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Pediatric kidney care experience after the 2023 Türkiye earthquake

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ABSTRACT

Background. Two earthquakes on 6 February 2023 destroyed 10 cities in Türkiye. We report our experience with pediatric victims during these catastrophes, with a focus on crush syndrome related–acute kidney injury (Crush-AKI) and death.

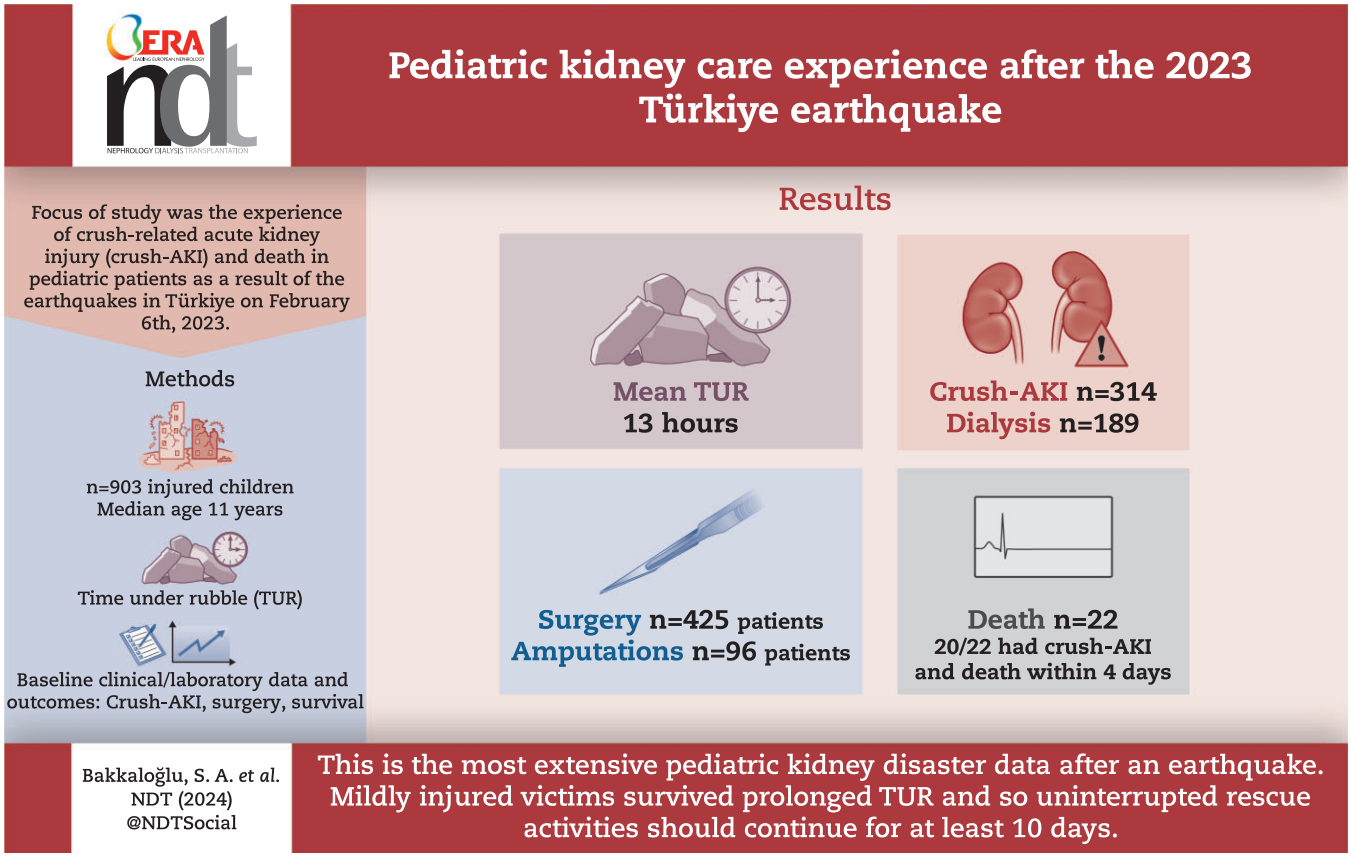
Method. Web-based software was prepared. Patient demographics, time under rubble (TUR), admission laboratory data, dialysis, and kidney and overall outcomes were recorded.

