Ann Med Res 2021;28(2):296-302

Annals of Medical Research

DOI: 10.5455/annalsmedres.2020.05.513

Original Article

The intersection of two global problems: Refugees and inborn errors of metabolism

Asburce Olgac[1], Nazli Gulenc[2], Cigdem Seher Kasapkara[1], Mustafa Kilic[1], Saliha Senel[2], Leyla Tumer[3]

[1]Department of Pediatric Metabolism, Dr. Sami Ulus Maternity and Child Health Training and Research Hospital, Ankara, Turkey
[2]Department of Pediatrics, Dr. Sami Ulus Maternity and Child Health Training and Research Hospital, Ankara, Turkey
[3]Department of Pediatric Metabolism and Nutrition, Gazi University Medical Faculty, Ankara, Turkey

Abstract

Aim: The aim of this study was to evaluate the awareness of inborn errors of metabolism (IEMs), and their inheritance, symptoms, treatment modalities, and preventive measures among parents of Syrian refugee children who were admitted to our outpatient clinics.

Materials and Methods: A survey using a semi-structured interview questionnaire in Arabic was conducted among randomly selected parents. Demographic data were evaluated. The relationship between demographic data, including education level and income with study variables were analyzed.

Results: 123 parents participated in the study. The rate of consanguinity was 67.5%. The majority (82.9%) of participants were unaware of the term IEM. The education level of parents were shown to have an impact on the knowledge of IEM ($p<0.05$). Nearly all participants mentioned that they wanted to be informed of the newborn screening program of Turkey.

Conclusion: This is a unique study on the awareness of IEM among refugee Syrian population in Turkey. Understanding the level of awareness of CMDs of the refugee population, may improve diagnosis and management strategies, and will be a solution, at least in part, for a global problem.

Keywords: Awareness; inborn errors of metabolism; newborn screening; refugee

INTRODUCTION

Turkey host many Syrian refugees/asylum seekers, who have fled their country over the course of the Syrian Civil War. The estimated amount of Syrian refugees residing in Turkey is approximately 3.5 million around by March 2020, most of them living in various cities in the out camp settlements (http://reporting.unhcr.org/turkey).

The refugee population is a vulnerable group with special conditions, in the need of community-based preventive programs for several health conditions. They face a variety of health problems, especially in children, including nutritional disorders, growth and developmental delay, anemia, under-immunization, and communicable diseases (1). Despite these health needs, they may have psychological trauma, and they are socio-culturally handicapped. Several factors including language problems, cultural differences, and economical factors may decrease their access to health services, affecting their treatment negatively, especially in specific, chronic and complex health issues (2). The burden of congenital metabolic disorders (CMDs) is another problem that Syrian refugees may undertake due to their ethnic background and their limited access to education and information on factors associated with IEM.

Inborn errors of metabolism (IEMs), are described as a group of rare genetic disorders which results from an enzyme defect in a metabolic pathway. IEMs constitute a challenge for health professionals due to their complex clinical, genetic and biochemical nature. They comprise a broad range of genetic diseases most of which are inherited in an autosomal recessive manner, when both parents are carriers of the disorder. Although individually rare, collectively they are common, especially in geographic areas where consanguineous marriages are frequent (3,4).

The incidence of IEMs is higher in the Middle East due to the high rate of consanguineous marriages (5). Waters et al have conducted a meta-analysis and estimated the global birth prevalence of all-cause IEMs to be 50.9 per 100 000 live births, and have shown the birth prevalence rates to be the highest in the Eastern Mediterranean region, correlating with a higher observed rate of parental consanguinity (6).

Received: 21.05.2020 **Accepted:** 06.07.2020 **Available online:** 19.02.2021
Corresponding Author: Asburce Olgac, Department of Pediatric Metabolism, Dr. Sami Ulus Maternity and Child Health Training and Research Hospital, Ankara, Turkey **E-mail:** mabolgac@yahoo.com

Many IEMs result in deteriorating health with progressive psychomotor dysfunction, pain, respiratory distress and early death, if left untreated (7). Newborn screening (NBS) aims to achieve pre-symptomatic and rapid diagnosis of treatable disorders, including some IEMs, for which timely intervention is critical to improve the outcome. It is a cost-effective, highly sensitive and specific test has become a mandatory public health measure in many countries in recent years (8). By providing early diagnosis, NBS may help prevent or reduce morbidity and mortality related to CMDs (9).The National NBS Program (NBSP), which started in Turkey in 1986 as local screening program only for phenylketonuria (PKU) has later transformed into a national program in 2006, and congenital hypothyroidism and biotinidase deficiency were added, and the screening rate reached 95% by 2008, is also applied to all newborns.

