

COMMUNITY-ACQUIRED PARASITOSEs AMONG THE POPULATION OF BULGARIA: A BRIEF LITERATURE REVIEW AND ANALYSIS OF NATIONAL DATA FOR THE PERIOD 2020 - 2024.

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ABSTRACT

Background

Community-acquired intestinal parasitoses, including enterobiasis (*Enterobius vermicularis*), giardiasis (*Giardia intestinalis*), and hymenolepiasis (*Hymenolepis nana*), represent widespread parasitic diseases affecting humans worldwide, primarily in preschool and school-aged children as a result of poor personal hygiene habits and fecal-oral mode of transmission. These conditions act as important indicators for assessing societal health literacy, hygiene practices, and socioeconomic status. While mandatory parasitological screening in high-risk groups in Bulgaria increases the detection of these invasions, the post-COVID-19 resurgence reveals ongoing public health challenges. This paper reviews global literature and analyzes national surveillance data to examine the prevalence rates between 2020 and 2024.

Materials and Methods

The data were obtained from annual reports of Regional Health Inspectorates (RHI), Independent Medical Diagnostic Laboratories (IMDL), the National Centre for Infectious and Parasitic Diseases (NCIPD), and the National Center of Public Health and Analyses (NCPHA) within the period of 2020 to 2024. The

prevalence rate was estimated using the following equation: $[(\text{Number of diagnosed cases} \times 100) / \text{Total number of examined persons}]$ for enterobiasis; the incidence was calculated via the formula: $[(\text{Number of diagnosed cases} \times 100,000) / (\text{Annual population})]$ for giardiasis and hymenolepiasis. Statistical methods used include descriptive statistics, the Mann-Whitney U test for sex and age differences, and the Kruskal-Wallis test for age groups at $p < 0.05$.

Results

Enterobiasis prevalence decreased during the pandemic period (2020–2022), however it increased above the pre-pandemic levels by 2024 (1.73%), with the highest rates in preschoolers and specific districts like Yambol (6.89%). The annual giardiasis incidence rose from 7.2 to 12.1 per 100,000, predominantly in children aged 0–19 years (76.8%; $p=0.0079$), with peaks in Yambol and Sliven. Hymenolepiasis incidence averaged 1.42 per 100,000, exhibited differences according to age (87.7% in preschoolers; $p=0.0010$) and was concentrated in seven districts. The vulnerable demographic group across parasitoses were children, aligning with global patterns, though adult cases also raised concerns.

Conclusions

The prevalence of community-acquired parasitic infections in Bulgaria continues to be an important problem, as the post-pandemic increase in incidences indicates effective surveillance but inadequate control measures such as pharmacological treatment and case isolation. Effective health education and improved hygiene, along with medication availability, are essential in limiting the spread of these diseases, especially among children.

Keywords: enterobiasis, giardiasis, hymenolepiasis

TEXT

Brief overview of the problem

Community-acquired intestinal parasitoses are one of the most common invasions among humans, with determining factors for their spread being the hygiene habits, socio-economic development and health culture of society. Children are more often, mainly in preschool and early school age (1). This group of parasitic invasions includes three nosological entities: enterobiasis, giardiasis and hymenolepiasis.

Enterobiasis is caused by the nematode *Enterobius vermicularis* and is globally distributed, most com-

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monly affecting school- and preschool-aged children (2). It is the most common helminth infection in the USA and Western Europe, with 30-50% prevalence in certain groups (3). Over the past 20 years, 12.9% of children worldwide have been infected with *E. vermicularis*. The prevalence of enterobiasis in children based on geographic location is as follows: Europe 24.9%, South America 14.3%, Asia 13%, Africa 2%, and North America 1.9% (4).

Humans are the only host. Invasion occurs by ingestion of infective eggs from environmental exposure or self-inoculation. Larvae hatch in the small intestine, while adults inhabit the large intestine, usually the cecum. At night, gravid females migrate to the perianal area to deposit eggs, which become infective within 4 to 6 hours under optimal conditions. Egg production by adult females begins about a month after invasion (2).

Fingers and nails are easily contaminated by scratching the perianal area. Reinvasion can occur by placing contaminated fingers or objects in the mouth. Eggs shed from the skin contaminate the home environment (e.g. blankets, sheets, clothing, dust), facilitating spread to other people through close household or personal contact (5).