Results. A total of 903 injured children (median age 11.62 years) were evaluated. Mean TUR was 13 h (interquartile range 32.5, max 240 h). Thirty-one of 32 patients with a TUR of >120 h survived. The patient who was rescued after 10 days survived. Two-thirds of the patients were given 50 mEq/L sodium bicarbonate in 0.45% sodium chloride solution on admission day. Fifty-eight percent of patients were given intravenous fluid (IVF) at a volume of 2000–3000 mL/m^2 body surface area (BSA), 40% at 3000–4000 mL/m^2 BSA and only 2% at >4000 mL/m^2 BSA. A total of 425 patients had surgeries, and 48 suffered from major bleeding. Amputations were recorded in 96 patients. Eighty-two and 66 patients required ventilator and inotropic support, respectively. Crush-AKI developed in 314 patients (36% of all patients). In all, 189 patients were dialyzed. Age >15 years, creatine phosphokinase (CK) ≥20 950 U/L, TUR ≥10 h and the first-day IVF volume <3000–4000 mL/m^2 BSA were associated with Crush-AKI development. Twenty-two deaths were recorded, 20 of 22 occurring in patients with Crush-AKI and within the first 4 days of admission. All patients admitted after 7 days survived.

Conclusions. These are the most extensive pediatric kidney disaster data obtained after an earthquake. Serum CK level was significantly associated with Crush-AKI at the levels of >20 950 U/L, but not with death. Adolescent age and initial IVF of less than 3000–4000 mL/m^2 BSA were also associated with Crush-AKI. Given that mildly injured victims can survive longer periods in the disaster field, we suggest uninterrupted rescue activity for at least 10 days.

Keywords: acute kidney injury, children, crush syndrome, earthquake, Türkiye

GRAPHICAL ABSTRACT



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INTRODUCTION

On 6 February 2023, earthquakes hit southern and central Türkiye and northern and western Syria. These events are classified among Türkiye's most devastating massive disasters, with more than 50 000 deaths, more than 100 000 injured and more than 500 000 collapsed buildings [1–3]. Nine hours apart, two solid and destructive earthquakes in 11 densely populated geographical areas destroyed essential infrastructure, including 42 heavily/moderately damaged and 94 slightly damaged hospital buildings [3]. Cold winter conditions hampered initial rescue efforts, and broad fissures in roads and damaged airports made transportation impossible in some areas [3]. Using ships and military helicopters became mandatory for patient transport, personnel and material shipments [4].

Earthquakes should be considered a "kidney disaster" because of crush syndrome–related acute kidney injury (Crush-AKI) [5]. Crush injury resulting from a direct trauma of a body part such as extremities or trunk may be accompanied by crush syndrome, the systemic manifestation of traumatic muscle injury [6], which can then lead to kidney insufficiency/failure. Other systemic manifestations of crush syndrome include arrhythmias due to electrolyte imbalances, respiratory distress syndrome due to the inflammatory response and disseminated intravascular coagulation due to liberated thromboplastin [5, 7].

A recent meta-analysis showed that the occurrence of AKI in children with exertional rhabdomyolysis is infrequent, while after earthquake-related injuries, it was 25% [8]. Fluid third spacing due to muscle tissue necrosis and subsequent intravascular volume depletion, kidney hypoperfusion; tubular obstruction due to myoglobin and uric acid; nitric oxide depletion, endothelial activation and cytokine release leading to kidney vasoconstriction; free radical release and enhanced kidney ischemic damage all contribute to Crush-AKI [5, 7]. Therefore, rapid fluid electrolyte treatment in entrapped crush casualties should begin while under the rubble, where applicable, and continue after extrication based on volume status monitoring [9–11].

Roughly 1 billion children (1–14 years of age) live in countries with high seismic risk, and in natural disasters, up to 43% of acutely injured patients are children [12, 13]. Additionally, crush syndrome is the second most frequent cause of death after direct impact of trauma [14], and 7 in 10 severely injured adult earthquake victims develop crush syndrome. However, there are limited pediatric data [11, 15–19]. Thus, we report our experience based on more than 900 pediatric disaster victims during the 6 February earthquakes. In addition to a general overview of the patient demographics and patient-important clinical events and admission laboratory values, we particularly focused on the predictors of Crush-AKI and death.

