



## RISKS FOR THE CREATION OF AN *ENTEROBIUS VERMICULARIS* OUTBREAK IN A PEDIATRIC HOSPITAL SETTING IN PLEVEN, BULGARIA

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### ABSTRACT

**Introduction:** *Enterobius vermicularis* is a nematode that causes enterobiasis in humans. Due to the contact nature of transmission of the invasion, children in institutions such as kindergartens, elementary schools, and pediatric hospitals are at risk.

**Purpose:** This study aimed to determine the prevalence of enterobiasis among children aged between 1 and 17 who were hospitalized for different medical reasons in a pediatric hospital.

**Materials and methods:** Over a period of two months, 139 boys and 126 girls were hospitalized in the Pediatric Clinic of Dr Georgi Stranski University Hospital - Pleven, Bulgaria, where they were examined for *Enterobius vermicularis*. The diagnosis of enterobiasis was determined via light microscopy using material obtained from the perianal areas.

**Results:** Our study found a high prevalence of *Enterobius vermicularis* infection among hospitalized children (14.72%), which significantly exceeded the rates of infection in the Pleven region. Children over 7 years of age were more affected, and boys were more likely to be infected than girls ( $p < 0.0005$ ).

**Conclusion:** Our study on the distribution of enterobiasis in hospitalized children emphasizes the necessity of mandatory testing for such children. The risk of infecting the hospital staff and contacting children requires using hygiene measures to protect the hospital environment.

**Keywords:** *Enterobius*, Enterobiasis, inpatients,

### INTRODUCTION

Enterobiasis is a cosmopolitan parasitosis that is a major medical and social problem worldwide. Every year, over a billion people get infected with the causative agent of the disease – the helminth *Enterobius vermicularis* [1]. The disease can affect all ages but is most common in children and people from lower socio-economic strata [2]. In Bulgaria, the incidence of enterobiasis is highest among preschool children (those attending kindergartens, nurseries, social homes, etc.) [3]. Patients in children's hospitals vary in conditions, age, background, and hygiene habits. Hospital settings are ideal for transmitting enterobiasis due to direct spread between contacts, high susceptibility of children to the disease, high survival rate of the worm's eggs in the external environment, and the immaturity of the immune response in children [4, 5].

Our study aimed to assess the prevalence of *E. vermicularis* infections among hospitalized pediatric patients and to analyze the potential epidemiological risks during their stay in the pediatric ward.

### MATERIALS AND METHODS

For 2 months, we tested 265 children (139 boys and 126 girls) hospitalized in the Pediatrics clinic of University Hospital – Pleven for enterobiasis via the perianal swab method. The age of the children tested ranged from 1 to 17 years. They were randomly selected among the hospitalized patients.

The samples were collected early in the morning after waking up and before morning defecation and cleaning of the perianal area. We examined the perianal samples on a native smear with 10% NaON via optical microscopy (100x magnification).

The data was processed with IÂ SPSS Statistics 19.0 and MS Excel v. 2010. Structural (extensive) indicators or relative shares were determined and analyzed with Student's t-test and  $\chi^2$ -test. A  $p < 0.05$  was accepted as statistically significant.

## RESULTS

The mean age of the tested patients was 6.31±4.77. Of the 265 tested children, 39 (14.72%) had positive perianal swab tests for *E. vermicularis* eggs. Of them, 139 were male (52.45%) with a mean age of 6.27±4.62, and 126 (47.55%) were female with a mean age of 6.36±4.96 (p>0.05); 163 (61.51%) of the tested children were from urban areas, and 102 (38.49 %) were from rural areas (p<0.0005).

The frequency of patients positive for *E. vermicularis* based on gender and place of residence is shown in Table 1.

**Table 1.** Distribution of tested and positive children for *Enterobius vermicularis* based on gender and place of residence.

Hospitalized children	Number of tested patients	Infected with <i>E. vermicularis</i>		
		n	%	p
Female	126	9	7.14	< 0.0005
Male	139	30	21.58	
Urban	163	15	9.2	< 0.0005
Rural	102	24	23.53	
Total	265	39	14.72	

Table 2 shows the rate of Enterobius infection among patients based on the diagnosis upon admittance to in the paediatric clinic.

**Table 2.** Distribution of tested and positive children for *Enterobius vermicularis* based on reason for hospitalization

Diagnosis at admittance	Number of tested patients	Number of positive patients	%
Pyelonephritis	9	3	33.33
Gastro-intestinal tract diseases	18	5	27.78
Allergies	13	3	23.08
Diabetes mellitus	5	1	20
Acute bronchiolitis	59	11	18.64
Bronchopneumonia	89	13	14.61
Hemorrhagic diathesis or anaemia	12	1	8.33
Water-electrolyte imbalance	19	-	0
Bronchial asthma	15	-	0
Neurological symptoms	9	-	0
Inflammatory arthritis	6	-	0
Other	11	2	18.18

We also divided the patients into three age groups: early childhood group (ages 1 to 3) – 88 patients, preschool age group (ages 4 to 7) – 90 patients, and school age (7 and above) – 87 patients. The data is shown in Table 3.

