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ORIGINAL ARTICLE

Kidney disease profile and encountered problems during follow-up in Syrian refugee children: a multicenter retrospective study

Ayse Balat[1] · Beltinge Demircioglu Kilic[1] · Bagdagul Aksu[2,3,4] · Mehtap Akbalik Kara[1] · Mithat Buyukcelik[1] · Ayse Agbas[4] · Fehime Kara Eroglu[5] · Tulin Gungor[5] · Demet Alaygut[6] · Nurdan Yildiz[7] · Funda Bastug[8] · Bahriye Atmis[9] · Engin Melek[9] · Midhat Elmaci[10] · Sebahat Tulpar[11] · Cemile Pehlivanoglu[12] · Serra Surmeli Doven[13] · Elif Comak[14] · Yilmaz Tabel[15] · Atilla Gemici[16] · Berfin Uysal[17] · Gamze Seval Ozzorlar[18] · Nuran Kuçuk[19] · Ali Delibas[20] · Gul Ozcelik[21] · Nilufer Goknar[22] · Ismail Dursun[23] · Pelin Ertan[24] · Ipek Akil Ozunan[24] · Ferah Sonmez[25]

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Abstract

Background Children are one of the most vulnerable groups in conflict zones, especially those with chronic diseases. This study aimed to investigate kidney disease profiles and problems during follow-up in a population of Syrian refugee children residing in Turkey.

Methods Syrian refugee children aged between 0 and 18 years were included in the study. Demographic data, diagnosis, particular interventions due to nephrological problems, and problems encountered during follow-up were obtained from all participating pediatric nephrology centers.

Results Data from 633 children from 22 pediatric nephrology centers were included. Mean age of the children was 94.8 ± 61.7 months and 375 were male (59%). 57.7% had parental consanguinity and 23.3% had a close relative(s) with kidney disease. The most common kidney diseases were congenital anomalies of the kidney and urinary tract (CAKUT) (31.0%), glomerular disease (19.9%), chronic kidney disease (CKD) (14.8%), and urolithiasis (10.7%). Frequent reasons for CAKUT were nonobstructive hydronephrosis (23.0%), vesico-ureteral reflux (18.4%), and neurogenic bladder (15.8%). The most common etiology of glomerular diseases was nephrotic syndrome (69%). Ninety-four children had CKD, and 58 children were on chronic dialysis. Six children had kidney transplantation. Surgical intervention was performed on 111 patients. The language barrier, lack of medical records, and frequent disruptions in periodic follow-ups were the main problems noted.

Conclusions CAKUT, glomerular disease, and CKD were highly prevalent in Syrian refugee children. Knowing the frequency of chronic diseases and the problems encountered in refugees would facilitate better treatment options and preventive measures.

Keywords Children · Conflict zones · Kidney disease profile · Syrian refugees

Introduction

Children are the most at-risk group in natural or man-made disasters. Unfortunately, conflicts around the world are increasing and many people are forced to leave their home and live as refugees in neighboring countries. There is not sufficient/detailed data on how refugees can survive and live in emergent situations, especially those with chronic illnesses. The crisis in Syria has not only forced many people to seek refuge in neighboring countries but has also caused many to be displaced within Syria. Unfortunately, almost half of the refugees are children, and the United Nations International Children's Emergency Fund (UNICEF) stressed that 6 million children still living in Syria need humanitarian assistance. There are serious problems in essential nutritional support and vaccination to prevent infectious diseases [1]. Additionally, observing the war's psychological trauma may have a long-lasting impact on their lives [2, 3].

During these challenging times, health centers created by Syrian and non-Syrian volunteer physicians in safe border

✉ Ayse Balat
aysebalat@hotmail.com; abalat@gantep.edu.tr

Extended author information available on the last page of the article

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regions are admirable [4, 5]. Most countries are involved in "emergency action plans" for life-threatening emergencies. However, non-life-threatening medical conditions are handled differently based on the management of health services in each host country. This could potentially create health disparities, especially for refugees with chronic diseases, resulting in several problems in the care of chronic diseases and patient adherence to treatment [6, 7]. For example, in the recent Syrian conflict, while some of the neighboring host countries have made serious preparations for refugees by providing camps, food, and free health services, other countries have provided their health services for a fee albeit cheaper than what their citizens pay [6]. The Turkish Ministry of Health provided free access to all community health centers including university hospitals for registered Syrian refugees [8]. This approach has made a significant impact especially in the follow-up and treatment of patients with chronic disease.

A recent study from Europe stressed the importance of the nephrological approach to migrants and refugees relating to managing CKD stage 5 including medical, logistical, financial, and moral–ethical questions [9]. These are mainly the responsibilities in the societal (macro), local (meso), and individual (micro) levels; facilitating objective decisions with additional data; enough information and education about cultural sensitivity, legal rights, and obligations; and medical knowledge to understand the needs of this population [9]. Each of these domains contains crucial details and precisions in itself. Similarly, a German pediatric cohort of refugee children with kidney replacement therapy (KRT) well describes the challenges in the care of this population [10].

Recently, precautions to be taken, especially for children with kidney disease in conflict zones, have been published and stressed the importance of adopting disaster nephrology principles that may contribute to improved survival of pediatric kidney patients in chaotic circumstances [11].

In this study, the kidney disease profile of Syrian refugee children residing in Turkey and common problems encountered during the follow-up and treatment period have been investigated. To our best knowledge, this is the most detailed study providing information about the Syrian refugee children with kidney disease in refugee hosting countries.

