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Is there a need of health assessments for resettling refugees? A cross-sectional study of 1431 refugees who arrived in Denmark between 2014 and 2018

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ABSTRACT

Background: Refugees have increased health risks due to factors related to their country of origin, the migration itself and the receiving country. Based on systematic general health assessments of newly arrived refugees, we aimed to study the characteristics with regard to background, migration and health needs.

Methods: All refugees (children/adolescents and adults) arriving in Aarhus, Denmark from 1 January 2014 to 1 November 2018 were offered a general health assessment by a doctor including: medical history, a physical examination and blood samples.

Results: A cohort of 1431 (of 1618 invited, (88.4%) participants accepted the health assessment. The most commonly found health conditions in children were vitamin D deficiency (28.3%), elevated serum-IgE (34%) and lack of immunity against vaccine-preventable diseases (measles 20.1%, polio 3.9%). In adults, vitamin D deficiency (34.6%), IgE elevation (30%), latent tuberculosis (20.3%) and symptoms of PTSD (15.9%) were most prevalent. We found participants from Southern Asia (Iran, Afghanistan and Pakistan) to be overrepresented with regard to vitamin D deficiency, vitamin B12 deficiency and symptoms of PTSD. Furthermore, we found that origin in Africa was associated with latent tuberculosis. In total, 63.8% of examined refugees had one or more health problems requiring further testing, treatment or follow-up.

Conclusions: A comprehensive health assessment among recently arrived refugees showed multiple health issues to address, and demonstrates the need of systematic health assessments for resettling refugees.

1. Introduction

Migration continues to rise worldwide, and the number of international migrants is now estimated to be nearly 272 million globally (International Organization for Migration (IOM) and United Nations (UN) Migration, 2020). Migrants face specific health challenges. However, in countries with available data on migrant health, these data often point in ambiguous directions. This can in part be attributed to the diversity of the refugee populations with regard to country of origin, age, sex, type of migration and socioeconomic status (Rechel et al., 2013). Migrants often come from countries where poverty and conflicts have caused health systems to break down, limiting access to health services, which can cause neglected health conditions (MSF (Médecins Sans Frontières), 2015). Especially for infectious disease like hepatitis, tuberculosis, and intestinal parasites, studies have shown an overrepresentation amongst migrants (Hahné et al., 2013; Barnett et al., 2013; Redditt and Graziano, 2015). Conversely, when considering lifestyle factors such as alcohol consumption and tobacco smoking, some studies have found refugees to initially have healthier habits than the native population (Frederiksen and Norredam, 2012; Wang et al., 2016).

Some of these health problems can be detected by health assessments upon arrival (Barnett et al., 2013; Padovese et al., 2014; Kortas et al., 2017) and by providing specialised medical treatment in migrant health (Carballo et al., 2017). Nevertheless, refugees migrating from the same

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origin can experience varying degrees of health examinations when arriving in the receiving country (Hvass and Wejse, 2017).

Often, the cost of screening is one of the limiting factors towards the planning of health screenings (Bozorgmehr et al., 2017). In one of the few cost-effectiveness studies on single parameter screening in migrants, hepatitis B screening was found to be cost-effective (Veldhuijzen et al., 2010). Moreover, health assessments generally offer the opportunity to treat various conditions in early stages (Wilson and Junger, 1968), sustain healthy lifestyle habits (Padovese et al., 2014) and provide important knowledge on potential disease burden in a society (European Centre for Disease Prevention and Control (ECDC) 2018).

Published data on systematic health assessments are scarce. So far, most studies of newly arrived refugees have (i) focused on single diseases; (ii) were based on small populations sizes; (iii) were performed in asylum centres, where only part of the cohort remained in the country; (iv) did not include family reunified to refugees; or (v) were performed without a known denominator. Also, only a few studies report on the number of findings requiring follow-up.

Therefore, the aim of this study was to:

i) describe demographic characteristics and assess prevalence rates of certain health conditions in a consecutive sample of newly arrived refugees and family reunified in Denmark and
ii) to evaluate how many of the screened participants had findings requiring follow-up.

To address this, we conducted a study offering comprehensive health assessment to a complete cohort of refugees and family reunified arriving in Aarhus, Denmark, making it possible to study a complete refugee population with a known denominator: The AARHAUS study (AArhus Refugee Health Assessments Using Systematic approaches)

2. Material and methods

2.1. Study participants

We performed a cross-sectional study of health assessments in a cohort of newly arrived refugees in Denmark. In this study, newly arrived refugees are defined as refugees, who have received a residence permit within the last 3 years. The study was conducted in Aarhus, the second largest city in Denmark with 340,000 inhabitants. The municipality of Aarhus receives three refugee groups based on type of arrival: (i) quota refugees through UNHCR; (ii) refugees with asylum seeking background and (iii) immigrants arrived through family reunification to refugees, hereafter referred to as "family reunited" in the current paper. All three groups are offered a voluntary health assessment through their municipal assigned social worker, after receiving residence permit. The health assessment is conducted by a medical doctor with an interpreter in the mother tongue of the refugee (Fig. 1). If the patient was a minor, the mother, father or accompanying person was asked to answer questions where applicable.

The health assessment can be conducted up to three years after receiving residence permit. We defined the study cohort as refugees who had the health assessment done between January 2014 and November 2018. Even though the time span between arrival in Aarhus and health assessment is usually brief, participants could have arrived before the study period, and participants who arrived during the study period might have had the health assessment performed after the study period ended. We assumed these two groups to be equal in size when we calculated participation rate. We did not have access to data on length of stay before health assessment.

The offer of a voluntary health assessment was mandatory by Danish law between 2013 and 2016. After the law was amended in 2016, Aarhus Municipality chose to continue to offer health assessments to all newly arrived refugees and family reunified refugees.

2.2. Health assessments

The health assessments were very comprehensive, covering both infectious and non-infectious diseases as well as elements involving psychiatry and social medicine (Fig. 1). The content was based on a ministerial guideline on this field and relevant scientific literature (The Danish National Board of Social Services, 2015). In this paper we present the results from the blood sample panel and PTSD screening, as data on these parameters were collected systematically and were readily available.

Most parameters used in the health assessment were screening analysis/questions which require various follow-up testing to become diagnostic (Table 1).

If symptoms of PTSD were severe, the participant was referred directly to a specialised PTSD clinic at Aarhus University Hospital Department of Psychiatry, or the family physician was advised to refer. If mental health problems were suspected in children, the child was referred to the municipal psychological pedagogical department.

Country of origin was determined based on the patients own definition of his/her home country (For children, country of origin was according to parents definition). For the blood sample analysis, local cut-offs (based on international scientific literature) from Aarhus University Hospital Department of Biochemistry, Department of Immunology and Department of Microbiology were used for all parameters (Aarhus University Hospital, 2020) (Table 1).

