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Original Article

Evaluation of Effects of the COVID-19 Crisis on Disease Management in Children with Type 1 Diabete

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Abstract

Background: With the spread of the coronavirus disease 2019 (COVID-19), strict laws such as quarantine were implemented in many countries, including Iran. The spread of this disease and the general quarantine overshadowed the treatment and management of some chronic diseases, including type 1 diabetes, and many families faced a serious challenge in providing medicines and periodic tests for their children. This study was conducted with the aim of investigating the effects of the COVID-19 crisis on disease management in children with type 1 diabetes.

Method: Based on a researcher-made questionnaire, this cross-sectional study was conducted on 85 children with type 1 diabetes between the ages of 2 and 18 years in 6 months at the Children's Medical Center Hospital. This questionnaire is either collected from the parents during the face-to-face visit of the child with type 1 diabetes, or the virtual visit (telemedicine), and they were asked to complete the relevant questionnaire. This questionnaire included demographic information, laboratory tests, and the challenges of patients' families during the pandemic. In order to properly understand the management of this disease, parents were asked to enter the results of tests related to fasting blood sugar and HbA1c 3 times at the beginning of the pandemic, during quarantine, and during the implementation of the study.

Results: Based on the results, the level of HbA1c, the problem of insurance coverage, the problem of attendance, ketoacidosis, and infection before the pandemic, during the pandemic, and at the time of the study among children with type 1 diabetes were unchanged (P>0.05). There was a significant difference between fasting blood sugar levels, insulin levels, blood sugar control levels, and hospitalizations in type 1 diabetes patients before the pandemic, during the pandemic, and the study period (P<0.05).

Conclusion: Increasing the use of continuous glucose monitors and the widespread use of telemedicine visits may improve the impact of the pandemic on disease management. It is suggested that more multicenter studies with a higher sample size should be conducted in order to investigate the impact of the COVID-19 crisis on children with diabetes.

Keywords: Coronavirus Diseases 2019; COVID-19; Type 1 Diabetes; Telemedicine

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Introduction

Diabetes is a complex chronic disease that requires long-term medical care and multifaceted risk reduction strategies regarding glycemic index control (1). Accurate control of glycemic index can significantly reduce the risk of cardiovascular diseases and capillary complications. Poor metabolic control is associated with short-term complications such as hypoglycemia, failure to follow the prescribed treatment regimen, and failure to visit a specialist doctor regularly (2, 3).

With the spread of COVID-19 all over the world, the public health of societies was severely affected by this disease. Although diabetes has been introduced as one of the risk factors for this disease, several studies have shown that children with diabetes do not show a different pattern of the disease.

However, some studies have also mentioned that infectious diseases in patients with type 1 diabetes may lead to diabetic ketoacidosis (DKA). Therefore, children and adults with type 1 diabetes may not have a good prognosis if they are infected with COVID-19. Therefore, this information shows that people with type 1 diabetes are one of the vulnerable groups facing this disease (3, 4).

In Iran, like other countries, strict laws were adopted to reduce the spread of this disease. In the meantime, most of the outpatient services of hospitals and elective and unnecessary surgeries were stopped. During this pandemic and the implementation of general quarantine in the country, in-person and outpatient services for patients with type 1 diabetes were canceled or severely reduced, which made the treatment follow-up of many affected patients a serious challenge. On the other hand, the fear of contracting COVID-19 is another reason that many families do not measure HbA1c for their children (5). Another challenge created by COVID-19 was insulin rationing and glucose strip testing (6, 7).

Various research has shown that telemedicine can be effective in the management of some chronic diseases. By facilitating personal management, reducing costs, and increasing quality of life, telemedicine can be effective in the management of diabetes (8-10).

This study was conducted to investigate the effects of the COVID-19 pandemic and its consequences on children with type 1 diabetes.

Methods and materials

In this cross-sectional descriptive study, the population included 85 children with type 1 diabetes referred to the Children's Medical Center Hospital of Tehran University of Medical Sciences . The inclusion criteria for this study were children aged 2 to 18 with type 1 diabetes. Children whose type 1 diabetes was not confirmed were excluded. This study, which is based on a questionnaire, was conducted in five months. The questionnaire was provided to the parents of 85 children with type 1 diabetes. This questionnaire was either collected from the parents during the face-to-face visit of the child with type 1 diabetes, or was provided to the parents during the virtual visit (telemedicine), and they were requested to complete the relevant questionnaire and send it again. In this questionnaire, the patient's parents were asked to fill in the section related to their child's personal information (demographic data, insurance coverage, type of insulin used), and also check the challenges faced during the outbreak of the COVID-19 disease.

