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ORIGINAL ARTICLE

Child and adolescent health in northwestern Syria: findings from Healthy-Syria 2017 study

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ABSTRACT

Objectives: Since the uprising in 2011, there has been limited health-care data from inside Syria in the academic literature. This study aims to provide an updated account of pediatric health needs in the northwestern part of Syria; this should help inform the management and delivery of health-care services in this population. **Methods:** This is a prospective study, using a data registry, of all pediatric patients seen in a single center in northwestern Syria, between February and December 2017. We used international classification of diseases (ICD-10) codes to define cases, and tested several covariates, including age, sex, season of the year, and conditions of living for possible correlations with major illness categories. **Results:** We included 11,819 patients, of whom 5,288 (45%) were male and 6,531 (55%) were female. Collectively, these patients had 23,427 encounters. Respiratory diseases were the most encountered illnesses among all age groups (6320 [27%]), except late teen females, among whom gynecological/obstetric complaints dominated. Infectious diseases caused the greatest disease burden across all age groups, with upper respiratory tract infections (URTIs), infectious diarrhea, and otitis media representing almost half (47%) of all cases in this category. Nutritional deficiencies were diagnosed in 978 patients (8%), mostly in infants and toddlers (92%). We identified 1192 (17%) cases of acute diarrhea among all age groups, making it the second most common condition after URTIs. As compared to town residents, patients living in camps for internally displaced people accounted for more cases of infectious diarrhea (58%), chronic anemia (60%), and malnutrition (66%), especially severe acute malnutrition (76% of malnutrition cases). Vaccine-preventable illnesses represented a sizable category; we reported 69 cases of hepatitis A, 2 of poliomyelitis, 9 of pertussis, 37 of varicella, 11 of mumps, 8 of rubella, and 1 case of measles. **Conclusion:** We have identified urgent health-care issues in this population, including extreme malnutrition, high rates of infectious diseases, and high rates of teenage pregnancy. Also, we observed a relapse of some vaccine-preventable illnesses, such as mumps and rubella, which are likely associated with the decline in vaccination rates.

Key words: Atmeh, burden of disease, child and adolescent health, internally displaced people, Syrian crisis, teenage pregnancy

INTRODUCTION

The eruption of conflict in Syria has brought the country's health-care system to collapse. The destruction of health-care

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facilities, critical shortages of supplies and personnel, and mass displacement of people from one part of the country to another have contributed to the failure of health-care delivery that has been described elsewhere extensively.[1-5] Recent estimates indicate that more than 5.6 million people have fled Syria as refugees, and 6.5 million people have been internally displaced.[6] Many local, regional, and international organizations have extended their assistance. Their efforts, however, remain limited and often uncoordinated. Among the nongovernmental organizations (NGOs) is the Syrian Expatriate Medical Association (SEMA), formed by a group of health-care professionals who are dedicated to providing the affected population with the much needed health-care services.[7]

Efforts to implement and maintain health information systems (HIS) in humanitarian crises or conflict areas, which meet international data protection standards, have been challenging. In Syria, further challenges include the exodus of staff who could carry out this work, the volume of work particularly at the time of attacks, the targeting of health facilities, and the intermittent internet connectivity. To address the gap in HIS, SEMA implemented a data collection and reporting system in SEMA-affiliated health-care facilities called "HealthySyria^{TB}," which enables data collection from the field; the main aim is to support reporting and planning for SEMA's health programs.

The Healthy-Syria project is a comprehensive medical project that aims to highlight the health-care challenges in Syria, especially in areas where internally displaced people (IDP) live. The project is inspired by the Global Burden of Disease (GBD) group experience and findings,[8] and envisioned to provide a good start, not only for patient care but for clinical research as well. This study is part of the Healthy-Syria 2017 project.

The aim of this study was to review the cohort data obtained prospectively from the routine clinical care of patients using the newly implemented HIS. The focus was on the clinical presentations of children and adolescents with a view to describing their disease burden and understanding their health-care needs.

METHODS

Overview

The SEMA is an NGO that was established in 2011 to serve the medical needs of people in Syria, especially those living in IDP camps. By 2017, it had registered branches in a number of countries including the United States, Turkey, Italy, and France with 40 affiliated medical facilities in Syria and neighboring countries (http://www.sema-us.org/).

The HealthySyria^{TB} program includes a simplified electronic medical record system developed by the authors (A.S.T. and B.B.). It is designed to describe morbidity and mortality records. The goal is to provide reliable and updated reports to help optimize health-care efforts, through an improved distribution of resources (financial, logistics, and man power), and to guide future structural improvement projects including a telemedicine system. We introduced this program in one of the SEMA-affiliated centers, in February 2017 and are in the process of gradually implementing it in the rest of our facilities. More information about the system is available as a video at https://vimeo.com/240285087 and the online version is available at www.healthysyria.net.

The study center is located in the northwest Syrian in a town called Atmeh, which is situated in Idlib governorate; the town is close to several camps that house scores of IDP [Figure 1]. During the study period, the study center served an estimated population of 500,000 people who settled within an area of approximately 65 km^2. Approximately, 250,000 people lived in this area before 2011.[9] However, as this area was considered relatively safe, because of its proximity to the Turkish border, the population density in this area continued to increase with each new wave of displacement; the most recent evacuation of civilians from eastern Ghouta in April 2018 resulted in an additional 300,000 to the population in Idlib governorate, some of whom reside in this area.

In the study district, there are a total of five medical centers, one specializing in burns, one in trauma and general surgery, one in trauma and orthopedic surgery, and two in women's and children's health. The study center offers free services for women and children health care; it is equipped with a pharmacy and a medical laboratory, which can process all basic laboratory workups. Our center is within 1 km distance from all IDP camps. All services are provided without charge. The children of this area are served by a total of nine physicians (five pediatricians and four pediatric residents). Six of these physicians, including three residents, are based in the study center. One visiting pediatric neurologist contributes to the care of these patients for 8-h shift on a weekly basis.

Data collection

This is a prospective data registry study, conducted under SEMA—institutional review board, approval number (2017-03). Data collection spans from February to December 2017. After the pediatrician makes a diagnosis, data entry is assigned to a dedicated staff member who inputs all the information related to patients' file using "HealthySyria^{TB}" program. All diagnoses entered are based on the international