Methods

Study design

Syrian refugee children between the ages of 0 and 18 years followed in the pediatric nephrology clinics in Turkey from 1 September 2012 to 31 May 2020 were included in the study. Refugee children without kidney problems and/or from other countries were excluded from the study. Demographic data and medical history (age, gender, time period lived in Turkey, number of siblings, any kidney disease of siblings and/or close relative(s), presence of parental consanguinity, family history of death from any kidney disease, age at diagnosis, follow-up period, number of cities they have lived in during the ongoing conflict, diagnosis, special medical procedures (kidney biopsy, peritoneal dialysis (PD), hemodialysis (HD), surgical intervention for any nephrological problem, kidney transplantation (KTx)) as well as problems encountered during follow-up were obtained from all participating pediatric nephrology centers. Patients with CKD were defined and staged according to the recent nomenclature for kidney function and disease report of a Kidney Disease: Improving Global Outcomes (KDIGO) Consensus Conference [12]. Children with CKD stage 5 were classified based upon KRT: CKD stage 5 without KRT (CKD 5 without KRT), CKD stage 5 treated by dialysis (D) (CKD 5D), or CKD 5 and KRT [12]. The etiologies of CKD were noted, such as congenital anomalies of the kidney and urinary tract (CAKUT), glomerular disease, and urolithiasis. Primary monosymptomatic nocturnal enuresis (PMNE) was diagnosed according to the report from the standardization committee of the International Children's Continence Society [13]. Approval was obtained from the ethics committee of Istanbul Aydin University (2019/155). The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Statistical analysis

Data were analyzed using SPSS software (Statistical Package for the Social Sciences, version 21, SPSS Inc., Chicago, IL, USA). The results are expressed as mean ± SD for descriptive data and as percentages for categorical data.

Results

The data of 633 children were collected from 22 pediatric nephrology centers in Turkey.

Mean age of the children was 94.8 ± 61.7 months and 375 (59%) of them were male. Mean residence time in Turkey was 3.8 ± 2.0 years. 57.7% had parental consanguinity while 1.5% and 23.3% had a sibling and close relative(s) with kidney disease, respectively. The mean age at diagnosis was 61.1 ± 53.8 months and the mean follow-up period was 3.8 ± 2.0 years. 33.1% of the families had moved to at least two cities. Demographic data of refugee children with kidney diseases are presented in Table 1. The most common kidney diseases were CAKUT (31.0%), glomerular disease (19.9%), CKD (14.8%), and urolithiasis (10.7%) (Table 2).

The five most frequent reasons for CAKUT were nonobstructive hydronephrosis (23.0%), vesico-ureteral reflux (VUR) (18.4%), neurogenic bladder (15.8%), unilateral renal agenesis and/or atrophia (11.2%), and unilateral ureteropelvic junction (UPJ) obstruction (9.2%).

Table 1 Demographic data of Syrian refugee children with kidney disease

Demographic data	
Age [months, mean ± SD (min–max)] (n = 633)	94.8±61.7 (1.8–252.0)
Gender (male/female) (n) (n = 633)	375/258
Residence time in Turkey [years, mean ± SD (min–max)] (n = 337)	3.8±2.0 (0.3–16.0)
Number of siblings [mean (min–max)] (n = 460)	2.9±2.0 (0–10)
Kidney disease in sibling (s) (n = 603) yes/no	9/594
Presence of parental consanguinity (n = 508) yes/no	293/215
Family history of kidney disease (n = 502) yes/no	117/385
Family history of death from kidney disease (n = 488) yes/no	30/458
Age at diagnosis [months, mean ± SD (min–max)] (n = 544)	61.1±53.8 (0.1–211.0)
Follow-up period [months, mean ± SD (min–max)] (n = 561)	17.3±17.5 (0.5–84.0)

The most common etiology of glomerular disease in 87 children was nephrotic syndrome (NS) (69.0%), followed by Henoch–Schönlein nephritis (8.7%). Biopsy results of 41 patients were focal segmental glomerular sclerosis (FSGS) (39.0%), minimal change disease (MCD) (22.0%), membranoproliferative glomerulonephritis (MPGN) (7.3%), immunoglobulin A nephropathy (IgAN) (7.3%), and lupus nephritis (LN) (7.3%). Ninety-four children (14.8%) had CKD which resulted from CAKUT (44.7%), glomerular disease (14.9%), hereditary cystic disease (12.8%), and primary hyperoxaluria (4.25%). The etiology was unknown in 19.1% of cases.

Of the 633 children, 68 (10.7%) had urolithiasis; however, very few patients had data about the urinary stone location and underlying risk factors. Three children had cystine stones, one with staghorn stone, and another with hydroxyapatite stone. Sixty-four children (10.1%) had PMNE.

Tubular disorders (4.1%) in the children were Bartter syndrome (26.9%), distal renal tubular acidosis (RTA) (26.9%), proximal RTA (15.4%), isolated glycosuria (7.7%), Dent disease (7.7%), nephrogenic diabetes insipidus (3.8%), cystinosis (3.8%), and one patient with unknown etiology.

Fifty-eight of the 94 children with CKD were on a chronic dialysis program: 27 were on PD, and 31 were on HD (Table 3). Four patients were on a dialysis program while in Syria (one on PD, three on HD). The etiologies in children with CKD 5D were CAKUT (39.7%), glomerular disease (22.4%), hereditary cystic kidney disease (13.8%), primary hyperoxaluria (3.4%), and unknown (19.0%). Most PD patients were on continuous ambulatory peritoneal dialysis (CAPD) (74.1%), and the peritonitis rate per year was 1.3 ± 1.8. The access for HD was mostly permanent tunneled catheter (45.2%). Five patients switched from HD to PD during follow-up. Durations on PD and HD were 2.0 ± 1.7 and 1.3 ± 1.4 years, respectively. Only six children had KTx. The etiology in the KTx group was CAKUT in four, primary hyperoxaluria in one, and unknown in another. Donors were parents, and the average waiting period for transplantation was 14.2 months.