Not all analyses were included for all patients. Polio IgG was only included in the first half of the study period and measles IgG only in the second half due to financial reasons. Vitamin B12 was added in August 2016 after we became aware of deficiencies in other refugee populations. Eosinophil count was added in January 2016 and IgE was added to the blood sample panel in November 2016. Both were added to help identify parasitic diseases after notification of intestinal helminths from collaborators at asylum centres.

Because the blood samples were taken as screening samples and not on vital indication, difficult venous punctures were only repeated after consulting a medical doctor to ensure the clinical implication. When venous punctures proved difficult in children, not all analysis could be performed and often QuantiFERON-TB Gold was left out due to the large amount of blood required for this analysis (4 ml). More details regarding the method can be found in previous papers (Hvass and Wejse, 2019; Hvass et al., 2020).

Results requiring further testing, treatment or follow-up at either family doctor or hospital are referred to as 'findings' in the current paper.

2.3. Statistical methods

We established a database using the RedCAP (Vanderbilt, United States of America) system, storing demographic data, interview results and blood sample results. The participants were divided into age groups according to WHO definitions of children and adolescents (WHO, 2020). Regions of origin were grouped using the United Nations (UN) geoscheme (UN, 2020): Eastern Africa: Somalia, Ethiopia, Eritrea and Zambia. Middle Africa: Congo, Central African Republic. Western Asia: Syria, Lebanon, Iraq, Palestine, Jordan, Kuwait. Southern Asia: Iran, Afghanistan, Pakistan. Regions and countries with participants <10 were placed in the category "Others".

We performed bivariate analysis to establish the various prevalences based on age, country of origin, region of origin, age and gender using Persons chi-square tests. Also, we dichotomised polytomous outcomes for interpretability of model results. Linear regression was used to correlate the sum of findings to age and length of education. To account for various distributions of nationality, all results were stratified by nation. In all analyses, p-values below 0.05 (two-tailed) were considered statistically significant. The statistical analysis was completed using Stata (Stata/IC version16.0).

Table 1
Analyses included in the blood sample panel used in the AARHAUS study from 2014 to 2018. Normal range cut offs are based on guidelines from Aarhus University Hospital (Aarhus University Hospital, 2020).

Variable	Method	Normal range	Criteria for 'findings'
TB	QuantiFERON-TB Gold PLUS (QFT-Plus)	Negative test result. (intermediate results resampled)	Positive QuantiFERON test
Syphilis	Detection of antibody WR and RPRU.	Negative test result.	Positive antibody test
HIV	Chemiluminescent-microparticle-immune analyse(CMIA) (HIV antibodies against HIV 1, HIV 2 and p24 antigen.)	Negative test result.	Positive test result
HAV	IgM against HAV Chemiluminescent-microparticle-immune analyse(CMIA)	Negative test result.	Positive test result
HBV	HBsAg detection: Chemiluminescent-microparticle-immune analyse(CMIA) (If positive analysis included: HBeAg, anti-Hbe, anti-HBc total/IgM and anti-HBs	Negative test result.	Positive test result
HCV	Antibodies against HCV. Chemiluminescent-microparticle-immune analyse(CMIA)	Negative test result.	Positive test result
Measles-IGG	Detection of serum antibody (IgG and IgM) against morbilli virus immunologic assay	Detection of antibodies	Lacking antibodies
Polio-IGG	Detection of neutralising antibodies against poliovirus type 1 2 and 3 in cell culture.	Detection of antibodies	Lacking antibodies for ≥1 polio type
Leucocytes	Flowcytometry using device from "Sysmex"	"2 month - 2 years: 6.2–16.2 × 10^9/l 2 years - 12 years: 4.5–12.5 × 10^9/l 12 years –18 years:4.4–10.5 × 10^9/l >18 years: 3.5–10.0 × 10^9/l (Pregnancy: 6.1–14.1 × 10^9/l)"	Elevated values according to age
Eosinophil count	Flowcytometry using device from "Sysmex"	>2 month: < 0.5 × 10^9 (Pregnancy: <0.41 × 10^9)	Elevated values according to age
Ige	ImmunoCAP analysis using device from "Phadia"	0 - 1 years: < 15 × 10^3 IU/l 1 - 6 years: < 100 × 10^3 IU/l 6 - 10 years: < 150 × 10^3 IU/ l >10 years: < 115 × 10^3 IU/l	Elevated values according to age
Creatinine	Absorption photometry using "Cobas 6000″ and "Chemistry XPT"	2 month - 1 years: 14–34 µmol/l 1 year- 3 years: 15–31 µmol/l 3 years –5 years: 23–37 µmol/l Female/male 5 years to 9 years 28–50/26–49 µmol/l Female/male 9 years to 11 years: 32–58/31–59 µmol/l Female/male 11 years to 14 years: 34–62/39–68 µmol/l Female/male 14 years to 18 years: 41–80/52–93 µmol/l Female/male >18 years 45–90/60–105 µmol/l (Pregnancy: 43–74 µmol/l)	Elevated values according to age
TSH	Two place immunometric analysis. Chemiluminometric measuring. using "Centaur XPT"	1 month–1 year: 0.6 - 8.1 × 10^{-3} IU/l 1 - 18 years 0.6–4.5 × 10^{-3}IU/l >18 years: 0.3–4.5 × 10^{-3} IU/l (Pregnancy: ≤week 12: 0.1- 3.5 × 10^3IU/l ≥week 13: 0.300 - 4.00 × 10–3 IU/l)	Above or below normal range according to age
LDH	Enzymatic reaction by Absorption photometry using device: "Cobas 6000 + Chemistry XPT"	1 month–4 years 155–450 U/l 4 years–16 years: 100–345 U/l 16 years–18 years: 105–235 U/l 18 years–70 years: 105–205 U/l >70 years: 115–255 U/l (Pregnancy: ≤ week 12: 95–343 U/l ≥week 13: 113–186 U/l)	Elevated values according to age
Hemoglobulin	Photometric measuring using device from "Sysmex"	6 month–1 year: 5.8–9.4 mmol/l 1 year–2 years 6.0–8.3 mmol/l 2 years –12 years: 6.5–8.9 mmol/l 12 years –18 years 6.6–9.9 mmol/l Female/male 18 > years: 7.3–9.5 / 8.3–10.5 mmol/l (Pregnancy: 7–9.1 mmol/l)	Elevated values according to age
Vitamin D	Tandem mass spectrometry using "LCMSMS"	50–160 nmol/l	Below normal range (25–50 nmol/l: insufficiency; 13–25 nmol/l moderate deficiency; <13 nmol/l severe deficiency.)
Vitamin B12	Electro-chemiluminometric measuring using "Centaur XPT"	200–600 pmol/	Below normal range
HBA1C (adults only)	Photometric measuring using device from "Tosoh"	≥18 years 31–44 mmol/mol	Elevated values according to age
PTSD (adults only)	Questionnaire		Evaluation by medical doctor recommending referral to specialised PTSD clinic