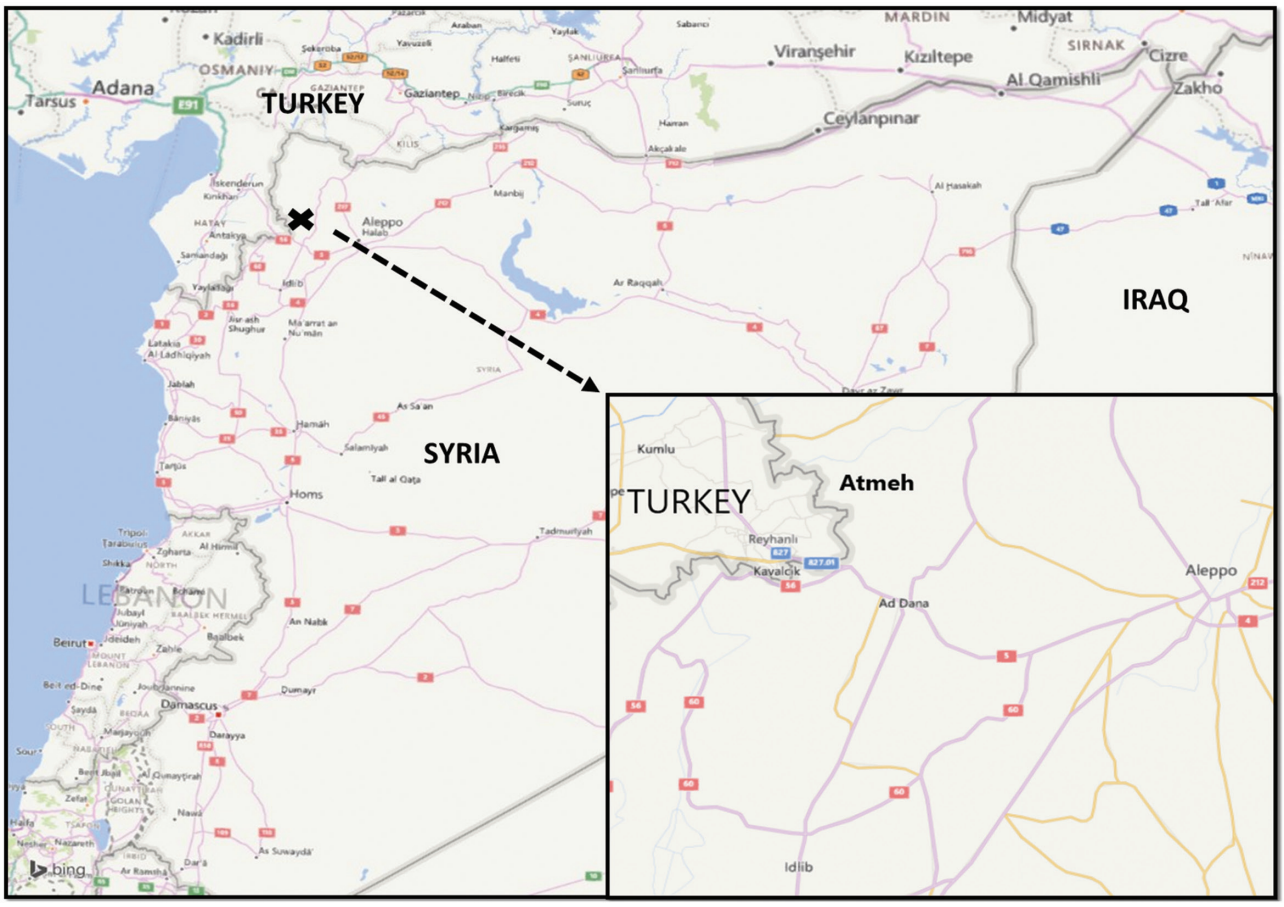

Figure 1: The study center location represented by the (x) sign in the map

classification of diseases (ICD-10) coding system, which has helped to reduce differences in reporting and has decreased the impact of language barriers among providers. Data were entered on daily basis, saved in a local server then synchronized with the mother server. The program designates a unique medical record number (MRN), composed of 12 digital figures and letters for each patient. This unique MRN prevents duplication and maintains anonymity for data analysis and maintains the patients' records for future use. On each subsequent visit, the program will create a new encounter for each department the patient uses. The minimum required data to create a medical record or register a visit include patient's name, date of birth, social number, sex, living conditions (IDP vs. resident), visit date, and diagnosis. Other recommended information includes height, weight, blood group, and drug allergies.

The pediatric clinic is open from Sunday to Thursday from 8 am to 3 pm, and the hospital provides 24-h emergency services. Once the patient arrives, the nurse performs a triage check including the vital signs and anthropometric measurements, then the patient is medically evaluated. On average, the pediatric clinic serves 50 patients a day. Newborn infants are usually assessed soon after birth by the on-call pediatrician who provides any required resuscitation; after 2 h of the customary care and stabilization, the infant is usually discharged home with his or her mother if they are well.

Data management

We divided patients into six distinct age groups: neonates (1–27 days), infants (28–364 days), toddlers (1–4 years), childhood (5–9 years), early teenage (10–14 years), and late teenage (15–19 years) groups. This classification has been used consistently in large epidemiological studies, such as the GBD 2016 study.[10]

Prevalence is presented as frequency and percentage for each disease entity. The denominator used for percentages is the total number of patients seen at the center. Thus, patients who visited the center but did not receive a diagnosis (e.g., normal examination) were included in the denominator for calculating the percentage/prevalence rates. The patient's condition of living is based on the location of residence; those who reside in any one of the IDP camps were designated as IDP, whereas those who lived outside the camp, whether renting or owning homes, were classified as town residents; some of this latter group could also be IDP from other areas.

In any given patient, when a diagnosis of an infectious disease was made within 2 weeks of a similar diagnosis, we considered both as a continuum of one disease entity that have not abated yet.

Online Supplementary Table 1 enlists the ICD-10 codes used in grouping diseases/conditions reported in this study, based on definitions used in previous GBD study.[10]

We used the World Health Organization (WHO) criteria for diagnosing acute malnutrition based on three criteria; mid-upper arm circumference (MUAC), weight-for-height/length (*z* score), and clinical (i.e., presence of edema). Although severe acute malnutrition (SAM) is defined by a very low weight-for-height (below – 3 *z* scores of the median WHO growth standards), by visible severe wasting (based on MUAC), or by the presence of nutritional edema.[11] The MUAC was mainly used for patients aged between 6 and 59 months, plus their *z* score. Although for patients under 6 months old, we mainly used the *z* score.

For acute diarrheal diseases, we used the WHO classification,[12] which classifies acute diarrhea into three categories:

1. Acute watery diarrhea: lasts several hours or days, and includes cholera
2. Acute bloody diarrhea: also called dysentery
3. Other acute diarrhea: not included in the above two categories

Finally, correlation between the prevalence of encountered diseases/conditions and potentially related variables was explored. We evaluated the effect of age, sex, season of the year, and condition of living (IPD vs. town resident) on the incidence of the most common communicable diseases and nutritional deficiencies.

Statistical analysis

We present descriptive results, using frequency, percentage, mean, standard deviation (SD), median, and minimum and maximum numbers (min – max), as appropriate. We used the chi-square test to calculate *P* values when comparing categorical and frequency results. We used McNemar's test to compare odd ratios (OR). We considered a *P* value of 0.05 or less as statistically significant. Analyses were carried out and graphs were prepared using Excel 2017 (Microsoft) and R version 3.3.2.

RESULTS

We included 11,819 patients in this study, of them 5,288 (45%) were males and 6,531 (55%) were females. Among these patients, 6300 (53%) lived in an IDP camp and 5,520 (47%) were residents in town. Their age distribution is as follows:

- Neonates: 862 (7%) patients, 467 (9%) males and 395 (6%) females, from all cases
- Infants: 3662 (31%) patients, 1921 (36%) males and 1741 (27%) females, from all cases
- Toddlers: 2383 (20%) patients, 1267 (24%) males and 1116 (17%) females, from all cases
- Childhood: 2103 (18%) patients, 1142 (22%) males and 961 (15%) females, from all cases
- Early teenage: 988 (8%) patients, 455 (9%) males and 533 (8%) females, from all cases
- Late teenage: 1821 (15%) patients, 36 (1%) males and 1785 (27%) females, from all cases

A total of 23,427 patient encounters were observed during the study period; 19,740 resulted in a recorded diagnosis. Encounters because of respiratory diseases topped the list of the most common illness categories for all age groups, 6320 (27%), except in the late teenage, when gynecological/obstetric complaints dominated, pregnancy-related issues represented the most common cause for consultation.

