Exploratory study of the impact of war on management of type 1 diabetes mellitus among children in Gaza

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Abstract

Background: The war in Gaza has led to the destruction of health centres and medication shortages, impacting the most vulnerable groups, including children with type 1 diabetes mellitus (T1D).

Aim: To determine how the conflict in Gaza has affected the care of children with T1D.

Methods: We collected data from 29 patients with T1D, aged ≤18 years, between June and July 2024 using an online questionnaire, and analysed the data using SPSS version 21. The data included their sociodemographic characteristics, medical history, diabetes-related data, the impact of war on T1D, and lifestyle changes.

Results: Of the 29 patients, 86.2% of their parents reported a decline in their children's activity levels, 17.2% due to fear, and 58.6% reported that their child's average weight loss was 2.6±2.7 (range 0–10) kg. Most patients (79.3%) were unable to receive adequate diabetes care during the war. As a result, 10.3% were hospitalized due to a diabetic emergency. At the family level, 79.3% of the patients' families experienced food insecurity and 96.6% had limited food choices. And 41.4% said their foods may not have been compliant with a diabetes diet requirement.

Conclusion: Children with T1D in Gaza could not receive adequate diabetic care due to the war and experienced food insecurity with limited food choices, medication shortages and poor glycaemic controls. There is a critical need to prioritize chronic disease management in conflict-affected areas and among populations with restricted access to healthcare, to prevent the consequent detrimental health effects.

Keywords: diabetes, children, paediatric, food security, medication, Gaza

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Background

Worldwide, wars are a major cause of mortality and morbidity, and represent a growing public health concern *(1)*. War has a serious impact on the health sector, either directly through injuries and psychological trauma or indirectly through diminished access to healthcare, malnutrition and the destruction of infrastructure *(2)*.

Palestinians have suffered from occupation for decades, and recently, Gaza has gone through unprecedented warfare. Consequently, the overall health status in Gaza has declined dramatically and is expected to worsen in the near future *(3)*. A recent report by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) estimates that 41 020 Palestinians have been killed and over 94 900 injured since 7 October 2023 *(4)*. Only 17 hospitals are partially functioning, as 19 of the 36 hospitals are out of service, and 43% of primary health care centres are partially functioning. More than 60% of residential buildings, 68% of the total road network and 130 ambulances have been reported damaged, and 96% of the analysed population may face a crisis or worse levels of food insecurity *(4)*.

Over 96% of women and children aged 6–23 months are not meeting their nutritional requirements due to a lack of minimum food diversity, and 346 000 under-5 children require feeding and micronutrient supplements. More than 50 000 children were estimated to require treatment for acute malnutrition in 2024 *(4)*. The United Nations estimates that there are approximately 350 000 people with chronic diseases who are unable to receive critical care *(5)*. Among them are 71 000 patients living with diabetes in Gaza as of 22 January 2024 (6), and over 1000 with T1D who are struggling to manage their chronic conditions *(7)*.

Type 1 diabetes mellitus (T1D) occurs due to an autoimmune or viral destruction of the pancreatic β-cells. It may occur at any age but it usually affects children and young adults, who represent about 5–10% of diabetes patients *(8)*. T1D is fatal without insulin therapy and regular medical attention, which makes it of particular concern in conflict zones *(9)*. Without treatment, blood glucose levels will remain elevated, resulting in various symptoms and serious complications *(10)*.

This study assessed the impact of the 2023 war in Gaza on the management of T1D among children aged ≤18 years, including challenges in accessing healthcare and insulin, food availability, patient monitoring, and follow-up.

Methods

Study population and design

Using a cross-sectional design, we collected data from June to July 2024 with a purposefully developed online questionnaire. Convenience sampling method was used to recruit participants. More than 130 T1D patients with correct contact information – members in T1D local association – received phone invitations; however, only 29 patients agreed to participate in the study and completed the questionnaire after receiving the link. Participants were informed that their participation was voluntary, and that their data would be kept confidential and were for research purposes only. The study protocol was approved by the Institutional Review Board at An-Najah National University (Ref. Int. R July 2024/4).

