

Using a mobile application to detect health needs among children and adolescents who are newly arrived migrants in Europe

B. Rath^{1,3}, S. Swenshon², K. Haase², T. Szeles², C. Jung², F. Jacobi², P. Myles³

¹Department of Public Health, Vienna Vaccine Safety Initiative, 10437 Berlin, Germany

²Department of Clinical Psychology, Psychologische Hochschule Berlin, 10179 Berlin, Germany

³Division of Epidemiology and Public Health, The University of Nottingham, Nottingham NG5 1PB, UK

Address correspondence to Barbara A. Rath, E-mail: Barbara.Rath@vi-vi.org, Barbara.Rath@nottingham.ac.uk

ABSTRACT

Background Unprecedented numbers of migrants have arrived in Europe, including children and adolescents. Little is known about their unique health needs. Prospective data collection has been sparse. Mobile applications may help to facilitate global health surveillance.

Methods A pre-validated survey instrument was converted into a mobile application covering self-reported exposures and disruptions of healthcare before/during migration, communicable and non-communicable diseases. Participation was voluntary, anonymous and confidential.

Results Data were obtained from 405 migrant children and adolescents in Berlin, Germany, between 7 October 2015 and 15 March 2016 (median age 19 years, range: 1–24; 80.7% males) with the majority from Syria (62.5%), Afghanistan (9.1%) and Iraq (8.2%). In total, 55% were without family, 64% registered asylum-seekers with access to healthcare; 54% had seen a doctor since arrival, with colds or respiratory complaints (37.5 and 13.6%), followed by pain (26.7%) gastrointestinal (12.4%) and skin problems (11.1%). Underlying conditions were reported in 15.6%, predominantly asthma. Overall, 73% reported being up-to date on immunizations, but only 22% held a vaccination record with 46.4% having lost it during migration.

Conclusions The lack of medical and immunization records among newly arrived migrants provides a challenge to healthcare systems. Mobile applications offer rapid screening tools in times of crisis, helping stakeholders with timely information.

Keywords e-Health, migrant, self-reported outcomes, young people

Background

Global migration has reached record numbers, with every third migrant being a child or adolescent and more than 80% being below the age of 35.^{1,2–4} Arrivals in Europe have declined since 2016, but the percentage of unaccompanied minors has been on the rise, with some unaccounted for.^{3,5,6} With regards to the specific health needs of migrants arriving to a new community, consistent data are sparse.^{7,8} Medical records may be absent, and previous physicians and caretakers may no longer be reachable. It is crucial for public health stakeholders to gain timely information on exposures prior to and during migration, including immunization coverage and communicable diseases. This can be accomplished by taking into account the subjective health needs of

children and adolescents and by putting communicable and non-communicable disease burden into context. Person-centred health strategies facilitate the participation of vulnerable populations.

Multiple aspects are of immediate importance to displaced children and adolescents: the continuation of well-child visits and immunization schedules, and the timely treatment of

B. Rath, Project Co-Supervisor

S. Swenshon, Project Coordinator

K. Haase, Project Coordinator

T. Szeles, Project Coordinator

C. Jung, Project Coordinator

F. Jacobi, Project Co-Supervisor

P. Myles, Project Epidemiologist

acute and chronic conditions. Health literacy and language barriers need to be addressed when migrants are to be integrated into a new healthcare system.^{9–12} A surge in need for language assistance may quickly overwhelm private physician offices and emergency rooms. High-risk groups requiring special attention need to be identified swiftly, including children with chronic conditions and infants lacking peri-natal care.

Forced migration is by definition unplanned, but the decision to leave is usually taken by an adult on the child's behalf. Reasons include political instability, war and conflict, economic hardship, religious or ethnic prosecution, natural and environmental disasters. As diverse as the motivations may be, it is crucial to determine urgent health needs as soon as possible after arrival, and to develop the capacities to provide adequate care.^{10,13,14} This includes involvement of community groups and translators, the dissemination of health messages in multiple languages, and the provision of healthcare on-site in shelters and camps.^{10,12,14,15} Digital tools have been increasingly used in global health settings providing a valuable first insight into short-term and long-term needs—saving critical time and resources in times of rapid change.^{16–18}

The considerations outlined above lead to the development of a mobile application for an anonymous and voluntary health survey assessing the subjective health needs of young migrants. The survey was focused but not limited to infectious diseases, immunizations, risk factors, exposures and underlying health conditions. The survey instrument was initially developed and validated during the aftermath of Hurricane Katrina in New Orleans, LA in 2005/6.^{19,20}

We are presenting the results of a pilot project assessing health needs in a convenience sample of 400 children and adolescents seeking asylum in Berlin, Germany.²¹ The main aim of this work was to conduct a survey of health needs of newly arrived migrant children and adolescents. This was accomplished by means of a novel mobile app to enable rapid and confidential data collection across multiple resource constrained settings in a standardized data format.

Methods

Survey instrument

The survey instrument was previously validated as the Health Survey for Children and Adolescents after Katrina (HSCAAK).^{19,20,22} Initially developed in English to assess the health needs of children and adolescents in New Orleans after Hurricane Katrina, it was specifically designed for anonymous and confidential self-reporting. On page one, the questionnaire provided a user agreement with basic

information about the anonymous and voluntary character of the Survey and its exclusive use for research purposes. The survey instrument itself consisted of 95 multiple choice questions and 1 free text item covering any basic symptoms and medical complaints, environmental exposures and untoward experiences during evacuation and displacement, access to education and healthcare including chronic medication, immunizations and well-child visits, as well as a validated psychological questionnaire provided by the National Child Traumatic Stress Network (NCTSN, <http://www.nctsn.org>, results reported elsewhere).^{19–22} In an open-ended question, respondents (and/or their parents) were then asked about any concerns relating to their current life as migrants. The survey was adapted to the circumstances of international migration, transferred to a mobile application for use on tablet computers or smart phones and translated into Arab, Farsi and Russian languages.

