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The Profile of Health Problems in African Immigrants Attending an Infectious Disease Unit in Melbourne, Australia

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Abstract. The number of African immigrants living in Western countries is increasing. A retrospective audit of sub-Saharan African patients attending the infectious diseases clinics of a Melbourne teaching hospital was performed. A total of 375 patients were included. *Helicobacter pylori* gastritis was diagnosed in 60% of those tested (35/58), schistosomiasis in 41% (84/206), chronic hepatitis B in 19% (32/167), and strongyloidiasis in 18% (32/179). Active tuberculosis (TB) affected 18% (51/276) and latent TB 55% (152/276). Pathologic parasites were detected in stool in 21% (31/145). Vitamin D deficiency (< 50 nmol/L) affected 73% (139/191), anemia 17% (52/312), iron deficiency 15% (22/151), and low neutrophil count 25% (78/312). Infectious diseases, vitamin D deficiency, anemia, and latent TB were common in sub-Saharan African immigrants. Clinicians need to be aware of these conditions to meet the health needs of this group. Comprehensive health checks should be encouraged for new arrivals, particularly from high-risk areas.

INTRODUCTION

The profile of immigrants arriving in Western countries is changing and, in response to United Nations High Commissioner for Refugees (UNHCR) requests, the recent regional focus of the Australian Humanitarian Program has been on Africa. In the 2006–2007 financial year, Africans made up 51% of entrants to Australia under this program and six of the top 10 source countries were in sub-Saharan Africa (Sudan, Burundi, Congo, Liberia, Sierra Leone, and Eritrea).[1] People applying for a permanent visa to come to Australia undergo a health assessment, which for adults includes a medical examination, chest x-ray for active or untreated tuberculosis (TB), and a human immunodeficiency virus (HIV) test.[2] In addition, pre-departure medical screening has been operating in East and West Africa since August 2005. This process is undertaken about 3 days before refugee and humanitarian visa holders are to travel to Australia and assesses clients' general health status and fitness to travel.[1] Health checks are not compulsory after arrival in Australia, although an increasing number of people access comprehensive health assessments through local medical officers. This is facilitated through the recent establishment of a specific Medicare Benefits number.[3]

Recent reports have highlighted the prevalence of infectious diseases among African refugees in Australia screened in specialist Migrant Health Units[4,5] and general practices.[6] There are, however, no published reviews from specialist infectious diseases clinics or tertiary adult hospitals in Australia regarding this group, and few worldwide. We undertook a clinical audit of infectious diseases, vitamin D deficiency, and hematologic abnormalities among adult patients from sub-Saharan Africa referred to the outpatient clinics of an infectious diseases unit in a tertiary Melbourne hospital, with the objective of improving patient management. We highlight some specific management issues encountered in this population, including TB, schistosomiasis, *Helicobacter pylori* (*H. pylori*) gastritis, and vitamin D deficiency, and discuss some of the associations found with these conditions and implications for clinical practice.

MATERIALS AND METHODS

A retrospective audit was performed of patients attending the infectious diseases outpatient clinics, including specialist HIV and TB clinics, at the Royal Melbourne Hospital, Australia, between January 1, 2003 and June 30, 2006. Patients were referred to these clinics for investigation and management of symptoms or abnormal screening test results that could be attributed to infectious diseases. All patients born in sub-Saharan Africa and Sudan were included, other than those who were documented to be "Caucasian" or "Asian." Patients were identified via the hospital registration database according to their country of birth. Data were collected from the patients' medical records and from the hospital pathology and radiology records. Background information collected included age, sex, country of birth, date of birth, date of arrival in Australia, preferred language, and interpreter requirements. Information regarding infectious diseases, vitamin D deficiency, and hematologic indices was also collected. The treating doctor(s) made the decision regarding which tests were performed, and not all the tests listed were performed for each patient. Some tests (e.g., gastroscopy for *H. pylori*) were only performed in those with symptoms suggestive of the disease. In the case of serology and QuantiFERON-TB Gold tests (QFT-G, Cellestis Limited, Carnegie, Victoria, Australia); the results were interpreted according to the recommendations of the manufacturer. Age and time in Australia were calculated at the time of the first clinic attendance in the study period. Disorders were defined by pre-specified criteria as follows.