A total of six patients underwent temporary dialysis (three were by PD). The diagnosis was hemolytic uremic syndrome (HUS) in five children and one child was diagnosed with congenital NS (CNS).

Eight patients died during follow-up due to sepsis. The diagnosis in four children was CNS, CKD 5 and KRT in two, one case had renal agenesis while the other had primary hyperoxaluria wherein the child died following liver transplantation. Surgical intervention was performed in 111 patients (17.5%). The most common procedures were PD catheter placement (3.8%), antireflux (3.8%), and stone surgeries (2.2%). Communication problems because of the language barrier, lack of medical records, and frequent disruptions in periodic follow-ups were the main problems noted.

Table 2 Diagnosis of the 633 Syrian refugee children followed in the Pediatric Nephrology Clinics

	Number of patients, n (%)
CAKUT	196 (31.0)
Glomerular disease	126 (19.9)
Chronic kidney disease	94 (14.8)
Urolithiasis	68 (10.7)
PMNE	64 (10.1)
Urinary tract infection	39 (6.2)
Tubular disorders	26 (4.1)
Hypertension	13 (2.1)
Hereditary cystic disease	7 (1.1)

CAKUT congenital anomalies of kidney and urinary tract, *PMNE* primary monosymptomatic nocturnal enuresis

Discussion

The arrival of refugees has created a significant burden on all healthcare centers, including university hospitals. These

Table 3 Characteristics of children on chronic dialysis program

	Patients, n = 58
Age [months, mean ± SD (min–max)]	120.9±65.7 (7–252)
Gender (male/female) (n)	24/34
Etiology, n (%)	
CAKUT	23 (39.7)
Glomerular disease	13 (22.4)
Hereditary cystic disease	8 (13.8)
Primary hyperoxaluria	2 (3.4)
Tubular disorders	1 (1.7)
Unknown	11 (19.0)
HD/PD	31/27
CAPD/APD	20/7
Emergency/scheduled dialysis	7/51
Switch from PD to HD	12
Switch from HD to PD	5
Chronic HD entry way, n (%)	
Permanent catheter (tunneled)	14 (45.2)
Temporary catheter (untunneled)	6 (19.4)
Arteriovenous fistula	11 (35.5)
Duration on PD [years, mean ± SD (min–max)]	2.0±1.7 (0–7)
Duration on HD [years, mean ± SD (min–max)]	1.3±1.4 (0–6)
Number of peritonitis per year [mean ± SD (min–max)]	1.3±1.8 (0–7)

CAKUT congenital anomalies of kidney and urinary tract, *HD* hemodialysis, *PD* peritoneal dialysis, *CAPD* continuous ambulatory peritoneal dialysis, *APD* automated peritoneal dialysis

centers have had to treat various types of kidney disease in a variety of patients including children who were affected socially and psychologically. Hence, healthcare professionals have faced a patient group with different genetic make-ups, cultural beliefs, and socio-economic statuses. Most of those patients did not have previous medical records and/or information of their medical history, making it difficult to assess their condition and address their health concerns. To date, only one single-center study evaluated the major causes of CKD in Syrian children [14]. The spectrum of pediatric kidney disease in the Middle East might be different from in Western countries. Considering the limited data in the Middle East regarding those children, we thought that kidney diseases in refugee children might provide information to help care for affected children in our environment and other places.

Gaziantep, bordering Syria, is one of the first destination cities for refugees and hosts the second highest number of refugees after Istanbul. In the first two years of the Syrian conflict, 130 patients were admitted to our clinic with various diagnoses, and most of the cases were CAKUT (26.2%), CKD (23.1%), and NS (18.5%) [15]. Since the start of the Syrian conflict, we have been caring for an increasing number of children with acute and chronic kidney problems. Therefore, in collaboration with several pediatric nephrology centers in Turkey, we conducted an analysis to determine kidney disease profile among Syrian refugee children, and to share the problems in follow-ups and treatment.

The most common types of kidney disease were CAKUT (31.0%), glomerular diseases (19.9%), CKD (14.8%), and urolithiasis (10.7%). CAKUT is the most common cause of prenatally diagnosed developmental malformations of urinary tract and the leading cause of CKD in children [16]. CAKUT may be expected to be one of the most common kidney problems in this geographical area since consanguineous marriages are common. Indeed, a study from the Kingdom of Saudi Arabia (KSA) demonstrated that neurogenic bladder was an important cause of CKD among pediatric patients. The study showed that genetically mediated kidney disease, congenital and infantile NS, and kidney stones were more prevalent in KSA than in other countries [17].

The spectrum of biopsy-proven kidney disease is different between countries and may change over time. We compared our data with available studies from Arab countries, Africa, Europe, and the USA. Similar to our study findings, NS was the most common indication for kidney biopsy in all reference studies. A recent systematic review analyzing the incidence of pediatric glomerular disease in 22 Arab countries revealed that MCD (29.25%), FSGS (22.34%), mesangioproliferative glomerulonephritis (MesPGN) (14.78%), MPGN (6.9%), IgAN (3.98%), and membranous glomerulonephritis (MGN)

(2.65%) were the most common glomerular diseases [18]. Similarly, kidney biopsy results of 55 Jordanian children showed that the most common diagnosis was MCD (27%), followed by FSGS (21%), MesPGN (12.7%), and IgAN (7.3%) [19]. It has been shown that NS was the predominant clinical presentation (75.9%) in 58 children, followed by FSGS (29.3%), MCD (20.7%), and MGN (13.8%) in a single-center study from Iraq [20]. The most common glomerulonephritis in 393 Iranian children was FSGS (37.1%) followed by MGN (16.5%) and LN (13.4%) [21]. MCD and FSGS were the most common glomerulonephritis (59%) in 326 children from KSA [22]. The results of a retrospective study from Turkey showed that MPGN (34%), FSGS (23%), and MCD (19%) were the most common histopathological subtypes in 112 children who underwent biopsy [23]. Recently, a descriptive and comparative review examined the changing epidemiology of childhood NS in tropical Africa and stressed that since 1989 the common histopathological types are proliferative glomerulonephritis (27.0%), FSGS (26.3%), MCD (17.7%), MPGN (16.8%), and membranous nephropathy (4.5%) [24].