Survey conduct

From 7 October 2015 until 15 March 2016, migrant families waiting for office appointments outside the Regional Office for Health and Social Welfare (LAGeSo) in Berlin, Germany were invited to participate in an anonymous, confidential and voluntary survey on self-reported health needs among children and adolescents aged 0–24 years of age, covering the recommended age spectrum for paediatric–adolescent studies in Global Health.²³ The survey was conducted in a separate room/building for privacy. School-aged children and adolescents were allowed to respond for themselves. For children younger than 12 years of age, parents and guardians provided the responses together with the child. No identifying information was obtained. The validation of the survey instrument was institutional review board (IRB)-reviewed and not considered human subjects research (FWA00002055 RPK-007); German law does not require additional review for anonymous surveys. Prior to participation, survey participants were informed and confirmed understanding that (i) the survey was anonymous, confidential and voluntary; (ii) data would be collected for research purpose only; and (iii) as soon as a reply had been uploaded, it would no longer be possible to track responses; (iv) participants could skip any questions that they did not wish to answer and/or terminate the survey at any time. They were also informed that the survey was not linked to any medical or office appointments. Participants were provided with a generic information leaflet informing them where medical, social and psychological services could be accessed in the area, if necessary. Participants responded to the survey without assistance if possible. Responses were entered into the

ViVi Health Survey App and uploaded for full anonymisation. If desired, assistance was provided by a team of trained interviewers and translators registered to assist with the project in full compliance with data confidentiality. Surveys lasted between 30 and 50 min.

Sample size and statistical analysis

We estimated the total eligible population for the survey to be 100 000 based on estimates of migrant arrivals to Berlin in December 2015 and given our stated requirements of a 5% margin of error and 95% confidence intervals, we needed a survey sample of 383 participants.²⁴ A descriptive analysis was conducted to estimate the percentage prevalence of various health needs and 95% confidence intervals using Stata version 14 (StataCorp Ltd., Texas).

Results

Socio-demographics

Table 1 summarizes the socio-demographic and pre-migration characteristics of survey participants.

Data were obtained for 405 children and adolescents (median age 19 years, IQR: 12–22 years; mean age 17.64 years, SD 6.14 and range: 0–24 years), of whom 83.9% were males and 16.2% were females (missing data on 3.7%). The 62.5% of the survey participants were from Syria followed by 9.1% from Afghanistan, 8.2% from Iraq and 6.2% from Pakistan. And 72.8% completed the questionnaire themselves while in 15.6% of the cases, the responses were provided solely by a parent or a guardian. In total, 18.3% were able to complete the questionnaire without assistance from a translator or the interviewer. A total of 15.8% of the children and adolescents were in Germany unaccompanied by a parent or guardian (median age 19 years, interquartile range, IQR: 17–22 years) with at least one such child being as young as 3 years.

The mean duration spent in Germany since arrival was 3.3 months (IQR: 1–3 months) and on average, survey participants had travelled for 3.5 months to reach Germany after departure from their home country (IQR: 0–2 months). Nearly 29% of the respondents had spent at least a month in another country during their migration journey with the median duration of stay elsewhere for these individuals being 1 month (IQR: 1–3 months).

Pre-migration home conditions

The predominant language spoken at home was Arabic (68.4%) followed by Farsi and Urdu (7.2 and 5.4%, respectively). Other languages included Albanian, Kurdish, Persian,

Table 1 Sociodemographic and pre-migration characteristics of survey participants (*n* = 405)

<i>Characteristic</i>	<i>Number (percentage; 95% CI)</i>
Age (years)	
0–1	5 (1.2; 0.5–2.9)
2–5	27 (6.7; 4.6–9.6)
6–15	58 (14.3; 11.2–18.1)
16–18	70 (17.3; 13.9–21.3)
19 and above	232 (57.3; 52.4–62.0)
Not recorded	13 (3.2; 1.9–5.5)
Sex	
Male	327 (80.7; 76.6–84.3)
Female	63 (15.6; 12.3–19.4)
Not recorded	15 (3.7; 2.2–6.1)
Family in Germany	
Parents	44 (10.9; 8.2–14.3)
Other family	89 (22.0; 18.2–26.3)
None	223 (55.1; 50.2–59.9)
Not known	49 (12.1; 9.3–15.7)
Home country	
Afghanistan	37 (9.1; 6.7–12.4)
Albania	4 (1.0; 0.3–2.6)
Eritrea	7 (1.7; 0.8–3.6)
Iraq	33 (8.2; 5.8–11.3)
Kosovo	2 (0.5; 0.1–2.0)
Pakistan	25 (6.2; 4.2–9.0)
Syria	253 (62.5; 57.6–67.1)
Other	31 (7.7; 5.4–10.7)
Predominant language at home	
Arabic	277 (68.4; 63.7–72.8)
English	1 (0.3; 0.0–1.7)
Farsi	29 (7.2; 5.0–10.1)
Urdu	22 (5.4; 3.6–8.1)
Other	64 (15.8; 12.6–19.7)
Not known	12 (3.0; 1.7–5.2)
Pre-migration school attendance (5–17 year olds); <i>n</i> = 105	48 (45.7; 36.3–55.4)
Post-migration school attendance (5–17 year olds); <i>n</i> = 105	14 (13.3; 8.0–21.4)
Pre-migration higher level education (college/ university) (18–25 year olds); <i>n</i> = 263	57 (21.7; 17.1–27.1)
Post-migration higher level education (college/ university) (18–25 year olds); <i>n</i> = 263	4 (1.5; 0.6–4.0)