Infectious disorders (excluding stool parasites). Chronic hepatitis B virus (HBV), detection of hepatitis B surface antigen (HBsAg) in serum; *Chlamydia* and gonorrhea, positive genital swab for culture or urine for polymerase chain reaction (PCR); *H. pylori* gastritis, detection of *H. pylori* at gastroscopy or a positive carbon-14 breath test for *H. pylori* or (in the absence of gastroscopy and breath test) positive *H. pylori* serology; malaria, positive blood film and/or immunochromatographic test (ICT) for *Plasmodium* species; TB, microbiologic

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or histologic evidence of clinically active *Mycobacterium tuberculosis* (MTB) infection and/or receiving treatment for TB during the study period; and latent TB infection (LTBI), a positive Mantoux test (≥ 10 mm) or a positive QFT-G and no evidence of active TB or history of past TB. Serologic tests were performed for hepatitis C virus (HCV), human immunodeficiency virus (HIV), schistosomiasis, strongyloidiasis, and syphilis.

Stool parasites. Pathologic stool parasites were identified by ICT of stool for antigen to *Giardia lamblia* and microscopy of stool for *Ascaris lumbricoides*, *Dientameba fragilis*, *Entameba histolytica*, *Giardia lamblia*, hookworms, schistosomes, *Strongyloides stercoralis*, *Taenia saginata*. Nonpathologic stool parasites were identified by microscopy of stool (*Blastocystis hominis*, *Endolimax nana*, *Entameba coli, Entameba hartmanii*, *Iodameba butschlii*).

Non-infectious diseases. Anemia, hemoglobin (Hb) < 20 g/L; microcytosis, mean cell volume (mcv) of red blood cells < 80 fL; macrocytosis, mcv ≥ 100 fL; low neutrophil count, neutrophil count < 2.0×10^9/L; eosinophilia, eosinophil count > 0.5×10^9/L; iron deficiency, serum ferritin < 20 mcg/L; any vitamin D (25[OH]D) deficiency, serum 25(OH)D < 50 nmol/L; moderate-severe vitamin D deficiency, serum 25(OH) D ≤ 25 nmol/L; hemoglobinopathy, abnormal Hb electrophoresis, or DNA evidence of thalassemia trait.

After assessment for normal distribution, means and standard deviations were calculated. Country of birth was separated into three regions—Sudan, Southern and East Africa (including the countries of Botswana, Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Somalia, South Africa, Uganda, Tanzania, Zambia, and Zimbabwe), and Central and West Africa (Congo, DR Congo, Ghana, Liberia, Niger, Nigeria, Senegal, and Sierra Leone)—according to the Australian Bureau of Statistics classification.[7] Five selected conditions (chronic HBV, HIV, schistosomiasis, TB, and moderate-severe vitamin D deficiency) were assessed for an association with the following variables: age (> 30 years), sex, region of birth, time in Australia (> 1 year), hematologic abnormalities (anemia, microcytosis, eosinophilia), and the other four selected conditions. Variables with a P value of < 0.05 on univariate analysis, as well as age and gender, were included in backward stepwise logistic regression models. These results were reported as adjusted odds ratios (AOR). Data were analyzed using Stata, version 9 (StataCorp, College Station, TX).

To maintain confidentiality, the names of patients involved were not recorded and data were stored on a computer kept in a secure area of the Infectious Diseases Unit. This work was undertaken as part of a clinic audit to improve patient care and according to guidelines that were current at the time; the project did not require approval from the hospital human research ethics committee.

