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The Impact of the 2023 Türkiye Earthquakes on Glycemic Control and Stress Levels in Children with Type 1 Diabetes: Single-center Experience

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What is already known on this topic?

Major natural disasters, such as earthquakes, can significantly disrupt the management of chronic conditions like type 1 diabetes mellitus (T1DM). In children with T1DM, stress and trauma from such events can impair glycemic control and lead to heightened psychological distress.

What this study adds?

This study is one of the first to evaluate the impact of the 2023 Türkiye earthquakes on glycemic control and psychological well-being in children with T1DM. It highlights the influence of parental stress, particularly maternal stress, on children's HbA1c levels and underscores the need for tailored interventions to support diabetes management during natural disasters.

Abstract

Objective: The 2023 earthquakes in southeastern Türkiye significantly impacted physical and emotional well-being in the region. This study evaluated the effect of the earthquakes on glycemic control, diabetes management, and stress levels in children with type 1 diabetes mellitus (T1DM).

Methods: Pediatric T1DM patients were assessed before and after the earthquake. Key parameters included glycated hemoglobin (HbA1c), insulin dosage, and psychological assessments using the Problem Areas in Diabetes Scale-Teen (PAID-T) version and the Post-Traumatic Stress Reaction Scale (PTSRS). Mixed-effects models were used to compare data across time points.

Results: Of the 79 participants, 45.6% were male, with a mean age of 143.5 ± 45.0 months. The earthquake disrupted insulin therapy in 36.7% of patients and caused glycemic control issues in 77.2%. HbA1c levels dropped from 9.7 ± 2.7% pre-earthquake to 8.8 ± 2.2% in the first three months, rose to 10.6 ± 1.9% in the following three months, and stabilized at 9.7 ± 1.9% by the fourth period. A positive correlation was observed between parental stress and children's HbA1c ($r = 0.423$, $p = 0.031$). Psychological effects were notable, with 43% reporting distress, and 63.3% experiencing loss of close family or friends. The mean PAID-T scores were 42.0 ± 14.5 for children and 53.7 ± 12.8 for parents, indicating a moderate to high level of diabetes-related distress in both groups. Although no validated cut-off score exists for the PAID-T, higher values reflect a greater perceived burden. The mean PTSRS score was 35.1 ± 17.4, which corresponds to a moderate level of post-traumatic stress reaction based on established cut-off values 35.1 ± 17.4.

Conclusion: The earthquake significantly affected glycemic control and psychological well-being in children with T1DM. Fluctuations in HbA1c levels and the link between parental stress and glycemic outcomes suggest a need for tailored interventions during crises.

Keywords: Earthquake, type 1 diabetes, children, disaster

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Introduction

On February 6, 2023, two devastating earthquakes, with magnitudes of 7.8 and 7.6, struck Kahramanmaraş, severely impacting southeastern Türkiye. These earthquakes caused widespread destruction, displaced millions, and resulted in tens of thousands of casualties (1,2,3). Following the initial quake, aftershocks continued to affect the region, with a significant earthquake of magnitude 6.4 occurring in Hatay on February 20, 2023 (4). Beyond the physical devastation, the emotional and psychological toll on affected populations was immense, particularly among vulnerable groups, such as children with chronic diseases (5).

These aftershocks exacerbated the destruction, intensifying the physical and psychological impacts on affected communities. Large-scale disasters not only cause significant physical destruction but also impose immense stress on individuals' mental health. Such events severely disrupt community infrastructure and healthcare services, complicating chronic disease management (6). In Antakya, Hatay, Mustafa Kemal University Hospital was the only facility providing medical care after the initial earthquake. However, it sustained damage during the February 20 earthquake, necessitating the relocation of patient care to a field hospital.

Type 1 diabetes mellitus (T1DM) is one of the most common chronic conditions among children and adolescents, requiring continuous monitoring and careful management. In individuals with T1DM, stress and traumatic events can directly affect glycemic control (7). Major disasters, like these earthquakes,often make managing glycemic levels more difficult, leading to both short-term and long-term health consequences. Disruptions in diabetes management can result in erratic blood glucose levels and severe health complications. In addition, earthquakes may trigger psychological problems, such as post-traumatic stress disorder (PTSD), anxiety, and depression, particularly in children and adolescents (8). Children and adolescents with T1DM face a dual health burden: managing their chronic illness while coping with the psychological effects of the trauma they have experienced. This combination can significantly impair their quality of life. The uncertainty and loss caused by the earthquake can further deteriorate their emotional and psychological well-being (9).