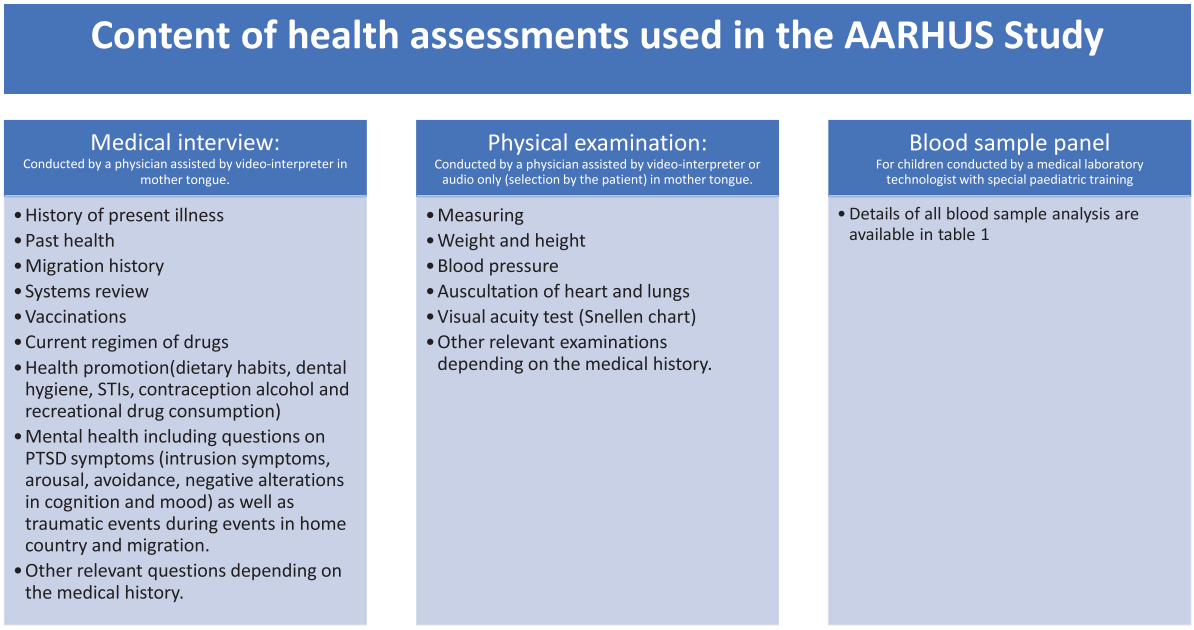

Fig. 1. The content of health assessments used in the AARHAUS Study. Medical interview, physical examination and blood sample panel.

The project was assessed by "The Central Denmark Region Committee on Health Research Ethics", who concluded approval was not required. The project was authorised by The Danish Data Handling Authority (file number 2015-55-0586) and the Danish Patient Safety Authority (file number 3-3013-2624/1).

3. Results

3.1. Demography

In total, 88.4% (1431/1618) accepted to participate in the health assessment during the study period from 1 January 2014 to 1 November 2018. As seen in Fig. 2, a total of 1365 participated in the medical interview and the physical examination, and 1277 had blood samples drawn. In total, 1431 participated either in the medical interview and physical examination, the blood sample panel, or both. Children/youth <19 constituted 42.8% of the cohort (n = 612) and adults ≥19 years 57.2% (n = 819).

Data on age and gender were available for the entire study population (Table 2). The majority had asylum seeking background (n = 874) (61.2%) and the participants originated primarily from Syria (66.2%). In total, 46.2% (n = 661) were female. The median age in the cohort was 22.9 years of age (range 0.4–76.0). Level of education was available for 767 adults ≥19 years.

3.2. Infectious diseases

In the screening panel for infectious diseases, latent tuberculosis (latent MTB infection) was the most common finding affecting 20.3% of adults and 6.7% of children/adolescents as seen in Table 3. In the total population, 14.9% (184/1431) were positive. This finding was significantly correlated to origin in Eastern Africa ((43/171), p < 0.000) and Middle Africa ((11/43), p = 0.046) and in a single country analysis to Ethiopia ((9/14) p <0.0 00) and Afghanistan ((16/51) p = 0.001).

With regard to vaccine-preventable diseases, lack of antibodies against measles was found in 20.3% of children/adolescents and 11.3% of adults. Lack of antibodies against polio was seen in 3.9% of children/adolescents and 6.8% of adults.

We found 10/1252 positive screening tests for syphilis (Table 3). All ten cases had confirmatory tests done at Aarhus University Hospital.

Elevated IgE was seen in almost a third of the study population, and elevated eosinophils in 6.8% (Table 3).

3.3. Chronic diseases

The overall rate of anaemia amongst tested children/adolescents was 1.9% (n = 10) and 14.0% (n = 102) for adults, based on age-, gender- and pregnancy-specific haemoglobin cut-offs (Table 3). Anaemia was significantly more common in adults (102/736) than children (10/526) (p < 0.0 00). Cases with anaemia were evenly distributed within the various countries and regions of origin. Only 5.0% had elevated Hba1c, indicating diabetes (Table 3).

Elevated TSH was seen in 6.1% (77/1265) of participants, and TSH below normal range was seen in 0.9% (12/1265) of participants.

3.4. Vitamin deficiencies

As shown in Table 3, we found 28.3% (150/530) of children and 34.6% (254/735) of adults to have moderate to severe vitamin D deficiency (P-25-OH-Vitamin D3 + D2 <25 nmol/l). For the total population 32% (404/1265). If the group with vitamin D Insufficiency was added (P-25-OH-Vitamin D3+D2 = 25–50 nmol/l) the participants with low vitamin D increased to 68.6% (868/1265). We found vitamin D deficiency to be correlated to origin in Southern Asia (p = 0.001). Also, vitamin B12 deficiency was correlated to origin in Southern Asia (p < 0.001). (Analysis included all age groups)

3.5. Mental health

As depicted in Table 3, patient records including evaluation of PTSD symptoms were available for 858 adults >=18 years old (94.6%). In 15.9% of cases (n = 129) patients were referred directly to a specialised PTSD clinic at Aarhus University Hospital's department of psychiatry (n = 68), or the refugee's family physician was given written advice to refer the patient (n = 61). In addition to these, symptoms of PTSD were mentioned in 13.3% of medical interviews. This adds up to 28.3% with varying degrees of PTSD symptoms. Within the subgoup referred to the PTSD clinic, we found participant origin from Southern Asia to be overrepresented ((31/129) p < 0.000).