RESULTS

A total of 375 patients born in sub-Saharan Africa attended the infectious diseases outpatient clinics of the Royal Melbourne Hospital between January 1, 2003 and June 30, 2006. Table 1 summarizes the characteristics of these patients. The mean age of patients attending the clinic was 33 years of age (range 16–76 years). Before arriving in Australia, 85% (229/268) of patients resided in at least one country other than their country of birth. The most common countries of transit were Egypt and Kenya (75/268, 28% each), and 41% (75/184) spent time in a refugee camp in Africa. Almost half the patients (179/375, 48%) required an interpreter. Patients born in Southern and East Africa were likely to have been in Australia for longer than other African patients (mean 4.7 years versus 1.3 years, $P < 0.001$). Only 15% of patients (51/351) had been in Australia for less than 3 months. Figure 1 outlines the frequency of documented investigation results for the 375 patients.

Table 2 shows the medical conditions identified in this patient group, along with the prevalence of these diseases reported in other studies of African immigrants to Western countries. Significant associations for selected infectious conditions and vitamin D deficiency are shown in Table 3. The prevalence of chronic HBV in this population of African migrants was 19% (32/167), with men and patients from Sudan more likely to be affected. The prevalence of HIV in this population of African migrants was 12% (26/215), and this was associated with duration of stay in Australia > 1 year. Antibodies to HCV were detected in 8/233 (3.4%), with 6/8 (75%) of these patients being viremic (detectable serum HCV PCR). Evidence of active TB was identified in 51/276 (18.5%) patients, and was more common in patients from Southern and East Africa and those with moderate-severe vitamin D deficiency.[8] Of the 51 patients with TB, 21 (41%) had disseminated TB (more than one organ involved), 17 (33.3%) had pulmonary involvement, and 2 (3.9%) were HIV infected. Fifty patients had results of both Mantoux and QFT-G tests documented and these results were discordant in 11/50 (22%). Nine patients were Mantoux positive and QFT-G negative, and two Mantoux negative and QFT-G positive. All were considered to have LTBI.

TABLE 1
Patient characteristics (N = 375 unless specified)

	n	Percent
Age (years)		
16–19	32	8.5
20–45	304	81.1
> 45	39	10.4
Male gender	192	51.2
Country of birth		
Sudan	118	31.5
Somalia	79	21.1
Ethiopia	78	20.8
Liberia	21	5.6
Eritrea	19	5.1
Other	60	16.0
Transit through a refugee camp (N = 184)	75	40.8
Preferred language for communication		
English	125	33.3
Dinka	70	18.7
Somali	56	14.9
Arabic	28	7.5
Other	96	25.6
Referral source (N = 368)		
General practitioner	155	42.1
Royal Melbourne Hospital*	114	31.0
Royal Children's Hospital, Melbourne†	51	13.9
Department of Human Services‡	18	4.9
Other	30	8.2

* The hospital of the audited clinics. Patients referred from inpatient services (75 patients), other outpatient services (21 patients), and the emergency department (19 patients).
† Adult family members of children seen at a nearby children's hospital.
‡ Tuberculosis unit of Government of Victoria's health department—referred people identified through contact tracing of tuberculosis cases.