Although IEM's are a major pediatric public health problem in Turkey, no such study has been previously conducted on the insight of the refugee population on these disorders. A limited number of studies on Syrian refugees are available in the literature to diagnose their health problems. The need for comprehensive planning of health services for this population has been suggested (10).

In the present study, we aimed to determine the awareness of inherited metabolic diseases among parents of Syrian refugee patients and their attitudes toward various factors associated with IEMs including symptoms, diagnosis, treatment and prevention.

MATERIALS and METHODS

Sample

A survey using a semi structured interview questionnaire in Arabic was conducted among randomly selected parents who brought their children to the outpatient clinics of Dr. Sami Ulus Maternity and Child Health Training and Research Hospital. The study was conducted between March 2019 and December 2019.The study was approved by the ethics committee of Gazi University Medical Faculty (Reference number: 627). Only Syrian refugee parents who were able to speak and read in Arabic were invited to participate in the study.

Measures

The questions of the survey were translated by a certified translator into Arabic, and was checked by a medical doctor whose native language was Arabic for any inconsistencies.

The questionnaire consisted of 2 parts, the first part involved questions about socio-demographic data, and the second part consisted of questions related to knowledge on IEMs.

The socio-demographic data section consisted of fourteen items related to the parent's age, sex, level of education (illiterate, primary school, intermediate school, high school, and university or higher education graduates), religion, status of employment (working vs. unemployed), income (sufficient vs. insufficient), length of residence in Turkey (less than 1 month, 1-6 months, 6-12 months, 1-2 years, >2 years), place of residency (urban vs. suburb), consanguinity of parents, parity, number of siblings, history of child death (Table 1).

Table 1. Demographic data of participants

	Mean	± SD
Age (Year)	29.33	8.14
Number of siblings	2.87	1.67
Parity	3.11	1.79
	N	**%**
Sex		
Female	74 (60.2%)	
Male	49 (39.8 %)	
Religion		
Islamic	122	99.1
Non-islamic	1	0.9
Duration of Residence in Turkey		
< 1 month	5	4.1
1-6 months	9	7.3
6-12 months	13	10.6
1-2 years	28	22.8
>2 years	68	55.3
Place of residency		
Urban	108	87.8
Sub-urban	15	12.2
Education		
Illiterate	23	18.7
Primaryschool	33	26.8
Intermediateschool	30	24.4
High school	17	13.8
University or higher education	20	16.3
Workstatus		
Unemployed	88	71.5
Permanentjob	35	28.5
Income		
Sufficient	31	25.2
Insufficient	92	74.8
Consanguinity		
None	40	32.5
First-degree cousins	58	47.2
Second-degree cousins	21	17.1
≥ Third-degree cousins	4	3.3
History of childdeath		17
Causality of war	2	
Known CMD	2	
CHD	2	
Brain disease	1	
Prematurity	1	
Unknown	22	

Table 2. Answers of parents participated in the study

	n (%)
Which of the following items can be a symptom/ symptoms of CMDs ?	
Mental retardation	33 (26.8 %)
Feeding disorder	31 (25.2 %)
Muscle weakness	29 (23.6 %)
Epilepsy	25 (20.3 %)
Hearing loss	18 (14.6 %)
Loss of vision	15 (12.2 %)
Respiratory distress	24 (19.5 %)
Metabolic acidosis	14 (11.4 %)
Low blood sugar	21 (17.1 %)
Heart disease	17 (13.8 %)
Liver and spleen enlargement	20 (16.3 %)
Renal disease	10 (8.1 %)
Sudden infant death syndrome	10 (8.1 %)
Bone disease	25 (20.3 %)
Which treatment options are available for CMDs?	
Medications	29 (23.6 %)
Special diets	30 (24.4 %)
Liver transplantation	16 (13 %)
Bone marrow transplantation	13 (10.6 %)
CMDs cannot be cured	8 (6.5 %)
No idea	68 (55.3 %)
Which diseases are screened by NBS in Turkey?	
Phenylketonuria	8 (6.5 %)
Biotinidase deficiency	11 (8.9 %)
Hypothyroidism	7 (5.7 %)
No idea	108 (87.8 %)
Due to which of the following reason/s would you like to know if your child has a CMD?	
To start treatment early	63 (51.2 %)
To prepare for the circumstances due to CMD	33 (26.8 %)
For family planning and genetic consultancy	18 (14.6 %)
I would not like to know if my child has a CMD	9 (7.3 %)

