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Screening of Imported Infectious Diseases among Asymptomatic Sub-Saharan African and Latin American Immigrants: A Public Health Challenge

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Abstract. Migrants from developing countries are usually young and healthy but several studies report they may harbor asymptomatic infections for prolonged periods. Prevalence of infections were determined for asymptomatic immigrants from Latin America and sub-Saharan Africa who ettended to a European Tropical Medicine Referral Center from 2000 to 2009. A systematic screening protocol for selected infections was used. Data from 317 sub-Saharan Africans and 383 Latin Americans were analyzed. Patients were mostly young (mean age 29 years); there were significantly more males among sub-Saharan Africans (83% versus 31.6%) and pre-consultation period was longer for Latin Americans (5 versus 42 months). Diagnoses of human immunodeficiency virus (HIV), chronic hepatitis B and C virus infection, and latent tuberculosis were significantly more frequent in sub-Saharan Africans (2.3% versus 0.3%; 14% versus 1.6%; 1.3 versus 0%; 71% versus 32.1%). There were no significant differences in prevalence for syphilis and intestinal parasites. Malaria and schistosomiasis prevalence in sub-Saharan Africans was 4.6% and 5.9%, respectively, and prevalence of Chagas disease in Latin Americans was 48.5%. Identifying and treating asymptomatic imported infectious diseases may have an impact both for the individual concerned and for public health. Based on these results, a systematic screening protocol for asymptomatic immigrants is proposed.

INTRODUCTION

The total number of international migrants worldwide in 2012 was estimated to be 214 million persons (3% of the worldwide population). Of these, 144 million underwent South-South migrations and 70 million underwent South-North migrations.[1] The latter, although representing a smaller proportion of the total, migrated between two geographical areas with an epidemiological health risk gradient, which is especially relevant for certain imported infectious diseases. Spain is one of the top 10 countries in terms of foreign born population with 5 million registered foreigners (10.7% of the total population) in January 2014. Moreover, Spain is the second country in the world, after the United States, in terms of net increase in immigration in the last 10 years.[2] Most foreign-born individuals in Spain are from European Union countries (41.7%), mainly Romania (15.9%), Great Britain (5.9%), and Italy (3.6%). Among those from non-European Union countries the most common origins are Latin America (24%), mainly Ecuador (4.4%), Colombia (3.6%), and Bolivia (3%); North Africa (14.83%), mainly Morocco (15.4%); and sub-Saharan Africa (3.77%) mainly Nigeria (1.06%), Equatorial Guinea (0.69%), and Senegal (0.37%). When global data on origin are analyzed, more than 4.2 million foreigners came from areas with an epidemiological health risk gradient with Spain.[3]

Migrants coming from developing countries are mostly young healthy individuals. However, they have been described as carrying significant infectious disease burdens, determined by geographic origin, ethnicity, health conditions at the departure point, and the migratory route.[4,5] They can suffer infections, which have a worldwide distribution (such as human immunodeficiency virus [HIV] or tuberculosis) or tropical infectious diseases characteristic of their areas of origin (such as Chagas diseases), which may confer a higher mortality caused by infectious diseases compared with the native population.[6] Many of these infections may be asymptomatic for long periods of time.[5,7]

Mobile populations may modify the epidemiology of certain infectious diseases in the World as they can introduce new infections that in the presence of a viable vector could produce outbreaks in the host country or reintroduce previously eradicated infections.[8,9] In other cases the incidence of certain globally distributed infections may be modified as incidence may increase in the host countries despite autochthonous cases declining.[10] The control of these infections may reduce the incidence and prevalence of many of them and modify their outcome. Therefore, identifying and treating imported infectious diseases, among asymptomatic patients may have an important impact both for the individual concerned and for public health.[11]

The objectives of this study were to describe the prevalence of infectious diseases in a cohort of asymptomatic immigrants to measure the burden of those latent infectious potentially harmful for the individual health and potentially transmissible to the community. Based on our results and the literature review, a systematic screening protocol for asymptomatic immigrants based on area of origin (sub-Saharan Africa and Latin America) and the time since arrival was proposed.