All individuals with T1D living in Gaza during the October 2023 war and aged ≤18 years were included in the study population. Patients were excluded if they did not complete the questionnaires or were older than 18 years. The sample size was limited due to the difficulties in communication and the challenging war conditions. The main researcher in this study is a member of the association for T1D patients and has access to all the patients.

Questionnaire development

Two researchers designed the questionnaire based on the basic concepts related to T1D. Some of the researchers are from Gaza and have direct contact with T1D patients. Content validity was conducted by sending the draft questionnaire to 5 experts (3 PhD holders in nutrition, 1 family medicine doctor and 1 nutritionist with masters degree in diabetes education). To evaluate the readability and clarity of the questionnaire and the amount of time required to complete it, a pre-test was conducted. Three patients participated in the pre-test and nothing changed as a result of it.

The questionnaire was divided into 4 sections, including sociodemographic data; displacement-related data [displacement location, duration, time, and type (houses, tents, schools, or others)]; diabetes mellitus-related data, which included 15 items, 3 of which were about diabetes mellitus history [age of diagnosis, duration since diagnosis, type and daily insulin dosage (fixed dose, carbohydrate counting)], 3 items were about diabetes mellitus follow-up [fasting blood glucose and hemoglobin A1C (HbA1C) testing frequency, and place of follow-up], 2 items about diabetes mellitus complications during the war (emergency admission due to diabetic complications, occurrence of ketoacidosis, hypoglycaemia or hyperglycaemia), impact of war on diabetes items (insulin availability and changes in insulin regimen), lifestyle-related items (changes in physical activity, sleep routine, time of waking up, and time to sleep); and anthropometric-related data [weight changes during the war and height (self-reported)]. The last section included data about access to a medical centre, food availability and suitability of available food to T1D patients.

Data analysis

Statistical analysis was conducted using SPSS version 21 after cleaning the data. Descriptive analysis (means and standard deviations) was conducted to analyse the data on the continuous dependent and independent variables. The categorical data were described with frequency and percentages.

Results

Characteristics of patients

The mean age at diagnosis was 6.0±3.7 years, and the mean number of times a patient had ketoacidosis since diagnosis was 1.4±0.5 (range 1–2) times, while the mean number of times a patient was admitted to the hospital due to a diabetes-related emergency was 1.5±1.9 during the year before the war (Table 1).

The most used insulin pairs are NovoRapid (rapid-acting) and Levemir (long-acting), with 15 (51.7%) participants taking both types. For the daily short-acting/rapid-acting insulin dose, 25 (86.2%) had fixed doses, while 4 (13.8%) relied on the carbohydrate counting method. Some 79.3% of the patients received routine checks at primary care clinics and 20.7% were checked at private clinics. Some 72.4% visited healthcare facilities only once a month, 10.3% more than once a month, 3.4% once every 3 months, 10.3% did not visit at all, and 3.4% visited only when necessary. As for the occurrence of any diabetes-related emergencies a year before the war, 16 (55.2%) confirmed having a diabetes emergency at least once.

Before the war, 22 (75.9%) of the patients carried out at-home blood glucose tests more than once a day, 4 (13.8%) never checked their blood glucose, and 3 (10.3%) carried it out once a day. As for the extensive diabetes clinical tests (HbA1C, renal function tests and a comprehensive dilated eye exam), 12 (41.4%) children had them monthly, 8 (27.6%) had them every 3 months, 4 (13.8%) had them every 6 months, 3 (10.3%) never had those clinical tests, and 2 (6.9%) had them yearly.

