Acta Parasitologica (2022) 67:809–819
https://doi.org/10.1007/s11686-021-00510-4

ORIGINAL PAPER

Neglected Tropical Diseases in Lebanon

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Received: 13 April 2021 / Accepted: 9 December 2021 / Published online: 3 February 2022

Abstract

Introduction Neglected tropical diseases (NTDs) are highly endemic and distributed within the Middle East and North Africa (MENA) region, affecting an estimated 65 million people. Lebanon suffers from several NTDs as they are either endemic in the country or imported via expats residing in endemic regions, refugees, and foreign labor force. The Syrian crisis and the displacement of refugees to Lebanon have made the country the largest host of refugees per capita right after the Syrian crisis in 2011, peaking in the year of 2013. Additionally, foreign labor in Lebanon come from different countries in Africa and Asia that are endemic with certain NTDs. The Lebanese diaspora is approximately twice the number of those residing in the country and is distributed throughout the continents carrying the risk of importing new NTDs.

Materials and Methods A descriptive study about the prevalence of NTDs in Lebanon, their distribution, and factors contributing to spread was performed. The Lebanese Ministry of Public Health (LMPH) database regarding reportable transmissible diseases was reviewed for reportable NTDs between 2002 and 2020 in relation to age, gender, prevalence, and geographical distribution. The medical literature was searched using several engines looking for all reports about NTDs in Lebanon, those relevant to regions hosting Lebanese diaspora, and countries where the refugees and migrant workers came from.

Results Only leishmaniasis, leprosy, echinococcosis, schistosomiasis, and rabies are mandatorily reportable NTDs by the LMPH. Additionally, case reports about fasciolosis, ascaridiosis, and Dengue were reported from Lebanon. The presence of the Syrian refugees in the country affected the prevalence of *leishmaniasis* and rabies. The most prevalent NTD in Lebanon is cutaneous leishmaniasis. The Lebanese diaspora reside mainly in South America, Africa, and in some Arab states known to be endemic with certain NTDs.

Conclusion Little information is known about NTDs in Lebanon. The country is at an increased risk of experiencing several new NTDs due to refugee influx, foreign labor, economic crisis, and ever-growing number of Lebanese seeking work opportunities abroad. More information is needed to assess the true burden of NTDs in Lebanon and the future steps to contain and mitigate their effects.

Keywords Neglected tropical diseases · Lebanon · Middle East · Lebanese Ministry of Public Health

Introduction

Neglected tropical diseases (NTDs) represent a group of infections that are rampant among the world's poorest populations who suffer from limited resources, lack of appropriate medical infrastructure, and sub-standard sanitation [1]. The momentum to address NTDs has increased in the past 2 decades due to several factors including advocacy for new approaches to control and eliminate these diseases, increased commitment from pharmaceutical donors to provide drugs, renewed governments' commitment, and the recognition that these diseases should be addressed as part of the Millennium Development Goal (MDG) agenda where they are considered as "other diseases" of MDG [2].

Lebanon is a small country (10,452 km^2) with a temperate climate located in the Eastern Mediterranean, bordered by Syria to the north and east and Israel to the south, with a population density of 667 per km [2, 3]. Lebanon has experienced several NTDs with different epidemiological characteristics. Some are endemic and mandatorily reportable to the LMPH [4–8], while others are mainly imported from other countries. Though it is a small country, Lebanon

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accommodates large numbers of refugees and migrant workers. The 2011 Syrian crisis has led to an influx of Syrian refugees into the country. They resided in several unorganized settlements without appropriate infrastructure [9, 10]. Additionally, hundreds of thousands of migrant workers, originating from Africa and Asia, are registered in the country; however, it is believed many more are working without valid registration [11]. The Lebanese diaspora is almost as twice the number of populations of residing in Lebanon and is distributed throughout the continents, in various areas known to be endemic for certain NTDs [12]. The recent economic crisis and the severe devaluation of the Lebanese currency that followed political unrest stemming from the popular October 17, 2019, uprising have forced more people to seek job opportunities outside the country [13, 14].

In this paper, we will address the status of NTDs in Lebanon and the factors contributing to their acquisition and spread. Notifiable NTDs will be described, those reported in the literature will be reviewed, and the risk of importation to Lebanon will be assessed in relation to the presence of Syrian refugees, migrant workers, and the Lebanese diaspora.