MATERIALS AND METHODS

On the first day of the earthquake, the Turkish Society of Pediatric Nephrology Council members prepared a simple, quickly answerable basic data collection form for pediatric earthquake victims. Pleksus Pharmacovigilance Services transformed it into web-based software. It was computer and cell phone compatible. Data on patient demographics, anthropometry, city of the earthquake, admission date, time under the rubble (TUR) in hours, admission laboratory data in serum samples including creatinine, potassium, uric acid, creatine phosphokinase (CK), albumin and bicarbonate levels, accompanying events such as surgical interventions, fracture, bleeding and administered intravenous fluid (IVF), urine output, dialysis support, dialysis type and duration, hospital and intensive care unit (ICU) stay, ventilator and inotropic support, and finally the kidney and overall patient outcomes were collected. Oligura in infants refers to an output of <1 mL/kg/h, while in children the value is <0.5 mL/kg/h. Crush injury was defined as direct trauma of a body part, such as extremities, with manifestations of local findings, including pain, pressure/edema, pallor/pulselessness or paresthesis/paresis, and/or CK levels of 5 times the upper limit of normal. As pediatric nephrologists, we mainly focused on the kidney manifestation of rhabdomyolysis, Crush-AKI, rather than other systemic manifestations. Crush-AKI was defined as crush injury + nephrological abnormalities characterized by one or more of the following: oligo/anuria, serum creatinine level >2 times the upper limit of age- and sex-referenced normal levels [20], potassium >6 mmol/L and uric acid >8 mg/dL [21]. Data entry started on 6 February 2023 and data as of the end of March 2023 were analyzed. On the 10 June, patient and renal outcomes were updated to learn about death, still hospitalized and dialyzed patients. Ethical approval was obtained from the Gazi University Ethics Committee.

Descriptive statistics were summarized as counts and percentages for categorical variables and median [interquartile range (IQR)] for ordinal or non-normally distributed continuous variables. Normally distributed continuous variables were given as mean ± standard deviation. The Chi-square test assessed categorical variables. Mann–Whitney U test was used to test the difference between two groups regarding ordinal or non-normally distributed continuous variables and Student's *t*-test for normally distributed ones. Receiver operating characteristic curves were used to describe and compare the performance of the diagnostics value of variables. In order to define associated factors of the development of Crush-AKI, univariate and multivariate logistic regression analysis was used, and adjusted odds ratios were calculated. The survival estimates were performed using the Kaplan–Meier algorithm, and the comparison between groups was evaluated with a Log-rank test. Univariate and multivariate Cox proportional hazard regression analyses were used to determine independent predictors of mortality. *P*-values <.05 were considered significant.

RESULTS

General characteristics of the patients

A total of 903 pediatric earthquake victims seen by pediatric nephrologists from 40 centers throughout Türkiye were evaluated. The median age of the patients was 11.62 (IQR 7.11, min–max 0.01–23.31 years). Of them, 62.9% were between 5 and 15 years old. Five percent of the patients were younger than 2 years old, and half of them were under 1 year old. Only six patients were over 18 years old (2 of them over 20 years old). There was an equal sex distribution [male to female ratio was 1.04 (460 vs 443, respectively)]. Half of the admitted victims were from Hatay, followed by Kahramanmaraş and Adıyaman. Patient distribution by age group and by earthquake city is given in Fig. 1.

Most victims (70%) were admitted in the first 4 days (10%, 21%, 20% and 19%, respectively). The median TUR was 13 h [IQR 32.5 h, max 240 h (10 days)]. There were 32 patients with a TUR of ≥120 h (≥5 days). Laboratory data at the admission of the patients are given in Table 1.

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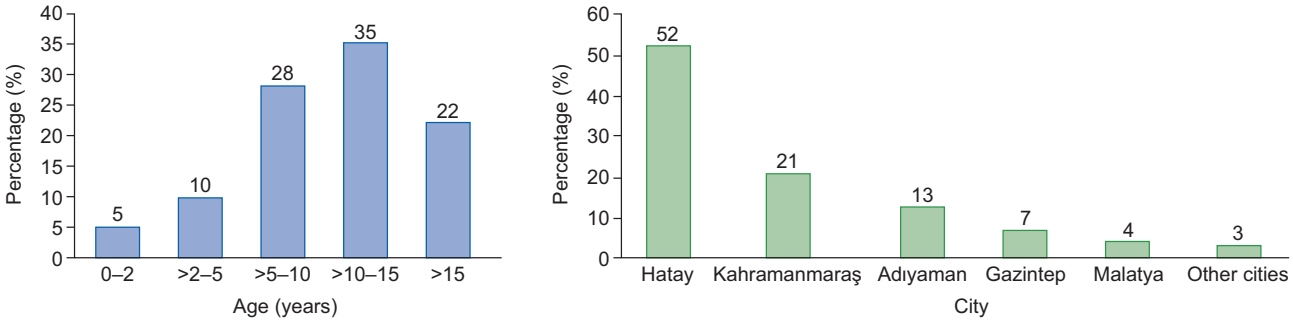


Figure 1: Patient distribution by age groups and by earthquake city.

Crush injury, IVF given, Crush-AKI and kidney replacement therapies

The majority of the patients (67%) were given 0.45% sodium chloride (NaCl) solution with 50 mEq/L sodium bicarbonate addition, 12% were given 0.9% NaCl solution with 50 mEq/L sodium bicarbonate addition, 11% were given 0.9% NaCl or 0.45% NaCl without bicarbonate addition, and 10% were given other IVFs. No patients were given potassium-containing IVFs, such as ringer lactate. Fifty-eight percent of patients were given IVF at a volume of 2000–3000 mL/m^2 BSA, 40% at 3000–4000 mL/m^2 BSA and only 2% at >4000 mL/m^2 BSA.