Punjabi, Nepali, Russian and Pashtun. Before migration, 90% had stayed with their parents while only 49% were staying with their parents or other family in Germany after migration. Before migration, the median number of people in the child/young adult's household was 6 (IQR: 5–8),

while after migration this number decreased slightly (median: 5; IQR: 3–10). However, post-migration 43 (11.2%) of the survey participants were living with 100 or more people (many of whom were strangers), presumably in migrant centres awaiting a decision on their asylum applications and allocation of a more permanent residence.

Schooling/Education

Overall, 13.3% of the participants were attending either school or university in Germany following migration. Prior to migration, 21.7% were in higher education compared to only 4 (1.5%) in higher level education (college or university) after migration and 3.2% were in special education facilities.

The migration journey

Various modes of transport were used for the migration journey with the predominant modes being boat, bus, train and on foot. Other means of transport included flights, trucks and cars (including taxis). Among survey participants, 75.3% had slept in the open air at some point during the migration journey with 71.9% being exposed to extreme cold and 33.8% affected by heat exhaustion during their journey. The migration journey also resulted in exposures to infectious disease and environmental risk factors such as sewage, unsafe drinking water and food, and respiratory irritants. And 6.2% reported being in contact with tuberculosis patients during the migration journey (Table 2). And 6.2% reported running out of medications for acute illnesses and 84.6% (33/39) of those on chronic medications experienced disruption of medication schedules, with worsening of their chronic illness reported by nearly 36.1% (22/61) of those with a chronic condition.

Physical health needs assessment

Approximately 64% of survey participants had access to the German healthcare system (which begins after being registered as asylum-seekers) and 54% have attended medical visits since then. The survey allowed participants to express their current state of health in lay terms (Table 3). The most common symptoms experienced were cold or respiratory symptoms (37.5 and 13.6%), followed by pain (26.7%) gastrointestinal (12.4%) and skin problems (11.1%). Underlying conditions were reported in 15.6%, predominantly asthma with exacerbations during and after migration in 46 and 36%, respectively. A total of 73% reported being up-to date on immunizations, but only 22% held a vaccination record with 46.4% having lost it during migration.

Table 2 Characteristics of the migration journey (n = 405)

<i>Characteristic</i>	<i>Number (percentage; 95% CI)</i>
Mode of transport (not mutually exclusive)	
On foot	337 (83.2; 79.2–86.6)
Bus	306 (75.6; 71.1–79.5)
Train	307 (75.8; 71.4–79.7)
Boat	323 (79.8; 75.5–83.4)
Airplane	93 (23.0; 19.1–27.3)
Other	54 (13.3; 10.3–17.0)
Exposures to risk factors for infection	
Sewage	107 (26.4; 22.3–31.0)
Floodwater/ocean/open water	255 (63.0; 58.1–67.5)
Unsafe drinking water	117 (28.9; 24.7–33.5)
Unsafe food	97 (24.0; 20.0–28.4)
Inhalation of respiratory irritants	97 (24.0; 20.0–28.4)
Inhalation of mould	6 (1.5; 0.7–3.3)
Inhalation of chemicals	10 (2.5; 1.3–4.5)
Inhalation of dust	40 (9.9; 7.3–13.2)
Inhalation of smoke/fumes	42 (10.4; 7.7–13.8)
Accommodation/sleeping arrangements	
Sleeping in open air	305 (75.3; 70.9–79.3)
Private residence	63 (15.6; 12.3–19.4)
Shelter or group home	160 (39.5; 34.8–44.4)
Temporary home/trailer/tent	114 (28.2; 24.0–32.7)
Hotel	141 (34.8; 30.3–39.6)
Hospital	14 (3.5; 2.1–5.8)
With friends/family	48 (11.9; 9.0–15.4)
Other (bus/train/boat/church/prison)	49 (12.1; 9.3–15.7)
Contact with tuberculosis patient during migration	
Yes	25 (6.2; 4.2–9.0)
No	300 (74.1; 69.6–78.1)
Don't know	61 (15.1; 11.9–18.9)
Missing	19 (4.7; 3.0–7.3)
Dehydration or heat exhaustion during migration	
Yes	137 (33.8; 29.4–39.6)
No	247 (61.0; 56.1–65.6)
Don't know	3 (0.7; 0.2–2.3)
Missing	18 (4.4; 2.8–7.0)
Exposure to extreme cold/hypothermia during migration	
Yes	291 (71.9; 67.3–76.0)
No	95 (23.5; 19.6–27.9)
Don't know	1 (0.3; 0.0–1.7)
Missing	18 (4.4; 2.8–7.0)

Thematic analysis of the findings

Key concerns relating to living in Germany as migrants are summarized in Table 4 and included the continuation of

Table 3 Access to healthcare services and physical health assessment (*n* = 405)