Materials andMethods

We conducted a descriptive review about NTDs pertinent to Lebanon in the following contexts:

(1) NTDs that are reportable
(2) NTDs that are non-reportable
(3) NTDs which the refuges and migrant workers can import
(4) NTDs which the Lebanese diaspora and workface may import
(5) Those reported in the literature.

Search Strategy

The database of the LMPH Epidemiological Surveillance Unit (ESU) website was reviewed regarding reportable NTDs in relevance to prevalence and gender, age, and geographical distribution in the country between 2002 and 2020.

Published literature regarding NTDs in Lebanon was searched using PubMed/Medline, Embase, Google Scholar, and Global Health to identify all literature referring to NTD case reports, review articles, systematic reviews, and meta-analyses. Only articles published in the English language were used with the following keywords "Lebanon" AND "NTDs", or "Neglected tropical diseases", or "Buruli ulcer", or "Chagas", or "Chromoblastomycosis", or "Cysticercosis", "Taeniasis", or "Dengue", or "Dracunculiasis", or "Guinea Worm Disease", or "Echinococcosis", "Fasciolias*is*", or "Human African Trypanosomiasis", or "African Sleeping Sickness", or "Leishmaniasis", or "Leprosy", or "Hansen's Disease", or "Lymphatic Filariasis", or "Mycetoma", or "Onchocerciasis", "Rabies", or "Schistosomiasis", or "Soil-transmitted Helminth*s*", or "Ascaris", or "Hookworm", "Whipworm", or "Trichuri*s*", or "Trachoma", or "Yaws" as to exhaust all possible data regarding NTDs in Lebanon, including those not reported. These keywords were taken from PLoS's NTDs broad list which included "African Trypanosomiasis, amebiasis, bacterial gastroenteritis, balantidiasis, brucellosis, Buruli ulcer, Chagas disease, chikungunya infection, cholera, cysticercosis, dengue fever, echinococcosis, fascioliasis, food-borne trematodiasis, giardiasis, hantavirus pulmonary syndrome, Japanese encephalitis, konzo, larva migrans, Lassa fever, leishmaniasis, leprosy, leptospirosis, lioasis, lymphatic filariasis, mycetoma, myiasis, neurocysticercosis, onchocerciasis, paracoccidioidomycosis, podoconiosis, rabies, relapsing fever, rift valley fever, scabies, schistosomiasis, snakebite, soil-transmitted helminthiases, taeniasis, trachoma, treponematosis, viral hemorrhagic fevers, and zika fever. Other keywords were taken from the WHO's NTDs list which included*:* dengue, rabies, blinding trachoma, buruli ulcer, endemic treponematosis (yaws), leprosy (Hansen disease), Chagas disease, Human African trypanosomiasis (sleeping sickness), leishmaniasis, cysticercosis, dracunculiasis (guinea-worm disease), echinococcus, food-borne trematode infections, lymphatic filariasis, onchocerciasis (river blindness), schistosomiasis (bilharziasis), and soil-transmitted helminthiases (intestinal worm*s)*. It is important to note that several of the keywords listed in WHO or pLoS lists will not be covered in this study.

The link between NTDs and the origin of refugees and migrant workers residing in Lebanon was also evaluated via published information about prevalence of NTDs in the country of origin. A search using the following keywords "Lebanon" AND "migrant workers", or "refugees" was conducted. The results of each search were used to combine the country of origin with "neglected tropical diseases" to determine the most prevalent NTDs in that country. For example, "Ethiopia" and "Neglected Tropical Diseases" were used in combination to determine the most prevalent NTDs in Ethiopia that could be carried into Lebanon by workers and refugees.

The same approach was followed regarding the major centers of residence where Lebanese diaspora and workforce are present. The United Nations High Commissioner for Refugees (UNHCR) studied the migration profile of Lebanon and provided data on both the number of Lebanese emigrants and immigrants. For inwards migration, the list of the countries of origin of those immigrants were mentioned with their main characteristics. Regarding the Lebanese diaspora around the world, lists of origin of countries were provided from IBGE: Caracteristicas Etnico-Racias de Poulacoa, Lebanese republic, Atlas of Lebanon, and Lebanon:

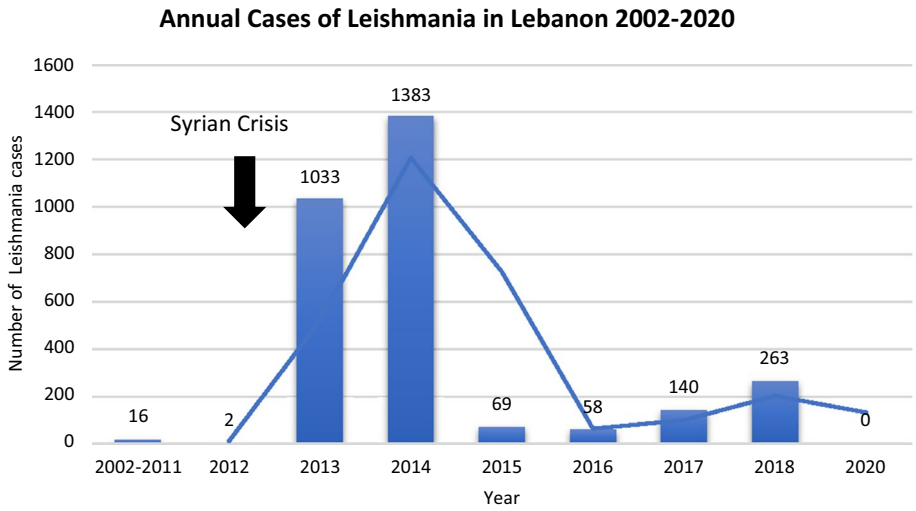

Fig. 1 Number of Leishmania cases between 2002 and 2020 in Lebanon. Data from the Lebanese Ministry of Public Health

migration profile by Francoise De Bel-air in the European University Institute. A search was done using the keyword "Lebanese diaspora", and the results were individually combined with the keyword "neglected tropical diseases" to determine the most prevalent NTDs in each country. For example, a search was conducted using the terms "Brazil" and "neglected tropical diseases".

Data were collected using Microsoft Excel spreadsheet, which was then transferred to the Statistical Package for Social Sciences program (SPSS, version 25) which was used for data cleaning, management, and analysis. Data were reported as number of cases, and presented as graphs. Results are discussed in relevance to the literature search, and each NTD was described separately.

Results

NTDs That Are Reportable

The LMPH's ESU website cites five NTDs as mandatorily notifiable, including: leishmaniasis, leprosy, echinococcosis, schistosomiasis, and rabies.

The LMPH recorded 2021 leishmania cases between 2002 and 2020 [15]. The cases were stable between the years of 2002 and 2012 (around 5 cases annually), peaking to 1033 cases in 2013, decreasing to 58 in 2016, increasing again to 140 cases in 2017, and reaching 263 cases in 2018 [16] (Fig. 1). Zero cases were recorded in 2020. Males and females were affected approximately equally with those under the age of 40 years mostly acquiring the disease; the disease was distributed primarily in Beqaa followed by the North[1] [15].

27 leprosy cases were recorded by the LMPH between 2002 and 2020 with a rate of 1.6 new cases per year, affecting mostly males with a variable age distribution, and diagnosed chiefly in the North and in Mount Lebanon. No other data in the literature exist concerning incidence of leprosy in Lebanon [17].

A total of 210 cases of echinococcosis were reported by the LMPH between 2002 and 2020, with a peak of 23 cases in 2002, and a trough of 5 in 2005 [18] (Fig. 2). Female cases were twice as many as male cases, and the disease affected almost equally those between 10 and 60 years of age. Cases were distributed throughout Lebanon but mostly in the Beqaa region [18]. Estimated 3.82 echinococcosis cases per 100,000 population were reported between 1949 and 1959 [4, 19].

Seven cases of schistosomiasis were recognized by the LMPH between 2002 and 2020 [20]. Patients were either 20–39 years of age or 60 + and 5 of the cases were male with a distribution in Beirut and Mount Lebanon. The literature cites 86 confirmed cases in 1961 after examination of the urine sample of 591 people [21].

Twelve confirmed cases of rabies were reported by the LMPH between 2002 and 2020 [22]. A total of 7369 animal bites were recognized by the LMPH between 2005 and 2016, most of which were from dogs. 2013 was the start of an exponential growth of bites described [23] (Fig. 3). Akkar and Nabatyieh had the most cases, and patients were preferentially male [22].

[1] The North region includes both the governorates of North and Akkar as per the LMPH.