Etiologically, infectious diseases caused most of the burden across all age groups; with upper respiratory tract infections (URTIs), infectious diarrhea, and otitis media representing almost half (47%) of all cases. Nutritional deficiencies were diagnosed in 978 patients (8%), mostly in infants and toddlers (92%). Patients in the IDP camps represented a greater proportion of those with nutritional deficiencies (66% of all cases) compared to town residents ($P \leq 0.001$). SAM cases were also more common among IDP (77% of all cases) ($p \leq 0.001$). Of interest, a similar distribution for dermatological conditions was observed. As for endocrine disorders, children and early teens were more affected (78%) than other age groups. The same pattern was found for the musculoskeletal illnesses with 64% of cases among IDP. Cardiac presentations were encountered only in 44 (0.003%) patients. A total of 59% were diagnosed in patients who were less than 1 year old.

Poisoning was encountered in 100 patients with clear predilection in males and young age; 60% of them occurred in children aged 4 years or younger. No difference was found related to the condition of living (camps vs. town). No cases were reported in newborn infants or late teenage groups. Thirty-two percent ($n = 32$) of cases labeled as "poisoning" were secondary to insect and arthropod envenomation, 41% ($n = 41$) secondary to food poisoning, and the remainder

27% (n = 27) were due to the ingestion of household chemicals and medications.

Figure 2 summarizes the top 20 most common diseases encountered by patients.

Table 1 summarizes the top 15 most common diagnoses encountered among different age groups.

Figure 3 summarizes the frequency and distribution of diagnoses classified by category.

A more comprehensive report about the incidence of all diseases is available in the online Supplementary Table 2.

Acute diarrhea

We reported 1192 (17%) cases of acute diarrhea among all age groups, which make this disease the second most common illness after URTI. It was more common in boys (652 [55%]) than in girls (540 [45%]) (P = 0.008). The most frequent age groups were infants (694 [58%]) and toddlers (358 [30%]), followed by childhood (68 [6%]), early teenage (37 [3%]), neonates (30 [3%]), and then late teenage (5 [0.4%]). Acute diarrhea was far more common in people who lived in the IDP camps (58% of all cases) compared to town residents (42%), ($P \leq 0.001$). Acute watery diarrhea, including cases of suspected cholera, represented 307 (25.7%) cases; however, none could be confirmed with existing resources.

Malnutrition disorders

We identified 978 (8%) cases of malnutrition among all age groups, which make it the sixth most common disease in the cohort. No sex predominance was observed, with 500 (51%) girls and 478 (49%) boys. The most common age group was infants (726 [74%]) followed by toddlers (178 [18%]), neonates (30 [3%]), childhood (28 [3%]), early teenage (13 [1%]), and late teenage (3 [0.3%]) cases. It was significantly more common in people who lived in the IDP camps (66% of all cases) than in town residents (33%) ($P \leq 0.001$).

SAM defined by anthropometric measurements, as described in the "Methods" section, was reported in 131 of 978 (13.4%) patients. Most were girls (80 [61%]) with 51 (39%) boys (P = 0.05). Infants were the most commonly affected group with 92 (70%) cases, followed by toddlers (34 [26%] cases), neonates (2 cases), childhood (2 cases), and 1 early teenage child. SAM was by far more common in people who lived in the IDP camp versus town residents (76% vs. 24%, $P \leq$ 0.001). The incidence of SAM peaked in summer associated with the peak of acute diarrheal diseases.

Vitamin D deficiency was reported in 151 patients. No sex predominance was observed, with 72 (48%) cases in males and 79 (52%) cases in females. The most common age group was infants with 96 (64%) cases, followed by toddlers with 50 (33%) cases, childhood with 3 cases, and 2 cases in neonates. No condition of living was predominant, with 76 (50%) cases in patients living in the IDP camp and 75 (50%) cases in town residents.

Special conditions

Neonatal jaundice represented the most common diagnosis in the newborn age group, accounting for 30% of their visits. It was more frequent in boys (152 [59%]) than in girls

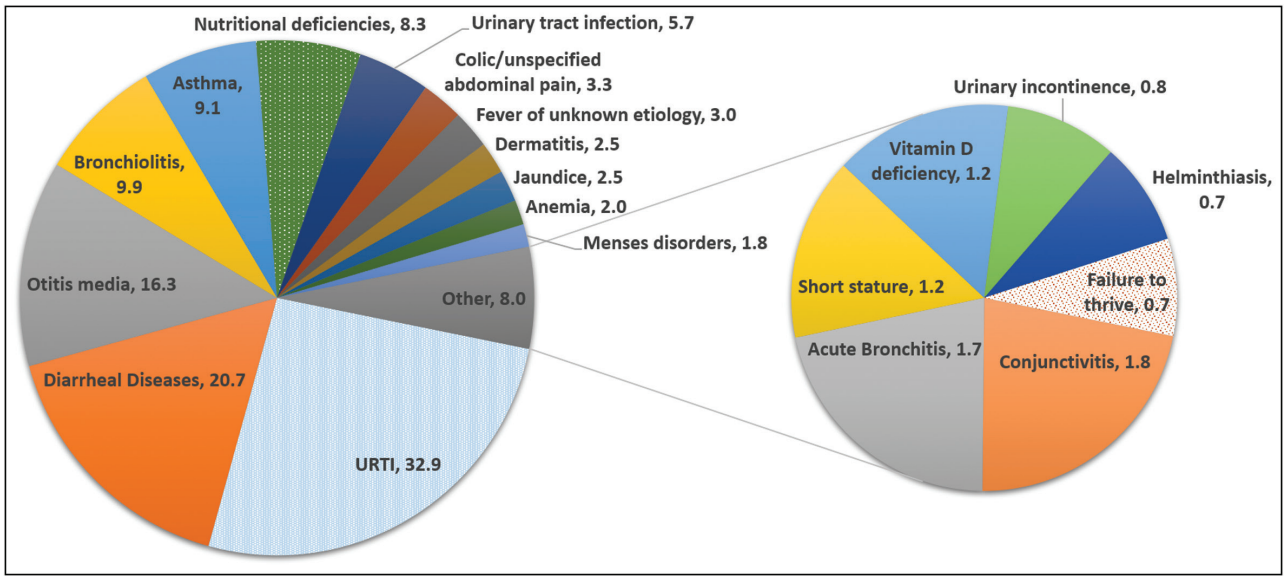

Figure 2: Top 20 causes of diseases in all studied population. Note: Percentages of this figure are of the total numbers of patients with these top 20 illnesses not the total of all cohorts. Values represent percentage among all patients