About 40% of parasitized individuals are oligo- or asymptomatic. The main clinical symptom is intense (peri-) anal itching, mainly at night, which can lead to sleep disturbance, enuresis in childhood and impaired concentration during the day. Scratching in the perianal area can cause excoriation and bacterial superinfection. Vulvovaginitis is rarely observed when pinworms migrate to the vaginal area. The role of *E. vermicularis* in the development of acute appendicitis is discussed, but has not been fully proven (6). Other possible symptoms are diarrhea, colicky abdominal pain, appetite loss, headache, irritability, and fatigue (7).

Diagnosis is confirmed by microscopic detection of eggs. Tape test is the most commonly used, with the sample taken in the morning before defecation or genital hygiene. The method's sensitivity increases from 50% with a single test to about 90% when performed on three separate days. Motile parasites may be visible on underwear, perianally, or in stool (6).

Treatment options include albendazole (400 mg once, repeated after 20 days) or mebendazole (100 mg once, repeated after 20 days) (8). *E. vermicularis* is susceptible to these anthelmintic drugs, but they

only kill adult forms and are not effective against eggs and larvae. Drug treatment is not sufficient to control enterobiasis and does not prevent reinfection (4).

Recommendations for the prevention of enterobiasis include frequent handwashing with soap and warm water, keeping nails short and clean, avoiding nail-biting and perianal scratching, bathing and changing underwear every morning, washing clothes and bedding in hot water followed by hot drying (9).

The prevalence of this parasite in society is influenced by the parents' education and occupation, the place of residence, the number of family members, and the socio-economic status of the family (10). To limit the spread, effective health promotion should include raising awareness among children and families (4).

Giardiasis is a parasitic invasion caused by the protozoan species *Giardia intestinalis* (syn. *G. duodenalis*, *G. lamblia*) (11). It is the most common protozoan infection in humans, associated with traveler's diarrhea and outbreaks in childcare facilities. The mechanism of transmission is fecal-oral. The parasite is particularly common in areas with poor sanitation, with prevalence rates ranging from 20 to 30% in developing countries and from 3 to 7% in developed ones (12). It affects people of all ages, especially young children, young adults, campers, and tourists visiting endemic areas (13).

G. intestinalis is a protozoan flagellate that undergoes two biological development stages: trophozoite and cyst. Infection occurs by ingestion of cysts in contaminated water and food or via contaminated hands. Excystation occurs in the small intestine, with two trophozoites being released from each cyst. In the proximal small intestine, trophozoites multiply by binary fission and are found free or attached to the intestinal mucosa. Encystment occurs when they pass to the large intestine. Since the cysts are infectious when excreted in the feces, human-to-human transmission is possible (14). The infectious dose is between 10 and 100 cysts (15).

The incubation period ranges from 1 to 3 weeks, with 50-75% of infected people being asymptomatic. Symptomatic cases are more common in children. The disease presents with acute or chronic diarrhea, with profuse, watery, foul-smelling stools. Other symptoms that may be observed include appetite loss, nausea, vomiting, flatulence, abdominal pain,

asthenia, weight loss, and less commonly, mild pyrexia, chills, and headache. Symptoms usually resolve within 2 to 4 weeks, but may be more severe and persistent in young children (12).

Chronic giardiasis is characterized by persistent diarrhea, anorexia, weight loss, nausea, and malaise. Symptoms of hypovitaminosis may also be observed. Extraintestinal manifestations are rare and include allergic reactions (urticaria, bronchospasm, erythema multiforme, reactive arthritis) and biliary tract involvement (16).

Diagnosis can be made using various methods. Materials for examination are fecal samples and duodenal juice. The most commonly applied method is direct wet mount examination using saline and Lugol's iodine solution to detect trophozoites and cysts, which remain unstained in the former and stained brown-yellowish in the latter. Enrichment and staining methods can also be used to detect cysts. While serological methods for demonstrating antibodies against *G. intestinalis* have low sensitivity, parasite antigens in feces can be detected by direct and indirect immunofluorescence. There is also an immunochromatographic test for detecting the parasite in a stool sample, which gives a result within 10 minutes. PCR and PCR-based methods are used to detect *G. intestinalis* DNA (17).

Giardiasis is treated with metronidazole tablets (250 mg three times daily for 5 days) or tinidazole tablets (2 g once), (8).

Contaminated food and water are the most common sources of giardiasis invasion, with person-to-person transmission possible via poor hygiene (13). In Western countries, foodborne outbreaks are primarily associated with consumption of fresh foods that are difficult to clean thoroughly and are consumed without additional processing that inactivates or removes the protozoa. Person-to-person transmission of giardiasis occurs easily. Food preparation and handling by staff who are infected or have been in contact with infected people can lead to food contamination, which can be prevented by strict adherence to personal hygiene (15).