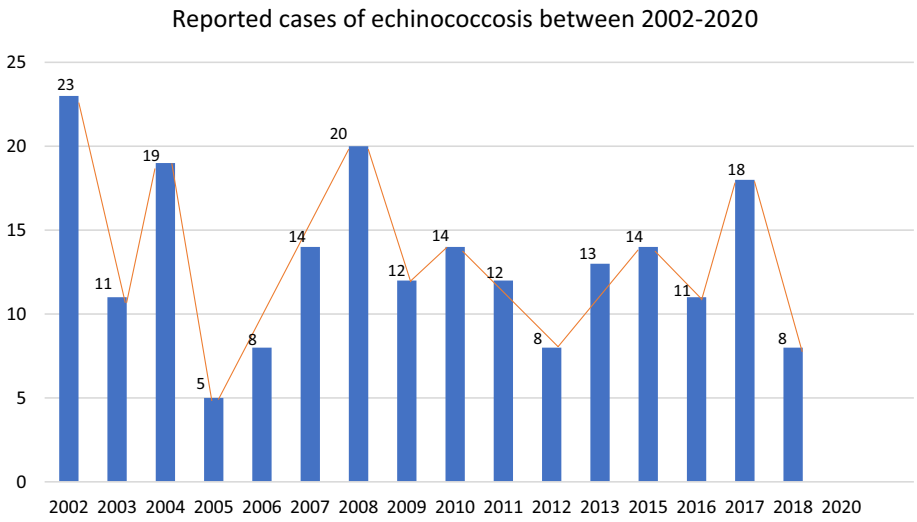

Fig. 2 Reported cases of hydatid cyst disease by the LMPH between 2002 and 2020

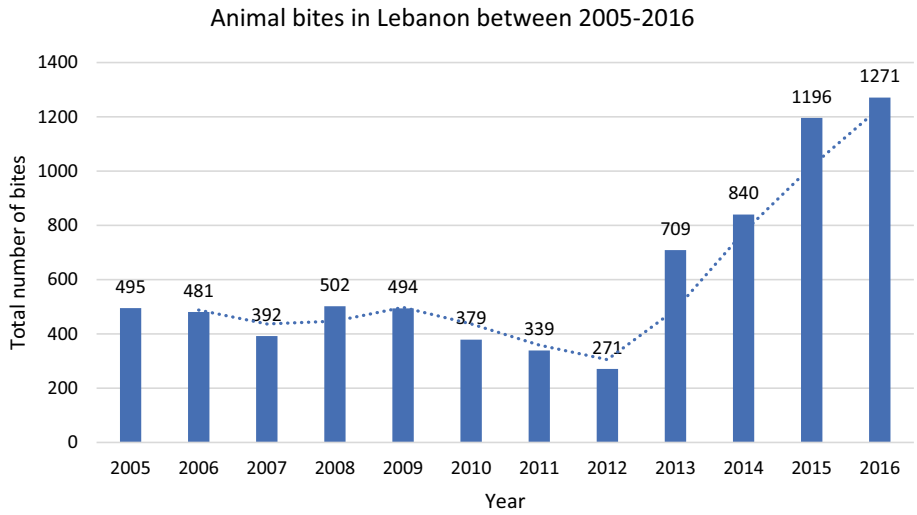

Fig. 3 Annual number of animal bites as reported to the LMPH

NTDs That Are Non-reportable

In the literature, eight NTDs have been described in Lebanon, and they are: *echinococcosis, fasciolosis, schistosomiasis, soil-transmitted helminthiasis* (ascariasis caused by *Ascaris lumbricoides,* trichuriasis caused by *Trichuris Trichiura*), dengue, rabies, taeniasis, and leishmaniasis. Of those, fasciolosis, soil-transmitted helminthiasis (ascariasis and trichuriasis), taeniasis, and dengue are non-notifiable.

Only 1 case of fasciolosis was reported in the literature between 1997 and 1998, and no other published data exist [24]. A total of 56 cases of *Ascaris lumbricoides* were recorded in 1997–1998 and 2007–2008, with 4 cases of trichuriasis recorded in 1997–1998 [24]. The American University of Beirut Medical Center (AUBMC) and the Islamic Hospital (IH) did a 5-year and 3-year retrospective study, respectively, and found that parasitic infections were 8.47% in AUBMC versus 45.35% in the IH with the percentage of *Ascaris lumbricoides* being 2.09% in AUBMC and 46.97% in the IH [25]. The last reported dengue epidemic that occurred in Lebanon was in 1945 affecting around 100, 000 people. Since then, only one case of dengue has been confirmed in 2012 [26].

