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**ORCID:** Faradjova N.A. <https://orcid.org/0000-0002-9227-5743>, Ragimova T.N. <https://orcid.org/0009-0003-0564-9095>, Sultanova S.S. <https://orcid.org/0000-0001-6497-8129>, Ismailova N.R. <https://orcid.org/0009-0005-0006-2580-0321>, Huseynova N.N. <https://orcid.org/0009-0005-7388-3419>.

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**Khalafli Kh.N., Tagiyeva F.Sh., Ragimov J.A., Ahmadzada L.A., Shikhaliyeva A.V., Huseynova Z.N.**  
Azerbaijan Medical University, Baku, Azerbaijan

## ANALYSIS OF CLINICAL MANIFESTATIONS IN PATIENTS WITH INTESTINAL NEMATODE INFECTIONS

e-mail: khalafli@mail.ru

This study evaluated the clinical and epidemiological features of intestinal nematode infections in Azerbaijan during 2022–2024. Preventive educational activities and parasitological examinations were conducted among 2,800 individuals, with dynamic laboratory assessment before and after deworming in 168 infected patients aged 1–65 years. A control group included 65 healthy individuals. Infection rates ranged from 7.7 % to 26.5 %, with ascariasis, enterobiasis, and hymenolepiasis being the most prevalent. The highest infestation rates were observed in children, particularly among girls aged 12–15 and boys aged 8–11. Clinical manifestations were dominated by gastrointestinal dysfunction, general weakness, allergic skin reactions, and anemia. The results demonstrate a high prevalence and significant clinical impact of intestinal helminth infections in Azerbaijan, especially in the pediatric population, underscoring the need for improved prevention, diagnostics, and sanitary-epidemiological control.

**Key words:** intestinal parasitic diseases, etiology, prevalence, human parasitosis, helminth infections.

**Халафлі Х.Н., Тагієва Ф.Ш., Рагімов Ж.А., Ахмедзаде Л.А., Шихалієва А.В., Гусейнова З.Н.**

## АНАЛІЗ КЛІНІЧНИХ ПРОЯВІВ У ХВОРИХ З КИШКОВИМИ НЕМАТОДОЗАМИ

У цьому дослідженні оцінювалися клінічні та епідеміологічні особливості кишкових нематодних інфекцій в Азербайджані у період з 2022 по 2024 рік. Профілактичні просвітницькі заходи та паразитологічні обстеження були проведені серед 2800 осіб, з динамічною лабораторною оцінкою до та після дегельмінтизації у 168 інфікованих пацієнтів віком від 1 до 65 років. Контрольна група включала 65 здорових осіб. Показники інфікування варіювалися від 7,7 % до 26,5 %, при цьому найпоширенішими були аскариоз, ентеробіоз та гіменолепіаз. Найвищі показники інфікування спостерігалися у дітей, особливо серед дівчаток віком 12–15 років та хлопчиків віком 8–11 років. Клінічні прояви характеризувалися шлунково-кишковою дисфункцією, загальною слабкістю, алергічними шкірними реакціями та анемією. Результати демонструють високу поширеність та значний клінічний вплив кишкових гельмінтозних інфекцій в Азербайджані, особливо у педіатричній популяції, що підкреслює необхідність покращення профілактики, діагностики та санітарно-епідеміологічного контролю.

**Ключові слова:** кишкові паразитарні захворювання, етіологія, поширеність, паразитарні інфекції людини, гельмінтози.

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The WHO expert assessment shows that diseases caused by helminths are the third most important infectious and parasitic diseases in the world, and diseases caused by plasmodials are the fourth (1.4 billion and 600 million cases, respectively) [8, 10]. Intestinal parasitosis ranks 4th among the causes of all diseases and traumas due to the damage they cause to the health of the population. Helminthosis is a widespread group of diseases and

to some extent determines the health status of the population. Entering the human body, helminths are capable of disrupting the microecological balance in the intestinal cavity and causing an imbalance of microflora [1, 9]. However, there is very little information on intestinal microbiocenosis during helminthosis in domestic and foreign literature [3, 5, 7]. In this aspect, the negative impact of some parasites on the immune status of infected persons

and the development of immunodepression are of special relevance, which promotes carcinogenesis and the emergence of associations with HIV-infection, tuberculosis and a number of other pathological conditions. In childhood, helminths are considered a factor that promotes the development of chronic food disorders, gastrointestinal tract dysfunction, intoxication, sensitization of the body, weakening of immunity. Until now, the clinical signs of helminthiasis have been studied in sufficient detail, but the global environmental changes that have occurred in the last decade, the widespread use of antibacterial, immunotropic and other drugs and a number of other factors have changed the clinical picture of helminthiasis, which requires further research. Entering the human body, helminths are able to disrupt the microecological balance in the intestinal cavity and create an imbalance of microflora [2, 4].

