SURVEILLANCE OF PARASITIC DISEASES IN BULGARIA: ANNUAL EPIDEMIOLOGICAL ANALYSIS FOR 2023

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ABSTRACT

The incidence and number of cases of several parasitic diseases subject to mandatory reporting and registration under the Ministry of Health (MoH) 2005 Regulation 21 increased after the end of the global pandemic of COVID-19 in 2023. In addition, parasitic infections imported from endemic tropical regions are recorded annually in the country. A significant number of people are screened for parasitic diseases each year. The primary indication for screening is prophylactic, followed by epidemiological and clinical indications. This report aims to analyse the dynamics of parasitic diseases in 2023. Data from the periodic and annual reports of the RHI, medical institutions and NCIPD were used as inputs. In 2023, 647 781 people were tested for parasites, of whom 2.0% were diagnosed with various parasitic infections. Cystic echinococcosis increased from 89 cases in 2022 to 117 cases in 2023. The annual incidence of the disease increased from 1.3% in 2022 to 1.81% in 2023.

Regarding soil-transmitted parasitic diseases, 447 people were diagnosed with ascariasis and 50 with trichuriasis. Among the 458 764 people tested, the prevalence of enterobiasis was 1.74%. Out of 1 305 suspected cases, 10 individuals were diagnosed with imported malaria. Unfortunately, the disease was fatal for one patient of Bulgarian nationality.

Analysis of the data showed no discernible trend in the incidence of parasitic diseases in 2023. However, cases of cystic echinococcosis show an upward trend. For the first time, no epidemic outbreaks of trichinellosis were recorded in 2023.

Keywords: parasitic diseases; incidence; zoonoses

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INTRODUCTION

Parasitic infections continue to represent a significant global health concern. These infections have a substantial impact on morbidity and mortality rates in developing countries, while also being prevalent in developed countries. Early diagnosis and treatment of parasitic diseases are of critical importance for reduction of morbidity and mortality, as well as for prevention of their transmission within the community (1). Approximately 25% of the global population is affected by one or more parasitic infections, with parasitic zoonoses transmitted via food or vectors being the primary concern. Moreover, zoonoses and communicable diseases that are common to humans and animals are receiving increasing attention on a global scale. The significant changes in climatic conditions, agricultural activities, demography, dietary habits, alongside with the intensified international travelling and trade, deforestation and urbanisation play a considerable role in the emergence and re-emergence of previously eliminated parasitic zoonoses (2).

The principal aim of this concise analysis is to present an overview of the human parasitic pathology in the country and to delineate some trends and projections about its prevalence.

MATERIALS AND METHODS.

The study encompasses the period between January and December 2023 and was conducted at the Department of Parasitology and Tropical Medicine, at the National Centre of Infectious and Parasitic Diseases (NCIPD), Sofia, Bulgaria. The data set comprised the annual reports of the Regional Health Inspectorates (RHIs), including information

about parasitological examinations conducted in the respective regions of the country, the identified cases of infection, and aggregated data on the examined population, including age, sex, and place of residence. In the case of infections subjected to mandatory registration and reporting, epidemiological survey cards were also provided.

To evaluate the infection burden and severity of involvement by nosological entity, indicators such as prevalence (%), morbidity and mortality per 100,000 population, and spatial distribution by districts were analyzed. In addition, the preparedness of the public health system for surveillance, and adequate response to parasitic disease outbreaks in the country was assessed.

RESULTS

PARASITIC INFECTIONS WITH LOCAL SPREAD

In 2023, a total of 647 781 persons were tested in the various parasitology laboratories in the country (including RHIs, SMDLs and NCIPD), and 13 535 (2%) were diagnosed with parasitoses (Table 1).

