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Prevalence of intestinal parasites in preschool children from a kindergarten in the West Pomeranian voivodeship in Poland

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ABSTRACT

Introduction: The aim of the present study was to evaluate the prevalence of intestinal parasites in preschool children in Złocieniec, a town in north-western Poland. Therefore, it was decided to assess the extent of intestinal parasite infection, the prevalence of individual parasite species, and the usefulness of clinical symptoms reported by parents/guardians of children for parasitological screening.

Materials and methods: The study was conducted in 88 children aged 3–6 years. Parasitological diagnosis was performed by standard coproscopic method. For intestinal parasites, direct smears of feces in saline (0.9% NaCl) and stained with Lugol's fluid were performed. Pinworms were examined by the cellophane sticking method (according to Graham).

Results: The prevalence of intestinal parasitic infection in children was 12.5%. In the study group of preschool children, 2 species of intestinal parasites were identified: *Blastocystis hominis* (3 cases) and *Enterobius vermicularis* (8 cases). The most frequently diagnosed species of intestinal parasites was human pinworm, with a prevalence of 9.09%, while the prevalence of *B. hominis* infection was 3.41%. There was no co-occurrence of these parasite species in any child. The highest incidence of intestinal parasite infestation was detected in 6-year-old children, whose infection rate was 45.45%, while no intestinal parasite species was detected in 4-year-old children. Among the preschool children infected with intestinal parasites, 81.82% lived in urban areas and 18.18% lived in the countryside, while all (100%) children infected with human pinworm came from urban areas. Clinical symptoms characteristic of *E. vermicularis* infection (1–9) were reported in 43 (48.86%) of the children examined, regardless of the test result. The occurrence of symptoms characteristic of enterobiasis (1–9) was reported in only 50% of the children infected with *E. vermicularis*, and only 1 child had 9 symptoms typical of the presence of *E. vermicularis*. There were no cases of reinfection with pinworms in 7 children (7.95%) with previously diagnosed pinworms.

Conclusions: The prevalence of intestinal parasites in preschool children in Złocieniec is lower than the prevalence in West Pomeranian voivodeship, but similar to that found in other regions of Poland. Therefore, the potential risk of infection among the inhabitants of Złocieniec is low. The prevalence of *E. vermicularis* in children in Złocieniec is similar to its prevalence in Poland and Europe. It was found that clinical signs reported by parents/guardians of children may not always serve as a guideline for parasitologic examination.

Keywords: parasitosis; children; digestive tract; intestinal parasites; Poland.

INTRODUCTION

Parasites are found throughout the world and their presence has a significant impact on quality of life.

The prevalence of parasitosis is determined by a number of factors. One of the reasons that increase the incidence of intestinal parasitosis is geographical location and climatic conditions. Parasites need the right conditions (humidity, temperature) to continue their development cycle, as well as the presence of hosts, e.g. for the cysts of the maggot worm (*Entamoeba histolytica*), the optimal living conditions are in tropical and subtropical climates [1, 2, 3].

The prevalence of Shigella has been demonstrated in the Indian peninsula, South America, Bangladesh, South Africa, Ethiopia and Italy [4, 5]. In Poland, *E. histolytica* infections are very rare (0.01–0.1%) and mainly affect people who travel to tropical and subtropical countries [6].

Paradoxically, human activities can sometimes contribute to the spread of parasites: domestic and animal husbandry, tourism, and human migration, as well as various professional and hobby activities (fishing, hunting, gardening) [2, 7, 8, 9, 10, 11]. Pollution of the environment (soil, water) by animal and human feces with parasite dispersal stages should also be considered, e.g. agrotechnical treatments (irrigation of pastures and croplands, fertilization) used by farmers in developing countries [12, 13, 14]. In addition, some wastewater treatment systems are unable to completely eliminate dispersal forms of parasites [15]. Despite the fact that in Poland there is a control of wastewater management (prohibition of the use of sludge containing eggs of the genera *Ascaris*, *Trichuris*, and *Toxocara*), cases of sludge contamination are still observed [16].