The methods of immunological diagnosis of helminths have not been practically developed in our republic, and these methods belong to the range of less suitable and expensive methods. In this regard, the search for methods of early verification of nematodes for the purpose of timely deworming does not lose its relevance. From this point of view, it is necessary to develop an action algorithm and to constantly improve the sanitary-epidemiological control system (taking into account the local natural climate, as well as social life conditions and the activity of the population). Until now, there are unsolved problems in the tactics of treating people infected with parasitosis. The above-mentioned problems not only confirm that the study of intestinal parasitosis is extremely relevant in modern conditions, but also require the search for new approaches to their diagnosis, treatment and prevention – they are appropriate and accessible in the daily work of all circles of practical health care [6, 11]. The serious ecological and parasitological situation of the 21st century requires a change in the strategy and tactics of the prevention of mass and socially important pathologies (first of all, due to the reduction of new infection risks). The analysis of measures for the prevention of parasitic diseases shows that the level of sanitary-educational work among both children and adults is qualitatively low. All of these determine the relevance of the current research work.

**The purpose** of the study was to assess the clinical features of intestinal nematodes in the Republic of Azerbaijan.

**Materials and methods.** The work was carried out within the scientific program of the Department of Epidemiology and Biostatistics of Azerbaijan Medical University in 2022–2024. The research work was carried out using the prospective method at the base of the Department of epidemiology and biostatistics of Azerbaijan Medical University. Laboratory examinations were carried out in

dynamics before and after deworming in 168 people with helminthiasis. These 168 people formed the main group. The comparison (control) group consisted of 65 uninfected healthy individuals (36 women and 29 men). There were 112 women and 56 men among the patients in the main group involved in the examination.

**Inclusion criteria** for the study: individuals with a diagnosis of intestinal parasites; the possibility of conducting dynamic observation on infected persons, the presence of written consent regarding the participation of parents of infected persons and children in the research.

**Exclusion criteria** from the study: the age of infected persons is up to 1-year, acute infectious diseases, dementia, patients with mental disorders, and patients with chronic diseases of internal organs, nervous system, and oncological diseases were not included during the observation period; parents of infected persons and children refused to participate in the study.

Diagnosis of helminthiasis was carried out as follows: 1) detection of helminth eggs in stool smears; 2) detection of helminth eggs in itching taken from perianal folds; 3) detection of helminth eggs in faeces, vomit masses. When examining feces, the smear method was used, and Graham's method was used to diagnose enterobiosis.

Parasitological examination was carried out using standard microscopic methods. Microscopic analysis was conducted using binocular light microscopes (Olympus CX23, Olympus Corporation, Japan). Standard laboratory consumables, including glass slides, cover slips, and adhesive tapes for perianal sampling, were used.

Statistical processing of the obtained data was carried out using Statistica 6.0, Microsoft Excel 7.0 software package according to the generally accepted methodology.

All procedures were carried out in compliance with the principles of the Declaration of Helsinki (2013 revision) and relevant international guidelines for epidemiological research. The study design ensured confidentiality, anonymity, and protection of personal data of all participants. The study was conducted in accordance with generally accepted ethical standards for biomedical research involving human participants. Given the observational and non-interventional nature of the study, which included routine parasitological diagnostics and standard deworming procedures, no additional invasive interventions or experimental treatments were applied.

Participation in the study was voluntary. Written informed consent was obtained from all adult participants prior to inclusion. In the case of pediatric participants, written informed consent was obtained from parents or legal guardians. Additionally, age-appropriate verbal assent was obtained from children whenever possible.