In the present study, the immediate and long-term effects of these catastrophic earthquakes on the glycemic control and stress levels of children with T1DM were examined. The emotional stress levels of their parents were also assessed, particularly mothers, who bear the primary responsibility for managing their children's diabetes in the aftermath of the disaster. Although previous studies have investigated the impact of natural disasters on glycemic control and psychological well-being in adults with T1DM, to the best of our knowledge, no similar studies have been conducted in pediatric populations. This gap in the literature underscores the novelty and importance of the present study, as children with T1DM may face unique challenges in managing their condition during and after large-scale disasters.

Methods

Study Population

Participants were selected from a pool of pediatric patients, aged 11 to 18, diagnosed with T1DM, along with their parents, who were receiving regular care at the Hatay Mustafa Kemal University Pediatric Endocrinology Department. Patients with additional comorbidities or those on medications affecting glucose metabolism were excluded. Further exclusion criteria encompassed pre-existing psychiatric disorders (such as depression, anxiety, or PTSD), developmental disorders, and conditions that could independently impact glycemic control (e.g., Cushing's syndrome or untreated thyroid disorders). Patients with a history of substance abuse or severe cognitive impairment that could hinder adherence to diabetes management protocols were also excluded. In addition, participants with a diabetes duration of less than six months and those residing outside the affected region during the earthquake were not eligible for inclusion.

The study was approved by the Ethics Committee of Hatay Mustafa Kemal University Tayfur Ata Sökmen Faculty of Medicine (protocol no.: 2023/37, date: 14.12.2023) and was conducted in accordance with the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from both the patients and their parents prior to participation.

Study Design

This study was designed as a prospective observational analysis. Data were collected at two time points: baseline (one month before the earthquake) and follow-up (post-earthquake). Patients who were unable to attend regular follow-up visits due to the earthquake were included from their first available post-event visit. Follow-up evaluations were conducted at 3-month intervals for up to one year. The primary outcomes of interest included changes in glycated hemoglobin (HbA1c) levels, continuous glucose monitor (CGM) readings, insulin dosages, and the frequency of hypoglycemic episodes. Psychological assessments of children were performed using the validated Problem Areas

in Diabetes-teen Scale (PAID-T) and the Post-traumatic Stress Reaction Scale (PTSRS). Mothers' diabetes-related stress was evaluated using the Problem Areas in Diabetes-parents of Teens (P-PAID-T) Scale (see below).

Patients were assessed during clinical visits both before and after the earthquake. At each time point, they underwent physical examinations, blood glucose testing, and completed questionnaires measuring diabetes-related issues and post-traumatic stress levels.

Scales Used in the Study

1. Data Collection Form: This form was developed by the researchers and includes questions about the demographic information of both the children and their parents, living conditions after the earthquake, experiences during the earthquake, and diabetes management following the event.

2. Problem Areas in Diabetes-parents of Teens Scale (P-PAID-T): Originally developed by Weissberg-Benchell and Antisdel-Lomaglio (10) in 2014 to identify problem areas faced by parents of adolescents with diabetes, the scale was later revised by Shapiro et al. (11) in 2017 reducing the number of items to 15. It is a 6-point Likert scale with scores divided into three main categories: "not a problem (1-2)", "moderate problem (3-4)", and "serious problem (5-6)". The total score ranges from 15 to 90, with higher scores indicating more significant stress perceived by parents in managing their child's diabetes. The Turkish validity and reliability study of the scale was conducted by Sari et al. (12).

3. Problem Areas in Diabetes-teen Scale (PAID-T): This 14-item scale follows the same 6-point Likert structure as the parent version, with categories for "not a problem (1-2)", "moderate problem (3-4)", and "serious problem (5-6)". Originally developed by Weissberg-Benchell and Antisdel-Lomaglio (10) in 2011 to identify problem areas for adolescents with diabetes, it was revised in 2017 to its current form (11). Scores range from 14 to 84, with higher scores reflecting more significant stress perceived by adolescents in relation to their diabetes management. The Turkish validity and reliability study of the scale was conducted by Sarı et al. (13).