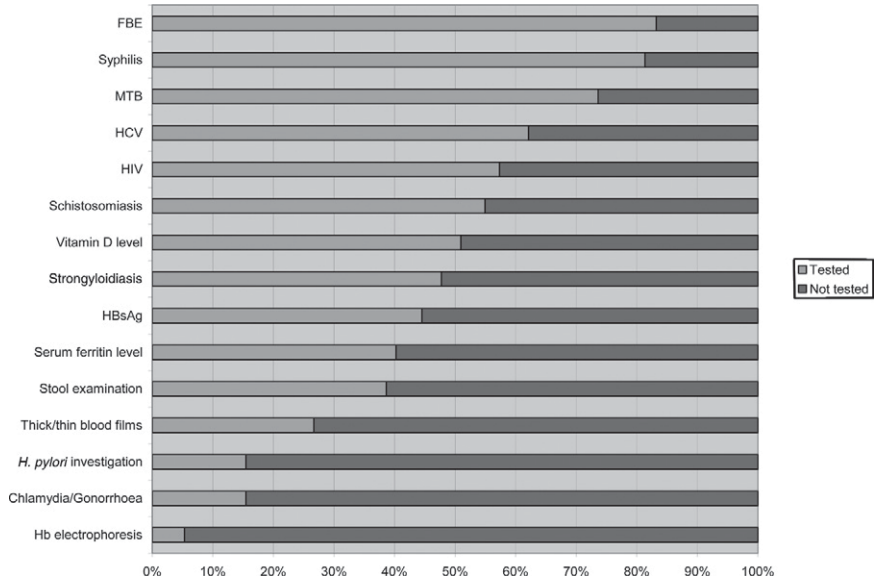

FIGURE 1. Proportions of patients with documented investigation results ($N = 375$). FBE, full blood examination; MTB, *Mycobacterium tuberculosis*; HIV, human immunodeficiency virus; HBsAg, hepatitis B surface antigen; HCV: hepatitis C virus; *H. pylori, Helicobacter pylori*; Hb, hemoglobin.

Schistosoma serology was positive in 84/206 (41%) patients tested, and this was associated with microcytosis and eosinophilia. Of those with positive *Schistosoma* serology, 60 had stool tested and four of these (6.7%) had *Schistosoma* ova identified. Sixty-three had terminal urine tested and none had *Schistosoma* ova identified. Co-infection with schistosomiasis and chronic HBV was found in 7.2% (10/139) of those tested for both infections.

Stool parasites were detected in 71/145 (49%) patients tested. In 31 patients (21%) these were pathogenic parasites, and 30 of these had only one pathogenic pathogen isolated, most frequently *Giardia lamblia* (10 patients). Fifty-two patients (36%) had non-pathogenic parasites detected in their stool, of whom 17 also had pathogenic parasites detected.

Anemia was documented in 52/312 patients (17%) and microcytosis in 14% (45/311). Of those who were anemic, one-third (10/32, 31%) were iron deficient, 40% (21/52) were microcytic, and 6% (3/52) were macrocytic. Two patients had a documented hemoglobinopathy—one patient had sickle cell detected on hemoglobin electrophoresis, and one had alpha thalassemia trait detected on DNA testing. Eosinophilia was diagnosed in 15% of patients in our study and affected 34% of those with schistosomiasis and 34% with strongyloidiasis. One-quarter of people tested (78/312, 25%) had a low neutrophil count and this was not significantly associated with HIV or any other infection.

DISCUSSION

Our study documents the frequency of infectious diseases, vitamin D deficiency, and hematologic abnormalities among sub-Saharan African immigrants attending the infectious diseases clinics of a Melbourne tertiary hospital. The most prevalent conditions seen were MTB infection (over 70% had either latent or active TB), vitamin D deficiency (over 70%), *H. pylori* (60%), and schistosomiasis (41%). Blood-borne viruses were also frequently detected, in particular chronic HBV (19%) and HIV (12%).

This is the first published study from an adult tertiary hospital in Australia regarding infectious diseases and nutritional deficiencies among immigrants from sub-Saharan Africa. The strengths of this study were its large sample size, the ability to report on infectious diseases (e.g., *H. pylori* gastritis) whose diagnosis requires resources usually only available in the hospital setting, and more comprehensive documentation of a wider spectrum of infectious diseases than have previously been reported in this population. The main limitation of this study was the retrospective clinical audit design, which meant not all patients had all of the variables of interest documented; hence, these are underestimates of true disease for this selected population. Another limitation was that "country of birth" may not have been a true indicator of geographic exposure to diseases, as many people had spent prolonged periods in other countries. The rates of infectious diseases and deficiencies reported are likely to overestimate the population prevalence in Melbourne's African community for two reasons: 1) the study was based in a tertiary referral center for infectious diseases and refugee health, and most people were referred for further investigation and management of abnormalities detected on screening health assessments, creating a referral bias; and 2) some tests (e.g., gastroscopy or carbon-14 breath test for *H. pylori* gastritis, urine microscopy for *Schistosoma* ova) were only performed on those with clinical indications for the test. However, the results of this study give an indication of the burden of health problems among African immigrants seen in a hospital-based clinic.