Physical activity, sleep data and anthropometric measurements before and during the war

Before the war, 55.2% of the patients exercised daily, 17.2% never exercised, 13.8% exercised 3 times a week, 6.9% exercised twice weekly, and 6.9% exercised 6 days a week with a mean duration of 43.6±35.6 minutes. Most patients (41.4%) exercised at home, 37.9% preferred walking, 10.3% exercised at the gym, 6.9% did not exercise, and 3.4% were active all the time (naturally active). During the war, 86.2% of the participants' parents reported a reduction in activity levels of their children, 6.9% said their children were more active, and 6.9% reported no change. Figure 1(a) shows that 17.2% of the participants attributed their inactivity to fear, 10.3% said they did not have enough space due to overcrowded refugee areas, and 10.3% said they did not have enough food. Regarding sleep and

Table 1. **Sociodemographic and lifestyle characteristics of the patients (N = 29)**

Characteristics		N	%
Sex	Male	15	51.7
	Female	14	48.3
Address before the war	North Gaza	1	3.4
	Gaza City	14	48.3
	Nuseirat Camp	6	20.7
	Al-Zawaydah	0	0
	Deir Al-Balah	2	6.9
	Khan Younis	5	17.2
	Rafah	1	3.4
Address during the war	North Gaza	0	0
	Gaza City	8	27.6
	Nuseirat Camp	6	20.7
	Al-Zawaydah	2	6.9
	Deir Al-Balah	6	20.7
	Khan Younis	5	17.2
	Rafah	2	6.9
Living conditions during the war	Private property	8	27.6
	Tent	10	34.5
	With family/friends	9	31
	Refuge in school/other	2	6.9
Source of income during the war	No income	5	17.2
	Government salary	9	31
	Private business	7	24.1
	Foreign aid	6	20.7
	Ministry of community affairs	1	3.4
	Non-governmental organization	1	3.4

wake hours before the war, the mean time of sleeping was 20.00±3.5 and waking up was 6.20±1.0, with an average duration of 8.5±1.7 hours sleep. Thirty-one percent of the participants said their children slept for longer hours and 31% said their sleep was inconsistent due to fear (Figure 1b).

The most recent weight before the war was 32.2±10.8 (range 15–58) kg and the height was 131.5±20.3 (range 70–172) cm. The mean weight measured at the time of the study (during wartime) was 32.1±12.6 (range 14–60) kg, with an average estimated weight loss of 2.6±2.7 (range 0–10) kg. Among the participants, 58.6% reported that their children had lost weight.

Diabetes mellitus type 1-related data during the war

Most patients (79.3%) could not receive proper diabetes care during the war. Among the minority who received some medical care during the war, 10.3% were admitted to the hospital due to a diabetic emergency, 3.4% only made phone calls for medical consultation, and only 6.9% received their medication from the healthcare facilities. Twenty-two patients (75.9%) were unable to acquire their full diabetes medication as usual when compared to before the war (Table 2).