MATERIAL AND METHODS

The Tropical Medicine Unit is a referral center at the infectious diseases department of the Ramón y Cajal Hospital in Madrid, Spain. Patients are self-referred, referred from primary care, other specialized clinics, or non-governmental organizations for immigrants. The majority of the attended immigrants are Latin Americans and sub-Saharan Africans. At the Tropical Medicine Unit a high proportion of the attended patients are asymptomatic referred for a health exam.

Data from Latin American and sub-Saharan African asymptomatic immigrants who attended the Tropical Medicine Unit from 2000 to 2009 were collected. An immigrant was defined

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as a foreign-born person who had not traveled outside the host country since arrival. An asymptomatic patient was defined as a patient with no symptoms at the time of consultation and who attended for a health exam.

An estimation of the sample size needed to obtain representative results for the source population was calculated. For this purpose the prevalence of the least frequent disease among the immigrant cohort attended at the Tropical Medicine Unit, which was HIV infection (4.4%) was used.[5] Given an α level of 0.05 and an absolute error of 1.5%, 700 cases were randomly selected.

Demographic variables included age, sex, country and area of origin, and pre-consultation period (defined as months elapsed from arrival in Spain to first consultation at the Tropical Medicine Unit). Frequencies of demographic variables were calculated for each of the areas of origin and compared.

Diagnoses of infectious diseases were made using standard diagnostic techniques. The health exam performed for all asymptomatic immigrants was based on systematic screening that included a blood count, serum biochemistry, basic urine analysis, and selected infectious diseases: HIV, hepatitis B and C virus (HBV, HCV), and syphilis serology, tuberculin skin test (TST), stool parasites and, polymerase chain reaction (PCR) for malaria in sub-Saharan Africans (since 2005), and Chagas serology (indirect immunofluorescence test [IFI], enzyme-linked immunosorbent assay [ELISA]), in Latin Americans (since 2007). Frequencies of infectious disease diagnoses were calculated for each of the geographical areas and compared.

For analysis the pre-consultation time was divided into two periods: the first 12 months and > 12 months after arrival to Spain. This division was based on results of published series of imported infectious diseases in immigrants where elapsed time from arrival to diagnosis is reported.[5,12] The split in the first 12 months aimed to collect acute and subacute infections usually diagnosed in recently arrived immigrants.[5,7] Furthermore, on other infections that may remain asymptomatic for long periods of time such as Chagas disease or that may be reactive longer after arrival such as tuberculosis can be reported. Moreover, a long follow-up period would allow detection of infections newly acquired in the host country. For each period of time and each of the groups of origin, the prevalence of infectious diseases was calculated.

Calculated frequencies were used to describe qualitative variables and the median and interquartile range (IQR) to describe quantitative variables. Estimation of prevalence with its respective 95% confidence intervals (CIs) were obtained. Qualitative variables were compared using the χ^2 test, the Fisher test, or the χ^2 test for linear trends when necessary. For quantitative variables the Student *t* test for non-paired data or the Mann Whitney *U* test were used. Statistical significance was defined by $P < 0.05$ values. All calculations were performed using SPSS 15 software for Windows (SPSS, Inc., Chicago, IL) and Stata v 13.0 (Stata, College Station, TX).

RESULTS

Data from 700 asymptomatic immigrants were analyzed. In this study group 55.1% (386) were male, and median age was 29 years (IQR 23–36 years).Among those from Latin America the most frequent countries of origin were Bolivia (77.8%; 265), Ecuador (9.1%; 35), and Colombia (3.4%; 13). Among those from sub-Saharan Africa the most frequent countries of origin were Senegal (20.5%; 50), Nigeria (13.5%; 41), and Cameroon (11.3%; 29).

The median pre-consultation period was 20 months (IQR 5–47 months). Demographic characteristics of the study population compared by area of origin are shown in Table 1.

The prevalence of infectious diseases in the study population with respect to area of origin is shown in Table 2. The prevalence of infectious diseases in the study population with respect to the pre-consultation period is shown in Table 3 for sub-Saharan Africans and in Table 4 for Latin Americans. The most relevant characteristics are described below.