Cystic echinococcosis: In 2023, 104 (89%) primary cases of cystic echinococcosis (CE) and 13 (11%) cases of postoperative recurrence were registered. The most affected age groups were 10-14 years and 45-49 years with 13 cases each. The 30-34 years and 55-59 years age groups were also highly affected with 12 and 10 cases of CE respectively. The proportion of children and adolescents (0-19 years) affected was 25.6% (n=30). The distribution of echinococcal cysts according to their respective organ localizations was as follows: 75 individuals (64.1%) had liver cysts, 26 (22.2%) had cysts with pulmonary localization, nine patients (7.7%) were with multiple echinococcosis, and seven (6%) had extrahepatic-pulmonary localization (spleen, kidney, peritoneum). The annual incidence rates had a very uneven territorial distribution. In 2023, the highest incidence rates were registered in the districts of Sliven (8.15‰), Kardzhali (6.37‰) and Shumen (3.9‰).

Trichinellosis: During the analyzed period no outbreaks of trichinellosis were recorded. Sofia RHI reported a single sporadic case.

Taeniasis: During the year under review, six taeniasis cases were reported, with *Taenia saginata* identified as the causative agent. A single case of taeniasis was reported in four regions of the country (Varna,

Table 1. Diagnosed parasitic infections with local spread in 2023.

Nosological unit	Number examined	Number of positives	Incidence per 100,000 / Prevalence in %
Zooanthroponoses with epidemic risk			
Echinococcosis	1327	117	1.8 per 100,000
Trichinellosis	87	1(sporadic)	0.02 per 100,000
Taeniasis ((beef tape-worm)	7953	6	0.09 per 100,000
Soil-transmitted helminth infections			
Ascariasis	551261	447	6.9 per 100,000
Trichuriasis	551261	50	0.7 per 100,000
Community-Acquired Parasitic Diseases			
Enterobiasis	458764	7983	1.74%
Giardiasis	442205	673	10.4 per 100,000
Hymenolepiasis	406921	110	1.7 per 100,000
Urogenital trichomoniasis	4294	271	4.2 per 100,000
Opportunistic parasitic infections			
Visceral leishmaniasis	29	2	0.03 per 100,000
Toxoplasmosis	16322	1680	10.29%
Blastocystosis	339676	1800	0.53%
Cryptosporidiosis	150	0	0
Pneumocystosis	88	17	0.26 per 100,000

Plovdiv, Razgrad and Haskovo), and two cases were identified in the capital, Sofia.

Soil-transmitted helminthiases (STH): A total of 497 cases of soil-transmitted helminthiases with traditionally local distribution (ascariasis and trichuriasis) were recorded by the country's parasitology laboratories, with significantly predominating ascariasis cases (Table 1). The parasitology departments of the RHI maintained a record of 147 STH-endemic settlements in nine country districts (six have been removed from the record out of regulatory requirements). Prophylactic examinations were conducted in 36 settlements (24%), with 118 688 individuals tested. Of these, 36 cases (0.03%) were diagnosed with ascariasis. All infected individuals were treated, and subsequent control examinations demonstrated that the treatment had been 100% effective. As in previous years, cases of trichuriasis were recorded primarily in nursing homes for individuals with mental disabilities.

Enterobiasis: Enterobiasis cases were predominantly concentrated among preschool children (n = 3705, 46.5%), school-aged children and adolescents (n = 2989, 37.4%), with a significantly lower relative proportion observed among adults (n = 1286, 16.1%).

Giardiasis: Out of the 673 cases of giardiasis, 403 (60%) were in children in childcare and early school age (up to 9 years). A higher prevalence was recorded in the districts of Burgas, Sliven and Yambol.

Hymenolepiasis: Over 95% of all cases of hymenolepiasis were documented in three country regions. The highest notification rates were observed in Sliven (n = 43), Yambol (n = 35) and Sofia-city (n = 27), predominantly among social home residents and minority groups. Most infected individuals (n = 76, 69%) were of preschool and primary school age.

Visceral leishmaniasis: During 2023, two cases of visceral leishmaniasis were registered. One was local (Kolarovo village, Petrich municipality), while information was lacking for the other one, which appeared in the database of the National Center for Public Health and Analyzes (for V. Tarnovo region), (no epidemiological survey card). Both patients were male and in the age group 45-49. One of the cases was fatal.

Blastocystosis: In 2023, 339 676 individuals were screened for blastocystosis, with 1 800 cases diagnosed (0.53% prevalence).