G. intestinalis cysts are resistant to the external environment, as they can be found in water for 1–3 months at temperatures between 4 to 20°C. They are resistant to UV radiation and chlorination. *G. intestinalis* cysts die at 60–70°C for 5 minutes and at 100°C for 3 minutes, as well as by withering. Phenol-based disin-

fection is effective, and mechanical clearance by filters with pore size less than 8 µm is also possible (18).

Globally, *G. intestinalis* is the most common cause of waterborne disease outbreaks (contaminated drinking water, natural sources, swimming water ingestion, etc.) (13).

In 2022, 10,894 cases of giardiasis were reported across 24 EU/EEA Member States, with a reported incidence of 3.9 cases per 100,000 population. The highest incidence rates were reported in Spain and Germany. Seasonality is observed, with peaks in September and November, and to a lesser extent in March and June. Most cases occurred in the age group 0–4 years, and the fewest were among individuals aged 65 years and over. The male-to-female ratio was 1.3:1. The number of cases in 2022 was comparable to pre-Covid-19 pandemic levels (11).

Hymenolepiasis is caused by two cestode species - *Hymenolepis nana*, also called the dwarf tapeworm, with an adult length of 15 to 40 mm, and *Hymenolepis diminuta*, which is rare in humans but common in rodents (19). Hymenolepiasis is considered the most common cestode in humans worldwide, with the highest incidence among children in densely populated communities with poor sanitation. Cases are often observed in institutions such as kindergartens and schools (20). Incidence varies by region - Europe (0.5–5%), Asia (0.2–28.4%), Africa (1.8–2.9%), North and South America (0.9–23%) (21).

Direct person-to-person transmission is the most common route of *H. nana* invasion, especially in environments with poor hygiene and inadequate sanitation (20). *Hymenolepis* eggs shed in feces are infectious and can survive in the external environment for up to 10 days. When ingested through contaminated food, water, or hands, oncospheres release from the eggs, penetrate the intestinal villi and develop into cysticercoids. These rupture the villi, attach to the mucosa and develop into adults, which release eggs, excreted in feces. Internal autoinfection can also occur, in which an embryo hatches from the egg, penetrates the intestinal mucosa and continues the infectious cycle without passing through the external environment. The lifespan of adult forms is 4 to 6 weeks, but internal autoinfection allows the parasitosis to persist for years (19).

If an intermediate host (various species of beetles and fleas) ingests eggs, cysticercoids develop, which can infect humans or rodents when the host is in-

gested (19).

The disease can be asymptomatic or subclinical. Clinical manifestations develop in patients with a high parasitic burden and include dyspeptic syndrome (loss of appetite, nausea, diarrhea), neuro-vegetative syndrome (headache, fatigue, restless sleep, irritability), and allergic syndrome (transient urticarial rashes, rhinitis, itching of the skin). Laboratory tests show moderate anemia, hypoproteinemia, and moderate eosinophilia (22). Children with high parasite loads (>300 parasites) present with abdominal discomfort, irritability, diarrhea, and potentially malabsorption. Adults are rarely symptomatic, and diarrhea and abdominal discomfort may occur with severe invasion. Infection in adults, but not in children, is self-limiting (23).

Diagnosis is made by parasitological examination of a stool sample. Macroscopically, sexually mature forms are usually not detected, except with deworming. Microscopic diagnosis is based on the detection of parasite eggs. Threefold examination is recommended if the sample is negative. Enrichment methods may also be used (24).

Hymenolepiasis is treated with one of the following drug regimens: praziquantel (25 mg/kg once) or niclosamide - orally, adults - 2 g once for 7 days; children 11-34 kg - first day 1 g, followed by 500 mg for 6 days; children > 34 kg – first day 1.5 g, followed by 1 g for 6 days (8).

Aim of the study

The aim of this study is to analyze the prevalence of community-acquired parasitoses in Bulgaria’s population within the period from 2020 to 2024, to establish trends in the spread of these diseases, both

among the general population and among the child and adolescent groups, as well as to assess the state of the control and surveillance system.

MATERIALS AND METHODS

The analysis was prepared based on data from the annual reports of the parasitological structures of the Regional Health Inspectorates (RHI) and Independent Medical Diagnostic Laboratories (IMDL), from the annual analyses of parasitic diseases in Bulgaria by the National Center for Infectious and Parasitic Diseases (NCIPD) and from the annual information on registered infectious diseases at the National Center of Public Health and Analyses (NCPHA), covering the period from 2020 to 2024. We have determined two main epidemiological indicators, parasite prevalence (prevalence) and incidence per 100,000 population using the following formulas:

- for parasite prevalence - $x = (\text{Number of diagnosed cases} \times 100) / (\text{Total number of examined persons})$
- for incidence - $x = (\text{Number of diagnosed cases} \times 100,000) / (\text{Annual population})$

To characterize enterobiasis, we have used parasite prevalence as an indicator, because the invasion proceeds mostly asymptotically, while incidence per 100,000 was used as an indicator for giardiasis and hymenolepiasis.