One hundred fifty-four patients had creatinine levels of >2 times upper limit of age- and sex-referenced level, 124 patients had potassium levels of >6 mEq/L, 236 had uric acid of >8 mg/dL and 213 had oligoanuria.

Crush injury was noted in 675 (74.8%) patients, while 314 developed Crush-AKI, which accounted for 34.8% of all patients and 46.5% of the patients with a crush injury (Fig. 2). One hundred and eighty-nine patients (20.9% of all patients) underwent dialysis, including 125 (66.1%) intermittent hemodialysis (HD), 38 (20.1%) intermittent hemodiafiltration (HDF) and 26 (13.8%) continuous kidney replacement therapy (CKRT). When dialytic modalities were evaluated in terms of patient survival, HD and HDF had similar rates, which were significantly more favorable compared with those on CKRT. None of the patients underwent peritoneal dialysis. Only three patients under five required dialysis (ages were 2.05, 4.02 and 4.95). Patients underwent dialysis were older [14.1 (IQR 5.0) vs 10.1 (IQR 7.7) years, $P < .001$], had higher creatinine, potassium, uric acid, CK and lower bicarbonate levels than those without a need of dialysis (see Table 1). As of the end of March 2023, were 29 patients undergoing HD. The median number of dialysis days was 7 (IQR 18, max 35 days). However, by 10 June, there were no further dialysis-dependent patients.

Surgeries and amputations

Almost half of the patients ($n = 425$) had various surgical interventions. Fasciotomy was performed in 196 patients (21.7% of all patients and 62.4% of patients with Crush-AKI), amputation in 96 (10.6% of all patients and 30.6% of patients with Crush-AKI) and multiple amputations in 42 (4.7% of all patients and 13.4% of patients with Crush-AKI) (Fig. 2). Amputation rate ranged between 8% and 30% across the admitting centers. Patients with amputation vs others had significantly longer median TUR, more extended median hospital stay and ICU stay, more commonly developed Crush-AKI (60% vs 32%, $P < .001$), and had higher potassium, uric acid and CK levels, and lower albumin levels. At the same time, creatinine did not show any difference between the two groups (Table 1).

Two hundred twenty-five patients had fractures. Forty-eight patients suffered from significant bleeding, 44% intracranial bleeding. Eighty-two patients and 66 patients required ventilator and inotropic support, respectively (Fig. 2).

As of the end of March 2023, there were 311 hospitalized patients; the median length of hospital and ICU stays were 9 (IQR 15, max 51) days, and 1 (IQR 5, max 50) days. However, on 10 June, there was only one patient still hospitalized, and this only for physical therapy.

Risk of Crush-AKI development in patients with crush injury

Compared with those without Crush-AKI, patients with Crush-AKI more commonly underwent amputations (18.5% vs 9.3%, $P = .001$), had longer TUR and had higher median creatinine, potassium, uric acid, and lower mean albumin levels (Table 1).

In univariate analysis, hospital admission within the first 4 days of the earthquake, age >15 years, body weight >45 kg, CK ≥20 950 U/L, TUR ≥10 h and the first-day IVF volume <3000–4000 mL/m^2 BSA and >4000 mL/m^2 BSA were significant predictors of the development of Crush-AKI in patients with crush injury. In multivariate analysis, age >15 years, CK ≥20 950 U/L, TUR ≥10 h and the first-day IVF volume <3000–4000 mL/m^2 BSA and >4000 mL/m^2 BSA were the only significant risk factors for Crush-AKI development (Table 2).

Causes and associated factors of death

Twenty-two deaths were recorded, and 20 out of 22 had Crush-AKI. Overall mortality rate was 2.4%, while it was 6.4% among those with Crush-AKI. Twenty deaths occurred within the first 4 days of the earthquake. Causes of death were multiorgan dysfunction in 14 patients, sepsis in 1, pneumomediastinum in 4, pulmonary hemorrhage in 1, cerebral salt wasting and brain edema in 1, and brain death in 1.

Kaplan–Meier survival analysis showed that patients requiring inotropic and ventilator support, requiring dialysis, suffering from significant bleeding, developing Crush-AKI and having CK levels ≥45 395 had lower survival rates (Fig. 3). Most strikingly, the patient with a CK level of 2 845 602 survived, free of dialysis, and was discharged. Thirty-one out of 32 patients with a TUR of >120 h survived. Interestingly, the patient rescued after 10 days survived.