The second section of the form consisted of twenty-one items that questioned the parent's familiarity with IEMs, inheritance pattern and its relation with consanguinity, clinical symptoms, specific treatments, termination of pregnancy due to IEM, preimplantation genetic diagnosis (PGD), NBS, and requisition for information on IEMs (Table 2 and Table 3).

Procedure

The questionnaire in Arabic was offered to 250 parents who brought their children to the outpatient clinics of Dr. Sami Ulus Maternity and Child Health Training and Research Hospital between March 2019 and December 2019.Since the exact population of the study could not be foreseen, the sample size was accepted as to the referral of the specified patient group. Clinic staff and the coordinator department of the hospital were briefed about the study. 160 parents accepted to participate in the study. The major reasons for refusal to complete the questionnaires were unwillingness, and lack of time and interest. Among the 160 parents that agreed to participate, 123 parents had completed the questionnaire completely (Figure 1). After obtaining written consent, the parents were asked to fill in the questionnaire separately by themselves that took about 5 minutes in a private treatment room to enable them to feel comfortable.

The names of the parents and patients were kept confidential.

Data analysis

Data were analyzed using SPSS version 26. Frequencies, means, and standard deviations of the demographic variables were calculated. To examine relationships between demographic data including education level and income with study variables, Chi-square tests were used. The results in different categories were evaluated for their statistical significance (p-value).

Table 3. Percentages of answers to various questions and comparison with Chi-squate test according to education level

	Answer	Total n (%)	1 E + 2E + 3E n(%)	4E +5E n(%)	p
Have you ever heard of "Congenital metabolic disorders (CMDs) before?"	Yes	21 (17.1 %)	12 (14.0%)	9 (24.3%)	0.161
	No	102 (82.9 %)	74 (86%)	28 (75.7%)	
Are CMDs inherited from one generation to the next?	Yes	42 (34.1 %)	29 (33.7%)	16 (43.3%)	0.315
	No	81 (65.9 %)	41 (47.7%)	15 (40.5%)	
			16 (18.6%)	6 (16.2%)	
Can CMDs also occur in the sibling of a child with CMD?	Yes	46 (37.4 %)	28 (32.6%)	18 (48.6%)	0.091
	No	36 (29.3 %)	24 (27.9%)	12 (32.4%)	
	No idea	41 (33.3 %)	34 (39.5%)	4 (19%)	
Can CMDs occur in a child even if his/her parent does not show any sign of CMD?	Yes	11 (8.9 %)	7 (8.1 %)	4 (10.%)	0.634
	No	28 (22.8 %)	23 (26.7%)	5 (13.5%)	
	No idea	84 (68.3 %)	56 (65.1%)	28 (75.7%)	
Are CMDs more likely to occur in children whose parents are consanguineous?	Yes	17 (13.8 %)	12 (14.0%)	5 (13.5%)	0.948
	No	32 (26 %)	21 (24.4%)	11 (29.7%)	
	No idea	74 (60.2 %)	53 (61.6%)	21 (56.7%)	