4. Post-traumatic Stress Reaction Scale (PTSRS) for Children: Developed by Pynoos et al. (14) this 20-item scale assesses specific stress reactions following a traumatic event. It uses a 5-point Likert scale (0: never, 1: very rarely, 2: rarely, 3: often, 4: very often), with higher scores indicating a greater severity of trauma impact. A total score of 12-24 indicates a mild level of post-traumatic stress reaction, 25-39 a moderate level, 40-59 a severe level, and ≥60 a very severe reaction. The scale was adapted into Turkish by Erden et al. (15) and validity and reliability studies were performed.

Laboratory and Clinical Assessments

The physical and laboratory assessments included the following:

Glycemic Control Measures: HbA1c, random blood glucose levels, CGM data, insulin dosage, and the frequency of hypoglycemia.

Biochemical Parameters: Total cholesterol, triglycerides, liver function tests, kidney function (creatinine and estimated glomerular filtration rate), and complete blood count.

Psychological Assessments: PAID-T and PTSRS scores were used to evaluate the emotional and stress-related impact of the earthquake on diabetes management. These scales provided insights into how patients perceived their diabetes management and the emotional burden associated with the traumatic event.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation (SD) and categorical variables as percentages. The normality of continuous data was assessed using the Shapiro-Wilk test. Since HbA1c values and questionnaire scores were found to be approximately normally distributed, paired t-tests were used to compare pre-and post-earthquake HbA1c levels. Mixed-effects models were applied to repeated measures across time points. Mixed-effects models were used to analyze repeated measures across the two-time points. Associations between psychological stress scores and glycemic control were evaluated using Pearson correlation. A $p < 0.05$ was considered statistically significant. All statistical analyses were performed using Statistical Package for the Social Sciences version 29.0 (IBM Corp., Armonk, NY, USA).

Results

From an initial recruitment of 100 patients, 21 were excluded based on study criteria, leaving a final cohort of 79 patients and their parents were enrolled in the study. Table 1 presents the socio-demographic characteristics of the children and their families.

All patients were receiving insulin injections, with 53.2% using continuous CGM sensors. The intensive care unit (ICU) admission rate for T1DM was 29.1%. Regarding comorbidities, 5.1% (4/79) of patients had celiac disease, 5.1% (4/79) had hypothyroidism, and 13.9% (11/79) had other medical conditions. In addition, 25.3% of patients had

Table 1. Demographic characteristics of the study participants

Characteristic	Percentage (%) (n/79)
Gender, % (n)	
Male	45.6% (36/79)
Female	54.4% (43/79)
Age (years, mean ± SD)	12.0 ± 3.8
Duration of diabetes (years, mean ± SD)	4.3 ± 2.9
Puberty duration (years, mean ± SD)	3.2 ± 1.9
Residence, % (n)	
Urban	60.8% (48/79)
Suburban	27.8% (22/79)
Rural	11.4% (9/79)
Mother's educational level, % (n)	
Primary	43.0% (34/79)
Secondary	25.3% (20/79)
High school	15.2% (12/79)
Father's educational level, % (n)	
Primary	40.5% (32/79)
Secondary	25.3% (20/79)
High school	16.5% (13/79)
Family type, % (n)	
Nuclear	86.1% (68/79)
Divorced/separated	5.1% (4/79)
Economic status, % (n)	
Below minimum wage	35.4% (28/79)

SD: standard deviation

sought psychiatric consultation, with 2.5% using psychiatric medications. Following the earthquake, 77.2% (61/79) of patients experienced glycemic control issues.

During the earthquake, 89.9% of patients reported feeling the tremor strongly, while 3.8% felt mild shaking. After the earthquake, 24.1% of patients stayed in their family cars. During the post-earthquake period, 46.9% lived in tents, 45.6% in homes, and 3.8% in containers. Two patients (2.5%) were trapped under rubble, one for 1 hour and the other for 2 hours. Although there were no permanent physical injuries or immediate family losses, 63.3% of patients reported losing close friends or relatives.