Statistical analysis

Statistical analysis was performed by SPSS software Version 22 (IBM, Chicago, USA). Mean±SD and number (percentage) indicate quantitative and qualitative variables, respectively. Kolmogorov-Smirnov and Shapiro-Wilk tests were used for normality distribution. Mann-Whitney test, Chi-square test, independent t-test, Repeated Measures ANOVA, and Wilcoxon test analysis were used. *P*-value<0.05 was considered statistically significant.

Results

In this investigation, a total of 39 children (45.9%) were identified as boys, while 46 children (54.1%) were categorized as girls. The mean age of the subjects was computed at 13.36±3.47 years, with the youngest participant being 5 years old and the oldest being 17 years old. The period of affliction with the disease was determined to be 7.2±3.3 years. Most fathers, comprising 35 individuals (42.4%), possessed a diploma, whereas 43.5% of mothers were found to hold a diploma

as well. The insulin most frequently utilized by patients was Lantus and Noverpid, as indicated by a prevalence of 67.1% (57 patients).

The Repeated Measures ANOVA analysis test was employed to examine the variations in fasting blood sugar levels measured before the onset of the COVID-19 pandemic, during the period of quarantine, and post-pandemic. The findings revealed a notable disparity in fast blood sugar levels among the three-time points under scrutiny, accompanied by a decreasing pattern in the levels of blood glucose. The outcomes of the pairwise assessment indicate that the P-value was adjusted through the Bonferroni Correction for multiple comparisons. The disparity in the glucose levels among the individuals at the second time point compared to the initial time point (pre-COVID) did not display significance (P=0.99). The contrast in the glucose level at the third time point (after COVID) versus the initial time point (pre-COVID) exhibited significance (P<0.01).

The comparison of the HbA1c level before the COVID-19 pandemic, during the quarantine period, and after the pandemic revealed that the variable level did not exhibit statistical significance across the three time points (P=0.17).

Numerous households encounter challenges regarding insulin scarcity, with many opting to purchase additional insulin at a high cost, leading to the practice of insulin rationing. This practice, common among diabetic patients, poses significant risks of acute and chronic complications. A contrast of the quantity of insulin administered before the outbreak of the COVID-19 pandemic, throughout quarantine, and after the pandemic has revealed a noteworthy variance in insulin intake among patients (P<0.01). The pairwise comparisons indicate a substantial variance in insulin levels between the COVID-19 pandemic and the pre-COVID period, with significant discrepancies observed (P<0.01). Nonetheless, the variance in insulin levels between the pre-COVID era and the post-COVID period was also substantial (P<0.01), unlike the comparison between the COVID-19 pandemic and the post-pandemic phase, where no substantial distinction was seen (P<0.397). The analysis of hypoglycemia occurrences at the three examined time points revealed a statistically significant disparity during the evaluated time and pairwise comparisons, too (P<0.001). **(Table 1)**

The findings from the investigation into the challenges associated with virtual accessibility pre, during, and post the COVID-19 era, as assessed using the non-parametric Cochrans Q test, revealed a noteworthy disparity (P<0.001). Specifically, the analysis of pairwise comparisons solely between the pre and during-COVID-19 periods indicated an absence of substantial variance (P=0.99). There was a significant difference (P<0.001) in the difficulty of physical exercise before, during, and after COVID-19. Pairwise comparisons before and after COVID-19 also do not reveal a significant difference (P=0.259).

The outcomes of the comparison of nutritional status before, during, and after the COVID-19 pandemic revealed a lack of statistical significance (P=0.472). The outcomes of analyzing the issue during in-person consultations before, during, and after the COVID-19 pandemic demonstrated a lack of statistical significance (P=0.264). The findings from the comparison of the insufficiency of blood glucose test strips before, during, and after the COVID-19 pandemic indicated a statistically significant variance (P<0.001). Moreover, pairwise comparisons highlighted a substantial difference between after and before the COVID-19 period (P=0.485). Additionally, the insufficiency of blood glucose test strips before and after the COVID-19 pandemic showed statistical significance (P<0.001). Furthermore, the contrast in the inventory of blood glucose test strips before COVID-19 and during the quarantine period was statistically significant (P< 0.001).