According to the research on intestinal parasites in sewage sludge carried out in Katowice in 2003–2009, there was a probability of an epidemiological threat due to the presence of intestinal parasites in soil treated with sewage sludge. At that time,

eggs of *Ascaris* spp. and *Trichuris* spp. were detected in 6.56% of the samples [17, 18]. The presence of invasive forms of parasites in soil also poses a potential threat, especially to children. In a study conducted in 2017, geohelminth eggs were found in 41.4% of soil and sand samples from playgrounds in Szczecin. At that time, 4 species of parasites were diagnosed: *Toxocara* spp., *Toxascaris leonina*, *Dipylidium caninum*, and *Trichuris* spp. [19].

Factors that increase the transmission of intestinal parasites include changes in a person's eating habits and culinary preferences, consumption of food of unknown origin or unwashed food, and improper heat treatment. In particular, the consumption of raw meat or fish is a major cause of intestinal parasitosis [20, 21]. Infection with *Anisakis simplex* species is increasingly observed in people who consume raw fish in the form of sushi. Most cases have been reported in Asian countries where fish is an important staple food [21, 22, 23, 24].

Other factors that influence the incidence of intestinal parasites include socioeconomic conditions, adherence to personal hygiene, and a person's social status. Knowledge of parasitic infections and the risks they pose, maintenance of good hygiene habits, and improved sanitary standards contribute to reducing the prevalence of parasitic diseases [8, 25, 26, 27].

There is a noticeable difference between the incidence of infections in developed and developing countries, especially in African, South Asian, and Latin American countries, where human living conditions are difficult, e.g. lack of sewage networks, difficult access to drinking water or medicines [27, 28, 29, 30, 31]. The problem of intestinal parasitic infections (most commonly pinworms, roundworms, and giardiasis) particularly affects children [32, 33]. In both developed and developing countries, the increased likelihood of intestinal parasite transmission in young children may be facilitated by spending a lot of time in crowded spaces (nurseries, kindergartens, and schools), use of recreational areas (playgrounds, sandboxes), as well as not fully developed hygiene habits and geophagy [34, 35, 36, 37].

In addition, in developing countries, the risk of parasitosis is increased by poverty, malnutrition, illiteracy, high population density, and low socioeconomic status [38, 39, 40, 41, 42].

Intestinal parasites are most commonly transmitted by the oral route, e.g. ingestion of *Ascaris lumbricoides* eggs, *Cryptosporidium* spp. oocysts. The less common inhalation route is also possible. Invasion of intestinal parasites can occur through sexual contact (*Giardia lamblia* infections) and skin penetration (*Ancylostoma duodenale* – duodenal hookworm, *Strongyloides stercoralis* – intestinal eelworm) [43, 44].

Sources of intestinal parasite infection include water, soil, food, and contact with animals contaminated with schistosomiasis. Contamination of the environment with worm eggs, cysts, and protozoan oocysts is a major societal problem, especially since parasite transmission can occur at any stage of food production. The most common parasites found in contaminated food are *Giardia* spp., *A. lubricoides*, *Trichuris trichura*, and *Cryptosporidium* spp. Also, humans (sick or asymptomatic carriers) can be a source of parasitic infestation for other humans as well as for themselves (*Enterobius vermicularis* autoinvasion) [44, 45].

Therefore, in order to increase the elimination of intestinal parasitic infections in Poland, a registry of cases of selected gastrointestinal parasitic diseases is maintained. Reports of infectious diseases, infections, and poisonings in Poland are kept by the National Institute of Hygiene of the National Institute of Public Health (NIZP-PZH). Although the list of reported intestinal parasites has decreased since 2009, it still includes giardiasis, echinococcosis, and anthrax [46, 47, 48, 49, 50, 51, 52].

Preschool children may be particularly vulnerable to intestinal parasitic infections due to their high population density, use of recreational facilities, and immature hygiene habits. Because of the potential risk of disease and the possibility of asymptomatic carriage of gastrointestinal parasitic diseases in this age group, it is advisable to implement preventive measures to assess the incidence of parasitic infections [6, 32]. Therefore, the aim of the present study was to assess the prevalence of intestinal parasites in children aged 3–6 years attending a kindergarten in the West Pomeranian voivodeship.

MATERIALS AND METHODS

Parasitological studies were performed on children from a kindergarten in Złocieniec. The research project was approved by the Bioethics Committee of the Pomeranian Medical University in Szczecin (resolution No. KB-0012/37/16). The study material consisted of stool samples and perianal swabs from 88 preschool children – 34 girls (38.64%) and 54 boys (61.36%). The study included children aged 3–6 years with a mean age of 5.17 ±1.01 years. The largest age groups were 5 years (35.23%) and 6 years (47.73%), while the smallest group was 4 years.