Cryptosporidiosis: During 2023, 150 patients were tested in the laboratories of Sofia-Capital, Varna and Plovdiv, and no positive cases of infection were identified.

Pneumocystosis: In 2023, 88 suspected patients were tested for pneumocystis pneumonia. A total of 17 cases (19.32%) were diagnosed as positive and were all confirmed by real-time PCR at NCIPD.

IMPORTED PARASITIC INFECTIONS

In 2023, a total of 3 097 individuals were tested for imported parasitic infections. Of these, 110 were Bulgarian citizens, while the remaining 2 987 were of foreign nationality. Of them, 174 individuals (164 foreigners and 10 Bulgarian citizens) were diagnosed with different parasitic infections.

Malaria: A total of 1 305 individuals were tested for malaria in seven districts of the country and at NCIPD. Of them, 115 were of Bulgarian nationality and 1 190 were foreigners, mostly refugees residing in the districts of Sofia-city and Sliven. In 2023, ten cases of imported malaria caused by *P. falciparum* were recorded, nine in Bulgarian citizens and one in a foreigner. Unfortunately, one of the infected Bulgarians from Varna died, most probably due to delayed seeking of medical care.

Other imported parasitic pathogens: In 2023, 1 792 individuals were tested for imported parasitic infections different from malaria, and all of them were foreigners. A total of 164 cases (9%) were identified, with the following parasitic species diagnosed: *B. hominis* (n = 65), *G. intestinalis* (n = 38), *A. lumbricoides* (n = 5), *H. nana* (n = 3), T. trichiuris (n = 1), *Ancylostoma spp.* (n = 1), *Entamoeba coli* (n = 27) and *Iodamoeba butschlii* (n = 14). No indigenous secondary outbreaks were documented, and prompt treatment was provided to the infected.

DISCUSSION

The transmission of parasites from the environment to different hosts, including birds, mammals and humans, occurs through the food chain and different vectors. In numerous instances, birds and animals serve as reservoirs and play a pivotal role in the transmission of pathogens to humans, thereby contributing to the emergence of zoonotic pathology. Given the involvement of multiple sources, these

diseases are now regarded as One Health issues and represent a challenge for the control of zoonotic diseases. The One Health approach is an integrated and unifying methodology aiming to achieve a sustainable equilibrium between the health of humans, animals and ecosystems (3). Of the 20 Neglected Tropical Diseases (NTDs) listed by the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), 13 are of parasitic origin, thereby indicating their global impact (4). Although most parasites are not associated with acute disease, they have a detrimental influence on animal and human health and productivity through widespread morbidity. In some cases, this can ultimately result in mortality among affected individuals. Parasitic diseases are a pervasive global health concern. However, they are particularly prevalent in tropical and subtropical regions (5). It is estimated that approximately 25% of the worldwide population is affected by one or more parasitic infections, with parasitic zoonoses transmitted by foodborne and vector-borne routes representing a significant public health concern. Noteworthy, parasitic diseases predominantly affect the world's most impoverished and disadvantaged populations, who often lack access to adequate healthcare (2).

As to the endemic parasitic zoonoses, cystic echinococcosis (CE) is of the greatest medical importance in Bulgaria. In recent years, there has been a decline in its incidence, with the most significant decline occurring between 2020 and 2022. This period coincided with the peak of the pandemic caused by SARS-CoV-2. Due to the possibility of gaps in diagnosis and registration, the data may not be entirely indicative (Fig. 1).

As reported by the European Centre for Disease Control (ECDC), 16 countries reported 299 confirmed cases of CE caused by *E. granulosus sensu lato* in 2022. As was the case in 2020 and 2021, the number of reported cases of CE in 2022 was significantly lower than the average annual number of cases reported in 2018 and 2019 (299 cases in 2022 compared to an average of 430 cases in 2018-2019). The highest number of cases were reported in Bulgaria and Germany (89 and 96 cases, respectively), accounting for 62% of all cystic echinococcosis cases reported in 2022. Among the 208 cases for which the age was known, 35% of those diagnosed with cystic echinococcosis were between 25 and 44 years, with 29% -between 45 and 64. Of the 205 cases of cystic echinococcosis with known sex, the majority (59%) were female. Among the 127 cases with known import status, 59% have originated outside the EU/EEA in 2022 (6). Although the data are for 2022 (the annual analysis for 2023 has not been published yet), it is important to highlight some trends that are relatively constant over time. These include the fact that cystic echinococcosis predominantly affects people of working age, and according to our survey data for 2023, the age groups with the highest relative prevalence are 10-14 years and 45-49 years with 11% each, followed by the group of people between 30-34 years with 10%. The trend for a high relative proportion of affected children and adolescents is also