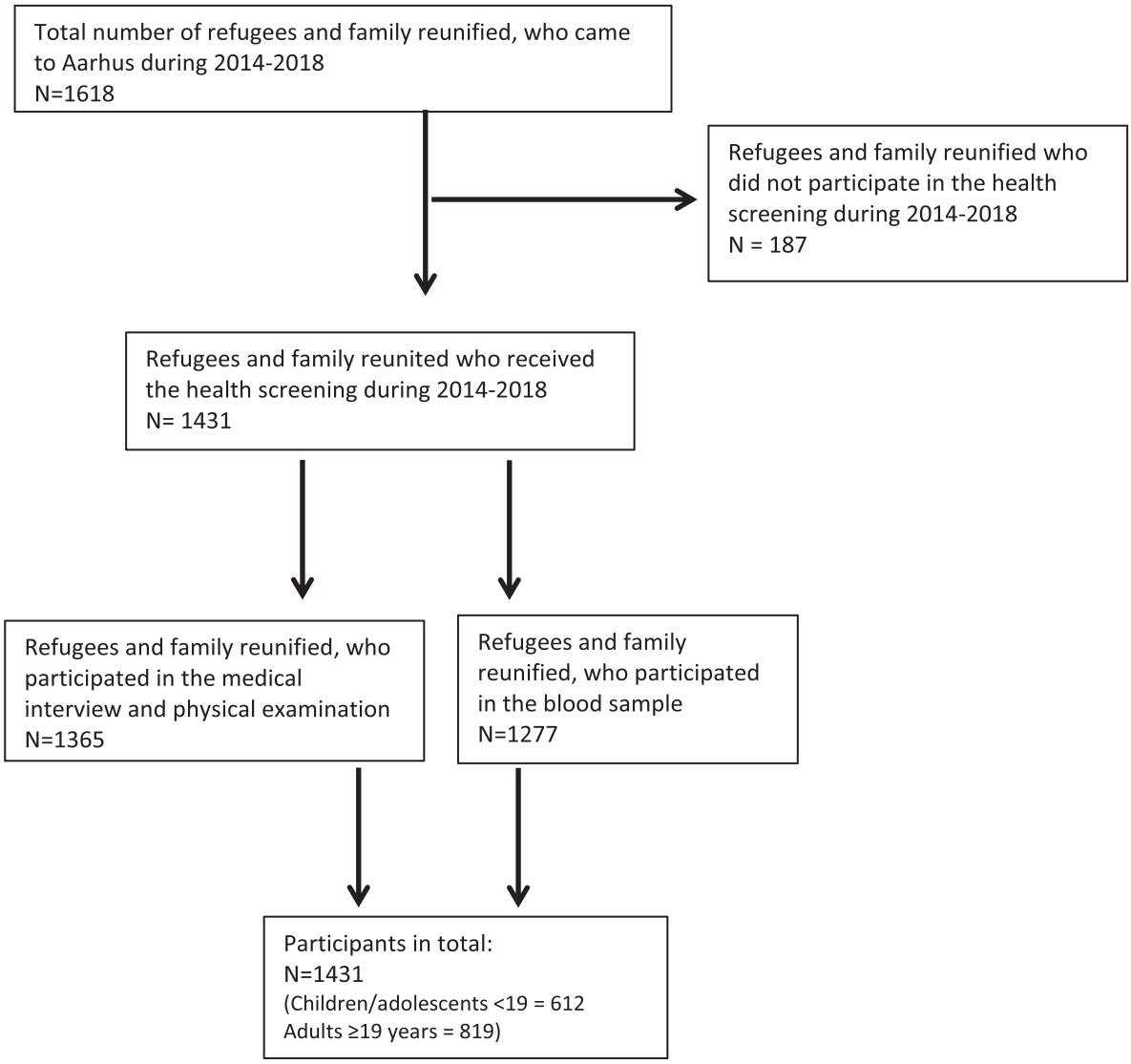

Fig. 2. Flow chart of the selection of the study population from 1 January 2014 to 1 November 2018.

Table 2
Demographics of the study population (n = 1431) stratified by country of origin.

	Number of participants	Children/youth <19	Female	Age median [range]	Average years of education (adults ≥19)	Type of arrival
Country of origin	*n*	%	%	years	Median /(years)	UNHCR/asylum seeking background/ family reunified to refugees/unknown.
Syria	947	43.4	46.0	23.6 [0.4–76]	12	9/588/350/0
Lebanon	17	23.5	58.8	27.2[6.4–60.9]	12	2/9/6/0
Iran	105	29.5	44.8	23.6 [5.5–31.9]	12	0/95/10/0
Iraq	12	25.0	58.3	27.2 [0.4–63.7]	10	1/7/4/0
Afghanistan	58	56.9	34.5	17.7 [0.6–75.6]	11	0/48/10/0
Somalia	58	63.8	49.2	16.5 [1.1–69.7]	2	1/21/36/0
Eritrea	120	37.5	40.0	22.9 [0.5–65.6]	10	0/81/39/0
Ethiopia	14	28.6	50.0	26.8 [6.9–36.9]	7	0/12/2/0
Central African Republic	15	60.0	60.0	14.3 [2.4–74.5]	4	15/0/0/0
Congo	36	50.0	58.3	17.6 [0.5–75]	8.5	36/0/0/0
Others[a]	27	29.6	59.3	34.6 [2.4–71.7]	12	12/7/7/1
Unknown	22	40.9	54.5	26.5 [1–69.4]	7	3/6/11/2
Total	1431	42.8	46.2	22.9 [0.4;76.0]	10	79/874/475/3

[a] Participants from countries with <10 participants: Libya, Morocco, Kuwait, Zambia, Russia, Jordan, Palestine, Columbia, Pakistan.

Table 3
Prevalence of infectious diseases, non-infectious diseases, vitamin deficiencies and mental health for children/adolescents and adults stratified by country of origin. Number of participants screened N, 'findings' (n) and prevalences.