Parasitological diagnosis was made by a standard coproscopic method. Direct smears of feces in saline (0.9% NaCl) and stained with Lugol's fluid were performed. On the other hand, tests for pinworms were performed using the cellophane sticking method (according to Graham). The prepared slides were evaluated under a light microscope (100x and 400x). Photographic documentation was performed using a Canon digital camera (AxioVision computer program) connected to a Ziess Axiolab light microscope. To assess the prevalence of intestinal parasites, the prevalence (extent of infection), expressed as the ratio of the number of infected persons to the number of examined persons, expressed as a percentage, was determined.

RESULTS

Out of 88 children aged 3–6 years attending a kindergarten in Złocieniec, the presence of intestinal parasites was detected in 11 children, and the degree of infection was 12.5% (Tab. 1). Of the children infected with intestinal parasites, 81.82% lived in urban areas and 18.18% in rural areas.

Two species of intestinal parasites were identified in the samples included in the analysis: *Blastocystis hominis* and human pinworm (*E. vermicularis*). No co-occurrence of the 2 species was found in any of the children. Stool parasitologic examinations

revealed the presence of *B. hominis* in 3 children (2 boys and 1 girl), and the prevalence of infection with this parasite was 3.41%. The intensity of the *B. hominis* infection was low in the children examined (Fig. 1 and 2).

TABLE 1. Extent of intestinal parasite infection in preschool children in Złocieniec

Parasite species	Incidence of infection	
	n	%
Blastocystis hominis	3/88	3.41
Enterobius vermicularis	8/88	9.09
Total	11	12.50

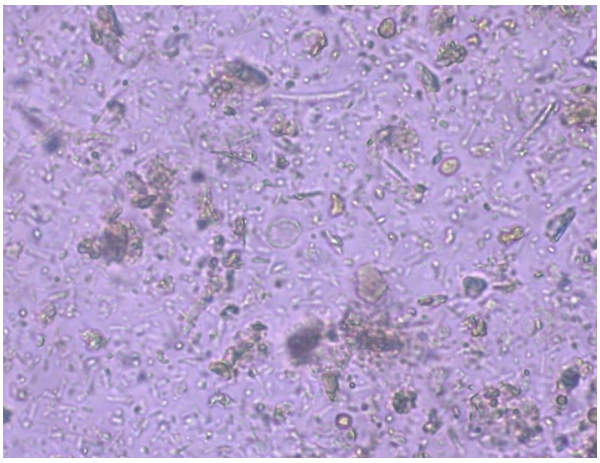

FIGURE 1. Hydatid form of *Blastocystis hominis* in the feces of a 6-year-old child (magnification 40x)

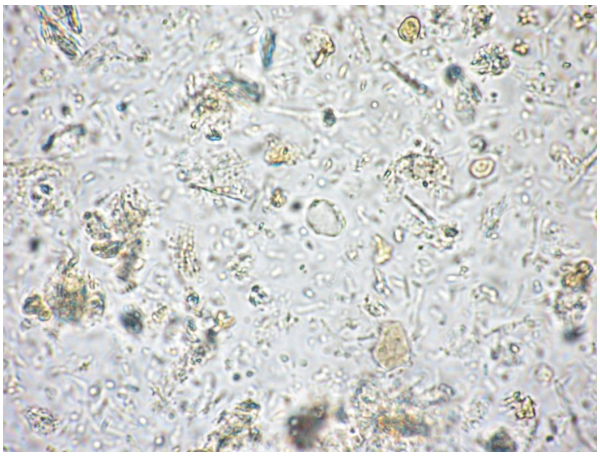

FIGURE 2. Hydatid form of *Blastocystis hominis* in the feces of a 5-year-old child (magnification 100x)

The presence of *E. vermicularis* in rectal swabs was detected in 8 children, including 2 girls and 6 boys. The prevalence of human pinworm infection was 9.09%, and the intensity of infection varied (Fig. 3 and 4).