Table 1: Top 15 most common diagnosis among different age groups

Diagnosis	Total		Male		Female	
	Frequency	Percentage among age group	Frequency	Percentage among age group	Frequency	Percentage among age group
Neonates (1–27 days)	Total (862 patients)		Male (467 patients)		Female (395 patients)	
Neonatal jaundice; due to all reasons	256	**29.7**	152	**32.54**	104	**26.32**
Abdominal colic/other and unspecified abdominal pain	92	**10.67**	43	**9.21**	49	**12.41**
Influenza due to other identified influenza virus	72	**9.36**	38	**8.14**	34	**8.61**
Omphalitis of newborn	67	**7.77**	31	**6.64**	36	**9.11**
Recurrent oral aphthae	57	**6.61**	27	**5.78**	30	**7.59**
Acute bronchiolitis	41	4.76	21	4.50	20	5.06
Conjunctivitis	39	**4.52**	25	**5.35**	14	**3.54**
Nonsuppurative otitis media	25	**2.90**	13	**2.78**	12	**3.04**
Nasopharyngitis, common cold	25	**2.90**	13	**2.78**	12	**3.04**
Infantile colic	24	**2.78**	18	**3.85**	6	**1.52**
Viral and other specified intestinal infections	24	**2.78**	10	**2.14**	14	**3.54**
Dehydration fever	23	**2.67**	12	**2.57**	12	**3.04**
Nausea and vomiting	21	**2.44**	10	**2.14**	11	**2.78**
Diaper (napkin) dermatitis	20	**2.32**	10	**2.14**	10	**2.53**
Fever of other and unknown origin	19	**2.20**	13	**2.78**	6	**1.52**
Infants (28–365 days)	Total (3662 patients)		Male (1921 patients)		Female (1741 patients)	
Nonsuppurative otitis media	901	**24.60**	502	**26.13**	399	**22.92**
Influenza due to other identified influenza virus	855	**23.35**	438	**22.80**	417	**23.95**
Acute bronchiolitis	668	**18.24**	389	**20.25**	279	**16.03**
Viral and other specified intestinal infections	605	**16.52**	344	**17.91**	255	**14.65**
Asthma	436	**11.91**	309	**16.09**	127	**7.29**
Other nutritional deficiencies	419	**11.44**	229	**11.92**	190	**10.91**
Viral intestinal infection, unspecified	266	**7.26**	140	**7.29**	123	**7.06**
Urinary tract infection	191	**5.22**	66	**3.44**	125	**7.18**
Acute watery diarrhea/suspected cholera	188	**5.13**	84	**4.37**	98	**5.63**
Abdominal colic/other and unspecified abdominal pain	156	**4.26**	88	**4.58**	68	**3.91**
Fever of unknown origin	135	**3.69**	64	**3.33**	69	**3.96**
Nasopharyngitis, common cold	129	**3.52**	70	**3.64**	59	**3.39**
Acute bronchitis	125	**3.41**	62	**3.23**	63	**3.62**
Diarrhea and gastroenteritis of presumed infectious origin	121	**3.30**	76	**3.96**	43	**2.47**
Recurrent oral aphthae	115	**3.14**	57	**2.97**	58	**3.33**
Toddlers (above 1–4 years)	Total (2383 patients)		Male (1267 patients)		Female (1116 patients)	
Nonsuppurative otitis media	643	**26.98**	370	**29.20**	273	**24.46**
Influenza due to certain identified influenza viruses	514	**21.57**	254	**20.05**	260	**23.30**
Viral intestinal infection, unspecified	459	**19.26**	273	**21.55**	186	**16.67**
Asthma	380	**15.95**	238	**18.78**	142	**12.72**
Acute bronchiolitis	311	**13.05**	198	**15.63**	113	**10.13**
Acute tonsillitis	177	**7.43**	107	**8.45**	70	**6.27**
Urinary tract infection	158	**6.63**	39	**3.08**	119	**10.66**
Streptococcal, tonsillitis	113	**4.74**	57	**4.50**	56	**5.02**
Fever of unknown origin	107	**4.49**	47	**3.71**	60	**5.38**
Acute pharyngitis	102	**4.28**	52	**4.10**	50	**4.48**
Acute watery diarrhea/suspected cholera	89	**3.73**	47	**3.71**	42	**3.76**
Streptococcal pharyngitis	88	**3.69**	41	**3.24**	47	**4.21**
Gastroenteritis and colitis of unspecified origin	63	**2.64**	27	**2.13**	36	**3.23**
Diarrhea and gastroenteritis of presumed infectious origin	62	**2.60**	40	**3.16**	22	**1.97**
Nasopharyngitis, common cold	57	**2.39**	30	**2.37**	27	**2.42**
Childhood (5–9 years)	Total (2103 patients)		Male (1142 patients)		Female (961 patients)	
Influenza due to other identified influenza virus	256	**12.17**	180	**15.76**	176	**18.31**
Asthma	177	**8.42**	107	**9.37**	70	**7.28**
Acute tonsillitis	173	**8.23**	99	**8.67**	74	**7.70**
Nonsuppurative otitis media	162	**7.70**	86	**7.53**	76	**7.91**
Streptococcal, tonsillitis	162	**7.70**	87	**7.62**	75	**7.80**
Urinary tract infection	126	**5.99**	26	**2.28**	100	**10.41**
Acute bronchiolitis	113	**5.37**	59	**5.17**	54	**5.62**
Viral and other specified intestinal infections	102	**4.85**	56	**4.90**	46	**4.79**
Streptococcal pharyngitis	79	**3.76**	40	**3.50**	39	**4.06**
Fever of unknown origin	70	**3.33**	27	**2.36**	43	**4.47**
Acute pharyngitis	65	**3.09**	37	**3.24**	28	**2.91**
Cystitis	60	**2.85**	12	**1.05**	48	**4.99**
Anorexia	59	**2.81**	28	**2.45**	31	**3.23**

Table 1: Continued

Diagnosis	Total		Male		Female	
	Frequency	Percentage among age group	Frequency	Percentage among age group	Frequency	Percentage among age group
Childhood (5–9 years)	Total (2103 patients)		Male (1142 patients)		Female (961 patients)	
Unspecified urinary incontinence	57	**2.71**	19	**1.66**	38	**3.95**
Chronic sinusitis	53	**2.52**	25	**2.19**	28	**2.91**
Early teenage (10–14 years)	Total (988 patients)		Male (455 patients)		Female (533 patients)	
Influenza due to other identified influenza virus	142	**14.37**	70	**15.38**	72	**13.51**
Urinary tract infection	87	**8.81**	11	**2.42**	76	**14.26**
Short stature	74	**7.49**	31	**6.81**	43	**8.07**
Asthma	69	**6.98**	49	**10.77**	20	**3.75**
Acute tonsillitis	68	**6.88**	29	**6.37**	39	**7.32**
Streptococcal, tonsillitis	62	**6.28**	27	**5.93**	35	**6.57**
Viral and other specified intestinal infections	52	**5.26**	28	**6.15**	24	**4.50**
Nonsuppurative otitis media	44	**4.45**	22	**4.84**	22	**4.13**
Acute pharyngitis	36	**3.64**	15	**3.30**	21	**3.94**
Acute bronchiolitis	35	**3.54**	21	**4.62**	14	**2.63**
Abdominal and pelvic pain	34	**3.44**	6	**1.32**	28	**5.25**
Acute sinusitis	30	**3.04**	16	**3.52**	14	**2.63**
Chronic sinusitis	29	**2.94**	9	**1.98**	20	**3.75**
Unspecified urinary incontinence	27	**2.73**	10	**2.20**	17	**3.19**
Fever of unknown origin	25	**2.53**	14	**3.08**	11	**2.06**
Late teenage (15–19 years)	Total (1822 patients)		Male (36 patients)		Female (1785 patients)	
Pregnancy	1183	**64.93**	NA	**NA**	1183	**66.27**
Excessive, frequent, and irregular menstruation	108	**5.93**	NA	**NA**	108	**6.05**
Urinary tract infection	103	**5.65**	0	**0.00**	103	**5.77**
Infection of vagina and vulva	81	**4.45**	NA	**NA**	81	**4.54**
Absent, scanty, and rare menstruation	80	**4.39**	NA	**NA**	80	**4.48**
Malaise and fatigue	29	**1.59**	0	**0.00**	29	**1.62**
Abdominal and pelvic pain	26	**1.43**	0	**0.00**	26	**1.46**
Female infertility, unspecified	23	**1.26**	NA	**NA**	23	**1.29**
Urethritis and urethral syndrome	22	**1.21**	0	**0.00**	22	**1.23**
Abortion: spontaneous	16	**0.88**	NA	**NA**	16	**0.90**
Other abnormal uterine and vaginal bleeding	14	**0.77**	NA	**NA**	14	**0.78**
Dorsalgia	14	**0.77**	0	**0.00**	14	**0.78**
Delayed menses	13	**0.71**	NA	**NA**	13	**0.73**
Dysmenorrhea, unspecified	11	**0.60**	NA	**NA**	11	**0.62**
Unspecified ovarian cysts	11	**0.60**	NA	**NA**	11	**0.62**