Does the clinical signs of CMDs only start at the neonatal period?	Yes	36 (29.3 %)	25 (29.0%)	11 (29.7%)	
	No	27 (22 %)	17 (19.8%)	10 (27.0%)	0.948
	No idea	60 (48.7 %)	44 (51.2 %)	16 (43.7%)	
Is it important to diagnose CMDs early?	Yes	48 (39 %)	33 (38.4%)	15 (40.6%)	
	No	11 (9 %)	8 (9.3%)	3 (8.2%)	0.620
	No idea	64 (52 %)	45 (52.3%)	19 (51.3%)	
Can some CMDs be treated?	Yes	53 (43.1 %)	35 (40.7%)	18 (48.6%)	
	No	9 (7.3 %)	7 (8.1%)	2 (5.4%)	0.414
	No idea	61 (49.6 %)	44 (51.2 %)	17 (45.9%)	
Can a pregnancy for a baby with an untreatable CMD be aborted?	Yes	42 (34.1 %)	27 (31.4%)	15 (40.5%)	
	No	45 (36.6 %)	18 (20.9%)	16 (43.2%)	0.327
	No idea	36 (29.3 %)	41 (47.7%)	6 (16.2%)	
Can parents who are carriers to a CMD can have a healthy baby by the help of in vitro fertilization?	Yes	37 (30.1 %)	21 (24.4%)	16 (43.3%)	
	No	54 (43.9 %)	40 (46.5%)	14 (37.8)	**0.037**
	No idea	32 (26 %)	25 (29.1%)	7 (18.9%)	
Have you ever heard of the newborn screening (NBS) program before?	Yes	46 (37.4 %)	26 (30.2%)	20 (54.1%)	
	No	77 (62.6 %)	60 (69.8%)	17 (45.9%)	**0.012**
	No idea				
Should NBS be mandatory?	Yes	39 (31.7 %)	22 (25.6%)	17 (46.0 %)	
	No	43 (35 %)	31 (36.0%)	12 (32.4%)	0.620
	No idea	41 (33.3 %)	33 (38.4%)	8 (21.6%)	
Should all newborn babies undergo NBS?	Yes	65 (52.8 %)	38 (44.2%)	27 (73%)	
	No	19 (15.4 %)	16 (18.6%)	3 (8.1%)	**0.026**
	No idea	39 (31.8 %)	32 (37.2%)	7 (18.9%)	
Should a CMD be screened in the neonates even if it is untreatable?	Yes	62 (50.4 %)	37 (43.0%)	25 (67.5%)	
	No	17 (13.8 %)	13 (15.1%)	4 (10.8%)	**0.013**
	No idea	44 (35.8 %)	36 (41.9%)	8 (21.6%)	
Would you like to be informed about CMDs by the health professionals?	Yes	74 (60.1 %)	47 (54.6%)	27 (73%)	
	No	6 (4.9 %)	3 (3.5%)	3 (8.1%)	0.057
	No idea	43 (35 %)	36 (41.9%)	7 (18.9%)	

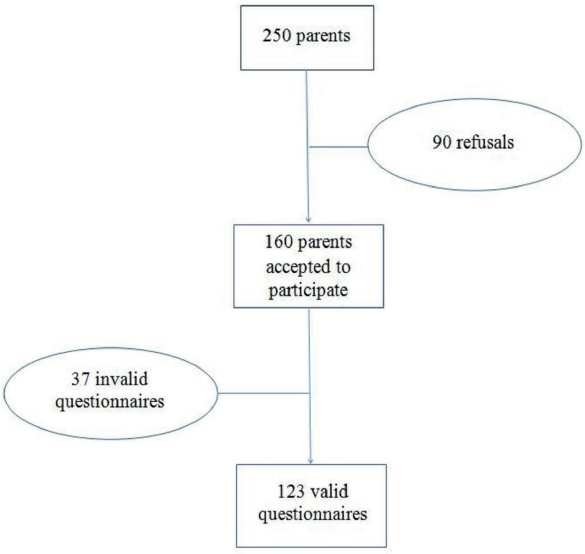

Figure 1. Flowchart of parents enrolled in the study

RESULTS

One hundred twenty-three parents participated in the study. The average age of parents was 29.33 ± 8.14 (range: 17-61 years), and 1.5% was under 18 years of age. The number of fathers interviewed was 49 (39.8 %) and mothers were 74 (60.2%). Only one parent was non-Muslim. 89 % of parents were living the urban areas of the city. 54.5% of participants were residing in Turkey more than 2 years.

The educational level of the parents was categorized as follows: illiterate (1E, 18.7%), primary school (2E, 26.8%), intermediate school (3E,24.4%), high school (4E, 13.8%),and university or higher education graduates (5E, 16.3%). Educational level was evaluated within two categories (Being illiterate and having a degree of primary and intermediate school were categorized as having a low educational level-1E + 2E+ 3E , while having high school, university or higher degrees were categorized as high educational level- 4E + 5E).

Eighty eight parents (71.5%) was unemployed, while 35 (28.5%) had a job. Twenty-five percent of parents stated that their income was sufficient, while 74.8% claimed to havean insufficient salary.