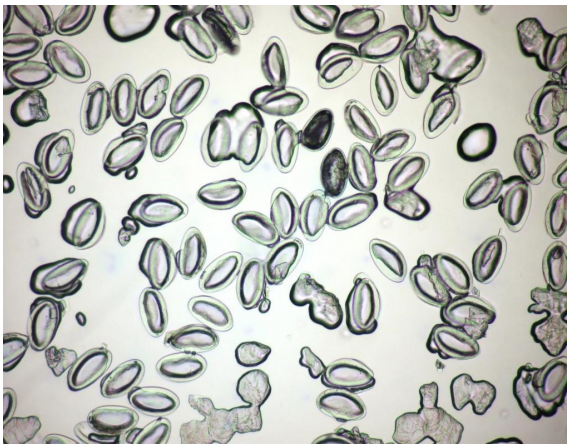

FIGURE 3. *Enterobius vermicularis* eggs in a preparation made by the cellophane sticking method in a 6-year-old child (magnification 10x)

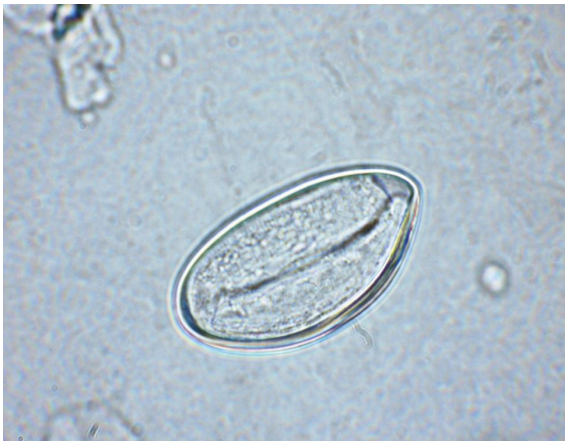

FIGURE 4. *Enterobius vermicularis* egg in a preparation made by the cellophane sticking method in a 3-year-old child (magnification 100x)

Based on the data obtained from the questionnaire, the place of residence of all children infected with pinworms was the city.

The number of *B. hominis* and *E. vermicularis* infections varied in each age group. Most cases of pinworms were found in 6- and 5-year-old children (4 and 3 cases, respectively), while no cases of pinworms were found in the 4-year-old group. The presence of *B. hominis* was found in 1 case each in 3-, 5- and 6-year-old children (Fig. 5).

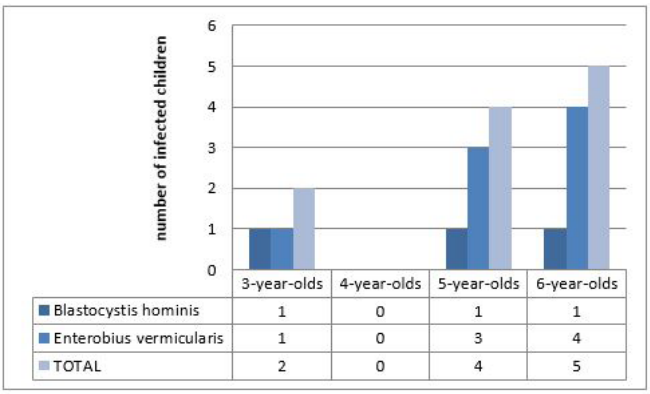

FIGURE 5. Number of *Blastocystis hominis* and *Enterobius vermicularis* infections in different age groups of children from a kindergarten in Złocieniec

In 2 children diagnosed with *B. hominis*, parents reported the following symptoms: sleep disturbances, loss of appetite, abdominal pain, and restless sleep/insomnia. In addition, microscopic examination of feces revealed undigested food debris in some samples. Starch grains and fat globules were present in 23 cases (26.14%) of all stool samples examined, while these structures were not detected in children infected with both *B. hominis* and *E. vermicularis*.

The results of the parental questionnaire showed that their reported clinical signs characteristic of the presence of *E. vermicularis*, based on the presence of at least 1 of 9 possible symptoms (regardless of the test result), were recorded in 43 (48.86%) of the children examined (Tab. 2). Parents/guardians of preschool children reported the presence of 1–3 symptoms suggestive of enterobiasis in 28 cases in the survey. Respondents also reported the presence of 4–6 symptoms in 12 children, while parents of 3 preschool children reported the co-occurrence of 7–9 potential disease symptoms associated with *E. vermicularis* infection. The most commonly reported symptoms were loss of appetite (22 children), teeth grinding (17 children), restlessness and hyperactivity, and watery eyes (14 children). The least commonly reported symptoms were persistent weakness (in 5 children) and anal skin lesions (in 5 children).