NA = Not applicable

(104 [41%]) ($P = 0.02$), with no significant difference between patients who lived in the IDP camp (146 [57%]) compared to those who resided in town (110 [43%]) ($P = 0.17$). The patients' median (IQRs) age at first presentation was 11 (9–19) days. More than half (51%) of them presented between days 3 and 11. Notably, one-third of these patients had delayed presentation at the age of 15 days and beyond.

Omphalitis was yet another common condition in the newborn age group, with an overall incidence of 8%. We reported 36 (53%) cases in girls and 31 (46%) cases in boys; 35 (52%) patients were living in an IDP camp, whereas 32 (48%) patients were town residents; no statistical differences were found. The mean (standard deviation [SD]) age at diagnosis was 12 (5.4) days, with median (IQRs) of 12 (3–15) days.

Undifferentiated febrile illnesses (UFIs) were an important issue in this cohort of patients, especially in infants (4%) and childhood (3%) age groups. We identified 344 patients (almost 3% of total cohort) who were treated for UFIs. No statistical difference was observed in sex or living conditions. One hundred and sixty-two (47%) patients were males and 182 (53%) patients were females. One hundred and sixty-four (47%) patients lived in an IDP camp, whereas 180 (53%) were town residents. Their median (IQRs) age was 1.5 years (8 month to 4.4 years). The incidence of these illnesses peaked in July, August, and September [Figure 4].

Vaccination-preventable diseases

- Measles, mumps, rubella, and varicella (MMRV): Collectively, we reported 57 cases of MMRV infections, of them 37 cases were of varicella, 11 were of mumps, 8 were of rubella, and 1 case of measles. Thirty cases were diagnosed in patients who lived in the IDP camp and 27 cases were town residents. Toddlers age group was the most commonly affected one with 23 cases. The mean (SD) age of presentation was 5.0 (3.3) years, with median (min–max) of 3.3 (0.5–13) years. The incidence

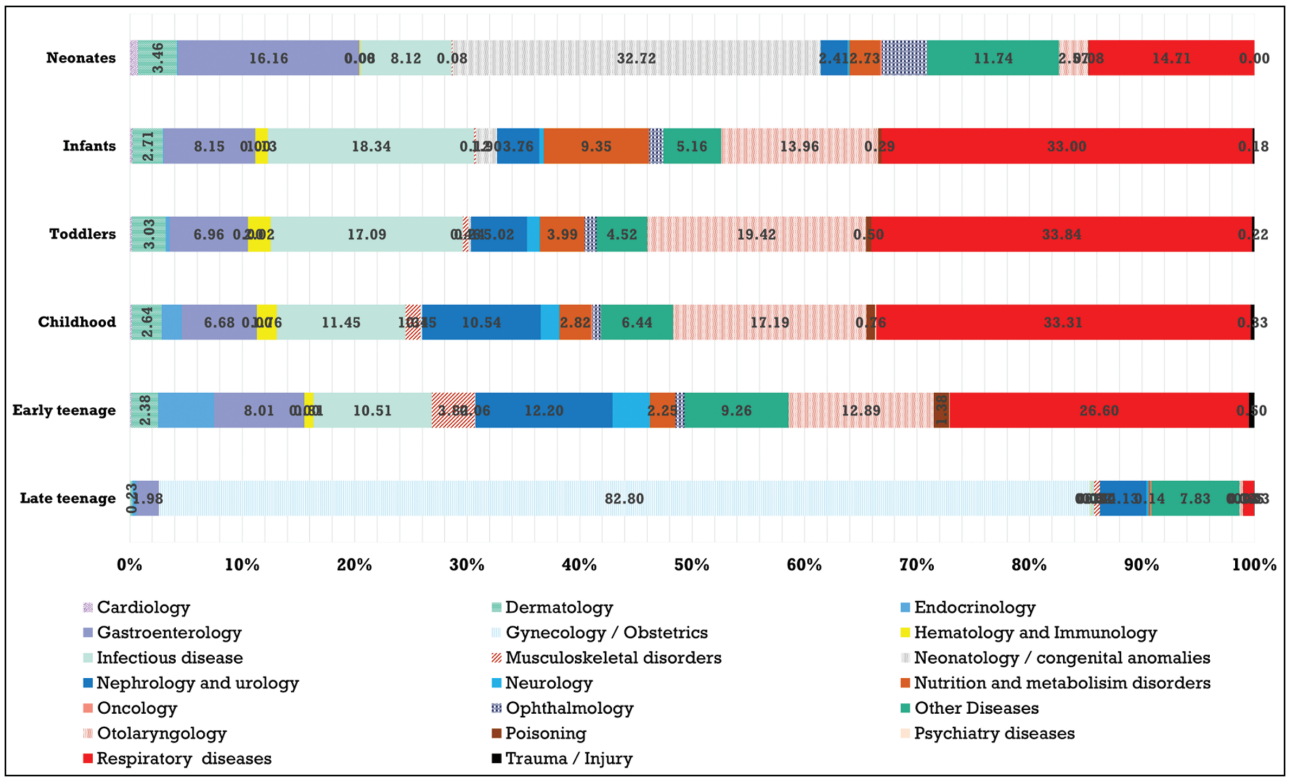

Figure 3: Frequency and distribution of diagnoses classified by category among different age groups. Values represent percentage among each age category

Table 2: Incidence of different diseases among town residents versus refugees

Diseases/conditions	Total number	Residents		Refugees		*P* value
		Frequency	Percentage	Frequency	Percentage	
URTI	4139	2339	**57**	1796	**43**	**<0.001**
LRTI	80	43	**54**	37	**46**	0.681
Infectious diarrhea	1192	502	**42**	689	**58**	**<0.001**
Otitis media	1949	961	**49**	988	**51**	0.637
Conjunctivitis	210	98	**47**	112	**53**	0.481
Infectious hepatitis	70	32	**46**	38	**54**	0.660
Chronic anemia	260	104	**40**	156	**60**	**0.010**
Malnutrition disorders	978	329	**34**	649	**66**	**<0.001**
Severe acute malnutrition	131	101	**77**	30	**23**	**<0.001**

of MMRV illnesses seemed to be steadily low until December 2017 when it started to increase.