The results of two large studies from Europe, specifically from Germany and the Czech Republic, have demonstrated that FSGS was more common in children over 10 years old [25], and the most common pathology in children with NS was MCD (39.7%) [26]. According to the Nephrotic Syndrome Study Network (NEPTUNE) report from the USA, MCD and FSGS were the most common diagnoses in children with proteinuria [27]. Focal segmental glomerular sclerosis (39%) and MCD (22%) were the most common pathologies in our study. Although the prevalence may vary between studies, the first three diagnoses appear to be similar to those found in other Arab and neighboring countries as well as in Europe and the USA.

Chronic kidney disease was the third most common disease in Syrian refugee children. A study of Afghan refugees demonstrated that 10.5% of patients with kidney disease were 0–14 years old with the most common referral being CKD stage 5 accounting for 34.6% [28]. In comparison, in the results of our study along with other available data from Syria and neighboring countries together with the European Renal Association-European Dialysis and Transplant Association (ERA-EDTA) and the United States Renal Data System (USRDS), CAKUT was also the most common cause of CKD stage 5 [14, 29–34] (Table 4).

Glomerular disease was the second most common etiology in CKD stage 5. In a study from Syria, the rate of chronic glomerulonephritis was 11% in 55 CKD children [14], while it was 22.4% in our study. From our experience, we did not find the refugee status and/or the resulting external conditions to accelerate progression of kidney disease. As previously mentioned, 94 children had CKD, and almost half of them had CAKUT (44.7%). All of these cases were admitted without any delay to the nearest pediatric nephrology center and optimally treated. Unfortunately, the percentage of unknown etiologies was also high (19.1%). This is one of the most striking points in the registries of most developing countries. Since the etiology is unknown in these cases, it is difficult to determine whether there is an extrinsic delay according to this study. It may be because of insufficient medical records and/or late detection of the disease since kidney failure was already present at the time of the first presentation in most cases. The reasons for late detection could be partially explained by late referral to healthcare centers because of the ongoing conflict and low socio-economic status.

After giving all the necessary information, the family decided on the dialysis modality in cases requiring KRT. Since the Ministry of Health covered expenses for both modalities, the financial burden did not affect the choice of dialysis modality, though most families preferred HD. This choice was partly understandable given the difficulty in providing suitable conditions for PD in refugee camps and/or in residential homes which tend to be small and crowded. Indeed, the frequency of peritonitis per year was higher than in Turkish pediatric PD patients (1.37 ± 1.8 vs. 0.30) [29]. Social and cultural challenges may have played a role in treatment modalities. The German pediatric cohort of pediatric refugee children with KRT mentions that some patients may prefer HD shifts not conflicting with prayer times, and stresses the importance of accommodation of these requests [10]. We did not encounter this problem because of the presence of prayer centers in our hospitals.

Although it is the most effective treatment choice for CKD 5, KTx rates are low in developing countries. In Surgical Kidney Hospital, Damascus, Syria, only 6% of 176 kidney transplant cases were younger than 14 years of age, and all received kidneys from living donors [35]. In this study, only six children had KTx and thus, transplantation was conducted without any issues. In all cases, similar to the transplant cases from Damascus, the donors were parents of the patients [35]. Transplantation policies, including whether to put the children on the transplant waiting list and financial coverage of health care, vary between countries. Lemke et al. stated that 25% of refugee children on KRT underwent KTx, and financial coverage is governed by the German Asylum Seekers Benefits Act [10]. In Turkey, KTx and treatment costs are covered by the Turkish Ministry of Health after the completion of a rigorous examination process by the ethics committee.

Urolithiasis was the fourth most common kidney disease in the Syrian refugee child population. It has been shown that most kidney stones in Syrian children were mixed stones of calcium oxalate and urate and/or phosphate, while pure stones of calcium oxalate or calcium phosphate were less common [36]. In our previous study, hypocitraturia was the most common cause of urolithiasis [15]. Unfortunately, we could not obtain detailed information about the metabolic evaluation

Table 4 Comparison of CKD/CKD 5D and KRT causes in Syrian refugee children with the other countries

Turkey [29] (n = 408)	Jordan [30] (n = 275)	Iran [31] (n = 3596)	Kingdom of Saudi Arabia [32] (n = 66)	Syria CKD [14] (n = 55)	ERA/EDTA [33] (n = 2167)	USRDS [34] (n = 3399)	Current study (n = 94)
CAKUT 24.5%	CAKUT 45.8%	CAKUT 40.82%	CAKUT 50.0%	Neurogenic bladder 27%	CAKUT 30.0%	CAKUT 29.3%	CAKUT 44.7%
GNs 24.3%	Heredofamilial disorders 23.2%	Urological disorders 27.44%	Neurogenic bladder 19.6%	Nephrolithiasis 18%	GNs 17.1%	Primary glomerular disease 21.7%	Glomerular disease 14.9%
VUR/rUTIs 17.4%	Glomerulopathies 26.2%	GNs 19.96%	Glomerular disease 13.6%	Chronic GNs 11%	Cystic kidney disease 9.4%	Cystic/hereditary/ congenital diseases 12.7%	Hereditary cystic disease 12.8%
Neurogenic/ nonneurogenic bladder 7.8%			Hereditary conditions 12.0%	Renal hypoplasia 11%	Hereditary nephropathy 8.6%	Secondary glomerular disease 8.2%	Urolithiasis 6.4%
Nephrolithiasis 0.7%				Reflux nephropathy 7%	Miscellaneous 11.6%	Tubulointerstitial diseases 4.5%	Tubular disorders 2.1%
Other 15.2%				Hereditary nephritis 5%	Unknown 15.2%	Miscellaneous conditions 14.3%	Unknown 19.1%
Unknown 7.4%				Unknown 3%		Etiology missing/ uncertain 5.5%	