HIV. A serology for HIV was performed in 94.4% (661 of 700) of the study population. Prevalence of HIV infection was significantly higher in sub-Saharan Africans (2.3%; 7 of 298). Most positive patients were male (75%; 6 of 8). The median pre-consultation period for sub-Saharan Africans was 2 months (IQR 0–3) and the pre-consultation period for the case diagnosed among Latin Americans was 14 months.

Hepatitis B virus. A serology for HBV was performed in 95.1% (666 of 700) of the study population. Chronic HBV infection was significantly more frequent among sub-Saharan Africans (14%; 42 of 300). Most patients with chronic HBV infection were male (81.3%; 39 of 48). The median pre-consultation period for sub-Saharan Africans was 5 months (IR 2–9) and for Latin Americans was 47.5 months (IR 29.5–72). Among sub-Saharan Africans, 73% (219 of 300) had at least one positive bio-marker of HBV infection versus 18.3% (66 of 366) among Latin Americans.

Hepatitis C virus. A serology for HCV was performed in 94.9% (667 of 700) of the study population. Prevalence of HCV infection for sub-Saharan Africans was 3.7% (11 of 300) and for Latin Americans was 3% (11 of 367). Chronic HCV infection was only diagnosed in sub-Saharan Africans (1.3%; 4 of 300): The median pre-consultation period was 2 months (IR 1.25–6.5). None of them were co-infected with HBV or HIV.

Syphilis. *Treponema pallidum* serology was performed in 93% (651 of 700) of the study population. There were no significant differences in prevalence among sub-Saharan Africans (2.3%; 7 of 298) and Latin Americans (1.4%; 5 of 353), and

TABLE 1
Demographic characteristic with respect to areas of origin

	Total (%)	Sub-Saharan Africans (%)	Latin Americans (%)	*P*
Immigrants (%)	700 (100%)	317 (45.3%)	383 (54.7%)	
Male (%)	386 (55.1%)	263 (83%)	121 (31.6%)	< 0.001
Median age* (IQR)†	29 (23–36)	27 (21–32)	32 (25–41)	
Median pre-consultation time‡ (IQR)	22 (5–47)	5 (2–10)	42 (25–62)	< 0.001

*Measured in years.
†IQR = interquartile range (P25–P75).
‡Defined as months elapsed from arrival to Spain to first consultation at Tropical Medicine Unit.

TABLE 2
Infectious diseases diagnoses with respect to areas of origin*

Diagnoses	Sub-Saharan Africans ($N = 317$) N (%)	Latin Americans ($N = 383$) N (%)	P
HIV infection	7 (2.3%)	1 (0.3%)	0.026
HBV infection			
Negative	81 (27%)	299 (81.7%)	< 0.001
Past infection	175 (58.3%)	59 (16.1%)	< 0.001
Acute infection	2 (0.7%)	1 (0.3%)	
Chronic infection	42 (14%)	6 (1.6%)	
HCV infection			
Negative	289 (96.3%)	353 (97%)	0.192
HCVAb+/PCR not done	3 (1%)	0%	
HCVAb+/PCR negative	4 (1.3%)	11 (3%)	
HCVAb+/PCR positive	4 (1.3%)	0	
Syphilis	7 (2.3%)	5 (1.4%)	0.381
Latent tuberculosis infection	181 (71%)	89 (32.1%)	< 0.001
Intestinal parasites	8 (2.9%)	4 (1.5%)	0.243
Chagas disease	NP	172 (48.1%)	
Malaria	10 (4.5%)	NP	
Schistosomiasis	8 (5.8%)	NP	
Eosinophilia	42 (13.2%)	53 (13.8%)	0.821

*The percentages have been calculated as number of cases divided by number of patients in whom the test was performed in each group. HIV = human immunodeficiency virus; HBV = hepatitis B virus; HCV = hepatitis C virus; Ab = antibody; NP = not performed.

50% were male (6 of 12). The median pre-consultation period for sub-Saharan Africans was 7 months (IR 2–11) and for Latin Americans 27 months (IR 3.5–60.5). In one case the patient had HIV co-infection.