Sample	Latent MTB A infection *N* (*n*)	Syphilis *N* (*n*)	HIV *N* (*n*)	HAV *N* (*n*)	HBV *N* (*n*)	HCV *N* (*n*)	Measles-IGG *N* (*n*)	Polio-IGG *N* (*n*)	Leuco–CYTESB *N* (*n*)	Eosinophil count *N* (*n*)	IGE *N* (*n*)	CREATI-NIN *N* (*n*)	TSHC *N* (*n*)	LDH *N* (*n*)	Hemo-GLOBIN *N* (*n*)	Vitamin D *N* (*n*)	Vitamin B12 *N* (*n*)	HBA1D *N* (*n*)	PTSDD *N* (*n*)
Children/adolescents																			
Region																			
Western Asia	336 (18)	364 (0)	366 (0)	353 (3)	367 (1)	367 (0)	138 (27)	139 (1)	366 (17)	230 (19)	95 (26)	366 (4)	366 (22)	353 (4)	366 (6)	367 (101)	164 (23)		
Southern Asia	58 (6)	59 (0)	60 (0)	53 (0)	60 (1)	60 (0)	53 (11)	6 (0)	61 (3)	56 (4)	53 (17)	62 (2)	62 (7)	57 (1)	61 (2)	65 (31)	54 (6)		
Eastern Africa	76 (7)	75 (0)	75 (0)	68 (0)	74 (0)	74 (1)	46 (8)	19 (5)	74 (16)	55 (9)	41 (22)	74 (0)	75 (12)	68 (1)	74 (0)	74 (17)	50 (3)		
Middle Africa	21 (3)	21 (2)	21 (0)	21 (0)	23 (0)	23 (0)	0 (0)	14 (1)	21 (2)	7 (1)	0 (0)	21 (1)	21 (3)	21 (0)	20 (1)	20 (0)	2 (0)		
Other	4 (0)	4 (0)	4 (0)	4 (0)	4 (0)	4 (0)	2 (2)	2 (0)	5 (0)	3 (1)	2 (0)	4 (0)	4 (1)	4 (0)	5 (1)	4 (1)	2 (0)		
Unknown	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)		
Prevalence	*6.7*	*0.38*	*0*	*0.6*	*3.8*	*0.2*	*20.1*	*3.9*	*7.2*	*9.7*	*34.0*	*1.3*	*8.5*	*1.2*	*1.9*	*28.3*	*11.8*		
Children/ adolescents total	495 (34)	523 (2)	526 (0)	499 (3)	528 (2)	528 (1)	239 (48)	180 (7)	527 (38)	351 (34)	191 (65)	527 (7)	528 (45)	503 (6)	526 (10)	530 (150)	272 (32)		
Adults																			
Western Asia	513 (86)	508 (0)	509 (0)	509 (0)	508 (10)	508 (5)	159 (19)	215 (12)	513 (74)	296 (8)	107 (26)	512 (6)	513 (37)	501 (21)	513 (75)	512 (181)	202 (43)	528 (33)	567 (88)
Southern Asia	97 (16)	96 (0)	96 (0)	96 (0)	96 (0)	96 (0)	78 (10)	16 (1)	98 (12)	82 (5)	78 (28)	98 (4)	98 (3)	93 (9)	98 (15)	98 (40)	80 (27)	100 (1)	99 (31)
Eastern Africa	95 (36)	94 (1)	94 (0)	94 (0)	94 (2)	94 (1)	31 (2)	44 (7)	94 (22)	50 (5)	28 (10)	94 (0)	94 (3)	93 (6)	94 (7)	94 (29)	37 (2)	106 (2)	111 (9)
Middle Africa	22 (8)	20 (6)	20 (1)	20 (0)	20 (1)	20 (3)	0 (0)	17 (0)	20 (5)	5 (2)	0 (0)	20 (0)	20 (0)	19 (13)	20 (4)	20 (2)	2 (0)	20 (1)	24 (1)
Other	7 (2)	7 (1)	7 (0)	7 (0)	7 (0)	7 (0)	3 (0)	3 (0)	7 (2)	4 (0)	3 (0)	7 (0)	7 (0)	7 (1)	7 (1)	7 (2)	3 (0)	7 (0)	9 (0)
Unknown	5 (2)	4 (0)	4 (0)	4 (0)	4 (0)	4 (0)	4 (0)	0 (0)	5 (0)	5 (0)	4 (3)	5 (1)	5 (1)	5 (0)	4 (0)	4 (0)	5 (0)	5 (1)	2 (0)
Prevalence	*20.3*	*1.1*	*0.1*	*0*	*1.8*	*1.2*	*11.3*	*6.8*	*15.6*	*4.5*	*30.5*	*1.5*	*6.0*	*7.1*	*14.0*	*34.6*	*21.9*	*5.0*	*15.9*
Total adult	739 (150)	729 (8)	730 (1)	730 (0)	729 (13)	729 (9)	275 (31)	295 (20)	737 (115)	442 (20)	220 (67)	736 (11)	737 (44)	718 (50)	736 (102)	735 (254)	329 (72)	766 (38)	812 (129)
Total *N* (*n*)	1234	1252 (10)	1256 (1)	1229 (3)	1257 (15)	1257(10)	514 (79)	475 (27)	1264	793 (54)	411 (132)	1263 (18)	1265 (89)	1221 (56)	1262	1265	601 (104)	766 (38)	812 (129)
Prevalence child/ adolescent and adult	(184) *14.9*	*0.8*	*0.1*	*0.2*	*1.2*	*0.8*	*15.4*	*5.7*	(153) *12.1*	*6.8*	*32.1*	*1.4*	*7.0*	*4.6*	(112) *8.9*	(404) *31.9*	*17.3*	*5.0*	*15.9*

[a]Mycobacterium Tuberculosis [b]Leukopenia and leucocytosis [c]Suppressed and elevated levels. [d]Adults ≥18 only.
Eastern Africa: Somalia, Ethiopia, Eritrea and Zambia. Middle Africa: Congo, Central African Republic. Western Asia: Syria, Lebanon, Iraq, Palestine, Jordan, Kuwait. Southern Asia: Iran, Afghanistan, Pakistan. Others (Countries from regions with <10 participants):Northern Africa(Morocco and Libya) Eastern Europe (Russian Federation) South America (Columbia).