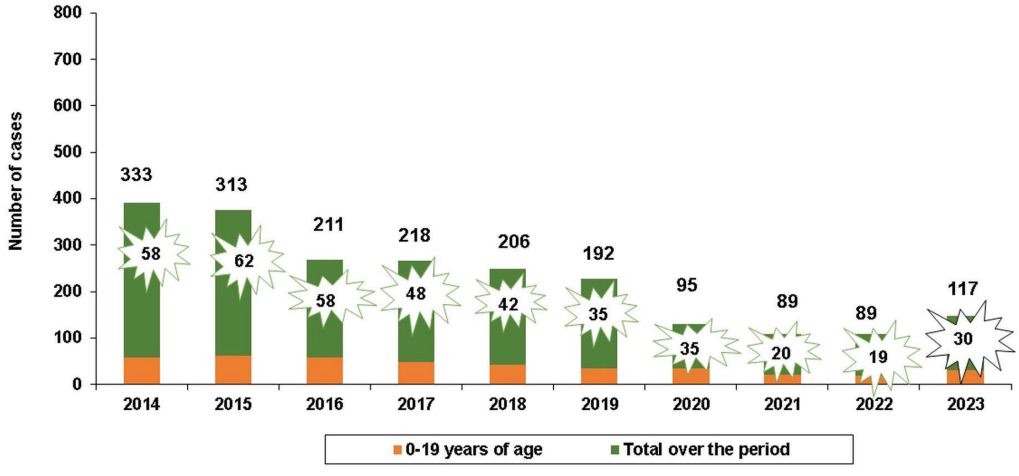

Figure 1. Registered cases of cystic echinococcosis for 2014 - 2023 (total and in persons in childhood and adolescence).

maintained, with 25.6%, 21.3% and 22.5% for 2023, 2022 and 2021, respectively (7). These data are of great concern because the infection is asymptomatic over a long period, which gives reason to believe that infection occurs at a relatively very young age.

Given that the primary means of transmission of the infection in humans is the consumption of water or food contaminated with tapeworm eggs or hands contaminated by contact with soil, it is imperative to prioritize the testing of environmental samples, particularly in regions with a high prevalence of the disease. Furthermore, greater efforts are required to increase the awareness of the disease, particularly among children. We contend that the principal reason for the persistently elevated levels of recorded incidence is the insufficient veterinary control on deworming of stray, yard and shepherd dog populations and meat production (predominantly in sheep) on private farms. Data on recorded CE cases over the next two - three years will indicate whether the decline in incidence observed in 2020-2022 was due to an improved health situation or was unfortunately related to gaps in diagnosis and treatment associated with the past Covid-19 pandemic.

Another zoonozis that has posed a significant public health concern for decades is trichinellosis. The greatest risk of trichinellosis is associated with the consumption of undercooked meat from pigs reared under uncontrolled husbandry conditions (unrestrained/free-range) or from hunted wild boar. For a considerable period, our country has been among the leading EU/EEA Member States in terms of recorded annual incidence. The data from the European Surveillance System (TESSy) for 2022 indicate that 28 European Union/European Economic Area (EU/EEA) countries have reported 39 cases of trichinellosis, representing a 49% decrease as compared to 2021. The notification rate in the EU/EEA is 0.01 cases per 100,000 population. The highest notification rates in the EU/EEA are reported by Latvia and Bulgaria, at 0.16 and 0.13 cases per 100,000 population, respectively (8). Considering those data, the information available for 2023 offers grounds for cautious optimism, given the absence of documented outbreaks and the occurrence of only one isolated case. In 2022, only one outbreak with nine cases was recorded, while in 2021, three outbreaks with 29 cases were documented, respectively (7, 9).