<i>Characteristic</i>	<i>Number (percentage; 95% CI)</i>
Access to health care services in Germany and during migration	
Health insurance in Germany	
Yes	259 (64.0; 59.1–68.5)
No	124 (30.6; 26.3–35.3)
Don't know	6 (1.5; 0.7–3.3)
Missing	16 (4.0; 2.4–6.4)
Medical visit since arrival	
Yes	218 (53.8; 48.9–58.0.7)
No	168 (41.5; 36.8–46.4)
Don't know	1 (0.3; 0.0–1.7)
Missing	18 (4.4; 2.8–7.0)
Reason for doctor's visit	
New health problem	85 (21.0; 17.3–25.2)
Regular check-up	105 (25.9; 21.9–30.4)
Pre-migration health problem	32 (7.9; 5.6–11.0)
Not known/not applicable	183 (45.2; 40.4–50.1)
Routine medical visits missed due to migration	
Yes	51 (12.6; 9.7–16.2)
No	312 (77.0; 72.7–80.9)
Don't know	21 (5.2; 3.4–7.8)
Missing	21 (5.2; 3.4–7.8)
Access to routine medical care since migration	
Yes	77 (19.0; 15.5–23.1)
No	309 (76.3; 71.9–80.2)
Don't know	1 (0.3; 0.0–1.7)
Missing	18 (4.4; 2.8–7.0)
Run out of prescribed medications for acute illness during migration	
Yes	25 (6.2; 4.2–9.0)
No	300 (74.1; 69.6–78.1)
Don't know	61 (15.1; 12.0–19.0)
Missing	19 (4.7; 3.0–7.3)
Assessment of acute illness (past month unless otherwise specified)	
Fever >100.4 (38.5°C)	
<1 month duration	16 (4.0; 2.4–6.4)
Persistent fever >5 months	1 (0.3; 0.0–1.7)
Jaundice (yellow skin or eyes)	
<1 month duration	1 (0.3; 0.0–1.7)
Persistent jaundice (4 months)	1 (0.3; 0.0–1.7)
Cold symptoms (ear, nose, throat, eye problems)	152 (37.5; 32.9–42.4)
Runny nose	106 (26.2; 22.1–30.7)
Stuffy nose	71 (17.0.5; 14.1–21.6)
Sore throat	72 (17.8; 14.3–21.8)

Continued

Table 3 Continued

<i>Characteristic</i>	<i>Number (percentage; 95% CI)</i>
Ear infection	13 (3.2; 1.9–5.5)
Red eye or eye drainage	10 (2.5; 1.3–4.5)
Flu-like illness	34 (8.4; 6.1–11.5)
Breathing problems/problems with lungs	55 (13.6; 10.6–17.3)
Shortness of breath	15 (3.7; 2.2–6.1)
Lung infection	3 (0.7; 0.2–2.3)
Asthma attack	1 (0.3; 0.0–1.7)
New onset cough	19 (4.7; 3.0–7.3)
Permanent cough >2 weeks	3 (0.7; 0.2–2.3)
Difficulty breathing	19 (4.7; 3.0–7.3)
Gastrointestinal/belly problems	50 (12.4; 9.5–15.9)
Watery diarrhoea (≥3 a day)	10 (2.5; 1.3–4.5)
Bloody diarrhoea	0 (0.0; 0.0–0.0)
Vomiting (≥1 episode)	8 (2.0; 1.0–3.9)
Constipation	
Pain	108 (26.7; 22.6–31.2)
New onset headache	17 (4.2; 2.6–6.7)
Back pain	7 (1.7; 0.8–3.6)
Tooth ache	10 (2.5; 1.3–4.5)
Neurological problems	
Blurred vision	3 (0.7; 0.2–2.3)
Numbness, tingling	6 (1.5; 0.7–3.3)
Skin problems (current) (rashes/infestations/wounds/bites)	45 (11.1; 8.4–14.6)
Skin blisters (vesicles)	5 (1.2; 0.5–2.9)
Blotchy rash (red spots)	10 (2.5; 1.3–4.5)
Hives (raised patches)	3 (0.7; 0.2–2.3)
Boils, draining abscess	2 (0.5; 0.1–2.0)
Cellulitis (warm, swollen tissue)	1 (0.3; 0.0–1.7)
Crusted skin (scabs, impetigo)	6 (1.5; 0.7–3.3)
Eczema/Dermatitis/allergic rash	24 (5.9; 4.0–8.7)
Rash with fever	0 (0.0; 0.0–0.0)
Open sore or wound	3 (0.7; 0.2–2.3)
Burn wound (chemical/heat)	1 (0.3; 0.0–1.7)
Wound infection	2 (0.5; 0.1–2.0)
Scabies (crabs)	3 (0.7; 0.2–2.3)
Lice	0 (0.0; 0.0–0.0)
Athlete's foot/fungal rash	2 (0.5; 0.1–2.0)
Spider bite/bug bite	4 (1.0; 0.4–2.6)
Animal bite	0 (0.0; 0.0–0.0)
Health problems due to accidents or violence (at any point in the migration journey)	63 (15.6; 12.3–19.4)
Gunshot/stab wound	8 (2.0; 1.0–3.9)
Sprained ankle	5 (1.2; 0.5–2.9)
Chemical accident/burn	2 (0.5; 0.1–2.0)
Traffic accident	4 (1.0; 0.4–2.6)