Immigrants are known to suffer with high rates of active TB, especially in the first year after migration.[9,10] African immigrants in Spain have a reported annual incidence of TB of 100.6/100,000 population, which is higher than immigrants from other regions or Spanish nationals.[11] The rate of latent TB infection in our study (55%) is consistent with other studies of African immigrants in Australia, the United States, and Europe (see Table 2). However, the rate of active TB in our study (18%) is higher than reported among African refugees screened in general practice clinics in Melbourne (< 1%)[6] and

TABLE 2

Proportion of patients with positive laboratory tests in this study, and comparison with reported prevalences in other studies of African immigrants to western countries*

	This study			Prevalence in comparison studies		
Infectious diseases	*N*	n	%	Australasia	Europe	North America
H. pylori gastritis†	58	35	60.3			93%[24]
Latent tuberculosis	276	152	55.1	25–55%[5,6]	12.9–43.6%[10,12,30]	39–71.9%[31–35]
Schistosomiasis (serology)	206	84	40.8	2.2–18.9[4,6,23,36]		43.9–64%[15,37]
Chronic HBV‡	167	32	19.2	6.4–16.4%[4–6]	6.6–10.9%[10,12,30,38]	3–32%[31–35,37]
Active tuberculosis	276	51	18.5	0.5%[6]	4.3%[10,12]	0.4–8.8%[31,34]
Strongyloidiasis (serology)	179	32	17.9	1–33.3%[4,6,23,36]	49%[39]	25–46.3%[15,37]
HIV	215	26	12.1	0.1–3.9%[5,16]	4.0–6.2%[10,12]	7.4–7.5%[31,35]
Syphilis – positive treponemal serology	305	26	8.5	1.1–8.3%[4–6]	15.2%[10]	7.5%
Malaria	100	7	7.0	5.0–10.4%[4–6]	18.1%[12]	13.9–64%[40,41]
HCV§	233	8	3.4	1.5–3.1%[4,6]	1.7–10.5%[10,12,30,38]	3.4%[31]
Chlamydia/Gonorrhea	58	0	0.0			
Stool parasites	*N*	n	%	Australasia	Europe	North America
Any stool parasites	145	71	49.0	24.3–65.8%[4,23,36]		25.1–58.6%[33,34,42]
Pathologic stool parasites	145	31	21.4	14.5–19%[4,23,36]	14.6–49.4%[30,43]	7.7–63%[31,35,42,44]
Giardia lamblia	145	10	6.9	3–13%[4–6,23,36]	7.7–14.6%[30,43]	4.4–11.5%[34,37,42]
Dientamoeba fragilis	145	6	4.1	1–2%[4,36]		1.9–2.1%[31,42,44]
Schistosomes¶	145	4	2.8	0–12.5%[4,5,23,36]	0%[43]	1.4–4.2%[31,34]
Entameba histolytica/*dispar*	145	4	2.8	2–5%[4,23,36]	1.1%[30]	1.4–5.3%[31,34,37,42]
Taenia saginata	145	3	2.1			0.7–2.3%[37,42,44]
Strongyloides stercoralis‖	145	2	1.4	0–2%[4,5,23]	1.1%[30]	0.4–3.5%[34,42,44]
Ascaris lumbricoides	145	2	1.4	0–1%[4,36]	4.6–34.8%[30,43]	0–1.9%[31,34]
Hookworms	145	1	0.7	0–5%[4–6,23,36]	1.1–2.6%[30,43]	0–3.7%[34,42,44]
Non-pathologic stool parasites	145	52	35.9	7.0–91.4%[4,23]		19.4–28.3%[31,34]
Non-infectious conditions	*N*	n	%	Australasia	Europe	North America
Vitamin D deficiency						
Any deficiency	191	139	72.8	87.1–92.2%[45,46]	34%[47]	53.5%[48]**
Moderate-severe deficiency	191	81	42.4	6.6–52.6%[4,45,46]		12.3%[48]††
Anemia	312	52	16.7	6.5–19.8%[4,6,36,45]	17–49.6%[30,49]	14.9–32.8%[32,34]
Eosinophilia	313	48	15.3	8.9–20%[23,36]	27.0–39.2%[30,50]	14%[34]
Iron deficiency	151	22	14.6	17–34.4%[4,6,36,45]	24.3%[49]	