In univariate analysis, death were significantly associated with inotropic and ventilator support, requiring dialysis, bleeding, Crush-AKI and its determinants, early admission and lower

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Table 1: Differences in clinical and laboratory characteristics of patients who developed Crush-AKI or not, who underwent dialysis or not, and who underwent amputation or not.

	All patients	Median (IQR)		P	Median (IQR)		P	Median (IQR)		P
		Crush-AKI (−)	Crush-AKI (+)		Dialysis (−)	Dialysis (+)		Amputation (−)	Amputation (+)	
TUR (h)	13 (32.5)	8.0 (32.0)	15.0 (30.5)	<.047	9 (32.5)	12 (23)		12.0 (30.0)	35.5 (39.3)	<.001
Creatinine (mg/dL)	0.61 (1.32), max:10.6	0.42 (0.26)	1.90 (2.70)	<.001	0.49 (0.37)	2.89 (1.89)	<.001	0.60 (1.33)	0.85 (1.34)	.130
Potassium (mmol/L)	4.6 (1.5), max: 9.5	4.2 (0.8)	5.4 (2.0)	<.001	4.25 (0.92)	6.10 (2.40)	<.001	4.5 (1.4)	4.9 (2.2)	.039
Uric acid (mg/dL)	5.64 (6.6), max: 26	3.7 (2.4)	10.4 (6.1)	<.001	4.16 (3.70)	10.76 (7.10)	<.001	5.5 (6.3)	7.4 (8.4)	.011
CK (U/L)	18507 (52989), (max: 2845602)	7339.5 (18525.0)	54725.0 (88528.0)	<.001	6253 (21554)	85390 (106372)	<.001	15742.0 (52166.0)	33706.0 (65764.0)	.016
Albumin (g/dL)[a]	3.2 ± 0.71, (min: 1.1)	3.36 ± 0.75	2.93 ± 0.75	<.001	3.29 ± 0.74	2.80 ± 0.72	<.001	3.26 ± 0.76	2.76 ± 0.81	<.001
Bicarbonate (mmol/L)	21.8 (5.0)	23.9 (4.4)	18 (7.05)	<.001	23.0 (5.5)	18.0 (7.9)	<.001	22.6 (6.5)	21.7 (6.65)	.404
Hospital stay (days)	9 (16)	7 (14)	15 (23.25)	<.001	7 (13)	19.5 (25.75)	<.001	10.0 (15.0)	16.0 (33.0)	.001
ICU stay (days)	1 (5)	0 (2)	5 (11)	<.001	0 (2)	7 (11)	<.001	1.0 (7.0)	5.0 (11.0)	.001

[a] Albumin levels were given as mean ± standard deviation.

albumin. Amputation, TUR, body weight or age were not associated with death. In multivariate analysis, significant predictors of death were ventilator and inotropic support and creatinine levels higher than twice the upper limit of normal for age and sex (Table 3).

DISCUSSION

We have reported the most extensive pediatric kidney disaster data after an earthquake. Most victims were 5–15 years old, with equal sex distribution. A CK level of >20950 U/L, an age older than 15 years and an IVF volume given on the first day <3000–4000 mL/m^2 BSA were associated with Crush-AKI development, and it was less common in late survivors. Severe injury requiring ventilator and inotropic support, and with creatinine levels twice the upper limit of normal for age- and sex-referenced levels were the main associates of death in pediatric earthquake victims. Median TUR was 13 h, while 32 patients stayed entrapped for more than 120 h—all survived but one, and only three required dialysis. Two out of five patients who were entrapped for >7 days needed dialysis, and one patient was alive after her rescue at 240 h after the earthquake without a need for dialysis. However, more favorable outcomes noted in patients with longer TUR and late admission to the hospitals may be explained by a selection bias, i.e. mildly injured victims may survive more extended periods in the disaster field. Therefore, we suggest an uninterrupted rescue activity for at least 10 days.

Our extensive data show that Crush-AKI developed in one-third of victims, which is in line with the prevalence of 30%–35% in previous small pediatric reports [11, 15, 16], but higher than the Marmara earthquake data (12% developed kidney problems) [21]. Thirty-five percent of our victims had Crush-AKI, of whom 60% required dialysis (21% of all victims), while in the Marmara earthquake 12% of all victims had kidney abnormalities and of these 75% required dialysis [21]. This discrepancy may be related to a relatively larger total body water and extracellular fluid compartment in children compared with the adults. This may explain more rapid dehydration and resultant AKI development, rapid response to fluid electrolyte treatment and less need for dialysis in children. A significant association between Crush-AKI and being older than 15 years supported this hypothesis.