Continued

Table 3 Continued

Characteristic	Number (percentage; 95% CI)
Household accident	8 (2.0; 1.0–3.9)
Broken bones	13 (3.2; 1.9–5.5)
Physical marks due to violence (including rape, torture)	14 (3.5; 2.1–5.8)
Genital mutilation/injury	0 (0.0; 0.0–0.0)
Assessment of chronic illness	
Presence of chronic medical condition	61 (15.1; 11.9–18.9)
Nature of comorbidity	
Diabetes	0 (0.0; 0.0–0.0)
Asthma	24 (5.9; 4.0–8.7)
Other chronic lung disease	3 (0.7; 0.2–2.3)
Allergies	9 (2.2; 1.2–4.2)
HIV/AIDS	0 (0.0; 0.0–0.0)
Other immune disease	1 (0.3; 0.0–1.7)
Heart defect/disease	2 (0.5; 0.1–2.0)
Cystic fibrosis	0 (0.0; 0.0–0.0)
Mental retardation	0 (0.0; 0.0–0.0)
ADHD	0 (0.0; 0.0–0.0)
Autism	0 (0.0; 0.0–0.0)
Depression	0 (0.0; 0.0–0.0)
Other mental health or behaviour problems	0 (0.0; 0.0–0.0)
Seizure disorder	0 (0.0; 0.0–0.0)
Sickle cell disease or trait	1 (0.3; 0.0–1.7)
Kidney failure/dialysis	2 (0.5; 0.1–2.0)
Liver failure	0 (0.0; 0.0–0.0)
Pre-migration prescribed medication for chronic illness	39 (9.6; 7.1–12.9)
Use of prescribed medication for chronic illness during migration (<i>n</i> = 39)	22 (57.9; 41.2–73.0)
Worsening of chronic condition during migration (<i>n</i> = 61)	28 (45.9; 33.6–58.8)
Post-migration regular use of chronic illness medication (<i>n</i> = 39)	16 (41.0; 26.3–57.6)
Worsening of chronic condition post-arrival in Germany (<i>n</i> = 61)	22 (36.1; 24.8–49.1)
Vaccination history	
Up to date immunization	
Yes	298 (73.6; 69.0–77.7)
No, vaccines still needed	46 (11.4; 8.6–14.8)
No, anti-vaccines	2 (0.5; 0.1–2.0)
Don't know	36 (8.9; 6.5–12.1)
Missing	23 (5.7; 3.8–8.4)
Missed scheduled immunizations post-migration	
Yes	28 (6.9; 4.8–9.8)
No	284 (70.1; 65.5–74.4)

Continued

Table 3 Continued

Characteristic	Number (percentage; 95% CI)
Don't know	70 (17.3; 13.9–21.3)
Missing	23 (5.7; 3.8–8.4)
Receipt of scheduled immunizations since migration	
Yes	158 (39.0; 34.4–43.9)
No	213 (52.6; 47.7–57.4)
Don't know	11 (2.7; 1.5–4.8)
Missing	23 (5.7; 3.8–8.4)
Ownership of vaccination card	
Yes	89 (22.0; 18.2–26.3)
No, it was lost	188 (46.4; 41.6–51.3)
No, never had vaccination card	35 (8.6; 6.3–11.8)
Don't know	21 (5.2; 3.4–7.8)
Missing	72 (17.8; 14.3–21.8)

education, finding permanent accommodation and jobs, fears of deportation, language difficulties, reunification with family and integration into German society. A total of 26 respondents also reported unsatisfactory conditions in migrant centres (particularly, dissatisfaction around waiting times for registration, access to healthcare for migrants, mixed facilities for both genders and different ethnicities and resentment relating to prioritization of Syrians over others).

Discussion

Main finding of this study

We are presenting the successful use of a person-centred mobile application for a comprehensive self-assessment among young migrants using a previously validated survey instrument.^{19–21} At a time of chaos and rapid fluctuation, the mobile app allowed a first insight into the health status and exposures of a vulnerable population on the move, providing timely data of relevance to public health stakeholders. The ViVI Health Survey App also helped to put communicable and non-communicable disease risks into context. Standardized confidential health assessments are useful to provide a basic understanding of imminent needs in migrant populations.

What is already known on this topic

Stakeholders should be able to rely on timely, evidence-based information to identify gaps in primary care, including

Table 4 Thematic analysis of free text responses relating to concerns about living in Germany as refugees or migrants (247 responses from parents and children)

Key theme	Frequency (%)
Continuing schooling/education	67 (27.1%)
Finding more permanent accommodation	61 (24.7%)
Finding a job	47 (19.0%)
Starting a new life in Germany (including being settled and comfortable with money; starting a family)	35 (14.2%)
Registration as a refugee/fears of deportation	34 (13.8%)
Language	23 (9.3%)
Reunification with family in Germany	18 (7.3%)
Family (both in Germany and in home country)	23 (9.3%)
Health and Healthcare	15 (6.1%)
Integrating into German society (including concerns around cultural differences and treatment of refugees by the local population)	19 (7.7%)
Finding friends/social network	8 (3.2%)
Unsatisfactory conditions in refugee/asylum centre (including some discomfort relating to mixed facilities for both genders and ethnicities)	16 (6.5%)
Peace in home country	6 (2.4%)
Safety	5 (2.0%)
General anxiety/stress/depression	3 (1.2%)
Potentially giving up childhood ambitions	3 (1.2%)
Fear of losing one's culture	2 (0.8%)

preventive health. Systematic health assessments are difficult to come by whenever populations are on the move, be it during internal displacement (including after natural disasters)^{19,20} or international cross-border migration.²⁵ Antimicrobial drug resistance is common in war-stricken countries, and inconsistent treatments during migration and disruptions of vaccination schedules may further increase the risk.^{26,27}