CKD chronic kidney disease, *CKD 5D and KRT* kidney failure with replacement therapy, *CAKUT* congenital anomalies of kidney and urinary tract, *GNs* glomerulonephritis, *VUR* vesico-ureteral reflux, *rUTIs* recurrent urinary tract infections

and/or type of stone in this present study. Only five patients had stone analysis. The incidence and the etiology of urolithiasis is variable according to geographical area. It has been shown that, besides the environmental and nutritional factors, metabolic disorders, anatomical abnormalities, and recurrent urinary tract infections are the main causes of stone formation in children. Although the region lies in the geographic "stone belt" of the Middle East, there are limited data about childhood urolithiasis in Arab countries. In this geography where consanguineous marriages are common, metabolic factors may be expected to be the most frequent cause of pediatric urolithiasis. Indeed, the data from neighboring countries support this statement. In a prospective study from Iran, 271 children aged 2 months to 16 years were evaluated [37]. The study found that 99% of cases were kidney stones of which 35.1% had metabolic, 10% infective, and 4.1% obstructive trends, while 110 children had no definite etiology. Hypercalciuria (25.5%), hyperoxaluria (18.4%), and hypocitraturia (18.1%) were more common than uricosuria (8.5%) and cystinuria (3.1%) [37]. Metabolic disorders (52%) were the major cause of stone formation in Iraqi children, and hypercalciuria (41.2%) was the second most common metabolic abnormality, followed by hyperuricosuria (36.3%) and hyperoxaluria (30.9%) [38]. A study from Turkey evaluating 162 children with urolithiasis or microlithiasis revealed metabolic abnormalities in 87% of cases, including hypercalciuria (33.8%), hypocitraturia (33.1%), hyperoxaluria (26.5%), hyperuricosuria (25.4%), hypocitraturia and hypercalciuria (21.1%), hyperphosphaturia (20.8%), and cystinuria (5.7%) [39].

Another patient group frequently followed up in pediatric nephrology clinics was PMNE (10.1%). The excess number of those cases may be due to the severe emotional and social stress of being a refugee.

Parental consanguinity was high in both our previous study (53%) [15] and the present study (56.8%), similar to the rate in Syria (53%) [13] and KSA (52–56%) [17]. The high percentage of parental consanguinity may explain the wide prevalence of CAKUT and also hereditary glomerular and tubular disorders, and highlights the importance of genetic counseling. Education of families about the genetic transmission of kidney diseases by stressing the risks for other siblings, and the possibility of prenatal diagnosis for some, is crucial for prevention.

There are many problems awaiting asylum seekers, such as differences in healthcare strategies between countries, access to related services, financial barriers, complex referral systems, limited health facility capacity, and suboptimal health education [6, 9, 10]. Since healthcare services are free of charge in Turkey, most problems are due to absent/insufficient medical records, language barriers, and disruptions in continuation of treatment and follow-up.

However, it is well known that the cost of KRT is high all over the world. According to our data, 60.6% of 94 children were on dialysis, while 39.4% on medical treatment because of CKD. Therefore, solutions to improve cost-effectiveness should be discussed urgently, and humanitarian solutions independent from the country's policies should be found, especially for children [9–11, 40].

Due to the lack of previous medical records, most patients required more laboratory tests for diagnosis (e.g., etiologies of CKD and chronic glomerulonephritis, detection of VUR). The confirmation of diagnosis is not different from Turkish children. All required genetic tests in state institutions are covered by the Turkish Ministry of Health, excluding some special tests in private centers. Therefore, it would be beneficial for every chronic patient to have a previous medical record to facilitate treatment, reduce cost, and improve effective monitoring in both man-made or natural disasters. Indeed, Sever et al. stressed that preparedness plans of medical professionals are not enough—patients and their families should be included in these plans [40].

The language barrier was one of the critical problems noted in this study. Most physicians could not speak Arabic, and the patients could not speak Turkish and/or English. Therefore, successful and effective communication was mostly dependent on the interpreter's translation capacity. Lemke et al. state that the availability of professional interpreters in hospitals did not meet the actual needs [10]. We have observed that the presence of Arabic-speaking physicians in some nephrology centers, as opposed to professional translators, makes patient follow-up easier. Therefore, a translator with a medical background would be more useful for better patient compliance.

Another problem was disruption in continuation of treatment and follow-up. Although the reasons for irregular follow-up are not fully understood, they may be due to lack of knowledge of the importance of disease and/or the heavy burden of a chronic disease on the patient and their family. Only a few patients refused treatment: these families accepted the disease as a fate and did not want to continue treatment and follow-up.

None of the patients with kidney disease went back to Syria. A few families preferred to go to European countries or Canada. This indicates that most refugees may choose to stay in host countries. For Turkey, this ratio is almost 70.5% [41]. Therefore, every host country should consider this situation and produce a long-term solution. For example, Jordan and Lebanon received support of the World Bank for their "Emergency Health Service Project" [6, 42, 43], and Iran established "Health Insurance System" for Afghan refugees [6, 44].