Latent tuberculosis infection. A tuberculin test was performed in 76.1% (533 of 700) of the study population. Prevalence of latent tuberculosis infection (LTI) was significantly more frequent among sub-Saharan Africans (71%; 181 of 256) than in Latin Americans (32.1%; 357 of 533). Most patients were male (67%; 357 of 533) and median age was 29 years (IR 23–35). The median pre-consultation period for sub-Saharan Africans was 5 months (IR 2–11.5) and for Latin Americans 43 months (IR 25.5–63). In five cases the patients had HIV co-infection.

Intestinal parasites. Stools were tested for parasites in 78.3% (548 of 700) of the study population. There were no significant differences in prevalence between sub-Saharan Africans (2.9%; 8 of 273) and Latin Americans (1.5%; 4 of 275). Most patients were male (68.5%; 375 of 548). The median pre-consultation period was 7.5 months for sub-Saharan Africans (IR 2.3–11) and 27 months for Latin Americans (IR 4.8–52.3). The most frequently isolated parasites were *Giardia lamblia* (7 cases), *Enterobius vermicularis* (2 cases), *Strongyloides stercoralis* (1 case) *Entamoeba histolytica* (1 case) and *Taenia saginata* (1 case).

Chagas disease. A serology for *Trypanosoma cruzi* was performed in 93.2%; (357 of 383) of Latin Americans. The prevalence of Chagas' disease was 48.1% (172 of 357). The most frequent country of origin was Bolivia (95.9%; 165 of 172). Most patients were females (67.4%; 116 of 172) and median age was 35 years (IR 28–42). The median pre-consultation period was 44 months (IR 28–62).

Malaria. A PCR for malaria was performed in 70% (222 of 317) of sub-Saharan Africans. Prevalence of malaria was 4.5% (10 of 222), all caused by *Plasmodium falciparum*. All patients were male (100%; 10 of 10) and median age was 26 years (IR 20–31.25). The median pre-consultation period was 4.5 months (IR 1.75–12.5). The case that presented the

TABLE 3
Infectious diseases diagnoses with respect to pre-consultation time in asymptomatic sub-Saharan African immigrants*

Pre-consultation time	≤ 12 months no. cases (%) 95% CI	> 12 months no. cases (%) 95% CI
No. patients	249	68
HIV infection	7 (3%) [1.4–6.2]	0
HBV infection		
Negative	64 (27.7) [22.2–33.9]	17 (24.6) [15.8–36.2]
Past infection	133 (56.3) [49.7–62.5]	42 (65.2) [53.2–75.5]
Acute infection	2 (0.9) [0.2–3.4]	0
Chronic Infection	35 (15.1) [11.1–20.4]	7 (10.1) [4.8–19.9]
HCV infection		
Negative	225 (96.2) [92.6–97.9]	64 (96.9) [89–99.3]
HCVAb+/PCR not done	2 (0.9) [0.2–0.3]	1 (1.4) [0.2–9.7]
HCVAb+/PCR negative	3 (1.3) [0.4–3.9]	1 (1.4) [0.2–9.7]
HCVAb+/PCR positive	4 (1.7) [0.6–4.5]	0
Syphilis	6 (2.6) [1.2–5.7]	1 (1.4) [0.2–9.7]
Latent tuberculosis infection	139 (66.9) [60.2–73.1]	42 (84.9) [72.4–92.3]
Intestinal parasites	6 (2.8) [1. 3–6.2]	3 (4.8)[1.5–14.1]
Malaria	7 (3.9) [1.8–8.1]	3 (7.1) [2.2–20.2]
Schistosomiasis	5 (4.9) [2–11.3]	3 (9) [2.8–25.2]
Eosinophilia	34 (14.3) [10.4–19.4]	8 (11.2) [5.7–21]

*The percentages have been calculated as number of cases divided by number of patients to whom the test was performed in each group. 95% CI = 95% Confidence interval; HIV = human immunodeficiency virus; HBV = hepatitis B virus; HCV = hepatitis C virus; Ab = antibody; PCR = polymerase chain reaction.