RESULTS AND DISCUSSION

Enterobiasis

Parasite prevalence data for the general population and of organized children's groups in unified child-care facilities (UCF) are shown in Fig. 1.

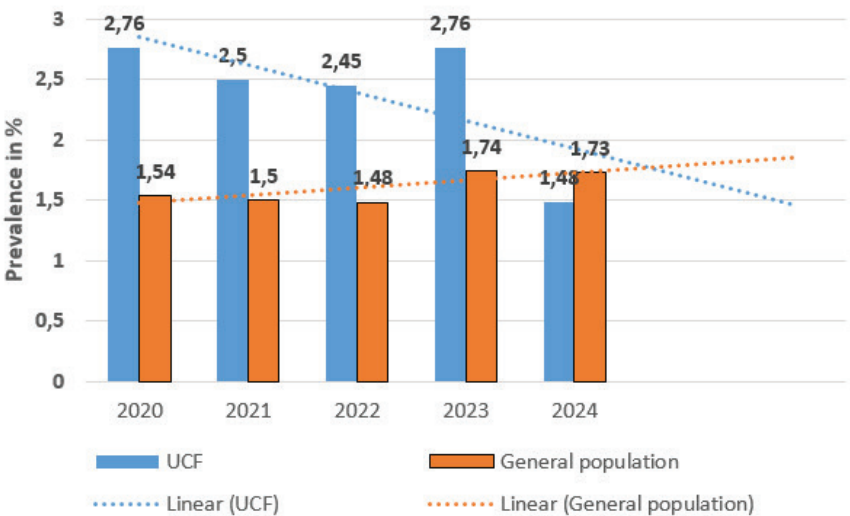


Figure 1. Annual enterobiasis prevalence for the period 2020-2024

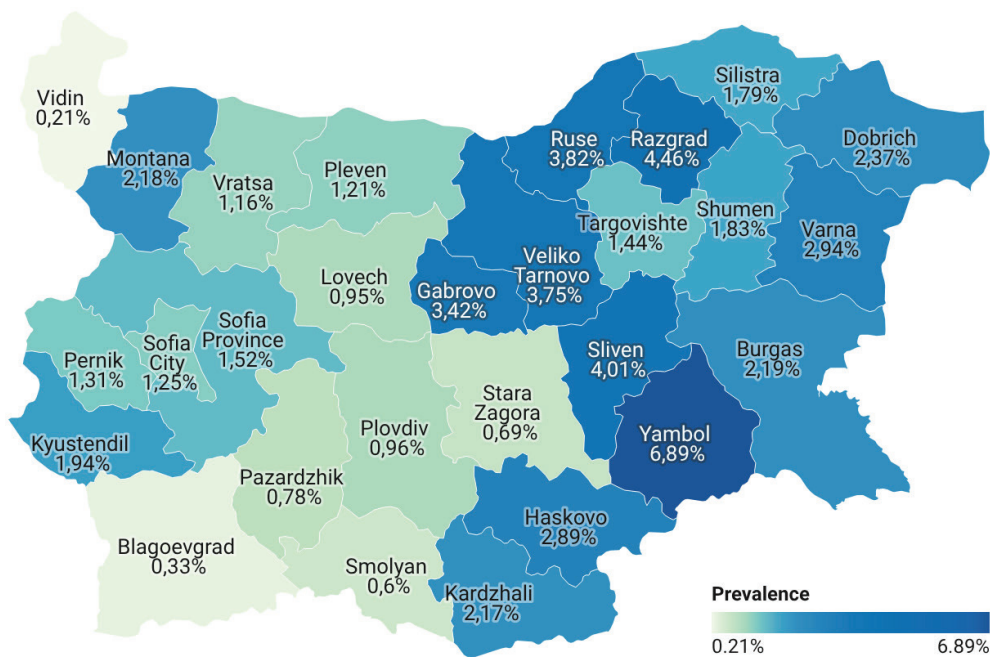


Figure 2. Average values of enterobiasis prevalence for the period 2020 – 2024 by administrative regions of the country.