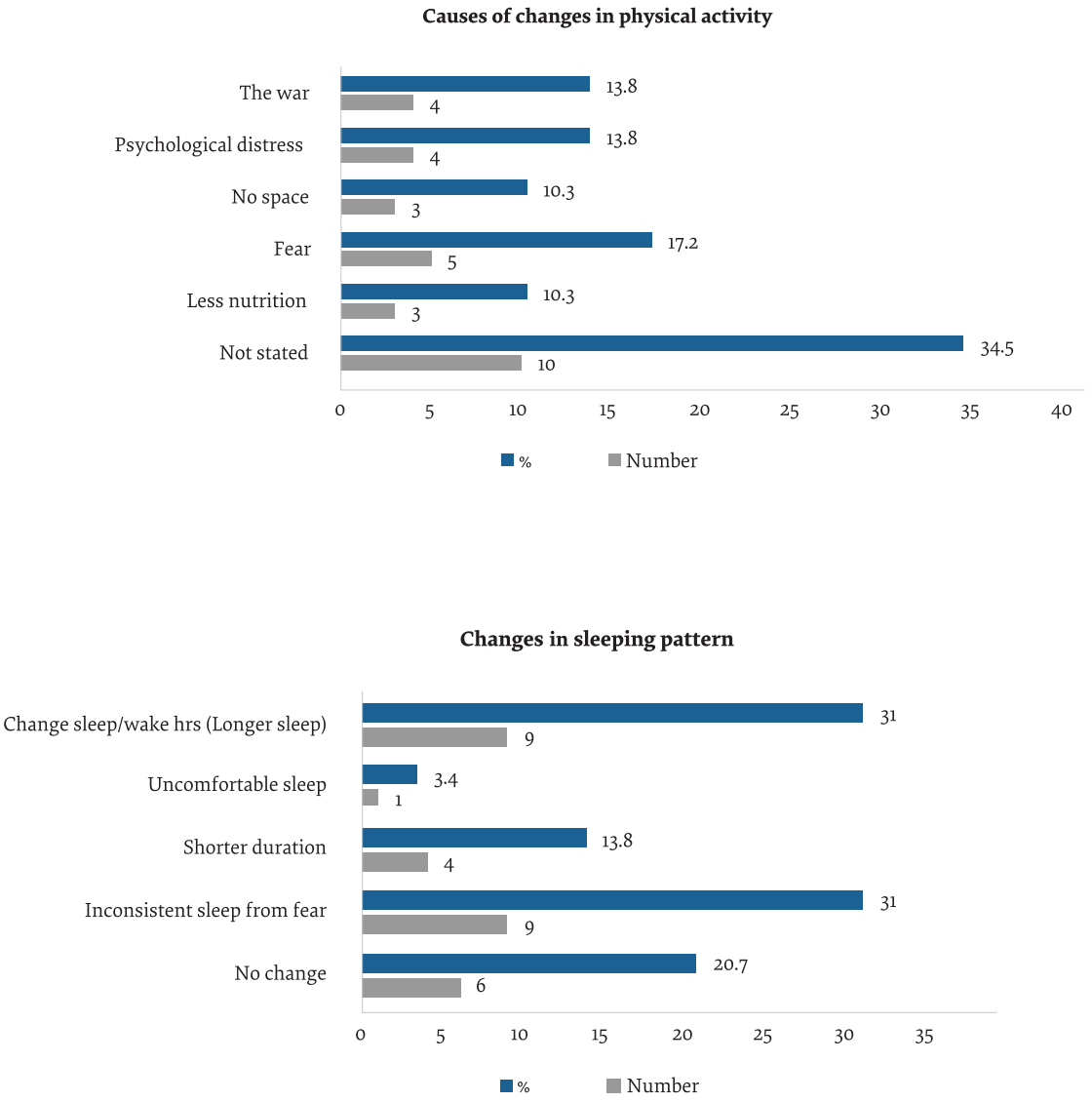
Diabetes complications and emergencies during the war

Most children (58.6%) could not carry out at-home blood glucose tests, while 27.6% tested blood glucose once a day, 6.9% tested twice a day, 3.4% tested once every 2 days, and 3.4% tested only when there was emergency. Among the participants, 58.6% said no test strips were available, 27.6% said the test strips were expensive, and 3.4% mentioned both reasons. Twenty-eight (96.6%) children suffered from diabetes-related complications during the war, including hyperglycaemia (34.5%), hypoglycaemia (3.4%), and 62.1% suffered from both. Sixty-nine percent of complications required medical attention, whereas only 60% were able to reach a medical centre.

Food availability during the war

Twelve participants (41.4%) said their main concern regarding food and nutrition during the war was the

Figure 1. Changes in physical activities and sleeping patterns among T1D patients during the 2023 Gaza war



availability of food fit for a diabetes diet (Figure 2). At the family level, 79.3% of the patient's families suffered from food unavailability, and 96.6% had no food varieties. Nineteen patients (65.5%) received humanitarian aid during the war with a mean of 0.9±0.9 (0–4) aid parcels per month. The mean of the main meals per day was 2.2±0.6 and snacks was 0.6±0.9.