- Poliomyelitis: We reported two cases of poliomyelitis, both presented with acute flaccid paralysis. The first one was in March 2017 in a 1-year-old girl who lived in an IDP camp. She was displaced from Deir ez-Zor district and her diagnosis was confirmed by laboratory tests. The second patient was identified in April 2017, a 9-year-old boy who was a town resident with a known diagnosis.
- Pertussis: We reported nine cases of pertussis (eight females and one male). Four of them were diagnosed in March, one patient in April, and four patients in May. Only two patients lived in an IDP camp and seven were town residents. Their mean (SD) age was 2 (2.4) years with a median (min–max) of 0.8 (0.3–8) years, and the most commonly affected age group was the infants. The diagnosis in these cases was made based on clinical presentation and supported by the presence of leukocytosis.
- Hepatitis A: We reported 69 cases of hepatitis A, of them, 31 cases were in females and 38 in males. As for living conditions, 38 of these patients lived in an IDP camp and 31 in town. Their mean (SD) age was 5.3 (3.0) years with median (min–max) of 5 (0.2–13) years. The incidence peaked in November and December 2017. The diagnosis in these cases was made based on clinical findings and supported by the presence of abnormal liver function tests, and occasionally, confirmed by definite virology markers.

Asthma

During the study period, asthma was diagnosed in 702 patients with 1090 acute episodes. Of them, 452 (64%) were in boys and 250 (36%) were in girls ($P \leq 0.001$). The incidence was

not different according to living conditions with 361 (52%) patients living in an IDP camp and 339 (49%) patients in town, (P = 0.52). Their age group distribution was as follows: 284 (40%) infants, 228 (32%) toddlers, 129 (18%) childhood, 52 (7%) early teenage, and 5 (0.7%) late teenage. Their median (IQRs) age was equal to 1.2 years (1 month to 3.3 years).

Pregnancy

Gynecological/obstetrical illnesses/conditions among late teenage girls represented 89% of all their visits, and pregnancy-related encounters were 66% of the total cases. We reported 1183 pregnancies in the adolescents who visited our center during the study period. Of them, 750 (63%) lived in an IDP camp and 433 (37%) were residents in town. Their mean (SD) age was 17 (1) years with median (IQRs) of 18 (17–19) years. The largest group of patients (319 [27%]) were the 18-year-old patients, followed by 19-year-olds (310 [26%]), 17-year-olds (266 [23%]), and 16-year-olds (169 [14%]). However, 15-year-olds accounted for 97 (8%) cases and 14-year-olds for 22 (2%) cases. Notably, pregnant teens who were less than 18 years old represented 48% of the total pregnant patients in this cohort. Despite their higher absolute numbers, pregnant IDP received less antenatal care visits than town residents (1.7 vs. 2.0 visits), OR (95% confidence interval) = 1.5 (1.3–1.7), ($p \leq 0.001$).

Effects of seasonal changes

We observed an increased incidence of diarrheal diseases and cases of UFIs during summer and an increased incidence of URTI during winter. MMRV infections showed moderate increase during spring and early summer with a surge during December. However, the prevalence of other communicable diseases was stable throughout the year. [Figure 4] shows the incidence of selected communicable diseases plotted by time. The incidence of lower respiratory tract infection (LRTI), acute conjunctivitis, and acute hepatitis seems to be stable over the course of the year.

Effects of age

We observed differences in the incidence of certain diseases according to patient's age. For example, the incidence of conjunctivitis was highest in neonates, malnutrition in infants, chronic anemia in toddlers, otitis media in infants and toddlers, and URTIs in childhood [Figure 5].

Effects of living conditions

We observed significantly higher rates of infectious diarrhea (58% of cases), chronic anemia (60% of cases), and malnutrition (66% of cases), especially the severe forms (76% of cases), among patients who lived in an IDP camp as opposed to town residents [Table 2].

DISCUSSION

In 2017, according to the United Nations High Commissioner for Refugees (UNHCR), 2.8 million children were displaced in Syria of a total of 6.5 million refugees, with 48% of Syrian registered refugees under 18 years of age. The United Nations

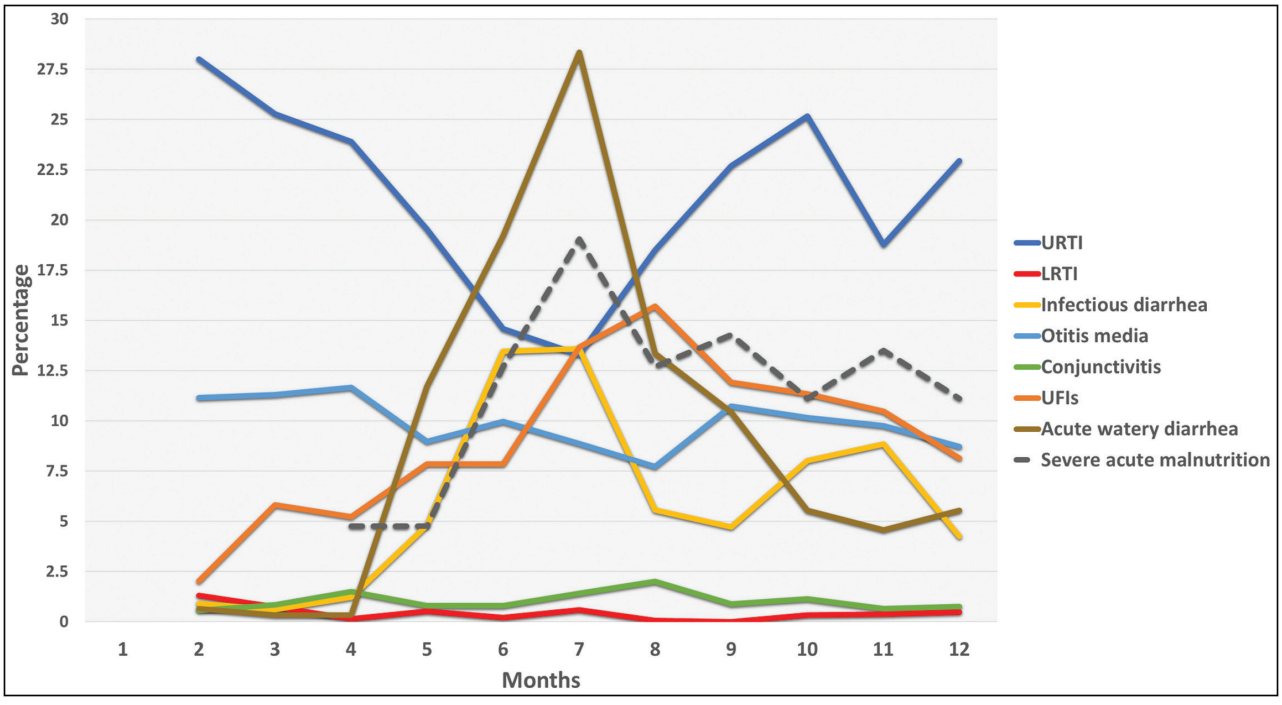

Figure 4: Selected communicable diseases plotted over monthsNotice the significant seasonal changes in incidence of the URTI and infectious diarrheal diseases. URTIs peak in winter and infectious diarrhea peaks in summer. Spring season includes months of March, April, and May; summer includes June, July, and August; fall includes September, October, and November; and winter includes December, January, and February. Values represent percentage among all patients