NTDs Which the Refuges and Migrant Workers Can Import

The United Nations High Commissioner for Refugees (UNHCR) reports Syrians compose the largest number of refugees in Lebanon. Additional refugees originate from Ethiopia, Iraq, Sudan, and Palestine [27] (Fig. 4). To note, Palestinian refugees have resided in Lebanon for more than 60 years and carry the same risks of acquisition as local Lebanese.

Concerning migrant workers in Lebanon, an analytical report done by Amnesty International showed that the

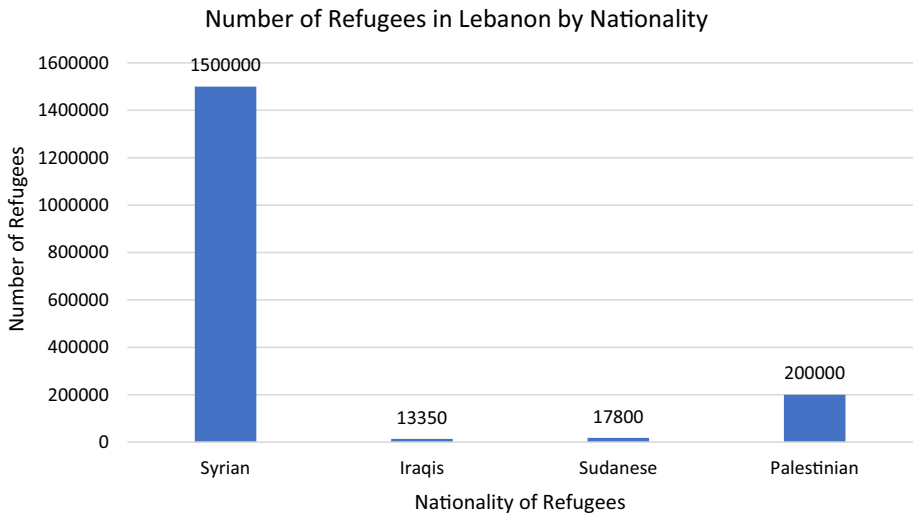

Fig. 4 2020 estimates of the number of refugees per thousand in Lebanon distributed by nationality. Estimates obtained from the 2020 report by the UNHCR

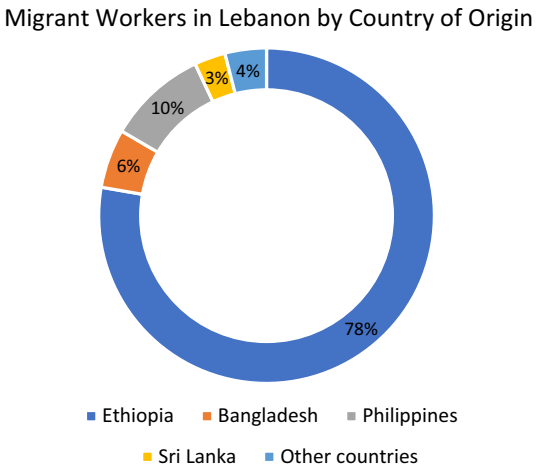

Fig. 5 Estimates of the origin of migrant workers in Lebanon, done by Amnesty International. Note that this represents the percentage of 186,429 female workers and excludes workers without a permit

majority are Ethiopian, followed by Bangladeshi, Filipino, Sri Lankan, and workers from other countries[2] [28] (Fig. 5). Data concern 186,429 female workers as most migrant workers are women and excludes workers without a work permit. These migrant workers originate from countries that are host to different NTDs [29–33] (Table 1).

NTDs Which the Lebanese Diaspora and Workface May Import

Regarding the Lebanese diaspora that is distributed around the word, estimates show that Latin America has the highest number of Lebanese followed by Africa and Arab states [34–43] (Table 2). No official governmental data exist. These countries have different endemic NTDs. Latin American is mostly endemic with trichiasis, ascariasis, Chagas disease, schistosomiasis, trachoma, lymphatic filariasis, dengue, cysticercosis, leishmaniasis, and onchocerciasis with African regions most commonly suffer from schistosomiasis, trachoma, lymphatic filariasis, and onchocerciasis. Finally, Arab States have mainly schistosomiasis, trichiasis, rabies, leprosy, and fasciolosis.