During the peak of refugee arrivals into Germany in 2015/16, catch-up vaccination campaigns were put in place to benefit the local population as well as the new arrivals considering that insufficient herd immunity may increase the risk of outbreaks.^{28,29} According to the United Nations Convention of the Rights of the Child, equal protection should be provided to all children.^{30,31} The general rule that 'undocumented vaccinations do not count'³² was partially lifted by the Robert Koch Institute recommending that migrants with uncertain vaccination status should receive a limited number of catch-up vaccinations immediately, with additional vaccines administered later in the community setting.³³

What this study adds

This study reflects the immediate health needs after arrival in Germany. The majority of young migrants did not have medical or immunization documents available. Unaccompanied minors with chronic conditions are particularly sensitive to disruptions of care.¹⁹ Only one-fifth of participants reported access to regular healthcare during migration. Most migrants were in good physical health nevertheless, but nearly 50% reported acute respiratory or gastrointestinal infections, 10% with chronic conditions, often worsening during migration. Improvement could potentially be achieved with mobile immunization records on smartphones³² empowering young people and their parents to be informed about their vaccination status, regardless of location.^{34,35}

Access to healthcare during and after migration is a key challenge. Children with chronic conditions required special attention as the migration experience may exacerbate symptoms or contribute to severe outcomes with acute infectious diseases, including respiratory infections and gastroenteritis/dehydration. Additional exposures occurred during migration: 25% of survey participants were either in contact with tuberculosis patients or not certain. The timely diagnosis of tuberculosis among migrants has been named a priority by the European Respiratory Society.³⁶

Refugee healthcare should take into account that living conditions may be crowded after arrival. Most survey participants reported sharing their households, including with strangers. Rare conditions and diseases not endemic in the local community, such as leishmaniasis, may be overlooked requiring attention by specialists.³⁷ International research and training programs have been developed such as the Monarch Collaboration (<https://monarchcollaboration.org>) and 'EUR-HUMAN: Competence and Safety in Primary Health Care for Refugees and Migrants' (<http://eur-human.uoc.gr>) to address these concerns. With education being high on the list of concerns among migrants, schools and universities may develop additional programs for migrants.^{38–40}

Young migrants, especially adolescents and unaccompanied minors, are unlikely to seek medical attention by themselves.⁴¹ Easy access to healthcare is key for these vulnerable populations, who may not (yet) be familiar with the local language and types of services available to them.⁴² For the benefit of survey participants, all were provided with general information where to access medical and psychological services if so desired. Refugee clinics and hospitals (including language and specialized services) were available within a short distance.

Participant's responses confirmed an urgent need for acute care as well as mid-long term services. This included

catch-up vaccination campaigns and integration of children into the well-child visit schedule. These needs were recognized and instituted in most of the larger shelters in subsequent months. After acute needs have been resolved, many of the psychological aspects of trauma and post traumatic stress needed to be addressed.²

Mobile applications can be used in the privacy of one's home and provide a first entry point, lowering barriers.⁴³ Mobile devices are increasingly used for public health surveillance, and the accuracy of this procedure has been found superior to traditional paper surveys.^{17,18} A recent Cochrane review addressed the value of self-administered survey questionnaire responses, collected using mobile apps versus other methods, and arrived at similar conclusions.¹⁶

New global health concepts should account for the progress made in migrant health.^{16,44} This may also include proposals to improve the accommodation of women and children in line with a recently published case study by the Directorate General for European Union proposing the development of specific precautions for women and children in reception centres for migrants.^{45,46}

Limitations of this study

The anonymity of the survey allowed respondents to be more forthcoming with issues and concerns. This of course, comes at the backdrop of not being able to verify the complaints through physical examination or medical encounters. Subjective health assessments may identify health needs among unaccompanied minors and adolescents who may otherwise avoid medical encounters due to peer pressure, anxiety or fear of being deported. Voluntary health assessments via mobile apps engage young migrants in a way familiar to them, delivering feedback in a timely fashion.^{47,48} Local and regional authorities may use anonymous surveys to optimize their planning of housing, healthcare facilities and vaccination campaigns.

The study is limited to a convenience sample. The health needs of infants and younger children will require additional focus, a subgroup underrepresented in the Berlin sample.^{2,6,7,46} The gender and age distribution in the survey reflected the population seeking asylum in Berlin at the time. This is of course, subject to change as the relative number of women and children seems to have increased lately.⁴⁵ Shifts in the composition of migrant populations underscore the need for constant data flow for stakeholders to remain on top of these changes. In addition to statistics gathered from immigration exams at healthcare facilities it will remain important to complement these top-down approaches with standardized assessments of subjective needs among migrant

populations. Besides immediate needs including physical well-being and shelter, education is high on the list. Paediatricians have long recognized that opening educational opportunities to children and adolescents will be a major milestone to achieving sustainable growth and well-being.

Conclusions

Use of the digital tool allowed rapid, yet comprehensive assessments of health risks and exposures in aggregate, along with the self-reported prevalence of communicable and non-communicable diseases. We encourage broader use of digital survey tools to empower migrants to make their voices heard and to support stakeholders in allocating resources where they are needed most urgently. The anonymous format removes barriers and assists migrants in gaining a better understanding of their own health. Anonymous surveys should include information about health services available to migrants.