When our victims with or without Crush-AKI were compared, the risk of Crush-AKI was 2–12 times less likely in children and early adolescents who were given 3000–4000 mL/m^2 BSA IVF on the first day after extrication. On the contrary, CK levels higher than 20 950 U/L and being under the debris for more than 10 h were significantly associated with the development of Crush-AKI. Although early and rigorous volume replacement is crucial to decrease the risk of Crush-AKI [9–11], we suggest that 3000–4000 mL/m^2 BSA can be considered a reasonable amount of IVF volume for children under winter conditions. Our results also suggests that >4000 mL/m^2 BSA volume infusion may not provide an increased benefit for preventing Crush-AKI. However, it should be kept in mind that these patients consisted of only 2% of victims and the volume of IVF infused on only the first day after extrication was evaluated in our series. In a limited number (n = 33) of pediatric victims of the Iran Bam earthquake, higher IVF volumes were given to prevent AKI and dialysis requirement [11]. Therefore, this area requires more detailed studies to make a clear conclusion.

We observed significantly higher CK levels than in previously reported smaller pediatric case series [11, 15, 16]. Three hundred and fourteen pediatric victims with Crush-AKI in our

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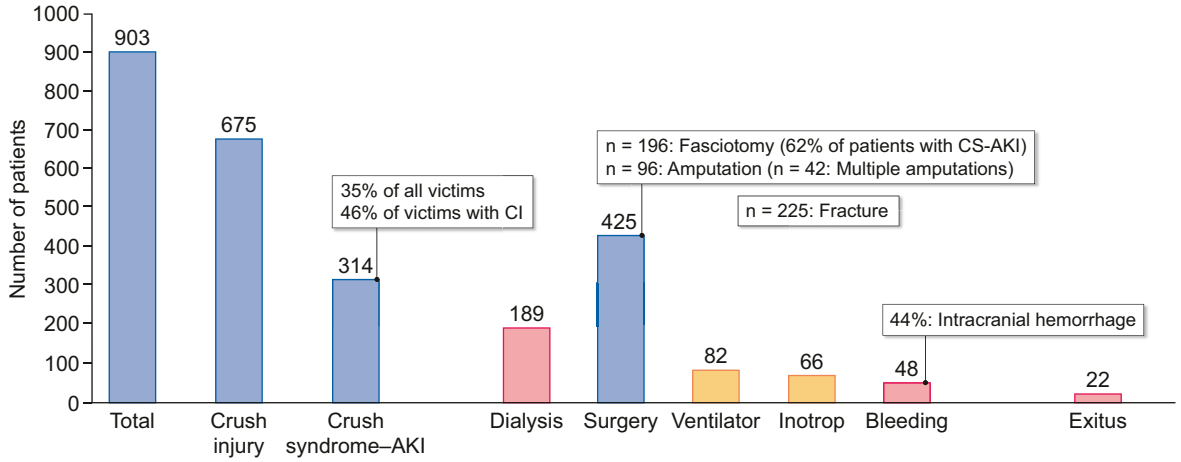


Figure 2: Overall patient-important events in pediatric dialysis victims (Number of the patients were given on the top of the bars). CI: crush injury; AKI: acute kidney injury; CS-AKI: crush-related acute kidney injury.

Table 2: Associated factors of Crush-AKI development in patients with crush injury.

	Univariate			Multivariate		
	OR	95% CI	P	OR	95% CI	P
Age >15 years	2.08	1.45–2.98	**<.001**	1.95	1.20–3.18	**.007**
CK ≥20 950 U/L	10.55	7.35–15.16	**<.001**	11.61	7.51–17.95	**<.001**
TUR ≥10 h	1.70	1.19–2.44	**.004**	1.79	1.15–2.80	**.010**
The first day IVF volume						
<3000–4000 mL/m^2 BSA	1.45	1.06–1.98	**.020**	1.64	1.05–2.58	**.031**
>4000 mL/m^2 BSA	4.27	1.35–13.57	**.014**	6.10	1.54–24.24	**.010**
Body weight >45 kg	1.96	1.38–2.79	**<.001**			
Admission—within the first 4 days	2.50	1.75–3.56	**<.001**			
Fracture	0.84	0.58–1.23	.380			
Sex (female)	0.99	0.73–1.34	.949			

OR: odds ratio.

report had median CK levels of 18 507 (IQR 52 989) U/L at admission, and the highest admission level was 2 845 602 U/L. Similarly, a single-center series of the 6 February earthquake showed CK levels around 98 000 and 22 000 U/L, respectively, in children who underwent kidney replacement therapy or who did not [18]. This may be partly related to the magnitude of the 6 February earthquakes. Mildly elevated CK levels were not associated with Crush-AKI, and our results emphasized that dialysis decisions should not be based solely on mildly/moderately elevated CK levels. On the contrary, a small, single-center data of the 6 February earthquake showed that "renal score" (based on estimated glomerular filtration rate, CK, TUR, presence of amputation or fasciotomy, and urine volume), CK and myoglobinuria were significant risk factors for the indication of kidney replacement therapy in crush syndrome [18]. Since the renal score contains CK as a categorical parameter to predict AKI, next to CK level, one may wonder as to the real role of CK in the renal score.