TABLE 2. Occurrence of reported symptoms (at least 1 symptom) for the presence of *Enterobius vermicularis* (9 symptoms) in infected and uninfected children with pinworms, attending a kindergarten in Złocieniec

Number of symptoms	Children infected by *E. vermicularis*	Children uninfected by *E. vermicularis*	Total
	n	n	
1–3	0	28	28
4–6	3	9	12
7–9	1	2	3
Total	4	39	43

Half of the children infected with *E. vermicularis* (4) had symptoms of pinworms (1–9), including 3 children whose parents reported the presence of 4–6 symptoms characteristic of pinworm infection. In contrast, only 1 child with pinworm infection reported the presence of all symptoms characteristic of *E. vermicularis*. The most common parent-reported symptoms of pinworm infection in children were sleep disturbance, loss of appetite, anal itching, and watery eyes (Fig. 6).

According to the survey data obtained, of the 88 children examined, 7.95% (7/88) of the preschool children (2 girls and 5 boys) had been diagnosed with pinworms in the past. At the same time, none of these children were diagnosed with pinworms in the current study.

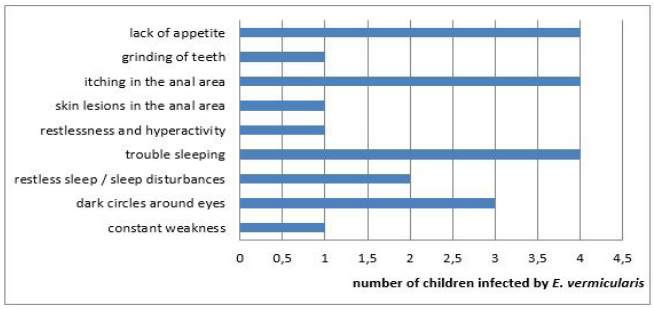

FIGURE 6. Number of declared clinical symptoms in children infected by *Enterobius vermicularis*

DISCUSSION

The incidence rates of some gastrointestinal parasitic diseases in Poland included in the NIZP-PZH epidemiological reports since 2009 are incomplete [8]. This is due to the abolition of surveillance of reported incidences of certain flatworm and helminth infections.

Following the introduction of the Law of December 5, 2008 on the Prevention and Control of Infections and Infectious Diseases in Humans, data on the number of infections caused by intestinal parasites such as human egg worm, human roundworm, intestinal eelworm and unarmed tapeworm were removed from the register. The information contained in the 2022 bulletin of the NIZP-PZH already refers only to the number of cases of giardiasis, cryptosporidiosis, echinococcosis, and anthrax [52, 53].

Despite the noticeable downward trend in the incidence of intestinal parasitic infections in Poland in 2003–2008 (based on reports from the NIZP-PZH), some parasitologists believe that it is reasonable to keep a register of parasitic diseases before the amendment of the law. Brochocka et al. emphasize that in order to monitor the epidemiological situation and assess the prevalence of parasites, the previous register should be restored [53].

Korzeniewski believes that the deletion of roundworm from the morbidity register is wrong, as the parasite could be a potential threat to public health, given the observed increase in the prevalence of the disease in Poland until 2008 [46, 47, 53, 54, 55, 56]. The risk of intestinal parasitic infections is particularly relevant for children, whose immune system is not fully developed compared to adults. In addition, the increase in potential infections in children is facilitated by spending a lot of time in crowded spaces, such as in educational institutions and recreational areas such as playgrounds and sandboxes [57].

The most common parasites in children worldwide include: *A. lumbricoides*, *G. lamblia*, *Cryptosporidium* spp., *T. trichura* (human trichuris), and *A. duodenale* (duodenal hookworm) [39, 58, 59].

Based on a nationwide survey conducted in Poland during the 2002/2003 school year, the prevalence of intestinal parasites in 7-year-old children varied by region (voivodeship).

The highest prevalence of intestinal parasites was observed in Warmian-Masurian (29.6%), Lublin (20.8%), and West Pomeranian (20.1%) voivodeships. On the other hand, the lowest number of identified cases of intestinal parasitic infections was observed in Lubuskie (8.9%) and Silesian (8.8%) voivodeships [60].

Intestinal parasitic infections in children in Poland are becoming increasingly rare, and the most frequently detected intestinal parasitoses are pinworm, giardiasis, trichomoniasis, and teniosis, whose etiological agent is the unarmed tapeworm (*Taenia saginata*) [61].