As part of the food- or water-borne diseases human cases of bovine tapeworm are recorded annually in Bulgaria. In 2023, six taeniasis cases were recorded, with the causative agent identified as *Taenia saginata*. In the preceding two years, there were two cases (in 2022) and nine cases (in 2021), respectively. The epidemiological studies identified data on the consumption of sausages that had not undergone thermal processing and were purchased by private individuals. However, the source of the infection remains unclear. Nevertheless, it is irrefutable that the occurrence of infection cases is attributable to the consumption of animal products that have not undergone veterinary inspection. This reinforces the question of the quality control of meat and meat products, as with trichinellosis, produced primarily in small private farms and sold to other individuals without legal control.

Soil-transmitted helminth infections represent a significant global health burden, disproportionately affecting the most vulnerable communities, particularly those with limited access to resources and services. The parasites are transmitted by eggs in human feces, which contaminate the soil in areas with poor sanitation (10). Following improvements in living conditions, the availability of treatment and the implementation of targeted control and health education programs, these infections have been almost completely eradicated in Western Europe. Currently, soil-transmitted helminths are predominantly found among marginalized populations in economically disadvantaged countries in Central Asia and Eastern Europe. Additionally, they are detected among marginalized populations in Central Europe, where environmental and socioeconomic conditions facilitate transmission (11). In Bulgaria, Ascaris lumbricoides and Trichuris trichiura are endemic to specific regions. The data for 2023 does not reveal a trend of dynamic change in the number of STH cases registered and the incidence per 100,000 population as compared to 2022. Overall, the incidence of ascariasis and trichuriasis in the last five years decreased slightly compared to the previous five years and is in the range that does not require mass deworming programmes in the population (Fig.