Discussion

Notifiable NTDs in Lebanon

Leishmaniasis

Lebanon was considered a country with low prevalence for leishmaniasis, since only 16 cases were reported to the LMPH between 2002 and 2011. As of 2013, the year that marked the eruption of the Syrian crisis and the influx of refugees to Lebanon, the country witnessed its first leishmaniasis outbreak (Fig. 3). The most significant risk factor for the spread of leishmaniasis is war as it results in population displacement and clustering leading to increased exposure [8]. The spread of leishmaniasis is also influenced by poor nutrition, socioeconomic status, and environmental changes [44].

Syria is the country with the highest prevalence of cutaneous leishmaniasis (CL) in the MENA region [45]. More than 6.5 million Syrians were displaced after the Syrian civil war facilitating the spread of leishmaniasis to neighboring countries including Lebanon, Iraq, and Turkey [46]. As of January 2019, an estimated number of 1.5 million Syrian refugees are present in Lebanon (Fig. 4)

[2] Other countries include Nepal, Benin, Burkina Faso, Cameroon, Ghana, Ivory Coast, Nigeria, Madagascar, Senegal, and Togo.

Table 1 The distribution of significant NTDs among the countries of origin of migrant workers in Lebanon

	Ethiopia	Bangladesh	Philippines	Sri Lanka	Other countries
Significant NTDs	Onchocerciasis, trachoma, schistosomiasis, and lymphatic filariasis	Leishmaniasis, dengue, lymphatic filariasis	Lymphatic filariasis, schistosomiasis, soil-transmitted helminthiasis, food-borne trematodiases, rabies and leprosy	Dengue	Dracunculiasis, buruli ulcer, yaws, leprosy, leishmaniasis, human African trypanosomiasis

[47]. The most recent data posted on LMPH website show 263 cases of CL imported from Syria, with no evidence of local transmission (Fig. 1). It also reveals that the distribution of cases has been mostly in regions closer to the Syrian border mainly Beqaa and North Lebanon, the two poorest areas in the country with underdeveloped sanitary infrastructure [8, 48, 49]

Leprosy

Lebanon is a country with very low prevalence of leprosy at less than 0.1 per 100 000 population [50]. In Lebanon, cases are mainly distributed in Akkar and Mount Lebanon [51]. Akkar is considered one of the poorest and underdeveloped areas in North Lebanon, and Mount Lebanon, despite its high socioeconomic standard, is the most densely populated area. Leprosy is likely to be under-diagnosed due to lack of knowledge and awareness among healthcare workers mainly in countries with very low prevalence. Only a few physicians are trained to recognize the typical skin anesthetic lesions or peripheral nerve pathology associated with the disease [52]. The WHO has published in 2018 clinical guidelines for the diagnosis and management of leprosy in endemic countries, but no similar WHO guidance exists for non-endemic countries, such as Lebanon [53].

Echinococcosis

Echinococcosis is a zoonotic infection caused by tapeworms under the genus Echinococcus [54]. Dogs are final hosts of cystic echinococcosis, while livestock are potential intermediate hosts [55]. The numbers reported by the LMPH (Fig. 2) are likely an underestimation of the actual number, since many physicians fail to report the infection and that the symptoms of the disease are general and may go unnoticed for the lifetime of the patient [56]. Per the WHO distribution map, the Middle East is an endemic region with the disease increasing the possibility of zoonotic transmission [57]. The LMPH shows Beqaa and the North to have the highest prevalence of the disease. This could be attributable to the lack of public awareness, poor hygienic conditions, and the increase in population, where over-crowded areas such as Syrian refugee camps are currently located. Beqaa represents the largest agricultural and farming area, where cattle and sheep flocks are concentrated and where these livestock can act as intermediate hosts for the disease. Another contributing factor is the recent problem of stray dogs and the polluted water that may be contaminated by the feces of infected dogs, whereby humans are the accidental intermediate host in which the parasite develops cystic larval form in the tissues or humans [4].