The decreasing trend in the prevalence of gastrointestinal parasitic infections is confirmed by the aggregate results of intestinal parasite examinations of 7-year-olds carried out by the Provincial Sanitary and Epidemiological Stations (WSSE) in Poland in 1992/1993, 1997/1998, 2002/2003. The prevalence of intestinal parasites in this period was 22.6%, 21.55%, and 14.55%, respectively [60].

The results of a study conducted at the WSSE Parasitology Laboratory in a group of children under 2 years of age in Krakow in 2002–2006 showed fluctuations in the extent of intestinal parasite infection from 2.4% in 2004 to 13.85% in 2002 [61].

In the present study, the prevalence of intestinal parasitic infection among preschool children in Złocieniec (12.5%) was reported to be similar to the national results of a study conducted in 2002/2003 among 7-year-old children [60]. In contrast, a study conducted in Warsaw in 2014 found intestinal parasitic infections in only 2.57% of children aged 3–6 years. In 47 positive cases out of 1823 samples tested, the following parasite species were found: *E. vermicularis* (2.1%), *Giardia intestinalis* (12.8%), *Blastocystis* spp. (14%), *Entamoeba coli* (23%), *Endolimax nana* (3%) [58].

Similarly, in the same age group, only *E. vermicularis* and *B. hominis* were detected in children attending a kindergarten in Złocieniec, where the prevalence of human pinworms was 4 times higher (9.09%) and the percentage of children infected with *B. hominis* was 3 times lower (3.41%) compared to the results obtained in Warsaw.

Many studies indicate that in Poland the prevalence of gastrointestinal parasites among children in rural areas is much higher than in urban areas [7, 60, 62, 63]. The results of a study conducted in the Warmian-Masurian voivodeship among preschool children and children's home graduates in 2003–2006 showed a higher percentage of children infected with intestinal parasites living in rural areas (17.3%) than in urban areas (10.3%) [7]. A similar relationship was found in a study of the prevalence of intestinal parasites in first-grade children in Poland in the 2002/2003 school year, in which the extent of invasion in first-grade children from rural areas was 19.0%, and in children from urban areas it was 10.45% [60]. On the other hand, the percentage of infected kindergarten children from Złocieniec was significantly higher in the urban areas (81.82%) than in the rural areas (18.18%).

The prevalence of intestinal parasites in African countries is also much higher in children living in rural areas than in developed countries. In rural Kenya, the prevalence of intestinal parasite infection ranges 12.6–54% [39, 59].

Among children attending a nursery school in Złocieniec, the most commonly diagnosed species of intestinal parasite was human pinworm, with a prevalence of 9.09%. The problem of pinworms in children is a common phenomenon both in Poland and worldwide. Literature data show different prevalence of *E. vermicularis* in children and adults.

A study carried out in the Warmian-Masurian voivodeship in 2003–2006 among preschool children and pupils of children's homes shows that the highest risk of human pinworms was among 7-year-old children (30.6%). The prevalence of *E. vermicularis* infection in kindergarten children in this voivodeship was 9.5%, which is similar to the prevalence of pinworms in children from a kindergarten in Złocieniec. On the other hand, the eggs of this parasite were detected in a much higher number of children from child care homes (36.7%) [7]. A much lower percentage of human pinworm infection (0.05%) was reported in a 2014 screening of children aged 3–6 years from 31 kindergartens in Warsaw [54]. In Silesia (according to the WSSE), human pinworm infection in 7-year-old children ranged 4.08–15.34% and in adults – 2.44–6.46% in 1999–2003 [64]. In Kraków, the average prevalence of *E. vermicularis* infection in children in 2000–2006 was 2.35%, which was 4 times lower than the prevalence of human pinworm in children from Złocieniec kindergarten. The study reported that the prevalence ranged from 0.46% in 2006 to 12.31% in 2002 [61]. A study conducted by the WSSE in Poland in the 2002/2003 school year showed that the most common parasite in 7-year-old children was *E. vermicularis*, whose presence was detected in 3827 pupils (12.15% of all diagnosed children) [60].