Regarding living conditions after the earthquake, 34.2% reported no significant challenges, while 29.1% experienced difficulties accessing food and water. Furthermore, 15.2% had trouble obtaining food, 5.1% struggled to access water, and 5.1% faced difficulty acquiring insulin. Only 2.5% of patients stated they were unaffected by the earthquake. In contrast, 43% reported psychological and economic impacts, 40.5% reported primarily psychological impacts (fear, anxiety), and 3.8% reported economic impacts. Of note, 83.5% of participants had no earthquake emergency preparedness kit (Table 2).

Table 2. Impact of the earthquake on participants' lives

Characteristic	Percentage (%) (n/79)
Strong perception of earthquake, % (n)	89.9% (71/79)
Lived in a tent post-earthquake, % (n)	46.9% (37/79)
Patients trapped under debris, % (n)	2.5% (2/79)
Hospitalization post-earthquake, % (n)	13.9% (11/79)
House damage, % (n)	
Minor	30.4% (24/79)
Severe	12.7% (10/79)
Destroyed	13.9% (11/79)
Main adverse effect psychological, % (n)	40.5% (32/79)
Economic impact, % (n)	3.8% (3/79)
Lack of emergency kit, % (n)	83.5% (66/79)

In terms of housing damage, 30.4% of patients' homes were classified as "lightly damaged", 22.8% as "undamaged", 13.9% as "destroyed", 12.7% as "severely damaged", and 6.3% as "moderately damaged". When asked about the time it took to return to everyday life, 8.9% of patients recovered within one week, 3.8% within one to two weeks, 5.1% within two to four weeks, 17.7% after more than four weeks, 8.9% within one to three months, and 17.7% within one to six months. However, 3.8% reported that they had not yet returned to everyday life.

Physical activity habits also changed post-earthquake, with 38.0% of patients reporting no physical activity, 30.4% engaging in activities such as walking, and 17.8% engaging in exercise. Regarding sleep, 8.9% of patients reported insomnia, 6.3% experienced inadequate sleep, and 30.4% reported reduced sleep quality, resulting in 45.6% of patients experiencing sleep disturbances.

Medical information was unavailable for 19.0% of patients. Earthquake-related stressors were identified in 57% of patients. Post-earthquake, 8.9% sought psychiatric support, with 1.3% receiving medication. Interestingly, none of the patients had prepared an emergency earthquake kit following the disaster.

After the earthquake, 36.7% of patients experienced disruptions in their insulin therapy, with 21.5% reusing needles and 27.8% encountering shortages of test strips. Post-earthquake diabetes-related hospital admissions occurred in 13.9% of patients, with 1.3% requiring ICU care. Moreover, 77.2% of patients recognized and reported difficulties in maintaining glycemic control.

The results of the patients' glycemic control, evaluated at three-month intervals before and after the earthquake, are shown in Table 3.

Table 3. Glycemic control before and after the earthquake

Timepoint	HbA1c % (mean ± SD)
Pre-earthquake	9.7 ± 2.7
Post-earthquake	9.5 ± 2.3
Post-earthquake (first three months)	8.8 ± 2.2
Post-earthquake (second three months)	8.7 ± 1.9
Post-earthquake (third three months)	10.6 ± 1.9
Post-earthquake (fourth three months)	9.7 ± 1.9

SD: standard deviation, HbA1c: glycated hemoglobin

When examining the timing of hospital visits post-earthquake, 11.4% occurred within the first month, 11.4% within two months, 15.2% within three months, 6.3% within four months, 8.9% within five months, and 3.8% within six months, with 53.2% seeking care within the first six months.

The mean scores for the assessments were as follows: the PAID-T child scale score was 42.0 ± 14.5 (with a possible score of 14-84), the PAID-T parent score was 53.7 ± 12.8 (with a possible score of 15-90), and the PTSRS average score was 35.1 ± 17.4 with a possible score of 0-80).

The mean PAID-T child scale score was 42.0 ± 14.5, the PAID-T parent score was 53.7 ± 12.8, and the PTSRS average was 35.1 ± 17.4.