Table 2 Lebanese populations in the diaspora

Country	Estimate	Upper estimate	Significant NTDs
Brazil	2,000,000	5,800,000–7,000,000 (Brazilian/ Lebanese governments)	Chagas disease, dengue, leishmaniasis
Argentina	1,200,000	3,500,000	Chagas disease, leishmaniasis, soil-transmitted helminthiasis
Colombia	1,000,000	3,400,000	Trichuriasis, onchocerciasis, Chagas disease
United States	500,000	900,000	Chagas disease, neurocysticercosis, dengue and chikungunya
Venezuela	341,000	500,000	Trichuriasis, leishmaniasis, schistosomiasis
Australia	271,000	350,000	Trachoma, leprosy, yaws
France	250,000	250,000–300,000	No significant endemic entity
Mexico	240,000	400,000–505,000	Ascariasis, Chagas disease, leishmaniasis, dengue
Canada	190,275	250,000–270,000	No significant endemic entity
Saudi Arabia	120,000	299,000	Leishmaniasis, onchocerciasis, dengue
Syria	114,000		Leishmaniasis
Ecuador	98,000	250,000	Chagas disease, rabies, onchocerciasis
Dominican Republic	80,000		Schistosomiasis, lymphatic filariasis, Chagas disease
United Arab Emirates	80,000	156,000	Trachoma
Nigeria	75,000	75,000	Trachoma, buruli ulcer, human African trypanosomiasis
Uruguay	53,000	70,000	No significant endemic entity
Ivory Coast	50,000	300,000	Schistosomiasis, lymphatic filariasis
Sierra Leone	44,000	150,000	Lymphatic filariasis, trachoma, schistosomiasis
Qatar	25,000	191,000	Leprosy
South Africa	5,100	20,000	Schistosomiasis, ascariasis, trichuriasis, hookworm

Schistosomiasis

In the past 20 years, schistosomiasis has been eliminated from Lebanon, Oman, and Tunisia, and transmission has been greatly reduced in Iraq, Jordan, Egypt, Morocco, Saudi Arabia, and Syria [58–60]. In 2014, schistosomiasis was reported in an Ethiopian expatriate working in Lebanon [61]. The disease is still a huge public health issue in Ethiopia with no robust control program put in place, and a high prevalence of urogenital schistosomiasis [20]. As such, expatriates coming from many of these endemic areas to Lebanon, and the prevalence of the disease in nearby countries pose a risk for transmission to Middle Eastern countries and Lebanon.

Rabies

Only eight cases of rabies were reported to the LMPH between 1991 and 1999 with an annual average of 184 animal bites between 1991 and 1996. Dogs were found to be the only vector of disease and the most reported source of animal bites [62]. A study done in 2013 showed a significant increase in the number of reported dog bites between 2000 and 2013, with a total of 5280 animal bites reported to the LMPH with an annual average of 431 bites per year [63]. Additionally, the number of dog bites increased between 2013 and 2016 from 709 in 2013 to 1271 in 2016, with a total average of 1004 bites (Fig. 3). The Syrian crisis in 2011 and the Lebanese garbage crisis of 2015 might have contributed to the doubling of reported dog bites during that time [64, 65].

Despite the low incidence of rabies in Lebanon, the risk remains significant because of the open nature of Lebanese–Syrian borders, the absence of appropriate control over the wild life, and the failure of both Lebanese and Syrian authorities to implement proper control measures in all districts of their countries, an effort that has been severely weakened after the Syrian war [63]. The ability of animals to cross borders, the reports of imported cases from many countries, and the higher incidence of rabies in border areas emphasize the importance of regional cooperation to control the prevalence of the disease.

The most important ways to decrease the rabies burden in the country are by control of canine rabies, regional cooperation, monitoring viral circulation in the various hosts, raising public awareness mainly in children, and timely administration of post-exposure prophylaxis [23, 63].

Non-notifiable NTDs Reported in Lebanon

Dengue

Ae. albopictus has been detected in Lebanon in 2003 which experienced a dengue epidemic in 1945, affecting more than

100,000 people within the span of a year [6, 66]. *Ae. aegypti* was thought to be eliminated from the Lebanon after the initiative to control malaria and mosquito was implemented between 1945 and 1975. However, any control programs were completely stopped after the start of the civil war in 1975 [66]. The *Ae. albopictus* strains found in Lebanon are part of a recent expansion of the insect related to those Europe, Africa and Northern American strains [67]. Dengue is endemic in Africa and countries of the Arabian Peninsula where a large Lebanese contingency of migrant workers reside. The risk of imported Dengue remains high and mainly among Lebanese who travel to the above-mentioned areas.

Cysticercosis/Taeniasis

A systematic review done on the prevalence of taeniasis in the MENA region, showed 116 cases in 1997–1998 decreasing to 27 in the same center in 2007–2008. However, these numbers are not representative as the results are taken from only one medical center and among patients who came to this hospital. The risk of infection in Lebanon is increased by the large influx of foreign workers coming from endemic areas in African and Asian countries and by the great number of Lebanese migrating to African countries while returning during vacations and possibly importing the infective worms [68]. The Lebanese people's habit of consuming raw or under-cooked meat as a form of delicacy reinforces that risk.