Acknowledgements

The authors thank the participants for volunteering their time to participate in the survey. The authors also thank the interviewers and translators, who participated in the pro-bono project as well as in regular trainings and briefings. The authors are grateful to Christian Hoppe, Brio Taliaferro and Boris Goldshteyn for their help with IT and data management. Last, but not least the team is deeply grateful to colleagues at KOMMmit e.V. for kindly accommodating the ViVi Health Survey team for the duration of the Survey.

Conflict of interest

The authors declare that they have no competing interests.

References

- 1 UNHCR. *Worldwide Displacement Hits All-time High as War and Persecution Increase*. 2015 [updated 18 June 2015; cited 2016 1 May]. <http://www.unhcr.org/news/latest/2015/6/558193896/worldwide-displacement-hits-all-time-high-war-persecution-increase.html>.
- 2 Kalkmann M. *Age Assessment and Legal Representation of Unaccompanied Children*. Informationsverbund Asyl und Migration; 2015 [updated 16 November 2015; cited 2016 July 20]. http://www.asylumineurope.org/sites/default/files/report-download/aida_de_update.iv__0.pdf.
- 3 AIDA. *Asylum Information Database—Country Report: Germany*. 2015 [updated November 2015; cited 2016 20 July]. http://www.asylumineurope.org/sites/default/files/report-download/aida_de_update.iv__0.pdf.

- 4 Eurostat. *Asylum Statistics*. 2016 [updated 20 April 2016; cited 2016 20 July 2016]. http://ec.europa.eu/eurostat/statistics-explained/index.php/Asylum_statistics.
- 5 Children St. *Children on the Move in Europe*. 2016 [cited 2016 20 July 2016]. <https://savethechildreninternational.exposure.co/children-on-the-move-in-europe>.
- 6 DW. *A Look at Germany's Unaccompanied Minor Refugees*. Deutsche Welle; 2016 [cited 2016 20 July 2016]. <http://www.dw.com/en/a-look-at-germanys-unaccompanied-minor-refugees/a-19411645>.
- 7 Bean T, Derluyn I, Eurelings-Bontekoe E *et al*. Comparing psychological distress, traumatic stress reactions, and experiences of unaccompanied refugee minors with experiences of adolescents accompanied by parents. *J Nerv Mental Dis* 2007;**195**:288–97.
- 8 Ager A, Burnham G, Checchi F *et al*. Strengthening the evidence base for health programming in humanitarian crises. *Science (New York, NY)* 2014;**345**:1290–2.
- 9 Vermette D, Shetgiri R, Al Zuheiri H *et al*. Healthcare access for iraqi refugee children in Texas: persistent barriers, potential solutions, and policy implications. *J Immigr Minor Health Cent Minor Public Health* 2015;**17**:1526–36.
- 10 Lee SK, Sulaiman-Hill CR, Thompson SC. Overcoming language barriers in community-based research with refugee and migrant populations: options for using bilingual workers. *BMC Int Health Human Rights* 2014;**14**:11.
- 11 Wangdahl J, Lytsy P, Martensson L *et al*. Health literacy among refugees in Sweden—a cross-sectional study. *BMC Public Health* 2014;**14**:1030.
- 12 Cheng IH, Wahidi S, Vasi S *et al*. Importance of community engagement in primary health care: the case of Afghan refugees. *Aust J Prim Health* 2015;**21**:262–7.
- 13 Nazzal KH, Forghany M, Geevarughese MC *et al*. An innovative community-oriented approach to prevention and early intervention with refugees in the United States. *Psychol Serv* 2014;**11**:477–85.
- 14 Ehiri JE, Gunn JK, Center KE *et al*. Training and deployment of lay refugee/internally displaced persons to provide basic health services in camps: a systematic review. *Glob Health Action* 2014;**7**:23902.
- 15 Zwi K, Rungan S, Woolfenden S *et al*. Methods for a longitudinal cohort of refugee children in a regional community in Australia. *BMJ Open* 2016;**6**:e011387.
- 16 Marciano Belisario JS, Jamsek J, Huckvale K *et al*. Comparison of self-administered survey questionnaire responses collected using mobile apps versus other methods. *Cochrane Database Syst Rev* 2015: MR000042. doi: 10.1002/14651858.MR000042.pub2.
- 17 Mukasa O, Mushi HP, Maire N *et al*. Do surveys with paper and electronic devices differ in quality and cost? Experience from the Rufiji Health and demographic surveillance system in Tanzania. *Global Health Action* 2017;**10**:1387984.
- 18 King JD, Buolamwini J, Cromwell EA *et al*. A novel electronic data collection system for large-scale surveys of neglected tropical diseases. *PLoS One* 2013;**8**:e74570.
- 19 Rath B, Donato J, Duggan A *et al*. Adverse health outcomes after Hurricane Katrina among children and adolescents with chronic conditions. *J Health Care Poor Underserved* 2007;**18**:405–17.
- 20 Rath B, Young EA, Harris A *et al*. Adverse respiratory symptoms and environmental exposures among children and adolescents following Hurricane Katrina. *Public Health Reports* 2011;**126**:853–60. (Washington, DC: 1974).
- 21 Myles P, Swenshon S, Haase K *et al*. A comparative analysis of psychological trauma experienced by children and young adults in two scenarios: evacuation after a natural disaster vs forced migration to escape armed conflict. *Public Health* 2018;**158**:163–175. doi:10.1016/j.puhe.2018.03.012.
- 22 Rath B, editor. Lessons Learnt from the Health Survey for Children and Adolescents after Katrina (HSCAAK). In: *48th Annual Meeting, Society for Epidemiological Research (SER)*; 2015 June 16–19; Denver, CO, USA: Society for Epidemiological Research (SER).
- 23 Patton GC, Sawyer SM, Ross DA *et al*. From advocacy to action in global adolescent health. *J Adolesc Health* 2016;**59**:375–7.
- 24 Bethlehem J, Shewhart WA, Wilks SS (eds). *Applied Survey Methods: A Statistical Perspective*. Hoboken, New Jersey: John Wiley & Sons, Inc, 2009:375.
- 25 Bozorgmehr K, Samuilova M, Petrova-Benedict R *et al*. Infectious disease health services for refugees and asylum seekers during a time of crisis: a scoping study of six European Union countries. *Health Policy* 2018. pii: S0168-8510(18)30079-4. doi: 10.1016/j.healthpol.2018.04.003. [Epub ahead of print].
- 26 Maltezou HC, Theodoridou M, Daikos GL. Antimicrobial resistance and the current refugee crisis. *J Glob Antimicrob Resist* 2017;**10**: 75–9.
- 27 Kassem DF, Hoffmann Y, Shahar N *et al*. Multidrug-Resistant Pathogens in Hospitalized Syrian Children. *Emerg Infect Dis* 2017;**23**: 166–8.
- 28 Takla A, Barth A, Siedler A *et al*. Measles outbreak in an asylum-seekers' shelter in Germany: comparison of the implemented with a hypothetical containment strategy. *Epidemiol Infect* 2012;**140**: 1589–98.
- 29 Jones G, Haeghebaert S, Merlin B *et al*. Measles outbreak in a refugee settlement in Calais, France: January to February 2016. *Euro surveillance* 2016;**21**:30167.
- 30 Oberg CN. Embracing international children's rights: from principles to practice. *Clin Pediatr (Phila)* 2012;**51**:619–24.
- 31 Rousseau C, ter Kuile S, Munoz M *et al*. Health care access for refugees and immigrants with precarious status: public health and human right challenges. *Can J Public Health = Revue can de Sante Publique* 2008;**99**:290–2.
- 32 Maurer W, Seeber L, Rundblad G *et al*. Standardization and simplification of vaccination records. *Expert Rev Vaccine* 2014;**13**:545–59.
- 33 RKI. Konzept zur Umsetzung frühzeitiger Impfungen bei Asylsuchenden nach. *Ankunft in Deutschland Epidemiol Bull* 2015;**41**: 439–48.
- 34 Seeber L, Michl B, Rundblad G *et al*. A design thinking approach to effective vaccine safety communication. *Curr Drug Safety* 2015;**10**: 31–40.
- 35 Seeber L, Conrad T, Hoppe C *et al*. Educating parents about the vaccination status of their children: a user-centered mobile application. *Prev Med Rep* 2017;**5**:241–50.