* *N* = number tested; n = number affected by condition; *H. pylori* = *Helicobacter pylori*; HBV = hepatitis B virus; HIV = human immunodeficiency virus; HCV = hepatitis C virus.
† Of the 35 patients diagnosed with *H. pylori* gastritis, 20 were diagnosed by gastroscopy, 8 by breath testing, and 7 by serology alone.
‡ Hepatitis B surface antigen (HBsAg) detected in serum.
§ HCV antibodies detected in serum.
¶ All patients with *Schistosoma* detected in stool also had positive serology.
‖ Both patients with *Strongyloides* detected in stool also had positive serology.
** Vitamin D levels ≤ 37.5 nmol/L.
†† Vitamin D levels ≤ 20 nmol/L.

higher than reported among African immigrants attending a tropical medicine unit in Madrid (4%).[12] This is not unexpected as 51% of patients in our study were referred to the Unit's TB clinic. Screening immigrants from sub-Saharan Africa for LTBI is important as many can be treated with isoniazid, which significantly reduces the risk of development of active TB[13] and subsequent risk of MTB transmission within the wider community. In the United States this approach has been shown to result in both health and economic benefits,[14] whereas in Spain it has been shown that much of the TB among African immigrants could be a result of recent (post migration) transmission.[11]

The association between vitamin D deficiency and MTB infection in this study group was previously reported.[8] Although a causal relationship between vitamin D deficiency and TB has not been proven, this population is at high risk for infections with MTB and vitamin D deficiency (see Table 2), and it is vital that all African immigrants have their vitamin

TABLE 3

Significant associations found for selected infectious diseases and vitamin D deficiency*

		Multivariate analysis		
Disease	Significant association/risk factor†	AOR	[95% CI]	*P* value
Chronic hepatitis B	Male gender	2.58	[1.10, 6.06]	0.029
	Region of birth (Sudan)	2.39	[1.08, 5.30]	0.032
HIV	Time in Australia > 1 year	6.06	[2.17, 16.86]	0.001
Schistosomiasis	Microcytosis	2.94	[1.29, 6.73]	0.010
	Eosinophilia	3.10	[1.51, 6.39]	0.002
Active tuberculosis	Region of birth (Southern and East Africa)	21.73	[4.80, 98.45]	< 0.001
	Vitamin D deficiency‡	4.19	[1.51, 11.67]	0.006
Vitamin D deficiency‡	Region of birth (Southern and East Africa)	3.43	[1.55, 7.57]	0.002
	Tuberculosis	As above		

* AOR = adjusted odds ratio; 95% CI = 95% confidence interval; HIV = human immunodeficiency virus.
† Backward stepwise logistic regression analysis including variables with a *P* value < 0.05 on univariate analysis as well as age (> 30 years) and gender.
‡ Serum 25(OH)D ≤ 25 nmol/L.

D levels checked, and that vitamin D replacement is given to those with vitamin D deficiency. The rates of moderate/severe vitamin D deficiency in this study (42.4%) were slightly higher than in a study of African immigrants attending general practitioners in Melbourne for health assessments (29%).[6]

Schistosomiasis (positive serology ± detection of ova in stool) was diagnosed in 41% of our study participants. In a study from North America, schistosomiasis was diagnosed in 44% of Lost Boys and Girls of Sudan and 73% of Somali Bantu refugees, although diagnosis in the latter group was based on pre-migration serologic specimens.[15] In contrast, the highest previously reported prevalence of schistosomiasis among African refugees in Australia was 24%,[4] probably reflecting the fact that our study included a biased sample of immigrants who were often referred to our clinic because of positive screening test results. In our study all patients with schistosomes detected in stool had positive serology, unlike a study from South Australia in which 7% of African immigrants with negative or equivocal serology had ova detected in stool.[4]