Soil-Transmitted Helminth (STH)

Soil-transmitted helminths (STH) pose a risk to more than a quarter of the world's population, and include *Ascaris lumbricoides*, hookworms (*Ancylostoma duodenale* and *Necator americanus*), and *Trichuris trichiura* [69]. It is expected that the actual prevalence in Lebanon is higher than reported in the literature as these infections are linked to poor sanitation and low socioeconomic conditions, while most data refer to patients from more developed urban areas [24]. This is exemplified by the studies done by AUBMC and IH in 1996, which showed a much higher percentage of parasitic infections in IH where the surrounding region is rural [25]. The contamination of water with fecal material, the use of animal and human fecal material as fertilizers in many rural areas, and the habit of consuming raw vegetables without cleaning them all favor infection [70].

Fascioliasis

Fasciola hepatica is an emerging and reemerging disease of global significance in Iran and Egypt [71]. Even though only one case of fasciolosis in Lebanon was identified in the literature [24], more cases are likely under-diagnosed especially given Lebanese citizens' frequent travel to the aforementioned countries, their habit of consuming raw vegetables, and the rich livestock population. Spread of human fasciolosis depends on several factors which include climate, farming practices, human dietary habits, animal population, and the presence of intermediate hosts. Livestock husbandry is an important part of farming in agricultural activities in the MENA region and one of the main propagators of fasciolosis [71]. Environmental changes, variations in human behavior, a move toward urbanization, immigration, dam building, and expansion of irrigation all facilitate fasciolosis spread [71].

NTDs at Risk of Importation

Lebanon hosts many migrant workers, and the majority are from Ethiopia (Fig. 5). Ethiopia has one of the largest burdens of NTDs in Africa with the five most common NTDs in the country being: Lymphatic filariasis, onchocerciasis, schistosomiasis, soil-transmitted helminths, and trachoma [72] (Table 1). Moreover, many migrant workers are present without a work permit; therefore, their actual numbers are unknown, making it more difficult to monitor disease trends among this group.

The Lebanese diaspora is distributed all over the world (Table 2). The largest number of Lebanese immigrants is in South America, followed by Africa and the Arab Peninsula. The risk of importing diseases from these countries is directly related to their distance to Lebanon, i.e., to the likelihood that a Lebanese immigrant would revisit his country. Therefore, Lebanese in Africa and Arab Peninsula are more likely to revisit Lebanon than those residing in South America or Australia. Therefore, Lebanon is at risk of importing leishmaniasis, onchocerciasis, dengue, Human African Trypanosomiasis, lymphatic filariasis, trachoma, and schistosomiasis among others.

Limitations

This report presents information mainly based on literature reviews and surveillance data carried by LMPH-ESU. Hence, different collection modalities, target population, sampling, and selection methods were accumulated. Therefore, direct comparisons and recommendations for preventative measures cannot be definitive. Due to the political crisis and the COVID-19 pandemic, data for 2019 are not available on the LMPH site. As for the number of dog bites, data beyond 2016 are not yet available on the LMPH site.

Conclusion

NTDs are generally underreported and under-evaluated in Lebanon. The country is at risk of importing NTDs due to the Syrian refugee crisis, presence of migrant workers, and the large Lebanese diaspora and workforce working abroad. Certain protocols need to be employed to address these risks and ensure the development of control measures. Improved data collection and better surveillance, continuous education of healthcare workers about NTDs, increase public awareness, control of stray dogs, construction of proper sanitary infrastructure, and better screening programs mainly among refugees and migrant workers are all needed to decrease the burden of NTDs in the country.

Author Contributions WA contributed to writing the manuscript, collected and analyzed the data, created tables and figures, and revised the manuscript. TM contributed to writing the manuscript, revision, and data collection. NY and RZ contributed to writing of the manuscript, and data collection. NB contributed to writing and data collection of the manuscript. HT contributed to statistical analysis and writing the manuscript. UM contributed to writing and review of the manuscript. ARB contributed to study inception, writing and review of the manuscript, and the final revision.

Funding None.

Declarations

Conflict of Interest The authors have no conflicts of interest to disclose.

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