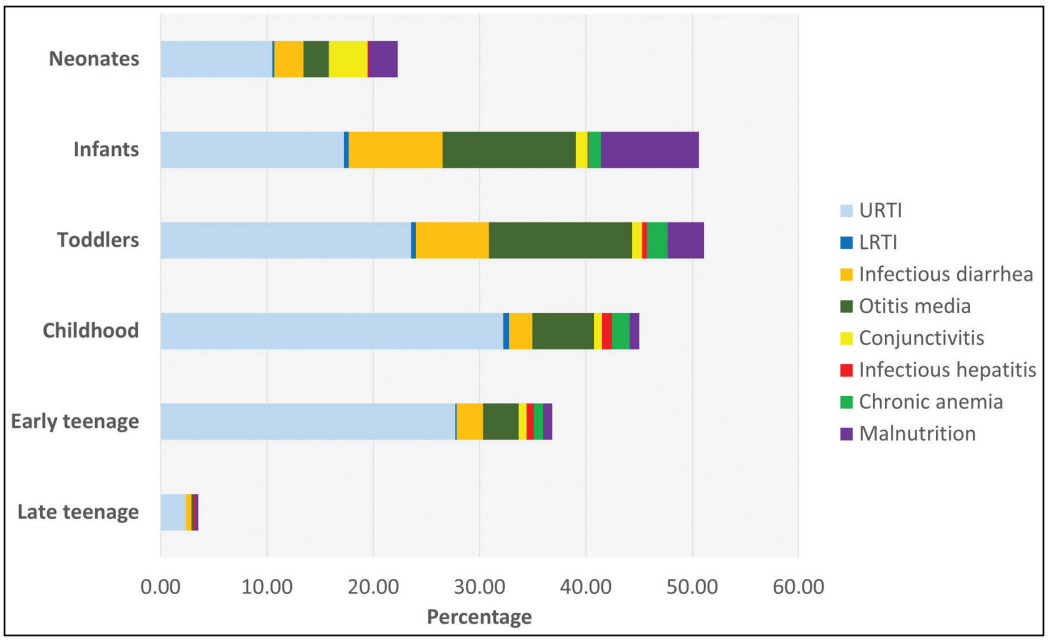

Figure 5: Most common diseases plotted against age groupNotice how the incidence varies among age groups. For example, otitis media is highest in infants and toddlers, and malnutrition is highest in infants and neonates. URTI is the most common disease among all age groups. Values represent percentage among each age category

Figure 6: (A) and (B) Selected pictures from the refugee camp where people live in poorly made tents, during Winter 2017, they give an idea how bad the sanitation is and how challenging transportation is

International Children's Emergency Fund (UNICEF) estimates that six million children still living in Syria are in need of humanitarian assistance and 420 thousand children living in besieged areas lack access to vital humanitarian aid. Studies have shown that IDP and refugee children are at risk of malnutrition (including severe malnutrition and death).[9,13] In 2016, the WHO reported a drop in children vaccination rates in Syria to below 60% for all vaccines.[14] This percentage may be even lower in IDP and refugee populations as accurate data are extremely difficult to obtain. Reports have shown increased incidence of deadly preventable infectious diseases such as meningitis, measles, and polio.[15] Nonetheless, quantitative studies describing nutritional and infectious status of this population are still lacking.

To the best of our knowledge, this is the first quantitative description dedicated to child and adolescent health focusing on northwestern Syria in the academic literature. In this cohort, infants have surpassed all other age groups in terms of number of medical encounters (2.6 encounter per patient), whereas newborns and childhood age groups have the least (1.6 encounter per patient). Adjusting for the short time span of the neonatal period (27 days), newborn infants are the clear leading age group in encounters burden (21.6 encounter/patient/year). The contribution of male patients to the disease burden was higher throughout all age groups except in teenage, when female patients' contribution to the burden became more prominent because of pregnancy-related issues. In the late teenage years, consultations for females outnumbered males by 50 to 1. This was mainly driven by pregnancy-related issues, making gynecologic and obstetrical presentations rank fourth among all disease/condition categories. In 2013, UNICEF reported that 21.7% of the Syrian population were aged 10–19 years, and that 10% of the females in this age group were married.[16] Assuming that this is true for the study center population, then the expected number of married teens in this population would exceed 3000. This conservative estimate indicates that the

study cohort encounters (1183 pregnancies) represent no more than 35% of the potential burden.

The complex social and economic factors, which promote early marriage, are exacerbated by conflict and the resultant poverty and suffering. For some families, economic drivers and a desire to protect girls drive early marriage. However, this can have significant impacts on the child brides, their pregnancies, and associated complications, their newborn infants, and societal implications.

The communicable diseases, as expected, represented the major bulk of the disease burden in this cohort. It accounted for more than half of all consultations across all age groups, infants and toddlers were the most affected, a pattern not out of the norm considering the conditions of living in this region. Notably, GBD 2016 study reported the incidence of URTIs, otitis media, and diarrheal diseases among Syrian children to peak in the first year of life.[17] The observed seasonal variations of these disorders were consistent with published literature, but the incidence of some infections based on the area of residence was relatively unfamiliar. For example, infectious diarrhea was more common in IDP camp inhabitants, whereas URTIs were more likely among town residents. This finding may be partially explained by the reluctance of refugees to make the "hard" journey to the medical center for seemingly simple issues, such as URTIs, compared to more threatening ones, such as diarrhea complicated by fever and dehydration [Figure 6]. However, this finding is more likely to be associated with the unsanitary living conditions in the camp as compared to town residence, such as overcrowding, shared toilets, contaminated water supplies, and deteriorated food quality. Other infections, however, were encountered almost equally among these two groups.

The IDP predominance was again observed for most of the vaccination-preventable illnesses. Pertussis infection, however, revealed a predilection toward town residents (seven of nine), which was reminiscent of URTIs distribution noted earlier. Of note was the case of the 9-year-old boy diagnosed with poliomyelitis. He had no verifiable records of his vaccination status, nonetheless, he would be expected to have full vaccination against poliomyelitis before 2011, raising the suspicion of a possible underlying immunodeficiency disorder or vaccine failure because of unidentified reason. Notably, WHO and UNICEF reported that vaccination rates among Syrian children have deteriorated remarkably over the past 7 years.[14] For example, in 2017, only 30% of infants had completed all three doses of poliomyelitis or diphtheria, tetanus, and pertussis vaccines as opposed to 80% of infants in 2010. However, despite this drop of vaccination rates, no cases of the wild poliovirus infection have been reported in Syria since 1999. Indeed, all cases reported thereafter were due to the circulating vaccine-related poliovirus type-2.[18] Importantly, no accurate data about the vaccination coverage in Atmeh were available during the study period, and it was probably the case in other parts of the country where IDP were heavily present.[19]

Cases of UFIs, especially in infants and young children, accounted for almost 3% of total disease burden in this cohort, with a trend toward increased incidence in females and town residents (53%). Their peak incidence occurred in July, August, and September, in parallel with infectious diarrhea, suggested a possible etiological association that should be explored. Major limitations in diagnostic capabilities of this center are obvious, however, the impact of these limitations on UFIs rates is hard to quantify.