Discussion

Most of the patients in this study experienced changes in their lifestyle habits compared to before the war. They became less active due to a variety of reasons, including the war itself, psychological distress, not having enough space to exercise, limited food, and fear. The sleeping patterns of the patients changed during the war, resulting in longer hours or shorter durations of sleep, uncomfortable sleep, and inconsistent sleep because of fear. It is worth noting that fear is the most common feeling among this study participants, which influences their lifestyle habits and indicates the serious impact of the war on the psychological status of the T1D patients. In a recent study in the Gaza Strip, poor sleep quality was prevalent among 52.8% of participants and excessive daytime sleepiness was prevalent among 43.6%, while short sleep duration was prevalent in 26.4%, which was attributed to a variety of reasons, including the conflict *(11)*.

The blockades and movement restrictions of the people in Gaza have isolated them from the entire world, resulting in a sedentary lifestyle *(12)*. The patients could not receive proper diabetes care compared to the time before the war, with minimum care received by the minority in form of hospital admission for diabetic-related emergencies and medical consultation via phone calls. Most of the patients could not access their medication, forcing them to change their insulin type,

Table 2. Changes in insulin types and doses during the 2023 Gaza war

Changes in insulin types	No.	%
No change	7	24.1
Pure to mixed	9	31.0
Lantus to levemir	3	10.3
Insulin pens to vials	5	17.2
Levemir to actrapid	1	3.4
NovoRapid to humulin	1	3.4
NovoRapid to apidra	2	6.9
Humalog & lantus to actrapid & mixtard	1	3.4
Changes in insulin dose		
No change	14	48.3
Increase	2	6.9
Decrease	7	24.1
Change medication type	3	10.3
Did not explain	3	10.3

Lantus, levemir: long-acting insulin; apidra, novoRapid, humalog: rapid-acting insulin; actrapid, humulin: short-acting insulin; mixtard: premixed insulin.

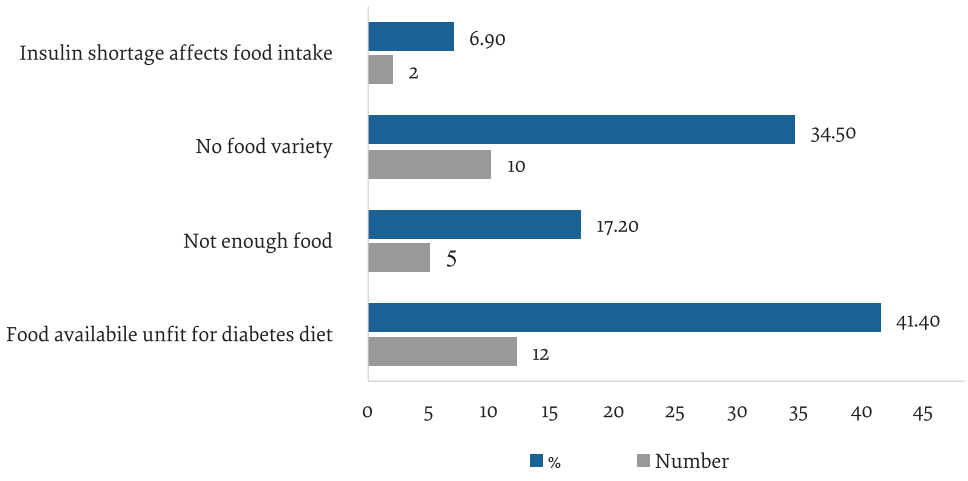
based mostly on the recommendations of healthcare professionals. These findings highlight the significant impact of war on diabetes care, challenges in accessing medical care and shortage of medication, leading to life-threatening consequences. The concern related to insulin access and diabetic care for people living with T1D had been studied previously, and the findings suggest that T1D patients have poor glycaemic control and are exposed to health complications *(9,13,14)*.