The consanguinity rate among the participants was 67.5%, where 70% were first-degree cousins, 25% second-degree cousins, and 5% third-degree cousins or more distant. Forty parents were non-consanguineous with their spouse. Average number of siblings in a family was

2.87 ± 1.67 (range: 1-11). Average parity was 3.11 ± 1.79. Seventeen percent of parents reported history of child death due to various conditions (casualty of war, n=2; metabolic disorders, n=2; congenital heart diseases, n=2, brain disease, n=1; prematurity, n=1; unknown etiology n=22).

Demographic data is summarized in Table 1.

The results showed that the majority of the parents (82.9%) had no knowledge of the term CMDs. Also, the majority of parents either thought CMDs were not inheritable (37.3 %), or did not have any idea about genetic inheritance pattern (28%). Sixty percent did not know about the effects of consanguinity on IEMs, and 26% did not agree with the statement that CMDs were more likely to occur if parents were consanguineous (Table 2)

The most common symptom that was thought to be related with CMDs was mental retardation (26.8%), followed by feeding disorder (25.2%), and muscle weakness (23.6%) (Table 3). Twenty-nine percent of parents thought CMDs were symptomatic only at the neonatal period. While 39% thought that early diagnosis of CMDs was important, 52% had no idea of this condition (Table 2).

Only 37 % of the participants knew about the NBS program, and 31.7 % thought that NBS should be mandatory. While the majority thought that all newborns should be screened for CMDs (52.8 %), and even for the untreatable ones (50.4 %), 87.8 % of parents did not have an idea about the diseases that were screened in the NBS program in Turkey (Table 3).

Although 43.1 % of parents thought that CMDs were treatable, 55.3 % of parents did not have an idea about the treatment options (Table 2). Medications and special diets were the most common treatment choices of CMDs (Table 3).

Sixty percent of parents wanted to get further information on CMDs. The majority of parents (64.2 %) claimed that they would like to know if their child had a CMD. The reasons were rated as following: 51.2 % thought early diagnosis and initiation of early treatment was important 26.8 % wanted to prepare for the circumstances related

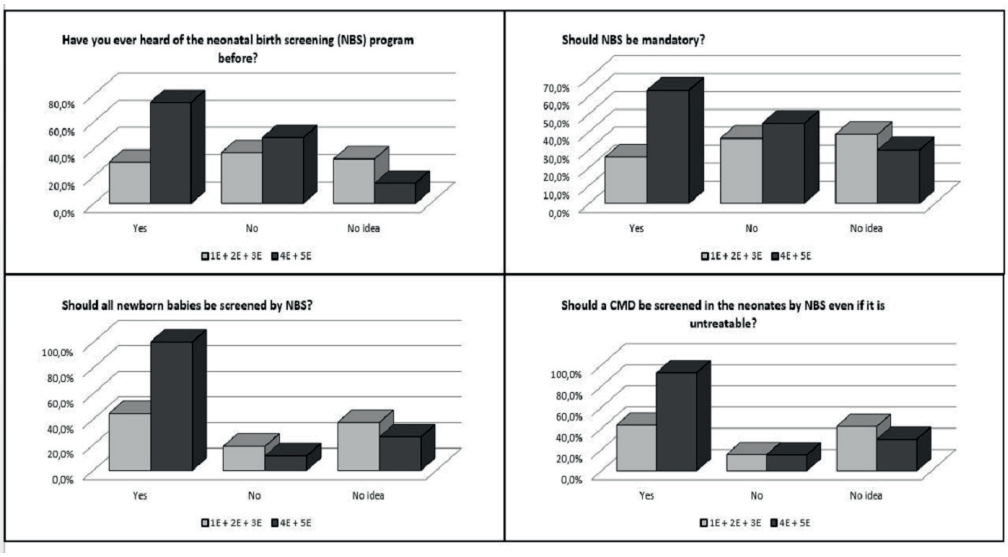

Figure 2. Answers of parents according to their educational level

to CMD, 14.6 % stated that they would require family planning and genetic consultancy, if one of their child had a CMD (Table 2).

Statistical analyses were used to determine the effects of education and income on the knowledge of certain items related with IEMs. No relationship between income and awareness on CMDs were detected ($p > 0.05$). When the knowledge of parents and their relationship with their educational level was evaluated, it was seen that, parents with a higher educational level (high school, university or higher degrees) were more acquainted with PGD ($p=0.037$) and the NBSP ($p=0.012$) (Table 3).The answers of parents with different educational levels is shown in Figure 2 and Table 3. According to the results of the statistical analyses, parents who had a higher degree of education had significantly better knowledge on the necessity of CMDs ($p=0.026$), and a significantly higher percentage of educated parents stated that all newborns should be screened by NBSP ($p=0.03$), even for untreatable metabolic disorders ($p=0.013$). However, even the educated parents were unaware of the NBSP of Turkey. Among the participants of the study, 87.8 % stated that they have not had heard about the program before (Table 3).