The nutritional deficiencies and their complications, especially iron-deficiency anemia, were more encountered in the IDP (66%) and in infants and toddlers, with no gender differences in incidence rates. Almost 77% of all malnourished children were less than a year old. This could be partially attributed to the diminished quantities and deteriorated qualities of the food supplies and reduced breast milk in stressed, malnourished mothers. Furthermore, the high proportion of young mothers in this cohort (almost half are less than 18 years old) and their limited access to proper education, especially in terms of infants' care and nutrition, make it more likely for these infants to have reduced breastfeeding and malnutrition even in the absence of drastic food shortages. More attention to maternal education along with other measures is needed to mitigate the impact of malnutrition on these infants.

Cases of vitamin D and/or calcium deficiency were of special importance, they represented 18% of all nutritional deficiency cases. Anecdotally, rates of exclusive breast feeding without proper supplementations were as high as 80% in these infants. As breast milk is known to be a poor source of vitamin D, this probably played a significant role in predisposing them to vitamin D deficiency and its consequences.

The cases labeled as "poisoning" were mostly in boys younger than 4 years of age. Seemingly, many patients of this category were grouped together based on a semantic association; thus, food poisoning cases were joined to "poisoning" because of insect envenomation, whereas they would have been more

accurately placed along cases of gastroenteritis and other gastrointestinal conditions.

Neonatal jaundice contribution to the newborn infants' burden of disease, especially among boys and refugees, was remarkable; it accounted for 30% of this burden. Although jaundice was encountered more frequently among refugee infants as opposed to town residents, the difference was not statistically significant ($P = 0.17$), probably as a result of inadequate sample size. Furthermore, the fact that one-third of these patients presented at an age of 15 days and beyond argues against a simple "physiological jaundice" and suggests a pathological process induced, perhaps, by deficient breastfeeding practices complicated by dehydration. Of note, a good proportion of these infants is cared for by inexperienced young mothers. Lastly, the contribution of other diseases, such as congenital hemoglobinopathies and hemolytic disease of the newborn, to the development of this prolonged jaundice, is hard to quantify, nonetheless, it should not be discounted altogether.

Cardiac illnesses were apparently underrepresented in this cohort, only 44 cases were diagnosed. Having 59% of these conditions encountered in less than 1-year-old patients is probably driven by the inability of our center to deliver the advanced services, such as surgical interventions, that older patients with more complex conditions may need. Furthermore, our data cover a period of 1 year; older patients with congenital heart diseases are more likely to be diagnosed before the study period and mostly would be followed in a specialized center. Similarly, a plausible explanation of less-than-expected rate of trauma cases in this cohort is the presence of other centers in the vicinity with trauma as their primary focus of care. Thus, it would be unwise to estimate the incidence of trauma in this population based on the figures we reported. The same caution should be exercised when it comes to psychiatric illnesses; despite the stressful conditions of these patients, which favor the development of conditions, such as depression and anxiety disorders, the psychiatric illnesses were almost absent in this cohort; only four cases were reported. This underrepresentation makes any estimate related to this category of illnesses in this population far from reality.

The profound shortages of health-care workers as a result of the unsafe operational conditions are another issue that needs to be addressed. The WHO reported 678 attacks on health-care personnel and facilities between early 2014 and March 2018.[20] SEMA and other organizations reported 382 attacks in 2017, with 61 casualties and 239 seriously injured among health-care workers. This unsafe environment has led many health-care providers, especially physicians, to flee the country. In Idlib governorate, for example, there are 492 fully trained physicians (of them 61 pediatricians) who serve an estimated population of more than three million. Notably, the average physician density (physician/10,000 people) in Syria before 2011 was 14.6, which is higher than both global (13.9) and regional (12.7) ones.[21] The UNICEF report issued in 2013[16] may clarify this further. It reports that 42% of the Syrian population is younger than 18 years of age, thus, the pediatric population in the region of our study center would have exceeded 210,000 people, served by only nine pediatricians (i.e., 23,500 patients per physician), a far larger number than the reported average of 1,546 patients per pediatrician in the USA during 1990s.[22] This severe shortage led many centers to rely on physicians-in-training to fill some of these gaps.

Limitations

Several limitations in our study need to be considered. First, the recent deployment of "HealthySyria^{TB}" program limited the analyzed data to the year 2017 only, which made it hard to generalize some of the findings related to the incidence/prevalence of diseases. Second, the limited diagnostic capabilities and suboptimal training and staffing of this facility along with many difficulties the patients face on seeking consultation may have skewed some of the study results, such as the incidence of URTIs or UFIs. Third, the uncertainties in terms of population totals and mix make it hard to predict the future trends in actual needs and specific burdens. Lastly, as the data of this study are derived from a single medical center in the northwestern Syria, it may not reliably represent other affected areas in Syria nor the diaspora communities in the neighboring countries.

Future directions

We are expecting to complete the implementation of "HealthySyria^{TB}" program in all SEMA-affiliated centers within the upcoming year. We also have invited other organizations to consider using this program in their affiliated centers, should this implementation proceed as planned, the reliability and the scope of collected data will improve, leading to a positive impact on the quality of future iterations of this study. For the next years of the Healthy-Syria studies, we expect a better data collection and coding that should lead to a more accurate estimation of prevalence of vaccination-preventable diseases, malnutrition, and other communicable and chronic diseases. We are also planning to have more centers in different areas, using the program to have a more generatable picture. This should improve the health needs assessments for the IDP and responsiveness. Importantly, it can inform the public health and population

health measures needed to address particular conditions in this population.

CONCLUSION

In this study, we provide a quantitative description of the burden of different diseases and conditions among children and adolescents in northwestern Syria. We found that infectious diseases represent the majority of the burden across all age groups, with URTIs, infectious diarrhea, and otitis media representing almost half of all cases in this category. There was also a high burden of nutritional deficiencies, with acute severe malnutrition that may contribute. We identify relapse of vaccination-preventable diseases including measles, mumps, and rubella, unsurprising given the decline in vaccination coverage in this area and others in Syria. The majority of infectious diarrheal diseases and malnutrition occurred in people living in IDP camps, likely related to poor sanitation and food supply. We reported a seasonal variation in the incidence of URTIs and infectious diarrhea and a high number of pregnancy and delivery in adolescents.

Our findings offer some insights that could help the medical and humanitarian organizations to better understand the scope of problems encountered and how to address the most urgent needs of the impoverished and displaced people living in this region. On the basis of these findings, a number of recommendations can be made around improving sanitation and living conditions for those in the IDP camps. Improving health services for them as well as education and public health measures (for both residents and IDP) can support the health of children and adolescents. Our data on the nutritional status may not represent all cases in the catchment area and may only be the more severe cases, as such, addressing nutrition and feeding at a population level can help reduce micro- and macronutrient deficiencies. Syria's war has led to an exodus of its health workers with those remaining being under increased pressure, some may not have been able to complete their specialty training. As such, supporting them with updated courses on conditions of particular concern, which are identified here, for example, infectious diseases, teenage pregnancies, and malnutrition can lead to improvements in the health of the populations.

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Conflicts of interest

There are no conflicts of interest.

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