One of the crucial subjects for refugees is health education, which begins with providing sufficient information to access relevant health institutions and extends to preventive medicine [6]. For example, our visit to one of the biggest camps by thinking what we could do for the prevention of kidney diseases and at least to detect silent hypertensive cases, resulted in the admission of other similar patients [45]. Therefore, offering regular training seminars for refugees, stressing the importance of follow-up in pregnancy, and providing the use of

prenatal ultrasonography to identify congenital kidney anomalies earlier would be beneficial for prevention.

In conclusion, it is crucial to understand the frequency of chronic diseases in refugees with different genetic make-ups, cultural beliefs, and socio-economic status. Coupled with assessment of the problems encountered during treatment and/or follow-up, this strategy will facilitate better treatment options and preventive measures. For this reason, screening programs, especially in camps and densely inhabited areas, are essential for early detection of high-risk groups. Prevention measures can have a positive financial impact by reducing the burden on the health budget in the long term. Such approaches should be encouraged.

Declarations

Conflict of interest The authors declare no competing interests.

References

1. UNICEF (2017) Humanitarian Action for Children- Syrian Arab Republic. unicef.org. https://www.unicef.org/appeals/syria.html Accessed Aug 2017
2. Hassan G, Ventevogel P, Jefee-Bahloul H, Barkil-Oteo A, Kirmayer LJ (2016) Mental health and psychosocial wellbeing of Syrians affected by armed conflict. Epidemiol Psychiatr Sci 25: 129–141
3. Akbarzada S, Mackey TK (2017) The Syrian public health and humanitarian crisis: a "displacement" in global governance? Glob Public Health 44:1–17
4. Aburas R, Najeeb A, Baageel L, Mackey TK (2018) The Syrian conflict: a case study of the challenges and acute need for medical humanitarian operations for women and children internally displaced persons. BMC Med 16:65. https://doi.org/10.1186/s12916-018-1041-1047
5. Aburas R, Najeeb A, Baageel L, Mackey TK (2018) The Brotherhood Medical Center: collaborative foundation of maternity and children's healthcare facility for displaced Syrians. Front Public Health 6:108
6. Akik C, Ghattas H, Mesmar S, Rabkin M, El-Sadr WM, Fouad FM (2019) Host country responses ton on-communicable diseases amongst Syrian refugees: a review. Confl Heal 22:8. https://doi.org/10.1186/s13031-019-0192-2
7. Rabkin M, Fouad FM, El-Sadr WM (2018) Addressing chronic diseases in protracted emergencies: lessons from HIV for a new health imperative. Glob Public Health 13:227–233
8. European Commission (2016) Needs assessment report for the preparation of an enhanced EU support to Turkey on the refugee crisis. https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/2016_needs_assessment_.pdf. Accessed Jun 2016
9. Van Biesen W, Vanholder R, Ernandez T, Drewniak D, Luyckx V (2018) Caring for migrants and refugees with end-stage kidney disease in Europe. Am J Kidney Dis 71:701–709
10. Lemke J, Schild R, Konrad M, Pape L, Oh J, Members of the German Society of Pediatric Nephrology (GPN) (2021) Distribution and management of the pediatric refugee population with renal replacement: a German pediatric cohort. Pediatr Nephrol 36:271–277. https://doi.org/10.1007/s00467-019-04374-9
11. Sever L, Balat A (2020) Renal crisis in children during armed conflict. Semin Nephrol 40:408–420. https://doi.org/10.1016/j.semnephrol.2020.06.008
12. Levey AS, Eckardt KU, Dorman NM, Christiansen SL, Hoorn EJ, Ingelfinger JR, Inker LA, Levin A, Mehrotra R, Palevsky PM, Perazella MA, Tong A, Allison SJ, Bockenhauer D, Briggs JP, Bromberg JS, Davenport A, Feldman HI, Fouque D, Gansevoort RT, Gill JS, Greene EL, Hemmelgarn BR, Kretzler M, Lambie M, Lane PH, Laycock J, Leventhal SE, Mittelman M, Morrissey P, Ostermann M, Rees L, Ronco P, Schaefer F, St Clair Russell J, Vinck C, Walsh SB, Weiner DE, Cheung M, Jadoul M, Winkelmayer WC (2020) Nomenclature for kidney function and disease: report of a Kidney Disease: Improving Global Outcomes (KDIGO) Consensus Conference. Kidney Int 97:1117–1129. https://doi.org/10.1016/j.kint.2020.02.010
13. Nevéus T, von Gontard A, Hoebeke P, Hjälmås K, Bauer S, Bower W, Jørgensen TM, Rittig S, Walle JV, Yeung CK, Djurhuus JC (2006) The standardization of terminology of lower urinary tract function in children and adolescents: report from the standardisation committee of the international children's continence society. J Urol 176:314–324
14. Saeed MB (2005) The major causes of chronic renal insufficiency in Syrian children: a one-year, single-center experience. Saudi J Kidney Dis Transpl 16:84–88
15. Kara MA, Kilic BD, Col N, Ozcelik AA, Buyukcelik M, Balat A (2017) Kidney disease profile of Syrian refugee children. Iran J Kidney Dis 11:109–114
16. Stonebrook E, Hoff M, Spencer JD (2019) Congenital anomalies of the kidney and urinary tract: a clinical review. Curr Treat Options Pediatr 5:223–235. https://doi.org/10.1007/s40746-019-00166-3
17. Kari JA (2012) Pediatric renal diseases in the Kingdom of Saudi Arabia. World J Pediatr 8:217–221
18. Alwahaibi NY, Al Issaei HK, Al Dhahli BS (2019) Incidence of pediatric glomerular diseases in Arab world: a systematic review. Saudi J Kidney Dis Transpl 30:15–23
19. Hadidi R, Hadidi M, alDabbas M (2014) Spectrum of biopsy-proven kidney disease in children at a Jordanian Hospital. Saudi J Kidney Dis Transpl 25:680–683. https://doi.org/10.4103/1319-2442.132238
20. Al-Saegh RM, Assad LW (2013) The spectrum of glomerular diseases as studied by immunofluorescence microscopy a single center study in Iraq. Arab J Nephrol Transplant 6:161–167
21. Mohammadhoseiniakbari H, Rezaei N, Rezaei A, Roshan SK, Honarbakhsh Y (2009) Pattern of glomerulonephritis in Iran: a preliminary study and brief review. Med Sci Monit 15:109–114
22. Alhasan K, Aloudah NM, Bakhit AA, Alhamad YM, Chihabeddine KM, Alfaadhel TA, Aljohani TE, Alhozali HM, Alsuwaida AO (2020) Renal histopathology spectrum in children with kidney diseases in Saudi Arabia, 1998-2017. Saudi Med J 41:369–375. https://doi.org/10.15537/smj.2020.4.24999
23. Ozkaya N, Cakar N, Ekim M, Kara N, Akkök N, Yalçinkaya F (2004) Primary nephrotic syndrome during childhood in Turkey. Pediatr Int 46:436–438. https://doi.org/10.1111/j.1442-200x.2004.01920.x
24. Olowu WA, Ademola A, Ajite AB, Saad YM (2017) Childhood nephrotic syndrome in tropical Africa: then and now. Paediatr Int Child Health 37:259–268. https://doi.org/10.1080/20469047.2017.1374002
25. Franke I, Aydin M, Llamas Lopez CE, Kurylowicz L, Ganschow R, Lentze M, Born M (2018) The incidence of the nephrotic syndrome in childhood in Germany. Clin Exp Nephrol 22:126–132. https://doi.org/10.1007/s10157-017-1433-6
26. Maixnerova D, Jancova E, Skibova J, Rysava R, Rychlik I, Viklicky O, Merta M, Kolsky A, Reiterova J, Neprasova M, Kidorova J, Honsova E, Tesar V (2015) Nationwide biopsy survey of renal diseases in the Czech Republic during the years 1994-