TABLE 4
Infectious diseases diagnoses with respect to pre-consultation period in asymptomatic Latin American immigrants*

Pre-consultation period	≤ 12 months no. cases (%) 95% CI	> 12 months no. cases (%) 95% CI
No. patients	36	347
HIV infection	0	1 (0.3) [0.04–2.1]
HBV infection		
Negative	29 (90) [72.7–96.8]	270 (80.9) [76.4–84.8]
Past infection	2 (6.6) [1.6–23.5]	57 (16.9) [13.3–21.4]
Acute infection	0	1 (0.3) [0.04–2]
Chronic infection	1 (3.3) [0.4–20.8]	5 (1.5) [0.6–3.5]
HCV infection		
Negative	31 (96.6) [79.1–99.5]	322 (97) [94.5–98.4]
HCVAb+/PCR not done	0	0
HCVAb+/PCR negative	1 (3.3) [0.4–20.8]	10 (3) [1.6–5.4]
HCVAb+/PCR positive	0	0
Syphilis	2 (6.9) [1.6–24.2]	3 (1) [0.2–2.8]
Latent tuberculosis infection	5 (22.7) [9.5–44.9]	84 (33.2) [27.4–38.9]
Intestinal parasites	2 (7.4) [1.8–25.8]	4 (1.6) [0.6–4.2]
Chagas disease	8 (28) [13.7–48.7]	164 (49.8) [44.4–55.2]
Malaria	0	0
Schistosomiasis	0	0
Eosinophilia	4 (9) [2.9–25.7]	49 (14.4) [11.1–18.5]

*The percentages have been calculated as number of cases divided by number of patients to whom the test was performed in each group. HIV = human immunodeficiency virus; HBV = hepatitis B virus; HCV = hepatitis C virus; Ab = antibody; PCR = polymerase chain reaction; 95% CI = 95% confident interval.

latest was diagnosed 28 months after arriving from the Republic of Guinea.

Schistosomiasis. Screening with serology (ELISA) for *Schistosoma* was performed in 43.8% (139 of 317) among sub-Saharan Africans and resulted positive in 5.8% (8 of 139). Most patients were male (75%) and median age was 22.5 years (IR 18.5–26.5). Median pre-consultation period was 4 months (IR 2–15.5).

Strongyloidiasis. Screening with serology (ELISA) for *Strongyloides* was performed only on those patients with eosinophilia (N = 95), and resulted positive in 56.1% (33 of 95) (46.2% for sub-Saharan Africans and 60.7% for Latin Americans, with no statistically significant differences). *Strongyloides* larva was recovered from the stools in only one case (4.3%).

Eosinophilia. A blood count was performed in all asymptomatic immigrants. There were no differences in prevalence of eosinophilia between sub-Saharan Africans (13.2%; 42 of 317) and Latin Americans (13.8%; 53 of 383).

DISCUSSION

The aim of this study was to describe the prevalence of selected asymptomatic infectious diseases in immigrants from sub-Saharan Africa and Latin America. In this way, we could measure the burden of latent infections potentially harmful for the health of the individual and potentially transmissible to the community. Therefore, we believe that identifying and treating such infections could result in a benefit both for the individual concerned and for public health. To achieve this, and based on the results of this study and the literature reviewed, a systematic screening protocol for infectious diseases in asymptomatic immigrants according to the area of origin and the time since the arrival is suggested.

With respect to the demographic variables, the significantly higher proportion of females among Latin Americans and males among sub-Saharan Africans observed is in keeping with official data on the immigrant population in Spain.[3] Gender must be taken into account for certain infectious diseases. Published Spanish data have reported a significant higher proportion of females among HIV-infected patients from sub-Saharan Africa. The low rate of sub-Saharan African women included in our study may probably highlight the need to implement measures to facilitate their access to health care. Moreover, if we take into account that immigrant women have been described as at a higher risk for exclusion and vulnerability. The high proportion of women of childbearing age in the group of Latin American is a relevant fact considering the vertical transmission of Chagas diseases. This evidences the need of protocols for screening, treatment, and follow-up of the pregnant woman and child with Chagas disease.[13]

A significant difference was also found in the pre-consultation periods between the two groups. This is mainly because sub-Saharan Africans were mostly referred soon after arrival to the Tropical Medicine Unit by several non-governmental organizations with whom the Tropical Medicine Unit has agreements. This is important mainly for certain infections such as HIV, where delayed diagnoses can translate into higher morbidity and mortality. In Spain 18% of new HIV diagnoses among immigrants were in Latin Americans and only 6% were sub-Saharan Africans, in contrast with Europe as a whole 19% of new HIV diagnoses were in sub-Saharan Africans and only 6% among Latin Americans[14]: Taking all this into account, probably efforts should be focused on decreasing the pre-consultation time, especially among Latin Americans.