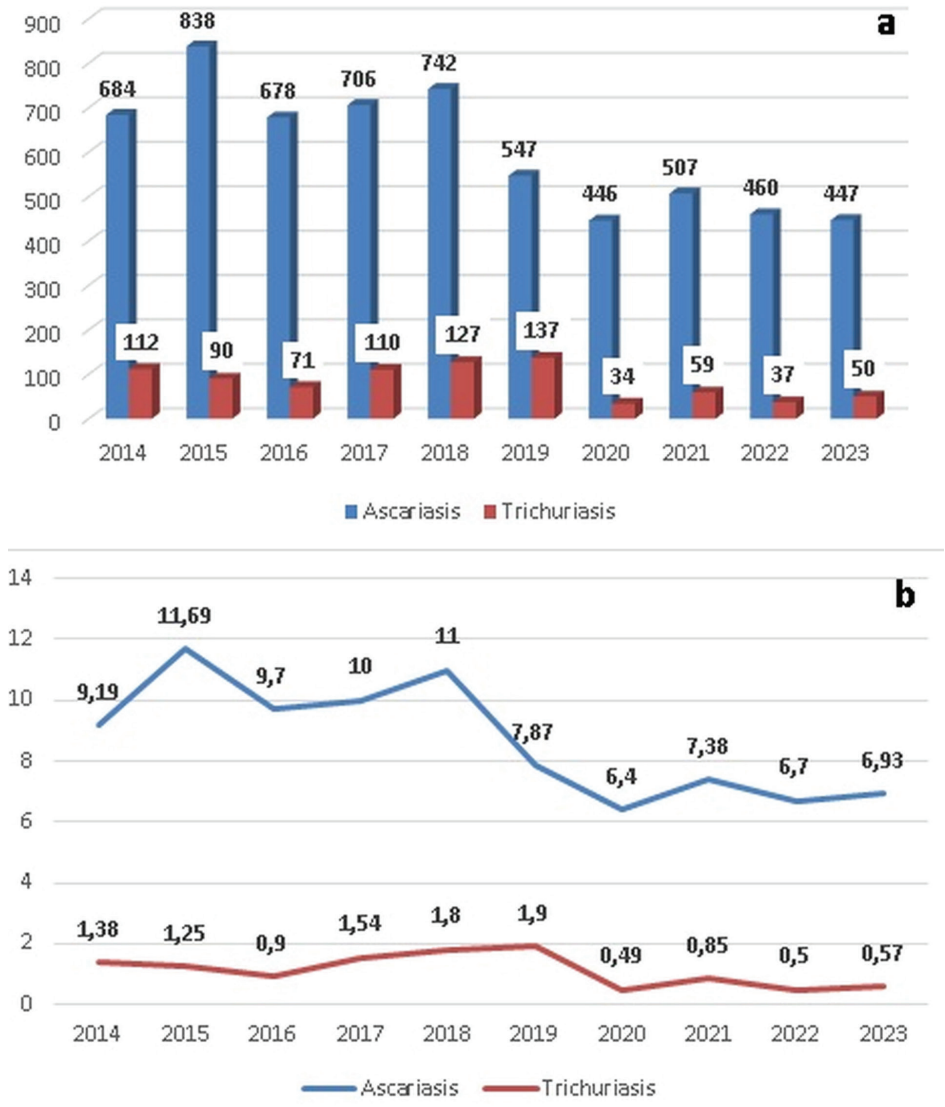

Figure 2. a: Number of cases of ascariasis and trichuriasis registered for the period 2014-2023; **b:** Incidence of ascariasis and trichuriasis for the period 2014-2023 per 100 000 population.

2 a, b). Therefore, surveillance and control measures for this group of diseases in the country are adequate and no additional measures are needed.

Among the parasitic infections with a contact mechanism of transmission, enterobiasis is the most prevalent one globally, as well as in Bulgaria. The highest prevalence of the infection is observed in children, with recent studies indicating that 12.9% of children worldwide are infected with *E. vermicularis* (12). Our data for 2023 is comparable, with over 80% of those infected being preschoolers, school-aged children, and adolescents. The elevated proportion of preschool-aged children diagnosed with enterobiasis is attributed to the fact that those attending organized childcare facilities are subjected to annual parasitological examinations. No significant difference in the registered morbidity of giardiasis and hymenolepiasis was observed as compared to previous years. For both diseases, the infected were mostly children of preschool and primary school age.

Like the majority of vector-borne zoonotic diseases, the epidemiology of visceral leishmaniasis is characterised by an uneven temporal distribution of cases and a high degree of unpredictability (Fig. 3). However, given the life-threatening nature of the disease and the annual registration of sporadic local or imported cases, it is imperative that the healthcare system is prepared and has a clear understanding of the diagnostic and treatment algorithms for such cases.

Notwithstanding the alteration in the taxonomic classification of *Pneumocystis jirovecii* and the

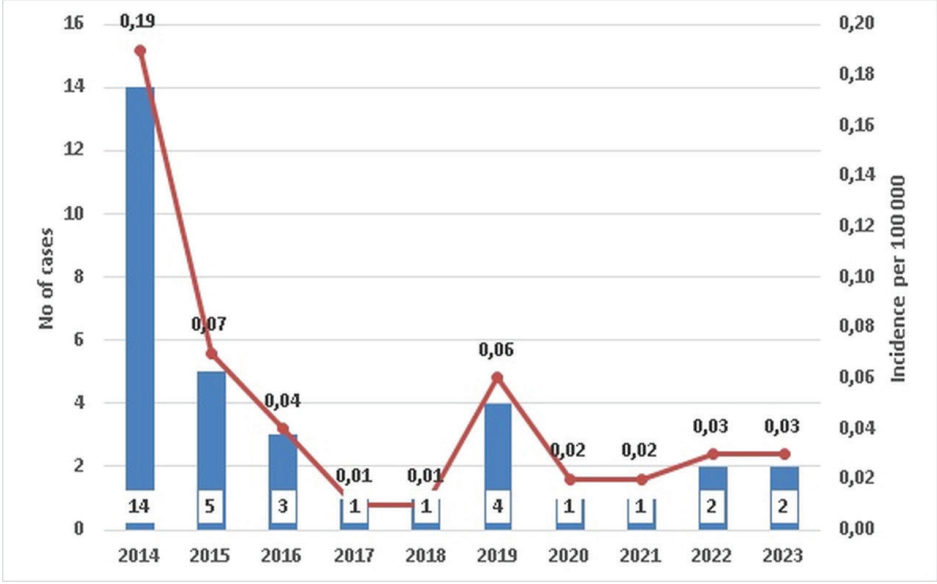

Figure 3. Number of cases and incidence per 100,000 population of visceral leishmaniasis in the period 2014–2023.