2011. J Nephrol 28:39–49. https://doi.org/10.1007/s40620-014-0090-z
27. Gipson DS, Troost JP, Lafayette RA, Hladunewich MA, Trachtman H, Gadegbeku CA, Sedor JR, Holzman LB, Moxey-Mims MM, Perumal K, Kaskel FJ, Nelson PJ, Tuttle KR, Bagnasco SM, Hogan MC, Dell KM, Appel GB, Lieske JC, Ilori TO, Sethna CB, Fervenza FC, Hogan SL, Nachman PH, Rosenberg AZ, Greenbaum LA, Meyers KE, Hewitt SM, Choi MJ, Kopp JB, Zhdanova O, Hodgin JB, Johnstone DB, Adler SG, Avila-Casado C, Neu AM, Hingorani SR, Lemley KV, Nast CC, Brady TM, Barisoni-Thomas L, Fornoni A, Jennette JC, Cattran DC, Palmer MB, Gibson KL, Reich HN, Mokrzycki MH, Sambandam KK, Zilleruelo GE, Licht C, Sampson MG, Song P, Mariani LH, Kretzler M (2016) Complete remission in the Nephrotic Syndrome Study Network. Clin J Am Soc Nephrol 11:81–89. https://doi.org/10.2215/CJN.02560315
28. Otoukesh S, Mojtahedzadeh M, Cooper CJ, Tolouian R, Said S, Ortega L, Didia SC, Behazin A, Sherzai D, Blandon P (2014) Lessons from the profile of kidney diseases among Afghan refugees. Med Sci Monit 20:1621–1627
29. Registry of the Nephrology, Dialysis and Transplantation in Turkey (2019). Registry. http://www.nefroloji.org.tr/folders/file/registry_2019.pdf. Accessed Oct 2020
30. Akl KF, Albaramki JH, Hazza I, Haddidi R, Saleh SH, Haddad R, Ajarmeh S, Al-Assaf RS, Al-Qadi E (2015) Aetiology of paediatric end-stage renal failure in Jordan: a multicentre study. West Indian Med J 65:263–266. https://doi.org/10.7727/wimj.2014.151
31. Shahdadi H, Sheyback M, Rafiemanesh H, Balouchi A, Bouya S, Mahmoudirad G (2019) Causes of chronic kidney disease in Iranian children: a meta-analysis and systematic review. Ann Glob Health 85:34. https://doi.org/10.5334/aogh.2391
32. Kari JA (2006) Chronic renal failure in children in the western area of Saudi Arabia. Saudi J Kidney Dis Transpl 17:221–228
33. ERA-EDTA Registry Annual Report (2017) https://www.era-edta.org/en/registry/publications/annual-reports/. Accessed Oct 2020
34. United States Renal Data System (2020) 2020 USRDS Annual Data Report: Epidemiology of kidney disease in the United States. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD
35. Saeed MB, Sherif S (2005) Pediatric renal transplantation in Syria: a single center experience. Saudi J Kidney Dis Transpl 16:342–347
36. Hadidy S, Shammaa MZ, Kharma A (1987) Some features of paediatric urolithiasis in a group of Syrian children. Int Urol Nephrol 19:3–8
37. Mohammadjafari H, Barzin M, Salehifar E, Khademi Kord M, Aalaee A, Mohammadjafari R (2014) Etiologic and epidemiologic pattern of urolithiasis in north Iran; review of 10-year findings. Iran J Pediatr 24:69–74
38. Ali SH, Rifat UN (2005) Etiological and clinical patterns of childhood urolithiasis in Iraq. Pediatr Nephrol 20:1453–1457. https://doi.org/10.1007/s00467-005-1971-0
39. Alpay H, Ozen A, Gokce I, Biyikli N (2009) Clinical and metabolic features of urolithiasis and microlithiasis in children. Pediatr Nephrol 24:2203–2209. https://doi.org/10.1007/s00467-009-1231-9
40. Sever MS, Sever L, Vanholder R (2020) Disasters, children and the kidneys. Pediatr Nephrol 35:1381–1393. https://doi.org/10.1007/s00467-019-04310-x
41. Erdogan MM (2020) Syrian barometer 2019 Orion Publishing, Ankara, p 184 https://www.mmuraterdogan.com/?pgid=kewjqheq-6a886be6-d746-4026-b7d1-c664aa35b29d. Accessed Jul 2020
42. World Bank (2017) Jordan-emergency health project. https://projects.worldbank.org/en/projects-operations/project-detail/P163387. Accessed Jun 2017
43. World Bank (2017) Lebanon health resilience project. https://projects.worldbank.org/en/projects-operations/project-detail/P163476. Accessed Oct 2017
44. Guterres A, Spiegel P (2012) The state of the world's refugees: adapting health responses to urban environments. JAMA 308:673–674
45. Kilic BD, Kara MA, Çol N, Alasehirli B, Avsar H, Ozdemir N et al (2015) The prevalence of hypertension in Syrian refugee children. The 3rd Congress of Mediterranean Kidney Society, 10-13 June 2015, Cappadocia, Turkey (oral presentation)