Since the study period also includes the COVID-19 pandemic, there may be some data distortion due to the reduced registration of suspected infectious diseases. With the beginning of the pandemic and the introduction of related public health measures, notifications for most diseases have decreased compared to previous years (25). This is also evident in the data from our study. The analysis of enterobiasis burden in Bulgaria shows a certain decrease in the prevalence of infected individuals both in the general population and in children in organized children's groups with values recovering at the end of the pandemic period and showing a tendency to increase in 2024 (Fig. 1). In terms of age structure, our data are identical to the literature (2), with preschool children being the most affected. This could be explained by the fact that this group is subject to mandatory parasitological exam-

inations according to the existing regulatory framework and the detection rate is significantly higher. In children and adolescents of school age, and in adults, most examinations are based on clinical (presence of symptoms) and epidemiological (contact with a parasitized person) indications. Given the specifics of the invasion and the absence of symptoms, this leads to a lower detection rate of cases in these groups. Territorial distribution of enterobiasis varies, with the most severely affected districts being Yambol (6.89%), Razgrad (4.46%), Sliven (4.01%), Ruse (3.82%) and Veliko Tarnovo (3.75%). The average prevalence values for the period are the lowest in Vidin (0.21%), Blagoevgrad (0.33%), Smolyan (0.6%), Stara Zagora (0.69%) and Pazardzhik (0.78%) (Fig. 2). These regional differences reflect varying health culture and childcare facility sanitation, as well as surveillance

Table 1. Distribution of giardiasis cases by sex and age.

Year	Total No of examined	Total No of infected	Sex		Age	
			Male	Female	0 – 19 years	>19 years
2020	303575	500	254	246	374	126
2021	268373	591	317	274	470	121
2022	430791	503	279	224	394	109
2023	442205	673	370	303	502	171
2024	445675	781	414	367	600	181
Total	1890619	3048	1634	1414	2340	708
Percent	100%	100%	53.6%	46.4%	76.8%	23.2%
Mean	378124	609	326	282	468	141
Standard deviation	85215	119.5	65.48	55.65	90.69	32.20
Mann Whitney test			P value = 0,2222		P value = 0,0079 **	

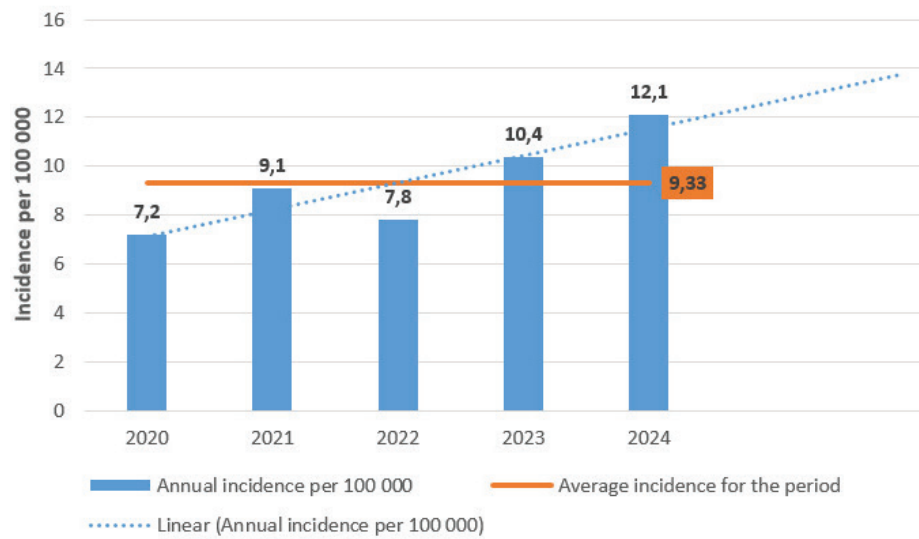


Figure 3. Annual giardiasis incidence for the period 2020-2024

and control gaps, such as improper sampling (26). Pre-pandemic data show a clear upward trend in enterobiasis prevalence among the general population and preschool children. Over a 10-year period, prevalence rose annually from 0.96% (2015) to 1.66% (2019), declined during pandemic years (2020–2022), then increased again, with 2023 (1.74%) and 2024 (1.73%) exceeding pre-pandemic levels (27,28).

Giardiasis

Giardiasis cases are registered annually, with incidence per 100,000 shown in Figure 3.