During the study period, immigrant population could be attended because in Spain immigrants were entitled to health care under the same conditions as the Spanish population, regardless of their administrative situation. However, this has changed since the actual Royal Decree-Law 12/2012 of 20 April came into effect,[15] and the medical care of those immigrants in an administrative irregular condition will be seriously hampered.

Screening for HIV is systematically recommended in those communities where HIV prevalence is ≥ 0.1%. This measure would reduce late diagnoses, which have been associated with a higher risk for opportunistic infections, less response to antiretroviral therapy, more HIV transmission, and therefore with higher mortality rates and costs.[16,17] On the basis of the prevalence observed in this study and others

in asymptomatic immigrant population,[5] systematic HIV screening in asymptomatic sub-Saharan African and Latin American immigrants should be recommended. Diagnosis occurred later in Latin Americans, probably caused by a lower degree of suspicion of HIV infection when compared with sub-Saharan Africans. This highlights the need for improving earlier screening among Latin Americans and the need for performing HIV screening regardless of the time since arrival, therefore infections acquired in the host country could also be diagnosed.

Screening for HBV may decrease the risk of transmission by studying possible contacts, educating on preventive measures, and vaccinating non-immune persons and contacts of those positive. Moreover, screening for HBV may allow an earlier treatment reducing the progression to liver failure and hepatocellular carcinoma.[11,18] International guidelines recommend screening when seroprevalence of chronic HVB infection is moderate to high, ≥ 2%,[19] although some authors suggest screening when seroprevalence are even lower (≥ 0.3%).[20] On the basis of such recommendations and the results of our study, screening for HBV infection in sub-Saharan Africans and Latin Americans may be recommended. There is no agreement on how to manage those cases where a core antibody for HBV is the only marker of infection, which seems to be quite frequent among sub-Saharan Africans.[7] Some authors suggest performing an HBV–DNA determination in those cases where alanine aminotransferase levels are elevated,[21] whereas others only if there are other risk factors for liver diseases, even with normal alanine aminotransferase levels.[22,23]

There is no consensus regarding screening for HCV infection in immigrants. Certain diagnostic and therapeutic guidelines for HCV infection recommend screening in high-risk groups (such as persons with HIV infection, and intravenous drug users among others) however they do not mention migrants from high prevalence countries.[24] A recent European study includes immigrants from countries with a high prevalence of HVC (Egypt, the Middle East, and Pakistan) as high-risk groups and recommend screening for HCV among them.[25] Specific Canadian guidelines for immigrants and refugees recommend screening for HCV in all immigrants from regions with an expected prevalence of disease ≥ 3%.[19] In a Spanish study where HAV and HCV prevalence among pediatric immigrants was reported, a low HCV prevalence suggested that systematic screening should probably not be recommended.[26] Therefore, pooling the reports and based on our results, we propose screening for HCV in all immigrants from sub-Saharan Africa and only in those immigrants from Latin America who have recognized risk factor by several guidelines.[24,25]

To consider screening for latent syphilis, we should take into account that untreated syphilis can be spread sexually up to 1 year after infection and from mother to child for up to 5 years after the initial maternal infection.[27] The benefit of screening for syphilis among pregnant women has been clearly established.[28] However, less is published about syphilis screening in immigrants, although this would allow treating asymptomatic cases, avoiding the long-term consequences of secondary and tertiary syphilis infection and reducing its transmission. Although prevalence seems to be higher among sub-Saharan Africans,[5,12,29] our study did not find a significant difference with respect to areas of origin. Taking all these data into account, we propose screening for syphilis in immigrants from sub-Saharan Africa and Latin America.