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Affiliations

Ayse Balat[1] · Beltinge Demircioglu Kilic[1] · Bagdagul Aksu[2,3,4] · Mehtap Akbalik Kara[1] · Mithat Buyukcelik[1] · Ayse Agbas[4] · Fehime Kara Eroglu[5] · Tulin Gungor[5] · Demet Alaygut[6] · Nurdan Yildiz[7] · Funda Bastug[8] · Bahriye Atmis[9] · Engin Melek[9] · Midhat Elmaci[10] · Sebahat Tulpar[11] · Cemile Pehlivanoglu[12] · Serra Surmeli Doven[13] · Elif Comak[14] · Yilmaz Tabel[15] · Atilla Gemici[16] · Berfin Uysal[17] · Gamze Seval Ozzorlar[18] · Nuran Kuçuk[19] · Ali Delibas[20] · Gul Ozcelik[21] · Nilufer Goknar[22] · Ismail Dursun[23] · Pelin Ertan[24] · Ipek Akil Ozunan[24] · Ferah Sonmez[25]

1 Division of Pediatric Nephrology, School of Medicine, Gaziantep University, 27310 Gaziantep, Turkey

2 Department of Pediatric Basic Sciences, Institute of Child Health, Istanbul University, Istanbul, Turkey

3 Division of Pediatric Nephrology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey

4 Department of Pediatrics, Haseki Training and Research Hospital, Istanbul, Turkey

5 Division of Pediatric Nephrology, Dr. Sami Ulus Children Training and Research Hospital, Ankara, Turkey

6 Division of Pediatric Nephrology, University of Health Sciences, Tepecik Training and Research Hospital, Izmir, Turkey

7 Division of Pediatric Nephrology, School of Medicine, Marmara University, Istanbul, Turkey

8 Department of Pediatrics, Kayseri Training and Research Hospital, Kayseri, Turkey

[9] Division of Pediatric Nephrology, School of Medicine, Cukurova University, Adana, Turkey

[10] Department of Pediatrics, Konya Dr. Ali Kemal Belviranli Maternity and Children's Hospital, Konya, Turkey

[11] Department of Pediatrics, Bakirkoy Dr. Sadi Konuk Training and Research Hospital, Istanbul, Turkey

[12] Department of Pediatrics, Umraniye Training and Research Hospital, Istanbul, Turkey

[13] Department of Pediatrics, Mersin City Hospital, Mersin, Turkey

[14] Division of Pediatric Nephrology, School of Medicine, Akdeniz University, Antalya, Turkey

[15] Division of Pediatric Nephrology, School of Medicine, Inonu University, Malatya, Turkey

[16] Department of Pediatrics, Aydin Maternity and Children's Hospital, Aydin, Turkey

[17] Department of Pediatrics, Bursa Dortcelik Training and Research Hospital, Bursa, Turkey

[18] Department of Pediatrics, School of Medicine, Gaziantep University, Gaziantep, Turkey

[19] Department of Pediatrics, Kartal Dr. Lutfi Kirdar Training and Research Hospital, Istanbul, Turkey

[20] Division of Pediatric Nephrology, School of Medicine, Mersin University, Mersin, Turkey

[21] Department of Pediatrics, Sariyer Hamidiye Etfal Training and Research Hospital, Istanbul, Turkey

[22] Division of Pediatric Nephrology, Goztepe Education and Research Hospital Istanbul, Faculty of Medicine, Istanbul Medeniyet University, Istanbul, Turkey

[23] Division of Pediatric Nephrology, Faculty of Medicine, Erciyes University, Kayseri, Turkey

[24] Division of Pediatric Nephrology, Faculty of Medicine, Celal Bayar University Hafsa Sultan Hospital, Manisa, Turkey

[25] Division of Pediatric Nephrology, Adnan Menderes University, Aydin, Turkey