Table1. The comparison of variables before, during, and after COVID-19

Variables	Before COVID-19	During COVID-19	After COVID-19	*P*-value
Fast blood Sugar	184.78 ± 63.35	181.16 ± 60.79	154.81 ± 57.32	< 0.001
HbA1C	8.48 ± 1.63	8.70 ± 1.77	8.41 ± 1.65	0.17
Use of insulin	0.76 ± 0.15	0.89 ± 0.20	0.911 ± 0.21	< 0.001
Hypoglycemia	8.75 ± 7.93	6.86 ± 8.21	4.80 ± 6.80	< 0.001

Discussion

This study was conducted to investigate the effects of the COVID-19 crisis on the management of the disease in children with type 1 diabetes. Based on our results, the level of HbA1c, the problem of insurance coverage, the problem of attendance, ketoacidosis, and infection before the pandemic, during the pandemic, and at the time of the study among children with type 1 diabetes did not change. There was a significant difference in fasting blood sugar levels, insulin levels, blood sugar check levels, and hospitalizations in type 1 diabetes patients before the pandemic, during the pandemic, and at the time of the study.

Several studies have examined the impact of the COVID-19 crisis on the management of children with type 1 diabetes. The COVID-19 pandemic has had a global impact on blood sugar control in diabetic patients (11, 12).

The study by Choudhary et al. reported that the pandemic did not affect blood sugar control. The use of blood glucose monitors improved during the pandemic. Despite a decrease in the number of visits among insured patients, the frequency of hospitalizations remained unchanged with the pandemic. The rapid adoption of telemedicine, improved access to blood glucose monitors, and possibly increased parental monitoring of diabetes care likely helped maintain glycemic control and hospitalization rates at pre-pandemic levels (13).

Several studies in both pediatric and adult populations have shown worsening glycemic control during quarantine periods (14, 15). In the study by Conejero et al., there was no significant change in insulin requirement (although there was an increasing trend in the percentage provided as basal insulin during the cell cycle)(14).

In the study by Chistoforidis et al., which evaluated the effect of quarantine on the management of diabetes in children with type 1 diabetes, the results showed that blood glucose readings were significantly lower during the quarantine period. No significant difference was recorded regarding the total daily dose of insulin and consumed carbohydrates (16). Also, in the study of Anjana et al, they stated that the use of self-monitoring of blood sugar increased significantly from 15.5% to 51.3% during quarantine. There was improvement in glycemic control during quarantine in a non-randomized subset of subjects, according to their results, the COVID-19 pandemic and subsequent quarantine did not negatively affect metabolic control in patients, and in fact, HbA1c levels seemed to improve (17).

Another multicenter study involving 102 children and adolescents with type 1 diabetes using the Dexcom G5 CGM system found that blood glucose control remained relatively stable during quarantine, with no significant changes in the percentage of time spent (18). The findings of this study are consistent with the results of the current study.

This study had several limitations. One is the small sample size and its single center. Another is that no before-and-after surveys looked at factors that may have caused pandemic-related changes in blood sugar control, such as quality of life, health habits, parental work history, physical activity, or school attendance.

Conclusion

We concluded that there was a remarkable difference in fasting blood sugar levels, insulin intake levels, blood sugar control levels, and rate of hospitalizations in type 1 diabetes patients before the pandemic, during the pandemic, and at the time of the study. The results of the current study found telemedicine services to be a suitable and cost-effective way to prevent the spread of this disease. Increased use of continuous glucose monitors and widespread use of telemedicine visits may improve the impact of the pandemic on disease management. It is suggested that more multi-center studies with higher sample sizes be conducted to investigate the impact of the COVID-19 crisis on children with diabetes.

Ethics approval

The study was approved by the Medical Ethical Committee of Tehran University of Medical Sciences (Ethics code: IR.TUMS.CHMC.REC.1400.213).

Conflict of interests

There is no conflict of interest.

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