Our patients underwent mainly intermittent HD, followed by HDF and CKRT. None of the patients was started on PD. The median age of victims was 11.6 years, and only 5% of the patients were under 2 years old. No patients under the age of 2 years required dialysis, and only three under the age of 5 years underwent dialysis. Continuous kidney replacement therapy was used in 14% vs 7% of our patients and Marmara earthquake victims, respectively [21]. After 24 years from 1999, twice as liberal use of CKRT was most probably related to the availability of devices/sets in ICUs for critically ill patients. However, it should be remembered that apart from a specific medical need, intermittent HD is the recommended dialysis modality in Crush-AKI [10, 12].

In our series, the overall mortality rate was 2.4%. Although, ventilator and inotrope support, bleeding, Crush-AKI and its determinants, need for dialysis, low albumin, early admission and CK level of >45395 U/L were associated with death in univariate analysis, multivariate analysis indicated that acute and severely injured patients who require ventilator and inotropic support were shown to be at significantly (10–20×) increased risk of death. Additionally, creatinine levels 2 times the upper limit of age- and sex-referenced normal contributed to the increased risk of death (at the borderline of significance). Therefore, close monitorization of creatinine levels and appropriate management including fluid electrolyte management and/or dialysis is essential.

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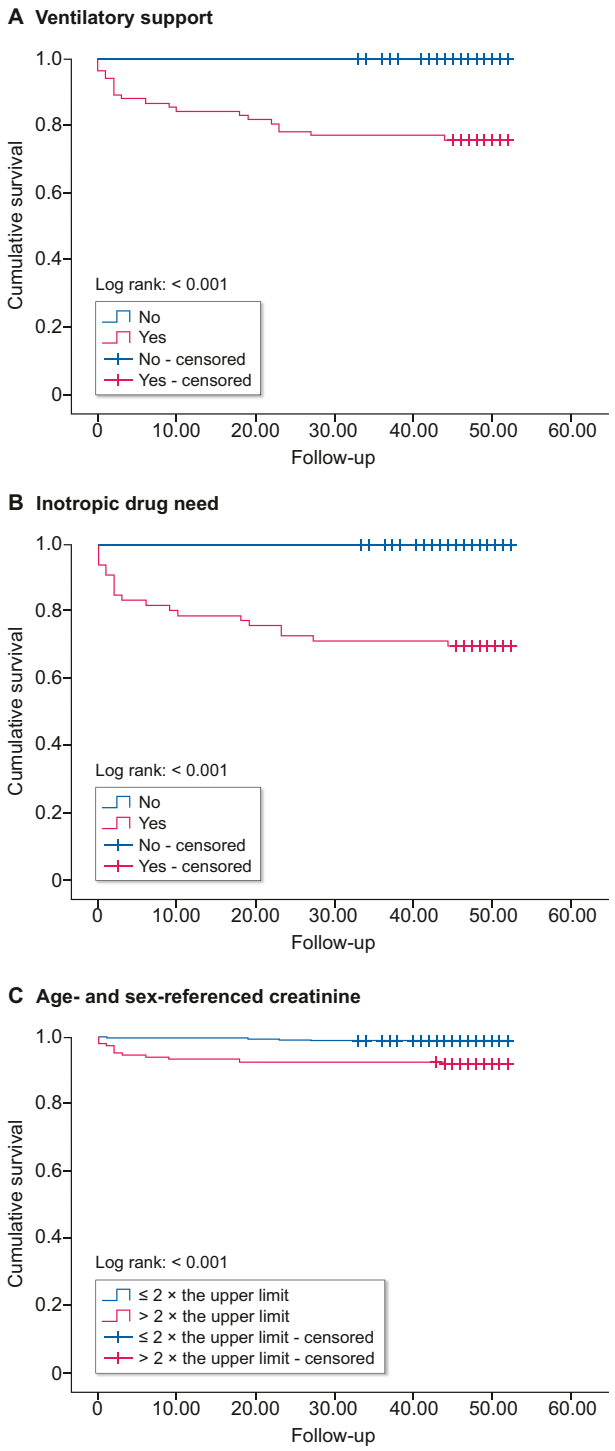


Figure 3: Associations among patient survival and ventilator support, use of inotropic drugs, and creatinine levels higher than twice the upper limit of age- and sex-referenced normal levels.