Our findings showed severe limitations in blood glucose monitoring during the war. Most experts recommend that insulin-treated patients should monitor their blood glucose at least 4 times a day, mostly fasting, before meals and before bed *(15)*. Results from our study revealed that the patients' testing patterns were far below the recommended standard; more than half of them were unable to conduct any blood glucose test at home due to the lack of test strips, and less than 30% managed to conduct their test once a day. It is necessary for diabetes patients to monitor their blood glucose regularly to avoid complications such as hypoglycaemia and hyperglycaemia.

The findings regarding food availability during the war highlight the high level of food insecurity because a significant proportion of the patients and their families experienced food shortages and reported a lack of food choices. Eating behaviours and dietary control are essential parts of strategies to improve glycaemic control, prevent acute and chronic diabetic complications and lower cardiovascular risk among T1D patients. The dietary guidelines recommend adjusting insulin to meals based on the carbohydrate content, taking into consideration the individual's features in the attempt to achieve best-balanced diet for each patient *(16)*. However, for some reasons already mentioned, it was challenging for our patients to achieve balanced diet, in addition to the lack of, or limited, aid received. Such lack of access or unavailability of appropriate food for T1D patients may result in poor glycaemic control and cause higher rates of complications.

This study has several limitations, including the limited access to data and healthcare facilities, a small sample size, self-reported data, and a limited focus on nutritional interventions and psychological stress. The use of convenience sampling may have introduced selection bias and limited the generalizability of the findings. However, the strengths of the study lies in its relevance, focus and potential to inform practice and policy for addressing nutritional and health challenges during humanitarian crises. Future research could use random or stratified sampling to enhance representativeness, include objective clinical measures alongside self-reported data, incorporate a control group for comparative analysis, expand data collection to include the psychosocial impact, healthcare access

Figure 2. Major concerns of patients about diabetes management during the 2023 Gaza war



metrics and comprehensive analysis and description of the barriers, and use a larger sample size.

Conclusion

Children with T1D in Gaza were unable to receive adequate diabetic care, experienced food insecurity, reported a lack of food diversity, had medication shortages, and experienced poor glycaemic controls. A vicious cycle may occur between T1D and the current war, which can have life-threatening consequences for T1D patients. Further research is needed to assess the long-term impact of the war on T1D patients in Gaza, with targeted nutritional support. These findings highlight the critical need to prioritize chronic disease management in conflict-affected regions and among populations with restricted access to healthcare, particularly for patients with T1D.

Étude exploratoire de l'impact de la guerre sur la prise en charge du diabète sucré de type 1 chez les enfants à Gaza

Résumé

Contexte : La guerre à Gaza a provoqué la destruction des centres de santé et une pénurie de médicaments, affectant les groupes les plus vulnérables, notamment les enfants atteints de diabète sucré de type 1 (DT1).

Objectif : Déterminer dans quelle mesure le conflit à Gaza a influencé la prise en charge des enfants atteints de DT1.

Méthodes : Nous avons recueilli les données de 29 patients atteints de DT1, âgés de 18 ans ou moins, entre juin et juillet 2024 au moyen d'un questionnaire en ligne ; nous avons ensuite analysé les données à l'aide du logiciel SPSS version 21. Les données comprenaient leurs caractéristiques sociodémographiques, leurs antécédents médicaux, les données liées au diabète, l'impact de la guerre sur le DT1 ainsi que les changements dans leur mode de vie.

Résultats : Parmi les parents des 29 patients, 86,2 % ont signalé une diminution du niveau d'activité de leurs enfants, dont 17,2 % était attribuée à la peur et 58,6 % d'entre eux ont notifié une perte de poids moyenne de 2,6 ± 2,7 kg chez leur enfant (intervalle 0-10). La majorité des patients (79,3 %) n'ont pas pu bénéficier d'une prise en charge adéquate de leur diabète pendant la guerre. En conséquence, 10,3 % ont été hospitalisés en raison d'une urgence diabétique. Au niveau familial, 79,3 % des familles des patients ont signalé une insécurité alimentaire, et 96,6 % ont rapporté des choix alimentaires limités. Enfin, 41,4 % ont déclaré que les aliments qu'ils consommaient n'étaient peut-être pas conformes aux exigences d'un régime alimentaire adapté au diabète.