DISCUSSION

There has been an ongoing civil war in Syria since 2011, and the undesirable effects the war conditions on children are inevitable, especially on refugees. According to the World Health Organization (WHO), access to healthcare for refugees is often restricted in host countries, and this is exacerbated by various reasons such as a lack of

inclusive policies, language and cultural barriers, financial ability to afford, and legal status (http://www.euro.who.int/). Refugees have to cope with many problems related with housing, nutrition, education, and especially health. Torun et al (1) reported that the most important problems of immigrants were language inadequacy, insufficient information, and lack of access to health services.

Despite adequate support provided by the government, identifying and addressing the health problems of Syrian refugees remain an issue. Developing new public health strategies for them that consider disadvantageous situations including language, low economical means and illiteracy is crucial (10). In order to address the needs of parents related with CMDs, it is important to learn their level of knowledge on these disorders. Our study is the first in the literature that has surveyed the knowledge of refugee parents on metabolic disorders.

Especially in the case of chronic and rare conditions, access to complete medical services of refugees that comprises of several items including diagnosis, follow-up, treatment and genetic consultancy may be constrained. Schiergens et al (11), have evaluated refugee pediatric patients of IEMs, and they have emphasized that complex chronic diseases may be overlooked in this population, since acute problems such as infectious diseases or trauma will be in focus. Therefore, they have suggested implementing screening programs for IEMs as part of the routine asylum application process for pediatric refugees.

Al Essa et al (12), have evaluated 500 Saudi parents who had a child with a known metabolic disorder, with a detailed questionnaire, and concluded that over 50% of the parents had no knowledge of the causes of their children's disease, its symptoms, inheritance or therapeutic modalities. They have also observed that level of education had a significant effect on the knowledge of CMDs of parents. It may not be irrational to expect the refugee population with several limitations to be ignorant of the rarely encountered and complex IEMs. Our study indicates that the majority of refugee parents are unaware of etiologies, symptoms, inheritance, and treatment options of IEMs. The results were more conspicuous among illiterate parents. Parents with a higher education level were significantly more aware about PGD and the NBSP.

Because being a carrier for an IEM does not cause any effect on health, most parents are unaware of their carrier status before having child with a CMD, and most affected children are the first child identified in the family (13). It is well known that the outcome of many IEMs is related with early diagnosis and treatment. Although screening programs aid to the early recognition of some, the education of refugee parents on the symptoms and causes of CMDs is crucial, since only a limited number of these diseases can be screened in the NBSP, and also their older children may already have an undiagnosed CMD.

Several studies in the literature have shown the public knowledge on the screening programs to be scarce, even in developed countries (14-16). In a recent study of Fitzpatrick et al, parental awareness on NBSP of Irish mothers were shown to be low (17). The authors have suggested the information provided to expectant mothers by health professionals on NBSP to be improved. A similar study of Mak et al (8) showed that the knowledge and awareness among the public in Hong Kong was shown to be seriously poor: 83% and 87.8% had never heard of the existing local newborn screening and expanded newborn screening respectively. Aria et al (16) have conducted a study among 1712 mothers on the knowledge of NBS and have shown that ' higher knowledge of newborn blood-spot screening was associated with higher level of education. Similarly, in our study, the percentage of parents that were not familiar with the NBSP was 63 %, and the knowledge on NBSP was found significantly correlated with educational levels of parents.

Although all newborns in Turkey are screened by the NBSP for phenylketonuria, biotinidase deficiency, hypothyroidism, and cystic fibrosis), unrecorded babies will not get the chance to be evaluated, unless they are admitted to a health care facility. For this reason, the NBSP should also be a part of the education program of refugees. Since treatment modalities including enzyme replacement therapies are covered by the Turkish healthcare system for registered refugees, increasing their knowledge on IEMs, especially treatable ones, may prevent further brain and organ damage. Furthermore, since the refugee population residing in Turkey is in a dynamic situation and tend to move to certain countries in Europe, increasing their knowledge on CMDs will be a solution, at least in part, for a global problem.