**Table 3.** Distribution of tested and positive children for *Enterobius vermicularis* based on gender and age.

Gender	ages 1-3			ages 4-7			ages 7+			TOTAL			p
	Tes- ted	Positive		Tes- ted	Positive		Tes- ted	Positive		Tes- ted	Positive		
		n	%		n	%		n	%		n	%	
Female	42	2	4.76	40	2	5	44	5	11.36	126	9	7.14	>0.05
Male	46	6	13.04*	50	11	22	43	13	30.23*	139	30	21.58	<0.025*
p			>0.05			<0.01			<0.025			<0.0005	
Total	88	8	9.09	90	13	14.44	87	18	20.69	265	39	14.72	

\*Shows a statistically significant rate of infection in boys over 7 years of age compared to boys aged 1-3 years.

## DISCUSSION

In Bulgaria, in the last couple of years, there has been an increase in the frequency of reported enterobiasis cases [6]. *E. vermicularis* infections most often present with perianal pruritus, abdominal pain, lack of appetite, and neurasthenic symptoms such as irritability and grinding of teeth [7]. The clinical presentation of enterobiasis is manifested by a variety of symptoms and their intensity depend on many factors: the number of helminths in the host's body, the number of separate instances of invasion, the duration of the infection, additional medical

conditions, the immunity of the host, and others. However, enterobiasis is often asymptomatic [8]. In this case, the host does not seek medical attention and, as such, acts as a hidden source of infection.

Under routine conditions in Bulgaria, enterobiasis testing is done based on prophylactic, clinical, or epidemiological indications. According to Bulgarian health legislation, children aged between 2 and 7 years undergo mandatory yearly parasitological tests as prevention [9].

In hospital patients, clinical indications are the only ones considered for parasitological testing, which

depends on the physician's diagnostic thinking and the requirements of the clinical algorithm.

In our study, the extent of enterobiasis among hospitalized pediatric patients (14.72 %) was statistically significantly greater than the extent of enterobiasis for the same year in the Pleven region (0.27 %), in establishments for children (nurseries, kindergartens, etc.) in the same region (0.91%) ( $p < 0.0005$ ). Similarly, a high incidence of enterobiasis among pediatric patients has been described in Denmark (22%) by Lacroix and Sørensen [10].

In our study, there was also a noticeable trend of increase in the frequency of enterobiasis with age among our three age groups, despite the roughly equal number of patients in each group. The extent of enterobiasis among children from 1-3 years of age was 9.09%; in children from 4-7 years of age – 14.44%; and in children above seven years (early school age) – 20.69%. Similar data for the age distribution of enterobiasis were found by Stoyanova et al. in North-Eastern Bulgaria – 9.57% of the children between the ages of 7-17 years were infected with *Enterobius vermicularis* [8]. A study on enterobiasis among 395 Norwegian children found a frequency of 18%, and the frequency in the age group between 6 and 11 years was 34% [11].

A higher infection rate among preschool and early school-age children creates a potential epidemiological risk not just in pediatric wards and hospitals but also after discharge in kindergartens and schools. In a hospital setting, these children, due to their increased activity, close contact with each other, and relative lack of proper hygiene habits, can easily contaminate the environment with the eggs of the parasite. Usually, 2-4 children share a room, and it is not unusual for a child's parent to spend the night in the same room. The direct person-to-person transmission route creates epidemiological opportunities to infect all potential contacts. Working in areas with an outbreak of enterobiasis also creates a risk of infection for medical personnel (nurses, doctors, orderlies, etc.)

In our study, analysis of the rate of infection based on sex showed that boys were statistically more likely to be infected with *E. vermicularis* (21.58%) compared to girls (7.14%) ( $p < 0.0005$ ). In the early childhood group, 13.04% of males were infected, while in the preschool and early school age, the percentages were 22.00% and

30.23%, respectively. The males over 7 were significantly more likely to be infected than the other two age groups. ( $p < 0.025$ ). We found no statistically significant difference in enterobiasis rates across different age groups among female patients ( $p > 0.05$ ). A study among 5-7-year-old children in Sri Lanka found that boys were statistically more likely to be infected [12]. The higher frequency of enterobiasis in male children could be explained by behavioural differences between the sexes, such as differences in play or hygiene.

In our study, children who lived in rural areas were more likely to be infected than urban children - 23.53% and 9.20%, respectively ( $p < 0.0005$ ). However, the total number of patients based on place of residence is too small to make any definite conclusions.

Analyzing the distribution of enterobiasis among hospitalized pediatric patients raises some questions from an epidemiological and organizational viewpoint. Based on clinical algorithms, children admitted to pediatric clinics do not have to be examined for parasites, which allows for the missing potential infection sources for enterobiasis and other contact parasitoses. Notably, in our study, the infection rate in most groups of children was high regardless of the reason for hospitalization. This rate is worrying as it shows a localized outbreak of enterobiasis without evidence for its search. Age differences in hygiene habits and close contact between the patients are prerequisites for the easy transmission of the infection in hospital settings, and create the possibility of infecting both the hospitalized children and the medical staff.

The lack of mandatory prophylactic testing in this age group can explain the high rate of infection among hospitalized children at an early school age. This rate creates an epidemiological risk since this contingent is only diagnosed sporadically based on clinical indications.

## CONCLUSION

Our study on the distribution of enterobiasis in hospitalized children puts forward the necessity of mandatory testing for contact parasitoses of all children admitted to the hospital. Given the risk of infecting children and hospital staff, specific hygiene measures are necessary to protect the hospital environment and reduce the likelihood of transmission.

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