Similarly, among kindergarten children in Złocieniec, the highest prevalence of infection with 44 human pinworms occurred in 6-year-old children, while no infection with this parasite was observed in 4-year-old children. Numerous reports emphasize the dependence of human pinworm prevalence on place of residence and geographical region. The prevalence of pinworms in children in other European countries is similar to the conducted study; 13.45% in Italy, 18% in Norway, 5.2% in Greece, and 24.4% in Estonia [7]. Most cases of infection by this parasite are recorded in people living in rural areas and in countries with temperate climate [60, 65]. In African and Asian countries the prevalence of the human pinworm is very low. In Dagi (Ethiopia), *E. vermicularis* was detected in only 7% of schoolchildren in 2012, and in Nairobi (Kenya), only 2 cases of human pinworm infection (0.1%) were detected in children under 5 years of age in 2010–2011. On the other hand, no infection by this parasite was detected in Makurdi (Nigeria) in 2004 among children aged 5–18 years and in Osogbo (Nigeria) in 2008 among children attending a local primary school (6–12 years) [28, 30, 39, 59]. A screening study conducted in Kathmandu (Nepal) in 2014 also reported no human pinworm infections in children younger than 15 years [40].

In Poland, human pinworm infections are reported much more frequently in children living in rural areas [7,60]. However, in the present study, 100% of *E. vermicularis* infections

were identified in children (8) living in urban areas, which is undoubtedly related to the fact that the majority of children (80%) participating in the study lived in urban areas.

The second parasite species detected in children aged 3–6 years attending kindergartens in Złocieniec was *B. hominis*, with a prevalence of 3.41%. In contrast, in a study conducted in 2014 among children of the same age attending 31 kindergartens in Warsaw, the prevalence of *Blastocystis* spp. infection was 4 times lower – 0.77% [58]. Similar results to the present study were reported in Bulgaria in 2006, where the prevalence of blastocystosis was 3.4% and the study group included both children and adults. In contrast, the percentage of infected children under 5 years of age in Sangkhlaburi (Thailand) in the school year 2001/2002 was 5 times lower (0.64%) compared to the prevalence of *B. hominis* in children from a kindergarten in Złocieniec [25, 66]. Despite the fact that until recently the parasite was considered a commensal with no negative effects on humans, *B. hominis* infection is now increasingly associated with the presence of a number of gastrointestinal disorders. In addition, the diversity of clinical manifestations due to the presence of different morphological forms makes the diagnosis and control of *B. hominis* quite difficult [6, 67]. Literature data show that the prevalence of *B. hominis* varies from low in developed countries to significant in developing countries [67].

The presence of *B. hominis* was reported as early as the 1980s, e.g. in Canada between 1986–1987, the prevalence of this parasite was 3.2% among persons attending routine examinations [68]. In contrast, a much higher prevalence of infection with this protozoan (12.5%) was found in a study conducted in Ankara (Turkey) in 2003–2004 among patients of a parasitological laboratory [69]. A high percentage (40.7%) of *B. hominis*-infected children under 15 years of age was reported in Metro Manila (Philippines) in 2002, undoubtedly related to the fact that this protozoan is widespread in countries with tropical and subtropical climates [70]. Since this protozoan is one of the most frequently detected parasites in the United States, a report was prepared between 2000–2004 to determine the prevalence of *B. hominis* in this population. During this period, 16,374 stool samples from 8187 patients were tested using the same diagnostic methods, and a decreasing trend in the prevalence of *B. hominis* infection was observed from 23% in 2000 to 11% in 2004 [71].

Infections with other species of intestinal parasites, such as *G. lamblia* and *A. lumbricoides*, reported in the PZH epidemiologic reports, were not detected in the study. Literature data show that these parasites are not uncommon in children in Poland and worldwide. In Poland, the prevalence of *G. lamblia* is about 5%, while worldwide, in developing countries, it is quite high at 20–30% [43].

The situation is similar in temperate climates, where the prevalence of this parasite is 9%. In a study conducted among residents of Szczecin in 1991–1996, the prevalence of *G. lamblia* infection was 0.76%, in Krakow in 2000–2006 it was only 0.19%, while in 2014 among children attending 31 kindergartens in Warsaw it was 0.33% [58, 61, 72].