Based on the theory that > 85% of tuberculosis in immigrants results from reactivation of latent tuberculosis acquired in their country,[30] screening for LTI has been described as a cost-effective measure for tuberculosis control.[31,32] However, several issues should be taken into account. Most reported cases of active tuberculosis in immigrants have been described in the first 5 years after arrival,[33,34] mostly among persons from sub-Saharan Africa and the Indian subcontinent.[35] We must consider that preventive treatment with Isoniazid is not free of toxicity and that < 30–60% of the patients complete such a long regimen correctly.[36,37] Moreover important limits to the tuberculin skin test (TST), which is the most commonly used screening test, have been described. The new interferon release assays (IGRAS) have been defined as having higher specificity and sensitivity (less interference with previous bacille Calmette-Guerin [BCG] vaccination) than TST, correlating better with surrogate measures of exposure to *Myobacterium tuberculosis* and they have a higher predictive value for LTI progression to active disease.[38,39] We therefore propose performing LTI screening in sub-Saharan African and Latin American immigrants who have spent < 5 years in the host country. Whenever possible, IGRAs should be performed mainly among those with a previous vaccination; otherwise the TST could be used.

There is no established method for intestinal parasite control in immigrants. Several studies determine that presumptive treatment of parasitoses with albendazole in immigrants coming areas at high risk saves both lives and money.[40] However, this is not free of potential toxicities and the risk of treatment (especially relevant in Latin American populations with a high prevalence of cysticercosis) or the possibility of not treating certain species correctly.[41] Other authors suggest screening by stool microscopy for ova and parasites in recently arrived immigrants.[42] The low prevalence and clinical significance of intestinal parasites observed in our results, questions the needs for performing stool analysis systematically. Furthermore, taking into account that the highest prevalence rates of intestinal parasites reported in the literature were in recently arrived immigrants,[4,43] we therefore propose screening stool samples for ova and intestinal parasites in sub-Saharan Africans and Latin Americans who have arrived within the last 6–12 months or if eosinophila is detected, regardless of the time since arrival.

More recently, screening immigrants from South Asia and Africa for *S. stercoralis* using serologic tests has been proposed based on the fact that most other intestinal parasites will clear without treatment a few years after migration, whereas *S. stercoralis* may persist for decades and could produce future severe manifestations in the presence of immunosuppression or human T-lymphotropic virus (HTLV) infection. Different studies have also found a higher prevalence of *S. stercoralis* when diagnosis was made by serology than when it was made with stool microscopy.[19] This is corroborated by our results, where among those diagnosed of probable strongyloidiasis by serology only one had *S. stercoralis* isolated on a stool analysis. Pooling on the reports systematic serological screening for *Strongyloides* should be recommended at any time after arrival.

Systematic screening for Chagas disease in immigrants from endemic areas is justified as they may be asymptomatic for long periods, there is a risk of fatal cardiac events, and the possible transmission outside endemic areas (vertical and

transfusion-related). Our study found a high prevalence of Chagas disease. However, this could be overestimated because of the specific programs carried out by personnel at the Tropical Medicine Unit, which encouraged immigrants from endemic areas to undergo screening for *T. cruzi* infection[44] and so screening was probably performed in high-risk populations. We did not observe significant changes in prevalence with respect to the pre-consultation period, probably because of the prolonged asymptomatic phase of the disease. Screening for Chagas disease should be performed in all Latin American immigrants, except those from the Caribbean area, and those persons born of Latin American mothers, regardless of the pre-consultation period. Taking into account the predominance of females of childbearing age in our series, the deleterious effect of delayed cardiologic treatment when necessary, and the long pre-consultation period observed, earlier diagnosis needs to be achieved. Among those with a positive result, even if asymptomatic, an electrocardiogram and echocardiography should be performed and treatment with Benznidazole considered.[45]