We suggest that, a public health education program needs to be carried out, in order to raise awareness on CMDs, so that early admissions to metabolism clinics can be made to provide early diagnosis and initiate treatments, especially for treatable IEMs (i.e.leaflets in various languages on CMDs in simple language, or educational sessions that provide simple information on symptoms and treatment choices, underlining the genetic basis of CMDs can be provided by an experienced metabolic team consisting of doctors, nurses and dieticians). Due to the fact that IEMs are more frequent in the middle-eastern communities, and since birth control may not be effectively carried out in the refugee population due to several factors (i.e. inaccessibility to birth control pills, religious factors, and unwillingness), public education for CMDs and NBSP should be a priority.

LIMITATIONS

Our study has several limitations. First of all, since a validated questionnaire regarding CMDs is not available, only a semi structured interview could be performed. Secondly, the sample size was also limited due to the fact that it was specified according to the amount of referrals of Syrian patients to our department in a certain period of time. Nevertheless, further studies that include a larger sample size are definitely required.

CONCLUSION

Although being rare diseases, CMDs should also be taken into consideration in the refugee population, since they may easily be overlooked. Also, due to the fact that many IEMs can be treated effectively, it is important to inform refugees about those diseases and their presentation, genetic nature, methods of prevention, and treatment. Understanding the level of awareness of CMDs of the refugee population, may improve diagnosis and management strategies concerning IEMs.

Acknowledgements: We thank all of the parents of our precious patients for participating in our study.

Conflict of interest : The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: The study was approved by the ethics committee of Gazi University Hospital (Reference number: 627).

REFERENCES

1. Torun P, Karaaslan MM, Sandikli B, et al. Health and health care access for Syrian refugees living in Istanbul. Int J Public Health 2018;63:601-8.
2. Ekmekci PE. Syrian refugees, health and migration legislation in Turkey. J Immigr Minor Healt 2017;19:1434-41.
3. El-Hattab AW. Inborn Errors of Metabolism. Clin Perinatol 2015;42:413-39.
4. Afzal RM, Lund AM, Skovby F. The impact of consanguinity on the frequency of inborn errors of metabolism. Dan Med J 2018;65:A5508.
5. Hamamy H. Consanguineous marriages: Preconception consultation in primary health care settings.J Community Genet. 2012;3:185-92.
6. Waters D, Adeloye D, Woolham D, Wastnedge E, et al. Global birth prevalence and mortality from inborn errors of metabolism: a systematic analysis of the evidence. J Glob Health 2018;8:021102.
7. Hatzmann J, Peek N, Heymans H, et al. Consequences of caring for a child with a chronic disease: Employment and leisure time of parents. J Child Health Care 2014;18:346-57.
8. Mak CM, Lam CW, Law CY, et al. Parental attitudes on expanded newborn screening in Hong Kong. Public Health. Nov 2012;126:954-9.
9. El-Hattab AW, Almannai M, Sutton VR. Newborn Screening: History, Current Status, and Future Directions.Pediatr Clin North Am 2018;65:389-405.
10. Ardic A, Esin MN, Koc S, et al. Using the Omaha System to determine health problems of urban Syrian immigrants. Public Health Nurs 2019;36:126-33.
11. Schiergens KA, Staudigl M, Borggraefe I, et al. Neurological Sequelae due to Inborn Metabolic Diseases in Pediatric Refugees: Challenges in Treating the Untreated.Neuropediatrics 2018;49:363-8.
12. Al Essa M, Ozand PT, Al-Gain SI. Awareness of inborn errors of metabolism among parents in Saudi Arabia. Ann Saudi Med 1997;17:562-4.
13. Henneman L, Borry P, Chokoshvili D, et al. Responsible implementation of expanded carrier screening. Eur J Human Genet 2016;24:1-12.
14. Detmar S, Hosli E, Dijkstra N, et al. Information and informed consent for neonatal screening: opinions and preferences of parents.Birth 2017;34:238-44.
15. Campbell ED, Ross LF. Incorporating newborn screening into prenatal care. Am J Obstet Gynecol 2004;190:876-7.
16. Araia MH, Wilson BJ, Chakraborty P, et al. Factors associated with knowledge of and satisfaction with newborn screening education: a survey of mothers. Genet Med 2012;14:963-70.
17. Fitzpatrick P, Fitzgerald C, Somerville R, et al. Parental awareness of newborn bloodspot screening in Ireland. Ir J Med Sci 2018;188:921-3.