The prevalence of HIV in our study population was 12% of those tested and 6.9% of the total group. This was a highly selected population, representing patients attending a tertiary referral center, and the rate is therefore much higher than the true rate among refugee populations. For example, the detection rate for HIV among a population of refugees screened in Western Australia between 2003 and 2004 was 0.12%,[5] and 3.9% (annual rate between 0% and 5%) among sub-Saharan African refugees arriving in New Zealand between 1995 and 2000, and screened during their stay at the Mangere Refugee Resettlement Center.[16] The HIV testing of applicants for permanent visas to Australia was introduced in 1989,[17] however all of the HIV-infected immigrants in this study immigrated after 1989. Although the true prevalence of HIV among sub-Saharan African immigrants in Melbourne is expected to be much lower than the prevalence found in our study, this finding supports the role of post-migration HIV screening among African immigrants rather than relying on the pre-departure screening result. Possible explanations for why immigrants who have been in Australia for > 1 year were more likely to be HIV infected include differences in administering the pre-immigration health assessment or improved sensitivity of pre-immigration HIV test over time, origin from a higher prevalence country, infection while in Australia, or infection during travel back to Africa. In a study of travelers who developed a travel-related illness, sexually transmitted infections (including HIV) were more common among immigrants who traveled to visit friends and relatives (VFRs) than among other travelers.[18]

The HBV serologic profiles and rates of co-infection with blood-borne viruses in this group have been reported and discussed elsewhere.[19] Viral co-infection (combination of HIV, chronic HBV, and/or HCV infection) was detected in only 1.5% patients tested for all three viruses,[19] but is important as co-infection is associated with more rapid progression to complications, such as liver cirrhosis, end-stage liver disease, and hepatocellular carcinoma (HCC).[20,21] Co-infection with chronic HBV and schistosomiasis has also been associated with accelerated liver damage.[22]

Helicobacter pylori was not routinely screened for in our study population, however the rate of positive results in those tested was extremely high (60%). Abdominal pain is a common complaint among African immigrants and was reported in 46% of the Lost Boys and Girls of Sudan in a survey undertaken in the United States,[15] and 30% of East African immigrants attending primary health care in Melbourne.[23] The prevalence of *H. pylori* gastritis in this population is unknown, however in a study of East African immigrants to the United States, 93% of those with symptoms of dyspepsia had positive *H. pylori* serology, and 73% reported improvement in symptoms following treatment.[24] *Helicobacter pylori* has been classified by the World Health Organization (WHO) as a type I carcinogen and therefore identification and treatment has implications beyond symptom relief.[25] A prospective study is warranted to determine the true prevalence of *H. pylori* gastritis in this population.

A low neutrophil count was identified in 25% of our study participants. The most likely explanation for this is benign ethnic neutropenia, which refers to the lower neutrophil count commonly encountered in healthy African individuals along with some other ethnic groups.[26] Benign ethnic neutropenia (neutrophil count $< 1.5 \times 10^9$/L) has been reported to affect 25–50% of persons of African descent, making it the most common form of neutropenia worldwide, and it is not thought to indicate increased susceptibility to infection.[26]

There have been very few hospital-based studies documenting the health issues faced by African refugees to Western countries. If not recognized and managed correctly these illnesses can have a significant effect on mortality and morbidity. For instance, of the infectious diseases listed in our study, HBV, HCV, HIV, schistosomiasis, and *H. pylori* are all potentially carcinogenic,[27] and vitamin D deficiency has been associated with higher rates of TB, breast, colon and prostate cancer.[28,29] The results of this study highlight the importance of awareness by all levels of the health system of the high rates of often undiagnosed health problems in African immigrants and refugees, and emphasize the need for policies supporting a comprehensive screening process for infectious diseases and nutritional deficiencies in immigrants and refugees settling in Australia.

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