Conclusion : Les enfants atteints de DT1 à Gaza n'ont pas pu recevoir les soins nécessaires à leur maladie et ont souffert d'insécurité alimentaire, de la limitation des choix alimentaires, de pénuries de médicaments et d'un mauvais contrôle glycémique en raison de la guerre. Il est crucial de prioriser la prise en charge des maladies chroniques dans les zones touchées par les conflits et auprès des populations ayant un accès limité aux soins de santé, afin d'éviter les effets néfastes sur la santé qui en découlent.

دراسة استكشافية لتأثير الحرب على علاج نمط 1 من داء السكري بين الأطفال في غزة

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الخلاصة

الخلفية: أسفرت الحرب الدائرة في غزة عن تدمير المراكز الصحية ونقص الأدوية، مما أثَّر على الفئات الأضعف، ومنها الأطفال المصابون بالنمط 1 من داء السُّكَّرِيّ.

الأهداف: هدفت هذه الدراسة الى تحديد تأثير النزاع في غزة على رعاية الأطفال المصابين بالنمط 1 من داء السُّكَّرِيّ.

طرق البحث: جمعنا بيانات من 29 مريضًا مصابًا بالنمط 1 من داء السُّكَّرِيّ، تبلغ أعمارهم 18 عامًا فأقل، في الفترة بين يونيو/ حزيران ويوليو/ تموز 2024 باستخدام استبيان إلكتروني، وحللنا البيانات باستخدام الإصدار 21 من برمجية SPSS. وقد تضمنت البيانات خصائصهم الاجتماعية والسكانية، وتاريخهم الطبي، والبيانات ذات الصلة بمرض السُّكَّرِيّ، وتأثير الحرب على المرضى المصابين بالنمط 1 من داء السُّكَّرِيّ، وتغييرات أنماط الحياة.

النتائج: أفاد 86.2% من آباء وأمهات المرضى البالغ عددهم 29 مريضًا بتراجع مستويات نشاط أطفالهم، ويرجع ذلك إلى الخوف في 17.2% من الحالات، وأفاد 58.6% منهم بأن متوسط فقدان أطفالهم للوزن كان 2.6±2.7 (النطاق 0–10) كجم. ولم يتمكن معظم المرضى (79.3%) من الحصول على الرعاية الكافية للمصابين بداء السكّري خلال الحرب. وقد أسفر ذلك عن دخول 10.3% منهم المستشفى بسبب حالات طوارئ داء السكّري. وعلى مستوى الأسر، عانت 79.3% من أسر المرضى من انعدام الأمن الغذائي، وكان لدى 96.6% منها خيارات غذائية محدودة. وأفادت 41.4% منها بأن طعامهم ربما لم يكن متوافقًا مع متطلبات النظام الغذائي لمرضى السكّري.

الاستنتاجات: لم يتمكَّن الأطفال المصابون بالنمط 1 من داء السُّكَّريّ في غزة من تلقي الرعاية الكافية للمصابين بداء السكّري، وعانوا من انعدام الأمن الغذائي مع محدودية الخيارات الغذائية، ونقص الأدوية، وضَعف القدرة على ضبط نسبة السكر بالدم بسبب الحرب. وثمة حاجة مُلحة إلى إعطاء الأولوية لعلاج الأمراض المزمنة في المناطق المتضررة من النزاعات وفيها بين السكان الذين يعانون من محدودية فرص الحصول على الرعاية الصحية، للوقاية من الآثار الصحية الضارة المترتبة على ذلك.

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