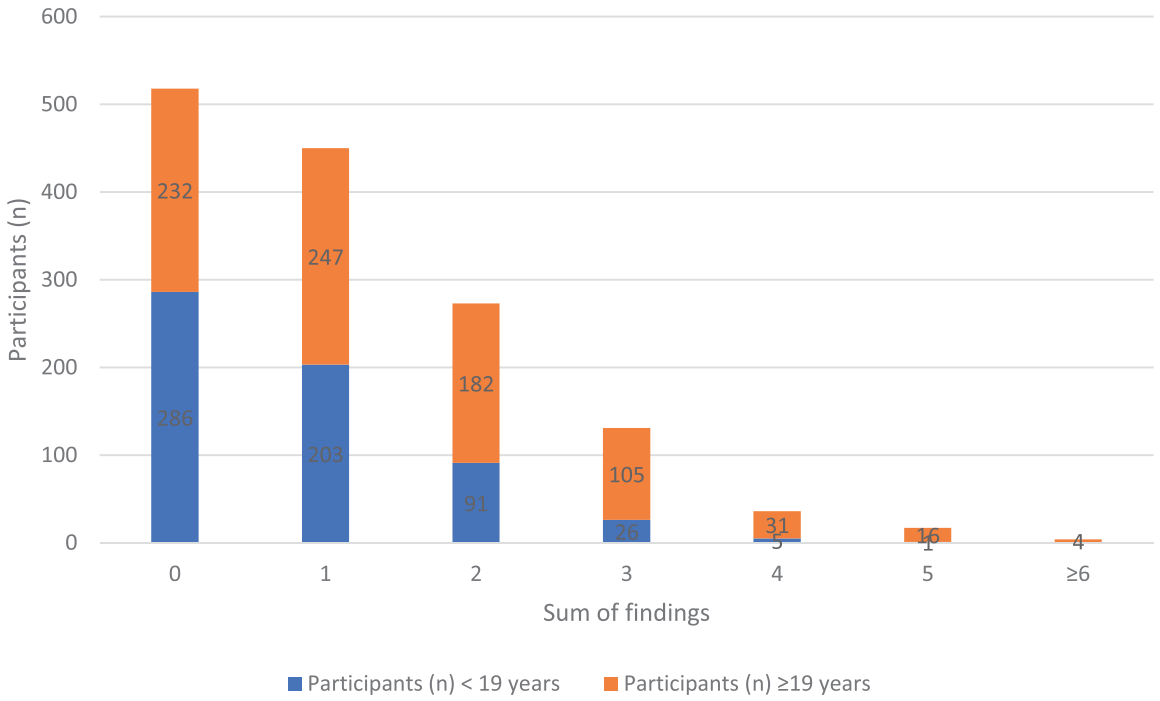

Fig. 3. Sum of findings requring follow-up for participatns <19 years old (blue) and ≥19 years old (orange). Each collum representing all patients with the indicated number of findings.

3.6. Conditions requiring follow up

In total, we found 63.8% (913/1431) with ≥1 finding (Fig. 3). We found significantly more participants from Southern Asia and Eastern Africa having ≥1 finding ($p < 0.0001$ and $p = 0.049$). Findings were more common in adults. In total, 53.3% (326/612) of children/youth had ≥1 finding and 71.7% (587/819) of adults had ≥1 finding. ($p < 0.000$). Using linear regression, we found the number of conditions requiring follow up was associated with increasing age and inversely associated to length of education (Both results were statistically significant $p \leq 0.001$ and $p = 0.002$).

If all patients with PTSD symptoms were added to the findings, along with vitamin D insufficiency, the number of participants with findings ascended to 80.2% (1147/1431).

4. Discussion

We have comprehensively evaluated physical and mental health status in an almost complete cohort of 1431 refugees in a well-defined geographical area through a 5-year period. We found the most common findings in children to be vitamin D deficiency (28.3%), IgE elevation (34.0%) and lack of immunity against vaccine-preventable diseases (measles 20.1%, polio 3.9%). In adults, the most common findings were vitamin D deficiency (34.6%), IgE elevation (30.5%), latent tuberculosis (20.3%) and symptoms of PTSD (15.9%) (Table 3). We found that 63.8% of refugees had one or more health problems requiring further testing, treatment or follow-up (53.3% for children/adolescents and 71.7% for adults). This demonstrates many undetected and untreated conditions in newly arrived refugees and documents a need to identify health problems in newly arrived refugees.

The results are similar to what has been found in an American study on migrant screening, where 61% of participants had ≥1 diagnosis needing follow-up (Barnett et al., 2013), and a study from Malta that found that 69% of asylum seekers presented with health problems in systematic health assessments (Padovese et al., 2014). (The age composition of the study populations in these two studies, were similar to the current study)

The number is far above what is seen in official screening programmes in other fields for single diseases. E.g. in breast cancer screening, 4% have results requiring follow-up (NHS, 2018) and 12% in retinopathy screening in diabetics (Kashim et al., 2018).

Even though ECDC has made a recommendation on health screening of refugees (European Centre for Disease Prevention and Control (ECDC), 2018), the current European screening programmes have adopted a variety of approaches to screening migrants. A recent review of refugee health screenings in Europe found that most screenings have low coverage, testing only for one infectious disease and in a narrow subset of migrants (Seedat et al., 2018). In our study, we found several non-infectious conditions to be more prevalent than infectious diseases. Some of the conditions most often needing follow-up were vitamin deficiencies, PTSD symptoms and lack of immunity against vaccine-preventable diseases.

4.1. Infectious diseases

The composition of refugee populations varies according to ongoing wars, disasters and migration routes, whereby direct comparison of prevalences can be complicated. For example, we found only 1.2% of participants positive for hepatitis B, where studies that have included participants from South East Asia, where the disease is more prevalent, found higher numbers (4–14%) (Redditt and Graziano, 2015; Lifson, 2002; Catanzaro and Moser, 1982). Studies with participants primarily from the Middle East found lower prevalences, ranging between 2 and 3.9 (Kortas et al., 2017; Ngo et al., 2018), which was more similar to our results. The results of this study for hepatitis B are also similar to what was found in a systematic review of hepatitis screening in Europe which estimated that 0.1%–5.6% of the general population was positive for HbAsg. The review also found hepatitis B to more prevalent in migrants than the general population in most countries. (Hahné et al., 2013).

We found 14.9% with latent TB. Other studies using an IGRA test (QuantiFERON-TB Gold In-Tube assay) have found results between 9% and 20% in migrants (Paxton et al., 2012; Warrington et al., 2018). Studies using TST skin test found higher results (32%–55%), presumably due

to the test also reacting to earlier BCG immunisation or non-tuberculous mycobacteria (Barnett et al., 2013; Padovese et al., 2014; Catanzaro and Moser, 1982). Surprisingly, many of the participants testing positive in the current study came from countries with a low incidence of TB and would not have been tested using the standard procedure for screening in Denmark. In comparison, a study in Danish patients starting anti-TNF alfa treatment, found 4.6% to have positive IGRA tests (Danielsen et al., 2014).

Overall, the prevalences of infectious diseases were similar to what was found in similar studies (Barnett et al., 2013; Padovese et al., 2014).

4.2. Vitamin deficiencies

Vitamin D deficiency was one of the most frequently seen findings. In the total study population, 31.9% had moderate and severe vitamin D deficiency, rising to 68.6% when mild deficiency was included. This is similar to what was found in other studies including mild deficiency in cohorts that also included participants from various African and Asian countries (64%–70%) (Ngo et al., 2018; Huntington et al., 2010). In comparison, a population based study in Denmark, found 14% to have moderate or severe deficiency (Thuesen et al., 2012)

4.3. Mental health

Regarding mental health, PTSD symptoms were mentioned in almost a third of the medical interviews. A study from Sweden screened for PTSD in an asylum centre using the "PC-PTSD score" and found 56.2% to have symptoms of PTSD (Leiler et al., 2019). In spite of the condition being seen this frequently, PTSD is rarely a part of screening programs for newly arrived refugees (Hvass and Wejse, 2017; Bernadette N Kumar, 2019).