The annual incidence of giardiasis varies yearly but shows an upward trend. Data analysis shows a correlation between the examination volume and the dynamics of incidence values. In 2020, when incidence levels were the lowest, about 303,000 people were tested, compared to 2024, when the most cases were registered and the number of people examined for giardiasis was nearly 446,000 people. During the COVID-19 pandemic, giardiasis incidence declined, which can be explained by the reduced testing demand for this pathogen and the significantly smaller number of persons examined during this period. Data analysis of the last 10 years shows that pre-pandemic annual rates were markedly higher. For the period 2015-2019 the lowest annual incidence was 15.1‰ (2018) and the highest rates were reported in 2016 (19.2‰) and 2019 (16.4‰) (27,28). Although pre-pandemic levels were significantly higher, the data from our study show a persistent upward trend approaching those figures.

The distribution of cases by demographic characteristics (sex and age) shows that males are relatively more affected, but no statistically significant differ-

ence between the incidence among males and females was found. Parasitized children and adolescents markedly outnumbered parasitized adults with a statistically significant difference (Table 1).

The age group 0 – 4 years is the most affected, followed by the age groups 5 – 9 and over 19 years, with a statistically significant difference between the individual age groups (Table 2). The data show that giardiasis is most common among children of preschool and early school age, which is explained by the fact that most of them are included in organized children's groups (nursery schools, kindergartens) and have not yet developed hygiene habits. However, the high proportion of infected adults is puzzling. It is an indicator of existing gaps in health education, personal and household hygiene.

Table 2. Distribution of giardiasis cases by age groups.

Year	Number of cases by age groups				
	0 – 4	5 - 9	10 - 14	15 - 19	>19
2020	86	202	80	6	126
2021	234	173	30	33	121
2022	203	148	25	18	109
2023	242	180	45	35	171
2024	329	201	40	30	181
Total	1094	904	220	122	708
Percent	35.9%	29.7%	7.2%	4.0%	23.2%
Mean	218	180	440	24	141
Standard deviation	87,75	22,33	21,62	12,22	32,20
Kruskal-Wallis test	P value = 0,0006***				

Giardiasis distribution in the country is uneven, with the highest average incidence rates for the period being found in the districts of Yambol, Sliven and Burgas (Fig. 4). Notably, no cases of giardiasis appeared in

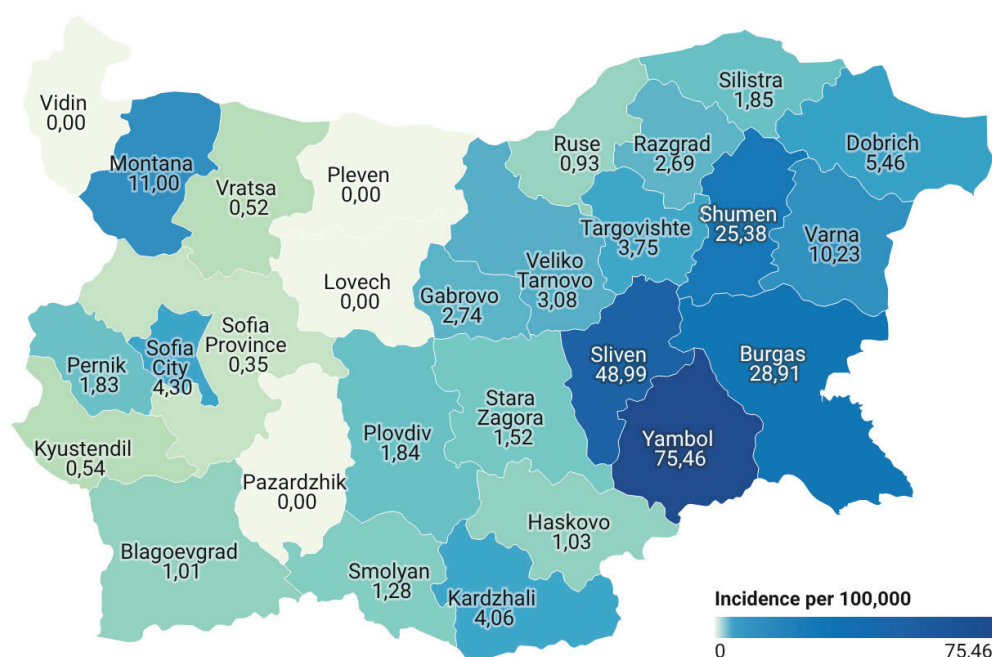


Figure 4. Average incidence rates of giardiasis for the period 2020 – 2024 by administrative regions of the country.

in the districts of Vidin, Lovech, Pazardzhik and Plev- en. This pattern is difficult to explain and we would attribute it rather to diagnostic gaps than to the ab- sence of this parasitosis.