Table 4 presents the correlation analysis between psychological scales and diabetic measurements, revealing variable relationships across different time points. While the PAID-T for children showed a positive correlation with HbA1c levels after the earthquake, the significance was not strong, indicating that higher reported stress levels may not directly correspond to glycemic control. The PAID-T for parents exhibited a notable positive correlation with HbA1c during the third three months post-earthquake ($r = 0.423$, $p = 0.031$), suggesting that parental stress could have some influence on the glycemic outcomes of their children during this period. Conversely, the PTSRS scores for children did not show significant correlations with glycemic control at any time point. This may suggest that post-traumatic stress reactions did not have a direct impact on diabetes management - or that the severity of PTSD symptoms in children was not strong enough to influence glycemic outcomes. Notably, the mean PTSRS score of 35.1 ± 17.4 falls within the moderate range but with considerable variability; thus, only a subset of children may have experienced clinically significant PTSD. Overall, these findings highlight the complex interplay between psychological stressors and diabetes control in the aftermath of traumatic events, suggesting that further investigation into these relationships may be warranted.

Table 4. Correlation analysis between scales and diabetic measurements

		PAID-T for children	PAID-T for parents	PTSRS for children
Age	Correlation coefficient (r)	0.056	0.225	-0.119
	Significance (*p*)	0.688	0.061	0.436
	Number of patients (n)	53	70	45
HbA1c (%) before earthquake	Correlation coefficient (r)	0.36	0.225	-0.376
	Significance (*p*)	0.109	0.201	0.113
	Number of patients (n)	21	34	19
HbA1c (%) after earthquake first 3 months	Correlation coefficient (r)	-0.167	0.364	-0.309
	Significance (*p*)	0.553	0.087	0.304
	Number of patients (n)	15	23	13
HbA1c (%) after earthquake second 3 months	Correlation coefficient (r)	0.506	0.224	-0.18
	Significance (*p*)	0.200	0.562	0.669
	Number of patients (n)	8	9	8
HbA1c (%) after earthquake third 3 months	Correlation coefficient (r)	0.296	**0.423**	0.059
	Significance (*p*)	0.219	**0.031***	0.857
	Number of patients (n)	19	**26**	12
HbA1c (%) after earthquake fourth 3 months	Correlation coefficient (r)	0.254	-0.147	0.257
	Significance (*p*)	0.426	0.633	0.420
	Number of patients (n)	12	13	12

*Pearson correlation analysis was used.
PAID-T: Problem Areas in Diabetes-Teen Scale, PTSRS: Post-Traumatic Stress Reaction Scale for Children, HbA1c: glycated hemoglobin

Discussion

The 2023 earthquakes in southeast Türkiye not only disrupted the daily lives of children with T1DM but also had a profound and lasting impact on their glycemic control and psychological well-being. This underscores the critical need for tailored disaster preparedness and mental health support in managing chronic conditions during crises (5,7).

The findings of this study suggest that the earthquake may have contributed to disruption of glycemic control and elevated stress levels in children with T1DM. The aftermath of the earthquakes appears to have posed immediate challenges to diabetes management. It may have led to long-term effects on both physical and mental health outcomes, as indicated by the observed fluctuations in HbA1c levels and the psychological distress reported within our cohort. In contrast to previous studies, we observed a transient improvement in HbA1c levels during the first three months following the earthquake (9). This initial decline may be attributed to the heightened attention families devoted to diabetes management in response to the trauma, as well as the increased efforts made by healthcare providers to maintain contact with patients. During the acute post-earthquake period, we established a support group for families of children with diabetes through phone communication, facilitating frequent interaction and guidance. Furthermore, after the 6.4 magnitude aftershock, when healthcare services were relocated to a field hospital and it became evident that hospital-based services would not be available for emergencies, families may have intensified their efforts to regulate glycemic control, knowing that immediate care could be inaccessible (16). However, the sharp rise in HbA1c levels during the third three-month period underscores the limitations of these short-term coping mechanisms in the face of prolonged disaster-related stress and healthcare disruptions. The subsequent deterioration in glycemic control suggests that as the emotional and logistical burdens of the earthquakes persisted, cumulative stress negatively affected the children's diabetes management routines (17).

The return of HbA1c levels to pre-earthquake values in the final phase of the study suggests a stabilization of diabetes management practices. However, this recovery in glycemic control does not mitigate the negative impacts experienced during the intermediate period, indicating the prolonged stress and difficulties families encountered (17). Our data highlight the importance of providing long-term support following natural disasters, as the challenges of managing a chronic condition are significantly amplified when healthcare systems, social support networks, and daily routines are so disrupted.