- 36 Dara M, Solovic I, Sotgiu G *et al.* Call for urgent actions to ensure access to early diagnosis and care of tuberculosis among refugees: Statement of the European Respiratory Society and the European Region of the International Union Against Tuberculosis and Lung Disease. *Eur Respir J* 2016;**47**:1345–7.
- 37 Khamesipour A, Rath B. Refugee health and the risk of cutaneous Leishmaniasis in Europe. *Int J Infect Dis* 2016;**53**:95–6.
- 38 Grieger D, Gardemann J. [Objectives and activities of the German Federal Working Group on migration and public health]. *Gesundheitswesen* 2003;**65**:704–8.
- 39 Martijn C, de Vries NK, Voorham T *et al.* The effects of AIDS prevention programs by lay health advisors for migrants in The Netherlands. *Patient Educ Couns* 2004;**53**:157–65.
- 40 Pottie K, Batista R, Mayhew M *et al.* Improving delivery of primary care for vulnerable migrants: Delphi consensus to prioritize innovative practice strategies. *Can Family Physician Med de Fam Can* 2014;**60**:e32–40.
- 41 Williams B, Cassar C, Siggers G *et al.* Medical and social issues of child refugees in Europe. *Arch Dis Child* 2016;**101**:839–42.
- 42 Bozorgmehr K, Mohsenpour A, Saure D *et al.* [Systematic review and evidence mapping of empirical studies on health status and medical care among refugees and asylum seekers in Germany (1990–2014)]. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2016;**59**:599–620.
- 43 VonHoltz LA, Hypolite KA, Carr BG *et al.* Use of mobile apps: a patient-centered approach. *Acad Emerg Med* 2015;**22**:765–8.
- 44 Bozorgmehr K, Bruchhausen W, Hein W *et al.* The global health concept of the German government: strengths, weaknesses, and opportunities. *Glob Health Action* 2014;**7**:23445.
- 45 Bonewit A, Shreeves R. Reception of female refugees and asylum seekers in the EU Case study Germany—Study for the FEMM Committee. In: *Policies DGfI, Affairs PDCCsRaC*. Brussels, Belgium: European Union, 2016.
- 46 Mylius M, Frewer A. Access to healthcare for undocumented migrants with communicable diseases in Germany: a quantitative study. *Eur J Public Health* 2015;**25**:582–6.
- 47 Puthoopparambil SJ, Bjerneld M, Kallestal C. Quality of life among immigrants in Swedish immigration detention centres: a cross-sectional questionnaire study. *Glob Health Action* 2015;**8**:28321.
- 48 Davison C, Michaelson V, Pickett W. It still takes a village: an epidemiological study of the role of social supports in understanding unexpected health states in young people. *BMC Public Health* 2015;**15**:295.