Compared with Marmara earthquake, with an overall mortality rate of 8% among hospitalized victims [21], we recorded 3 times lower death rates. In line with this, 2.4 times lower death rate were observed in children with Crush-AKI compared with victims of the Marmara earthquake with kidney abnormalities (6.4% vs 15.2%, respectively) [22]. The lower death rate may be partly related to the smaller body size of the children which reduces the risk of being injured as compared with adults, and partly due to the experience gained from the previous earthquakes [11, 15, 16, 21–24] and the rapid reaction of the pediatric nephrology community to this mass disaster [4]. Previously prepared guidelines for the disaster area, instructions for triage, principles of fluid-electrolyte therapy in the field and in the hospital [25], their adaptation to pediatric kidney care [26], and timely surgical and medical treatment significantly impacted better outcomes. Well-structured kidney disaster preparedness master plans and roadmaps with algorithms for pediatric kidney care should be incorporated into the pediatric nephrology fellowship curriculum [12]. On the other hand, working in harmony with other physicians and dedicated hemodialysis nurses/technicians, social workers and psychologists is also essential. Disaster nephrology should also be included in medical and para-medical curricula, and regular training courses should be organized [27].

Reliable data collection during these unforeseen events and careful analysis and interpretation of the results are particularly important for managing future events. In this way, conceptual information related to life-threatening crush injuries with concomitant kidney insult will increase, and eventually, more patients might be saved. We herein reported our online data collection efforts regarding initial admission laboratory values, given fluids, concomitant events, and final kidney and overall outcomes of the victims as a snapshot summary. There was no detailed information about daily fluid-electrolyte management and laboratory parameters, infectious episodes, neurologic sequelae, applied surgical interventions as salvage procedures, etc. This is the main limitation of this study. There was also some missing data due to instant deaths, unattended children and severe injuries/trauma to vital organs (i.e. weight/height measurement was impossible).

Although it is imperative to have a health system with a very high organizational capability and nationwide dedicated pediatric nephrologists, the real solution is structures resistant to succumbing to natural disasters. Therefore, people responsible for construction should be determined to make solid earthquake-resistant buildings according to internationally accepted standards.

In conclusion, earthquakes are also a major cause of mass casualties with Crush-AKI in children. Despite lower mortality rate compared with adults, approximately one-third of pediatric earthquake victims develop Crush-AKI, which can be reversed by timely and appropriate fluid electrolyte management and intermittent HD, when necessary. Rescue efforts should continue at least up to 10 days after an earthquake. Well-prepared, detailed disaster preparedness plans, including procurement, delivery and replacement of personnel/material and treatment algorithms, will facilitate handling this chaotic situation, and reliable data collection and correct interpretation of results will shed light on future mass disasters.

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Table 3: Associated factors of death in pediatric earthquake victims.

	Univariate			Multivariate		
	HR	95% CI	P	HR	95% CI	P
Inotrope	147.72	34.50–632.40	**<.001**	20.24	3.13–130.99	**.002**
Ventilator	111.63	26.08–477.76	**<.001**	9.89	1.53–63.87	**.016**
Bleeding	13.21	5.65–30.91	**<.001**			
Crush-AKI	18.96	4.44–81.18	**<.001**			
Dialysis	8.32	3.39–20.40	**<.001**			
CK >45 395 U/L	5.67	2.23–14.39	**<.001**			
Cre >2× ULN[a]	7.77	3.17–19.00	**<.001**	2.50	1.01–6.20	**.048**
K >6 mEq/L	6.23	2.59–14.96	**<.001**			
Uric acid >8 mg/dL	22.00	5.08–95.21	**<.001**			
Anuria	14.29	6.19–32.97	**<.001**			
Oligoanuria	11.47	4.23–31.10	**<.001**			
Admission in the first 3 days	3.42	1.26–9.28	**.016**			
Admission in the first 4 days	4.53	1.06–19.38	**.042**			
Albumin < 3 g/dL	2.91	1.16–7.31	**.023**			
Amputation	2.50	0.92–6.78	.072			
Rubble time >10 h	1.65	0.56–4.82	.362			
Age >15 years	0.59	0.18–2.01	.402			
BW >45 kg	1.60	0.60–4.30	.349			

[a]Twice the upper limit of normal for age- and sex-referenced creatinine level.
ULN, upper limit of normal; BW, body weight; Cre, creatinine; K, potassium.

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DATA AVAILABILITY STATEMENT

The data underlying this article are available in the article itself.

CONFLICT OF INTEREST STATEMENT

None declared.

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