Most imported cases of malaria, particularly those caused by *P. falciparum* present in the first 3 months after arrival. Therefore, an important proportion of immigrants may be asymptomatic on arrival to the host country.[46,47] Some asymptomatic cases have been detected long after arrival.[48] Different measures have been proposed to control asymptomatic cases. The United States Centers for Disease Control recommend pre-departure treatment of *P. falciparum* malaria in asymptomatic immigrants and refugees from certain sub-Saharan countries as a cost-benefit measure.[49] Other alternatives could be systematic screening for malaria in immigrants from endemic countries. Different tests have been used such as microscopy techniques,[50] or rapid antigen detection,[51] however, several reports have shown that PCR is, by far, the most powerful tool for such surveillance.[51,52] Such screening would prevent misdiagnoses of imported malaria cases leading to delayed treatment; would avoid unidentified reservoirs of malaria, which could contribute to local transmission and could also[53,54] avoid congenital,[55] transfusional,[56,57] or organ transplantation-associated transmission.[58,59] Our data found a prevalence of 4.6% among asymptomatic sub-Saharan Africans. In three cases malaria was diagnosed > 1 year after arrival to Spain, and in one of these cases as long as 28 months after arrival.[60] Screening for malaria among sub-Saharan African immigrants could therefore be considered even many months after arrival in the host country. We therefore propose malaria screening mainly within the first 12 months after arrival, however considering our results, such screening could be prolonged as far as 3 years after arrival. Moreover, if PCR is available this should be performed, otherwise microscopy techniques could be used.

Sub-clinical infections of *Schistosoma* sp. or low-grade disease can persist for decades after immigration and may cause future morbidity or deaths.[61] Early screening and treatment of schistosomiasis could not only avoid the development of bladder cancer but also it has been observed that treatment with praziquantel can reverse previous established hepatic fibrosis caused by schistosomiasis.[62] Serological enzyme immunoassays have been reported to have a significantly higher sensitivity than stool microscopy for schistosomiasis diagnosis, so screening should preferably be performed using serological tests.[4,63] Although in our study screening for *Schistosoma* sp. is not performed to a high proportion of the studied population, it gives relevant information about prevalence among high-risk asymptomatic sub-Saharan African immigrants and is consistent with other studies.[64] Therefore, serological screening for schistosomiasis among those with epidemiological risk factors for infection[65] or when eosinophilia or hematuria is detected is recommended. However, based on other published data,[19,66] probably screening could be recommended systematically in all immigrants from schistosomiasis-endemic areas of Africa, mainly West Africa, regardless of risk factors and based on the results and on the degree of suspicion of infection, performing stools and urine microscopy for ova could also be considered.

One of the strengths of this study was that the screening protocol has remained mostly unchanged during the study period. The fact that screening was performed regardless of the elapsed time since arrival to Spain reflected the changes in the prevalence of diagnoses with respect to the pre-consultation period. This may be relevant for elaborating screening recommendations. The high proportion of Bolivians in the study group was probably one of the limitations of this study. This was a result of the numerous public health programs for Chagas disease specifically targeting Latin Americans, mainly Bolivian immigrants, performed by the Tropical Medicine Unit. This could weaken the extrapolation of data to the global group of Latin American immigrants. The fact that not 100% of the patients were screened for each infectious disease, could be a limit; however, this is more relevant only in certain infections such as schistosomiasis or strongyloidiasis; meanwhile,

TABLE 5
Proposed systematic screening of infectious diseases in asymptomatic immigrants based on origin*

Sub-Saharan African immigrants	Latin American immigrants
Blood count; serum biochemistry; basic urine analysis	Blood count; serum biochemistry; basic urine analysis
HIV serology	HIV serology
HBV serology	HBV serology
HCV serology	HCV serology only if risk factors†
syphilis serology	syphilis serology
TST if ≤ 5 years since migration	TST if ≤ 5 years since migration
Stool analysis for ova and parasites if ≤ 6–12 months since migration or eosinophilia	Stool analysis for ova and parasites if ≤ 6–12 months since migration or eosinophilia
PCR for malaria if ≤ 3 years since migration	*T. cruzi* serology
Strongyloides serology	*Strongyloides* serology
Schistosoma serology	

*HIV = human immunodeficiency virus; HBV = hepatitis B virus; HCV = hepatitis C virus; TST = Tuberculin Skin Test; PCR = polymerase chain reaction.
†Identified risk factor.[24,25]

others such as HIV, HBV, HCV, syphilis, or Chagas disease reach > 93% of compliance. However, descriptive studies, such as this one, evidence the prevalence of asymptomatic infections in certain international immigrants and highlight that their detection and control is an important and increasing public health challenger.

CONCLUSIONS

The final proposed screening for infectious diseases for sub-Saharan Africans and Latin American asymptomatic immigrants is shown in Table 5.

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