Another critical factor influencing diabetes management in our cohort was the prolonged disruption of daily living conditions. Only 17.8% of patients could return to their pre-earthquake routines within the first month, while 17.7% managed to re-establish daily normality after six months. Alarmingly, 3.8% of participants had not regained their routines even one year post-disaster. For these families, the immediate priority shifted to securing necessities-shelter, food, and water-while disease management understandably took a backseat. The psychological and logistical strain of living in temporary housing for an extended period undoubtedly contributed to the fluctuations in glycemic control. The continued displacement and uncertainty surrounding the resumption of everyday life likely exacerbated stress for both children and their caregivers, complicating their ability to effectively manage T1DM (9). That some families remained unable to return to regular routines underscores the profound and lasting impact that such immense disasters can have on chronic disease management.

Psychological assessments further revealed considerable emotional strain on both children and their parents. The elevated scores on the PAID-T and PTSRS indicate that a significant portion of our cohort experienced substantial psychological distress (12). This finding aligns with existing literature showing that children with chronic diseases are particularly vulnerable to the psychological impacts of natural disasters, as they must navigate the dual burden of managing both their physical health and the emotional trauma of the event (9,17). Notably, the relatively low rate of psychiatric support uptake (8.9%) despite the widespread prevalence of stress-related symptoms (57%) highlights a critical gap in mental health services post-disaster, emphasizing the urgent need for targeted interventions.

In the present study, a positive correlation was observed between the PAID-T scores for parents and children's HbA1c levels during the third three-month period post-earthquake-the time point at which mean HbA1c peaked at 10.6%. This finding suggests that parental stress may play a role in diabetes management during prolonged post-disaster adversity. However, it is also possible that worsening glycemic control during this period may have contributed to elevated parental stress rather than being caused by it. Given the observational nature of this study, causality cannot be established, and the directionality of this association remains uncertain. Further longitudinal or interventional research is needed to understand the dynamics of this relationship better. Conversely, the lack of significant correlations between the PTSRS for children and glycemic control suggests that the psychological effects

of trauma may not directly impact diabetes management routines. This complexity highlights the necessity for further research to explore the nuanced relationships between various dimensions of psychological distress and diabetes outcomes, ultimately guiding targeted interventions for families affected by traumatic events.

In the study conducted by Şengül et al. (9) on adults with T1DM after the Marmara earthquake, an improvement in HbA1c levels was observed one year post-earthquake. However, the present study found that HbA1c levels in children increased one year after the earthquake but compared to the first three months following the event. This difference may be attributed to the long-term effects of diabetes on glycemic regulation in pediatric patients.

In terms of healthcare access, disruption to insulin therapy and diabetes management were reported by a significant portion of participants (36.7%), with nearly 28% experiencing difficulties with glucose monitoring supplies. These disruptions, alongside the high prevalence of living in temporary housing (such as tents and containers), further exacerbated the challenges of maintaining stable glycemic control (18). The physical stressors associated with displacement, combined with the emotional toll of loss and trauma, with 63.3% of participants reporting the loss of friends or family, indicates the necessity of integrating disaster preparedness into chronic disease management frameworks, especially in regions prone to natural disasters (9). This holistic approach will ensure that vulnerable populations, like children with T1DM, receive the comprehensive support they need during crises.

Clinical and Public Health Implications

Our findings suggest an urgent need for robust disaster preparedness plans tailored specifically for vulnerable populations, including children with T1DM. These plans must ensure continuous access to essential medications, glucose monitoring supplies, and healthcare services during natural disasters. Moreover, there is a need to integrate mental health support into diabetes care, especially in times of crisis, as psychological distress has been shown to directly impact glycemic control and overall health outcomes (16,18).

Efforts should also focus on raising awareness among healthcare providers, patients, and their families regarding the potential effects of disasters on diabetes management. Health systems should prioritize the development of emergency protocols that specifically address the unique needs of children with chronic diseases, ensuring that they are not overlooked during large-scale crises (16,18,19).