current categorization of this pathogen as a fungus causing opportunistic infections, the diagnosis is primarily conducted at the National Reference Laboratory for Diagnosis of Parasitic Diseases at NCIPD. Following the introduction of advanced diagnostic techniques, such as real-time PCR, the detectability of the infection has increased significantly. In 2023, 17 cases of pneumocystis pneumonia (PJP) were diagnosed, compared to 10 in 2022, 11 in 2021 and 18 in 2020 (9). The majority of cases were diagnosed in individuals infected with human immunodeficiency virus (HIV) and in other conditions resulting in immune deficiency. However, Pneumocystis jirovecii pneumonia (PJP) has also been identified in immunocompetent individuals (13).

Malaria is the most significant imported parasitic disease. Between 2014 and 2023, 110 cases of imported malaria were registered in the country with 10 cases occurring in 2023. A review of data from previous years suggests that the predominant cause of imported malaria cases is *P. falciparum*, all recorded imported malaria cases in the country in 2023, and 65% of the cases in the last decade were caused by this plasmodium. It is regrettable to note that a fatal outcome was also recorded in a case last year. Over the 10 years, six fatal cases were reported (Table 2).

All deaths occurring over the past decade have been attributed to complicated tropical malaria. The mean time for establishing an etiological diagnosis in fatal cases was 8 days, with the interval between the initial clinical manifestations and the lethal outcome

Table 2. Registered cases of imported malaria (2014-2023) and the disease outcome (Harizanov et al. 2024).

Year	No of cases	Recovered	Deceased	Case fatality rate
2014	10	9	1	10%
2015	19	20	0	0
2016	28	27	1	3.6%
2017	8	8	0	0
2018	8	8	0	0
2019	8	8	0	0
2020	5	5	0	0
2021	9	7	2	22%
2022	5	4	1	20%
2023	10	9	1	10%
Total	**110**	**104**	**6**	**5%**

averaging 11 days (across all affected). It was observed that none of the patients who had malaria and subsequently died had received chemoprophylaxis during their residence in an endemic area. These data demonstrate that travelers to malaria-endemic areas are not familiar with the mechanisms of infection and prevention measures remain inadequate. This deficiency has clinical and epidemiological consequences. There is a potential risk of the re-emergence of local malaria transmission in Bulgaria. The current level of vulnerability is moderate and is determined by the number of malaria cases imported from endemic countries. In our country, a high level of susceptibility is maintained, due to the presence of suitable climatic and faunal conditions that facilitate the local spread of the disease for the major part of the year. To mitigate the consequences of import and prevent the return of malaria to Bulgaria, it is necessary to maintain a high level of surveillance and control measures regarding this disease (14).

Concerning the remaining parasitic pathologies imported into the country, no notable differences were observed in comparison to the diagnosed local cases, except for one instance of hookworm infection. Importantly, due to control measures concerning the risk groups arriving from endemic countries (predominantly refugees and illegal economic migrants) as previewed in Bulgarian legal framework, no secondary outbreaks of endemic diseases among the local population were recorded as the infected individuals have been promptly treated.

In conclusion, the structure and dynamics of parasitic pathology registered in 2023 do not exhibit significant differences as compared to previous years. However, it is essential to maintain vigilance, particularly in the settings of a declining number of medical parasitologists in the country. According to us, it is necessary to secure the RHIs with personnel trained in this field, given that they are responsible for the primary control measures related to local and imported parasitic infections in the country. Furthermore, providing treatment for tropical malaria and visceral leishmaniasis, which can prove fatal in some cases is of vital importance. In our view, efforts are required to optimize the delivery system for unregistered but highly effective drugs for treatment of life-threatening parasitic diseases.

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