemic From the Perspective of Pediatric Patients With Type 1 Diabetes: A Web-Based Survey. Front Pediatr. 2020;8:491.
22. Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, Ho RC. Immediate Psychological Responses and Associated Factors during the Initial Stage of the 2019 Coronavirus Disease (COVID-19) Epidemic among the General Population in China. Int J Environ Res Public Health. 2020;17.

23. Cusinato M, Martino M, Sartori A, Gabrielli C, Tassara L, Debertolis G, Righetto E, Moretti C. Anxiety, depression, and glycemic control during Covid-19 pandemic in youths with type 1 diabetes. J Pediatr Endocrinol Metab. 2021;34(9):1089-1093.
24. Leonard BJ, Jang YP, Savik K, Plumbo MA. Adolescents with type 1 diabetes: family functioning and metabolic control. J Fam Nurs. 2005;11:102-121.
25. Hanson CL, De Guire MJ, Schinkel AM, Kolterman OG. Empirical validation for a family-centered model of care. Diabetes care 1995;18:1347-1356.
26. Lewin AB, Heidgerken AD, Geffken GR, Williams LB, Storch EA, Gelfand KM, Silverstein JH. The relation between family factors and metabolic control: the role of diabetes adherence. J Pediatr Psychol. 2006;31:174-183.
27. Jaser SS. Family interaction in pediatric diabetes. Curr Diab Rep. 2011;11:480-485.
28. Patton SR, Piazza-Waggoner C, Modi AC, Dolan LM, Powers SW. Family functioning at meals relates to adherence in young children with type 1 diabetes. J Paediatr Child Health. 2009;45:736-741.
29. Garcia-Perez LE, Alvarez M, Dilla T, Gil-Guillen V, Orozco-Beltran D. Adherence to therapies in patients with type 2 diabetes. Diabetes Ther. 2013;4:175-194.
30. Kanauchi M, Kanauchi K. The World Health Organization's Healthy Diet Indicator and its associated factors: A cross-sectional study in central Kinki, Japan. Prev Med Rep. 2018;12:198-202.
31. Zhong VW, Lamichhane AP, Crandell JL, Couch SC, Liese AD, The NS, Tzeel BA, Dabelea D, Lawrence JM, Marcovina SM, Kim G, Mayer-Davis EJ. Association of adherence to a Mediterranean diet with glycemic control and cardiovascular risk factors in youth with type I diabetes: the SEARCH Nutrition Ancillary Study. Eur J Clin Nutr. 2016;70:802-807.
32. Troncone A, Chianese A, Zanfardino A, Cascella C, Piscopo A, Borriello A, Rollato S, Casaburo F, Testa V, Iafusco D. Disordered eating behaviors in youths with type 1 diabetes during COVID-19 lockdown: an exploratory study. J Eat Disord. 2020;8:76.
33. Bignardi G, Dalmaijer ES, Anwyl-Irvine AL, Smith TA, Siugzdaite R, Uh S, Astle DE. Longitudinal increases in childhood depression symptoms during the COVID-19 lockdown. Arch Dis Child. 2020-320372.
34. Aragona M, Rodia C, Bertolotto A, Campi F, Coppelli A, Giannarelli R, Bianchi C, Dardano A, Del Prato S. Type 1 diabetes and COVID-19: The "lockdown effect". Diabetes Res Clin Pract. 2020;170:108468.
35. Baran RT, Surer-Adanir A, Karakurt MN, Dundar M, Aydin M, Ozbek MN, Demirbilek H. Evaluation of psychological characteristics of Turkish children with type 1 diabetes mellitus from two demographically and geographically distinct regions. Turk J Pediatr. 2018;60:554-561.
36. Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, Rubin GJ. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet 2020;395:912-920.