According to the latest data from NIZP-PZH, 1746 cases of lamblia infection were registered in Poland in 2015, and in 2016 there were almost 200 fewer cases – 1461. The lowest number of cases in 2016 was found in Łódzkie (8), Podkarpackie (12) and Wielkopolskie (24) voivodeships, and the highest in Silesian (378), Lubelskie (261) and Mazowieckie (218) voivodeships. On the other hand, there is a certain correlation between the number of lambliosis cases and the place of residence. In 2014–2015 in Poland, according to PZH, twice as many cases of the parasite were registered in people living in urban areas than in rural areas. Moreover, there is a decreasing trend of *G. lamblia* infections in Poland [46, 47, 48, 49, 50, 51].

The most common epidemiological problem in the world is roundworm. In 2002, an estimated 1.5 billion people worldwide were infected with *A. lumbricoides*. Sixty thousand patients, mostly children, die annually from severe roundworm disease. The greatest difficulties with this parasitic disease are in China, where the number of infected people reaches about 86 million, despite the introduction of a prevention program [73, 74].

In Poland, the prevalence of ascariasis in children aged 7 years in the 2002/2003 school year was 0.83% [58]. Recent data collected by the NIZP-PZH indicate that the number of human roundworm infections was 3091 in 2003, while almost twice as many (5817) were reported in 2008 [46, 56].

In the present study, the results of a questionnaire on the prevalence of potential clinical signs characteristic of intestinal parasites showed that the observations reported by the parents did not fully reflect the actual health status of their child. In fact, in 39 (48.75%) healthy children, parents reported the presence of at least 1 of 9 potential symptoms of enterobiasis, while only 50% of children infected with *E. vermicularis* reported symptoms of this disease. In addition, in 3 of the infected children, parents reported the presence of 4–6 symptoms characteristic of pinworms, and only 1 affected child reported the presence of all symptoms characteristic of *E. vermicularis*.

Due to the small number of children infected with intestinal parasites, it was not possible to statistically evaluate the results obtained. The conducted questionnaire survey indicates that the clinical symptoms reported by the parents/guardians of the children may not always be an indication to order a parasitological examination, since the presence of non-specific symptoms (e.g. lack of appetite, sleep disturbances, fatigue) is observed in a number of other diseases and disorders of the gastrointestinal tract, not only caused by intestinal parasites [44]. Parents' responses may be influenced by their education and knowledge about parasitic diseases.

The results of a questionnaire conducted at the Diagnostyka Kraków Laboratory in 2015 among parents of preschool children regarding the level of knowledge about parasitic diseases and the dangers of their presence in the environment indicate that the level of parents' knowledge is only satisfactory (on a rating scale: unsatisfactory, satisfactory, good, very good) [75]. On the other hand, a study conducted in Olsztyn in 2010, which examined the correlation of the occurrence of clinical symptoms characteristic of the presence of intestinal parasites, showed the advisability of performing parasitological examinations

in children in whom the co-occurrence of 6 different symptoms was reported [57].

From the literature, it can be concluded that the prevalence of parasitic diseases depends on a number of factors, including age, place of residence, and health status of the population [76]. Due to the higher risk of infection and the possibility of asymptomatic carriage of parasitic diseases of the gastrointestinal tract in preschool children than in adults, preventive measures consisting of observation of clinical symptoms and screening parasitological examinations are recommended. In Poland, parasitological examinations for enterobiasis and blastocystosis are performed in laboratories of sanitary-epidemiological stations, both in hospitals and private laboratories. Prevalence studies of intestinal parasites, including *B. hominis* and *E. vermicularis*, can contribute to the knowledge of the epidemiology of gastrointestinal parasitoses [6].

CONCLUSIONS

Preschool children may be particularly susceptible to intestinal parasitic infections due to their spending a lot of time in crowded spaces and recreational areas, and immature hygiene habits. Because of the higher risk of infection and the possibility of asymptomatic carriage of gastrointestinal parasitic diseases in preschool children than in adults, preventive measures consisting of observation of clinical symptoms and screening parasitological tests are advisable.

Based on the analysis, it was concluded that the extent of intestinal parasite infection in preschool children in Złocieniec is lower than the frequency of infection with these parasite species in the West Pomeranian voivodeship, but similar to the extent found in other regions of Poland. Therefore, the potential risk of intestinal parasite infection among the inhabitants of Złocieniec is low. In contrast, the prevalence of human pinworm in children in Złocieniec is similar to its prevalence in Poland and Europe. In addition, it was found that clinical symptoms reported by parents/guardians of children do not always serve as an indication for parasitological examination.

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