4.4. Study population

In most recent studies on health assessments of migrants, the study populations have consisted primarily of asylum seekers, with a high proportion of male participants (75.6–81%) (Kortas et al., 2017; Freidl et al., 2018; Jablonka et al., 2017). This could be attributed to the typical practice of male refugees travelling first and the rest of the family arriving later as family-reunified refugees. The current study has been performed after participants received residence permits and included family-reunified refugees. Thereby, this cohort represents the refugees who will stay in the country, and thus we can present a more accurate estimate of the potential disease burden in the society.

4.5. Barriers to seeking health care

In the study, we found length of education to be inversely correlated to number of findings. The health assessment also works as an introduction to a new health system, which is especially important to illiterates to whom finding information on their own is challenging. Many refugees experience a large number of barriers when seeking health care assistance in a new country (Seedat et al., 2018) and a study by Floyd et al. have shown how illiteracy adds to the layers of disadvantage in reaching statutory health care (Floyd and Sakellariou, 2017).

It could be argued, that many of the conditions found in this study, would have been detected via the established health system, even without the health assessment. However, the newly arrived refugees are not familiar with the local health system and without an introduction, this would cause delayed diagnostics and treatment. Also, appointments with Danish GPs and emergency rooms are of limited length, are typically based on the patient selecting one topic for the conversation, and trained interpreters in the patients mother tongue are rarely present (Bernadette N Kumar, 2019; Hee Schultz Dungu et al., 2019). Also, since several studies have shown refugees to have a good health upon arrival, but long-term residence leads to health deterioration as a result of poor living and working conditions, it is possible to affirm that their health needs would only increase with time (Rechel et al., 2013; Bernadette N Kumar, 2019).

This study augments the limited evidence currently available on systematic health assessments of infectious, non-infectious diseases and mental health in newly arrived refugees. It adds to the knowledge provided by studies on a few selected conditions and shows the variety of health problems seen in refugee health care. By looking at the person's health as an entity, we found a broad spectrum of health conditions requiring further attention. This suggests that there is a need of a broad approach to the individual's health, instead of few selected diseases in screening programmes.

4.6. Limitations

The study has a number of limitations. First, data from several parameters from the health assessment were not available for analysis. This includes data on, e.g. musculoskeletal pain, dental problems, skin diseases including scabies and cardiovascular diseases. All conditions frequently found in other similar studies (Barnett et al., 2013; Padovese et al., 2014; Kortas et al., 2017). This will probably have created an underestimation of the findings requiring follow-up.

Secondly, some of the subgroup analysis were conducted in relatively small groups, resulting in less accurate estimates.

A third limitation is that only 88.4% of refugees accepted participation in the health assessments and the remaining 11.6% may be distributed differently. One could argue that refugees accepting the assessment might be showing 'health seeking behaviour', creating an underestimation of prevalences – or the opposite – healthy individuals not prioritising health assessment, creating an overestimation. Still, based on the high participation rate, we believe that our results may still help answer the questions concerning prevalences of various diseases and the sum of findings.

5. Conclusion

We found that health assessments of newly arrived refugees detect several health problems needing follow-up afterwards. In total, 63.8% of participants required a medical follow-up, 80.2% if vitamin D insufficiency and all symptoms of PTSD were included. This shows health assessments are justified to uncover health problems neglected during war, disasters and migration in both children/adolescents and adults.

Health assessments provide a variety of benefits for both individual and society, firstly to detect earlier stages of various diseases and create a linkage to care, secondly to sustain healthy lifestyle habits, thirdly to prevent the potential spread of infectious diseases, and fourthly to provide knowledge of the potential disease burden in a society – when done systematically in a representative population.

Policy-makers needs to be aware of these benefits and should aim to provide evidence-based protocols in real time, and make recommendations readily available to clinicians. Hereby, the health assessments would be meaningful on both individual and population level.

We recommend that health assessments of both communicable diseases, non-communicable diseases and mental health are offered to all resettling refugees.

Declaration of Competing Interest

The authors report no conflicts of interest.

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References

Aarhus University hospital. Complete laboratory analysis collection 2020. https://www.auh.dk/om-auh/afdelinger/blodprover-og-biokemi/Til-fagfolk/analysefortegnelsen/primarsektor/ (accessed April 22, 2020).

Barnett, E.D., Weld, L.H., McCarthy, A.E., So, H., Walker, P.F., Stauffer, W., et al., 2013. Spectrum of illness in international migrants seen at geosentinel clinics in 1997-2009, part 1: US-bound migrants evaluated by comprehensive protocol-based health assessment. Clin. Infect. Dis. 56, 913–924. doi:10.1093/cid/cis1015.

Bernadette N Kumar, E.D., 2019. Migrant Health: A Primary Care Perspective. Taylor & Francis Group.

Bozorgmehr, K., Wahedi, K., Noest, S., Szecsenyi, J., Razum, O., 2017. Infectious disease screening in asylum seekers: range, coverage and economic evaluation in Germany, 2015. Eurosurveillance 22. doi:10.2807/1560-7917.ES.2017.22.40.16-00677.

Carballo, M., Hargreaves, S., Gudumac, I., Maclean, E.C., 2017. Evolving migrant crisis in Europe: implications for health systems. Lancet Glob. Health 5, e252–e253. doi:10.1016/S2214-109X(17)30040-2.

Catanzaro, A., Moser, R.J., 1982. Health status of refugees. JAMA 247, 1303–1308.

Danielsen, A.V., Fløe, A., Lillebaek, T., Hoffmann, H.J., Hilberg, O., 2014. An interferon-gamma release assay test performs well in routine screening for tuberculosis. Dan Med J. 61(6), A4856.

European Centre for Disease Prevention and Control (ECDC), 2018. Public Health Guidance on Screening and Vaccination for Infectious Diseases in Newly Arrived Migrants within the EU/EEA. ECDC Report from.

Floyd, A., Sakellariou, D., 2017. Healthcare access for refugee women with limited literacy: layers of disadvantage. Int. J. Equity Health 16, 1–10. doi:10.1186/s12939-017-0694-8.

Frederiksen, H.W., Norredam, M., 2012. Health Conditions for Newly Arrived Migrants (Sundhedsforhold hos nyankomne indvandrere). Danish Research Centre for Migration, Ethnicity and Health Report from.

Freidl, G.S., Tostmann, A., Curvers, M., Ruijs, W.L.M., Smits, G., Schepp, R., et al., 2018. Immunity against measles, mumps, rubella, varicella, diphtheria, tetanus, polio, hepatitis A and hepatitis B among adult asylum seekers in the Netherlands, 2016. Vaccine 36, 1664–1672. doi:10.1016/j.vaccine.2018.01.079.