Hymenolepiasis

Although the dynamic is relatively smoother, a trend of increasing incidence is observed in hymenolepias- is, with the average value for the studied period be- ing 1.42‰ (Fig.5).

The number of examinations for hymenolepiasis var- ies, with 292,361 examined persons in 2020, followed by a decrease to 199,453 in 2021 and a significant

rise in the next three years, reaching over 440,000 people tested in 2024.

The total number of people diagnosed with hyme- nolepiasis and their distribution by sex and age are presented in Table 3.

Hymenolepiasis shows the most pronounced age-spe- cific impact. Not only is the difference between par- asitized children and adolescents and the adult pop- ulation statistically significant, but the proportion of parasitized individuals in the preschool age is 87.7%. This also determines statistically significant differenc- es in morbidity between age groups (Table 4).

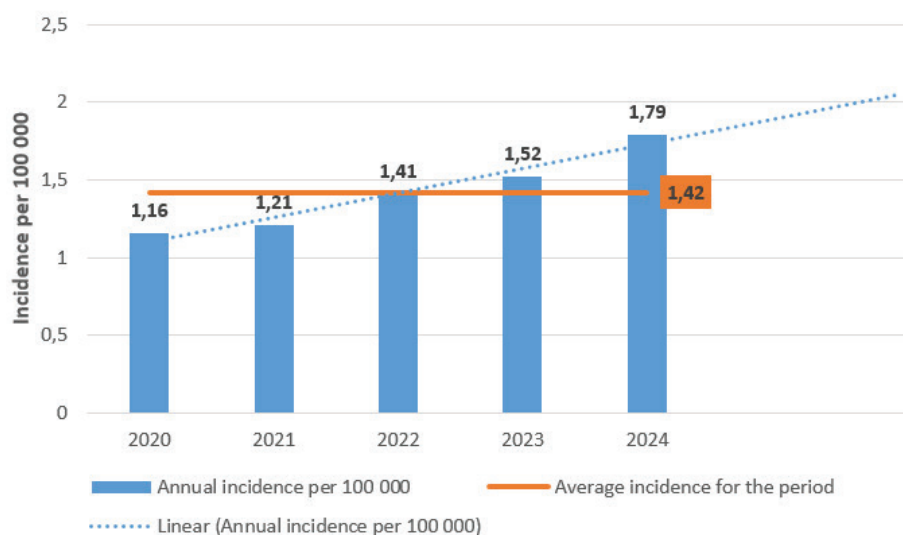


Figure 5. Annual incidence of hymenolepiasis for the period 2020-2024

Table 3. Total number of cases of hymenolepiasis per year and distribution by sex and age.

Year	Total No of examined	Total No of cases	Sex		Age	
			Male	Female	0 - 19 years	>19 years
2020	286447	80	38	42	74	6
2021	199453	79	50	29	77	2
2022	413039	91	51	40	90	1
2023	406921	98	59	39	91	7
2024	423326	115	66	49	112	3
Total	1729186	463	264	199	444	19
Percent	100%	100%	57%	43%	95.9%	4.1%
Mean	345837	93	53	40	89	4
Standard deviation	99004	14.8	10.5	7.2	15	2.6
Mann Whitney test			P value = 0,0952		P value = 0,0079 **	