Study Limitations

A literature review revealed a paucity of studies investigating the impact of natural disasters on children with T1DM, particularly as most existing research on the health impacts of earthquakes has primarily involved adult populations. Despite the limited number of children included in our study because of challenges such as casualties, relocation, and restricted access to healthcare services, we believe our findings are significant as they represent the first investigation of this age group in this context. Moreover, this study uniquely explored diabetes-related stress levels in both children and their mothers, offering valuable insights into the pivotal role parents play in managing their child's diabetes care under extraordinary circumstances.

However, several limitations of the study should be acknowledged. One key limitation is the focus on HbA1c levels without examining other potential contributing factors, such as body mass index, SD score (SDS), or changes in physical activity levels. Including these variables in future analyses could provide a more comprehensive understanding of the observed HbA1c fluctuations and offer a deeper interpretation of the data.

Another limitation is that participants completed the psychological scales at varying time points after the earthquake. This variability in timing may have influenced the standardization of results, potentially affecting the reliability of comparisons across the study population. Moreover, the psychological scales were administered at different time points following the earthquake, depending on when patients were able to attend follow-up visits at our center. Some completed the scales during their first post-earthquake visit, while others did so later during subsequent visits, potentially up to six months after the event. This variability likely influenced stress levels, which may have shifted from acute trauma to chronic distress. This heterogeneity limits the comparability of psychological scores across patients.

While correlation analyses were conducted to explore relationships between variables, they cannot fully address the variability introduced by differing assessment times. Future studies could improve data consistency and reliability by standardizing the timing of psychological evaluations.

A further limitation lies in the study's reliance solely on self-report scales for assessing psychological distress in both children and their mothers. The absence of semi-structured psychiatric evaluations by child psychiatrists limited the ability to diagnose specific psychiatric disorders, such as depression, anxiety disorders, or PTSD, which may have emerged following the earthquake. Incorporating such

clinical assessments in future research would provide a more robust understanding of the psychological impact of natural disasters on this population.

Lastly, the study did not document the duration participants spent in temporary housing, such as tents or shelters. Prolonged exposure to such conditions likely exacerbated psychological stress and increased vulnerability to illnesses, such as upper respiratory infections, which could have indirectly influenced blood glucose levels. Further investigation into these environmental factors would enhance the contextual interpretation of our findings.

Despite these limitations, this study illustrated the profound impact of natural disasters on the physical and psychological well-being of children with T1DM and their families, especially their mothers. We believe that these findings highlight critical areas for future research and intervention development.

Conclusion

In summary, the 2023 earthquakes in the southeast of Türkiye had a profound impact on the glycemic control and psychological well-being of children with T1DM. Our findings illustrated significant fluctuations in HbA1c levels and heightened psychological distress among this vulnerable population, emphasizing the need for tailored interventions in disaster preparedness and mental health support. The study reinforced the complex interplay between emotional stressors and diabetes management, revealing that immediate responses to crises may lead to temporary improvements, but prolonged disruptions can result in deteriorating health outcomes. Importantly, our results suggest a real need for enhanced awareness and proactive strategies among healthcare providers, families, and policymakers to ensure that the unique needs of children with chronic conditions are addressed in the wake of natural disasters. By implementing comprehensive support systems, healthcare providers can better equip families to navigate the challenges posed by such events, ultimately improving health outcomes and quality of life for children with chronic diseases, including T1DM.

Ethics

Ethics Committee Approval: The study was approved by the Ethics Committee of Hatay Mustafa Kemal University Tayfur Ata Sökmen Faculty of Medicine (protocol no.: 2023/37, date: 14.12.2023) and was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Informed Consent: Written informed consent was obtained from both the patients and their parents prior to participation.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: Gül Trabzon, Seda Aybüke Sarı, Concept: Gül Trabzon, Seda Aybüke Sarı, Simge Bilaloğlu, Şeyma Demiray Güllü, Design: Gül Trabzon, Seda Aybüke Sarı, Data Collection or Processing: Gül Trabzon, Seda Aybüke Sarı, Simge Bilaloğlu, Şeyma Demiray Güllü, Analysis or Interpretation: Servet Yüce, Literature Search: Servet Yüce, Simge Bilaloğlu, Şeyma Demiray Güllü, Writing: Gül Trabzon, Seda Aybüke Sarı, Servet Yüce.

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