Hahné, S.J.M., Veldhuijzen, I.K., Wiessing, L., Lim, T.A., Salminen, M., Laar, M.van de, 2013. Infection with hepatitis B and C virus in Europe: a systematic review of prevalence and cost-effectiveness of screening. BMC Infect Dis 13. doi:10.1186/1471-2334-13-181.

Hee Schultz Dungu, K., Kruse, A., Marie Svane, S., Thor Halberg Dybdal, D., Wørmer Poulsen, M., Wollenberg Juul, A., et al., 2019. Language barriers and use of interpreters in two Danish paediatric emergency units. Dan. Med. J. 66, 1–5.

Huntington, M.K., Shafer, C.W., Pudwill, R., Boer, L., Kendall, J., 2010. Prevalence of vitamin D deficiency among immigrants to South Dakota. S D Med. 63, 51–54.

Hvass, A.M.F., Wejse, C., 2017. Systematic health screening of refugees after resettlement in recipient countries: a scoping review. Ann. Hum. Biol. 44, 475–483. doi:10.1080/03014460.2017.1330897.

Hvass, A.M.F., Wejse, C., 2019. High coverage of the polio immunization program in refugees resettling in Denmark. A cross- sectional study of polio serology in newly arrived refugees. Expert Rev. Vaccines 10, 1–6. doi:10.1080/14760584.2019.1698953.

Hvass, A.M.F., Norredam, M., Sodemann, M., Thomsen, M.K., Christian, W., 2020. Are refugees arriving in Denmark an under-immunised group for measles? A cross-sectional serology study. Vaccine 38, 2788–2794. doi:10.1016/j.vaccine.2020.02.025.

International Organization for Migration (IOM) and United Nations (UN) Migration. World Migration Report 2020. 2020.

Jablonka, A., Happle, C., Wetzke, M., Dopfer, C., Merkesdal, S., Schmidt, R.E., et al., 2017. Measles, rubella and varicella IgG seroprevalence in a large refugee cohort in Germany in 2015: a cross-sectional study. Infect. Dis. Ther. 6, 487–496. doi:10.1007/s40121-017-0169-7.

Kashim, R.M., Newton, P., Ojo, O., 2018. Diabetic retinopathy screening: a systematic review on patients' non-attendance. Int. J. Environ. Res. Public Health 15. doi:10.3390/ijerph15010157.

Kortas, A.Z., Polenz, J., von Hayek, J., Rüdiger, S., Rottbauer, W., Storr, U., et al., 2017. Screening for infectious diseases among asylum seekers newly arrived in Germany in 2015: a systematic single-centre analysis. Public Health doi:10.1016/j.puhe.2017.07.011.

Leiler, A., Bjärtå, A., Ekdahl, J., Wasteson, E., 2019. Mental health and quality of life among asylum seekers and refugees living in refugee housing facilities in Sweden. Soc. Psychiatry Psychiatr. Epidemiol. 54, 543–551. doi:10.1007/s00127-018-1651-6.

Lifson, A.R., 2002. Prevalence of tuberculosis, hepatitis B virus, and intestinal parasitic infections among refugees to Minnesota. Public Health Rep. 117, 69–77.

MSF (Médecins Sans Frontières). Obstacle Course to Europe (MSF Report). 2015.

Ngo, C.C., Maidment, C., Atkins, L., Eagar, S., Smith, M.M., 2018. Blood screen findings in a 2-year cohort of newly arrived refugees to Sydney, Australia. Public Health Res. Pract. 28. doi:10.17061/phrp2811804.

NHS. NHS screening. March 2018. https://www.nhs.uk/conditions/breast-cancer-screening/results/ (accessed February 29, 2020).

Padovese, V., Egidi, A.M., Melillo, T.F., Farrugia, B., Carabot, P., Didero, D., et al., 2014. Prevalence of latent tuberculosis, syphilis, hepatitis B and C among asylum seekers in Malta. J. Public Health (Oxf.) doi:10.1093/pubmed/fdt036.

Paxton, G.A., Sangster, K.J., Maxwell, E.L., McBride, C.R.J., Drewe, R.H., 2012. Post-arrival health screening in Karen refugees in Australia. PLoS ONE doi:10.1371/journal.pone.0038194.

Rechel, B., Mladovsky, P., Ingleby, D., Mackenbach, J.P., McKee, M., 2013. Migration and health in an increasingly diverse Europe. Lancet 381, 1235–1245. doi:10.1016/S0140-6736(12)62086-8.

Redditt, V.J., Graziano, D., 2015. Arrived refugees in Toronto, Ont. Part 1. Can. Fam. Physician 61, 310–315.

Seedat, F., Hargreaves, S., Nellums, L.B., Ouyang, J., Brown, M., Friedland, J.S., 2018. How effective are approaches to migrant screening for infectious diseases in Europe? A systematic review. Lancet Infect. Dis. 18. doi:10.1016/S1473-3099(18)30117-8.

The Danish National Board of Social Services, 2015. Faglige Anvisninger Fra Socialstyrelsen vedr. Helbredsmæssige Vurderinger Af Nyankomne Flygtninge Og Familiesammenførte Til Flygtninge.

Thuesen, B., Husemoen, L., Fenger, M., Jakobsen, J., Schwarz, P., Toft, U., et al., 2012. Determinants of vitamin D status in a general population of Danish adults. Bone 50, 605–610. doi:10.1016/j.bone.2011.12.016.

UN. Standard country or area codes for statistical use (M49) 2020. https://unstats.un.org/unsd/methodology/m49/ (accessed May 5, 2020).

Veldhuijzen, I.K., Toy, M., Hahné, S.J.M., De Wit, G.A., Schalm, S.W., de Man, R.A., et al., 2010. Screening and early treatment of migrants for chronic hepatitis B virus infection is cost-effective. Gastroenterology 138, 522–530. doi:10.1053/j.gastro.2009.10.039.

Wang, Y., Min, J., Harris, K., Khuri, J., Anderson, L.M., 2016. A systematic examination of food intake and adaptation to the food environment by refugees settled in the United States. Adv. Nutr. An. Int. Rev. J. 7, 1066–1079. doi:10.3945/an.115.011452.

Warrington, P., Tyrrell, G., Choy, K., Eisenbeis, L., Long, R., Cooper, R., 2018. Prevalence of latent tuberculosis infection in Syrian refugees to Canada. Can. J. Public Health 109, 8–14. doi:10.17269/s41997-018-0028-7.

WHO. WHO. Adolescent Health 2020. https://www.who.int/southeastasia/health-topics/adolescent-health (accessed May 6, 2020).

Wilson, J.M., Junger, G., 1968. Principles and Practice of Screening for Disease. Geneva World Heal Bibliogr Organ WHO Public, p. 168. doi:10.1001/archinte.1969.00300130131020 Paper 34.