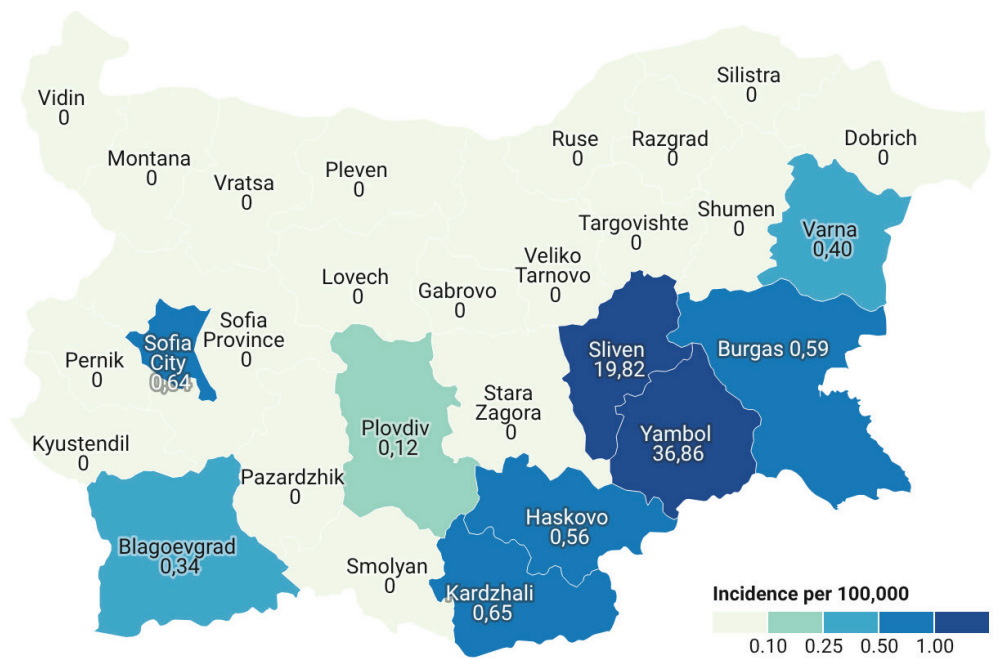


Figure 6. Average incidence rates of hymenolepiasis for the period 2020 – 2024 by administrative regions of the country.

No statistically significant difference in incidence by sex was found.

Territorial distribution of hymenolepiasis varies widely. The highest average rates occurred in Yambol and Sliven. In 19 districts no cases of hymenolepiasis were registered, and in the remaining seven, average annual rates ranged from 0.12‰ (Plovdiv) to 0.64‰ (Sofia city), but all were below 1 per 100,000 (Fig. 6). Analysis of data from the previous ten years reveals high variability in registered annual incidence rates. From 2015 to 2019, they ranged between 1.7‰ (2017) and 2.03‰ (2019), with a sharp jump in 2016 (6.67‰). During the pandemic period, the incidence rate decreased (average value 1.26‰), and in 2024 it again reached the pre-pandemic levels - 1.79‰.

There is a lack of highly effective medications for eti-

ological treatment registered in Bulgaria. This creates not only clinical but also epidemiological problems related to the impossibility of sanitizing the sources of the invasion and preventing its spread (26).

Table 4. Distribution of cases of hymenolepiasis by age group.

Year	Number of cases by age groups				
	0 – 4	5 - 9	10 - 14	15 - 19	>19
2020	39	31	1	3	6
2021	29	42	2	4	2
2022	48	34	2	6	1
2023	36	40	7	8	7
2024	70	37	2	3	3
Total	222	184	14	24	19
Percent	47.9%	39.8%	3.0%	5.2%	4,1
Mean	44	37	3	5	4
Standard deviation	15.85	4.44	2.39	2.17	2.59
Kruskal-Wallis test	P value = 0,0010***				

CONCLUSION

The data from our study, as well as those of other authors, indicate that community-acquired parasitoses remain a significant problem, affecting for both the population and the country's public health system. Although the COVID-19 pandemic led to a sharp decline in the incidence of parasitoses, as well as several other diseases of infectious and non-infectious origin, a recovery trend became evident after the end of the pandemic, with incidence levels returning to and even exceeding those observed before the pandemic. This phenomenon could be explained by the public restrictions imposed in connection with the pandemic. Community-acquired parasitoses (enterobiasis, giardiasis, hymenolepiasis) are an important indicator of the level of health awareness and hygiene practices in society, in connection with their mode of transmission. The fact that preschool and school-age children are most affected is easily explained, and our data are in line with global data, but the relatively high proportion of infected adults is worrying. These results may be largely explained by the existing regulatory framework in the country, which allows for a large number of individuals to undergo parasitological screening (children attending nurseries and kindergartens, adults working in the food industry, tourism and services). This, in turn, leads to higher detection rates, considering that these conditions are mostly oligo- or asymptomatic, which is why examinations based on clinical indications are quite limited in number. In addition, the regulatory requirements for surveillance and control of parasitic diseases in the country allow for the registration of nearly all cases of parasitic invasion, with only minimal gaps. As a result, data from studies in this field are of a high representative value.

Considering the general clinical course of these infections, we do not believe that community-acquired parasitoses seriously burden the healthcare system in the country. However, the observed persistent increase in their incidence clearly indicates existing gaps in control measures, related mainly to delayed diagnosis and inadequate treatment of cases. This is facilitated, on the one hand, by the lack of a broad range of medications for effective treatment, and on the other hand, by the failure to promptly exclude infected individuals from the community, creating prerequisites for the spread of the respective parasitic invasion. It is no coincidence that several parasitic

infections, including community-acquired ones, are classified as "neglected diseases", which is one of the main reasons for their widespread distribution both nationally and globally.

ACKNOWLEDGEMENTS

This research is supported by the Bulgarian Ministry of Education and Science under the National Program „Young Scientists and Postdoctoral Students - 2“.

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