The study did not involve any procedures that could pose additional risk beyond standard clinical practice. All diagnostic and therapeutic measures were performed within the framework of routine medical care. Formal ethical approval was not required as the study was based on standard clinical and laboratory procedures performed as part of routine diagnostic and preventive activities, without any experimental intervention. However, the study protocol adhered to institutional regulations and ethical norms governing clinical research.

#### Results of the study and their discussion.

We have analyzed the morbidity of 168 infected individuals in order to determine the main characteristics of helminthiasis and early detection of the disease. Laboratory examinations were carried out in dynamics before and after deworming in 168 people with helminthiasis.

These 168 people formed the main group. The comparison (control) group consisted of 65 uninfected healthy individuals (36 women (55.4±6.2 %) and 29 men (44.6±6.2 %)). There were 112 women (66.7±3.6 %) and 56 men (33.3±3.6 %) among the patients in the main group involved in the examination. During the distribution of children by age, it was found that 21 persons (18.4±6.6 %) were from 1 to 7 years old; 38 persons (33.4±4.4 %) were 8–11 years old and 55 (48.2±4.7 %) were 12–15 years old. At the same time, the analysis of the obtained data showed that during the distribution of adults by age, 22 people (40.8±6.7 %) were from 16 to 30 years old; 18 persons (33.3±6.4 %) were aged 31–50 and 14 persons (25.9±5.9 %) were over 50 years old. The distribution of patients of the main group by gender and age is presented in Table 1.

Table 1

**Distribution of the main group of patients with helminth infections by gender and age groups, years**

Age groups, year	Total (n=168)		Men (n=56)		Women (n=112)	
	Abs.	%	Abs.	%	Abs.	%
Children:						
1–7 years old	21	12.5±2.6	9	16.1±4.9	12	10.7±2.9
8–11 years old	38	22.6±3.2	16	28.6±6.1	22	19.6±3.8
12–15 years old	55	32.7±3.6	14	25.0±5.7	41	36.6±4.6
Total	114	67.8±3.6	39	69.6±6.1	75	66.9±4.4
Adults:						
16–30 years old	22	13.1±2.6	9	16.1±4.9	13	11.6±3.1
31–50 years old	18	10.8±2.4	3	5.4±2.1	15	13.4±3.3
Age 51 and older	14	8.3±2.2	5	8.9±3.8	9	8.0±2.5
Total	54	32.2±3.6	17	30.4±6.2	37	33.1±4.5
Final	168	100	56	33.3±3.6	112	66.7±3.6

From the data presented in Table 1, it can be seen that 41 girls aged 12–15 years (36.6±4.6 %) and 16 boys aged 8–11 years (28.6±6.1 %;  $p<0.001$ ) was the highest number. The largest proportion of infected adults was men from 16 to 30 years old – 9 people (16.1±4.9 %) and women from 31 to 50 years old – 15 people (13.4±3.3 %;  $p<0.001$ ).

The distribution of individuals with helminthiasis by gender and age showed that the highest specific gravity was found in women (66.7±3.6 %), while in children – 66.9±4.4 %, in adults – 33.1±4.4 %, was 5 %. The specific gravity of men was relatively low – 33.3±3.6 %, respectively, in children – 69.6±6.1 % and in adults – 30.4±6.2 %

Among the examined persons, the etiological structure of helminthiasis was represented as follows: incidence rate of ascariasis in the general structure of helminthiasis – 41.7±2.9 % (70 cases), enterobiasis – 36.9±2.8 % (62 cases), trichocephalosis – 2.9 % (5 cases), 4.7 % (8 cases) with hymenolepidosis, 3.7 % (6 cases) with teniids, and 10.1 % (17 cases) with other helminthiasis (Fig. 1).

In addition to the above, the etiological structure of helminthiasis among the examined persons, divided by age and sex, is represented as follows. So, according to the general structure of helminthiasis among children, the level of morbidity with ascariasis is 45 cases (39.4±4.9 %), with

enterobiasis – 45 cases (39.4±4.9 %), with others (with trichocephalosis, hymenolepidosis, teniidoses, etc.) – 24 cases (21.2±3.8 %) were organized. The level of morbidity among adults in accordance with the general structure of ascariasis and helminthiasis – 25 cases (46.3±6.8 %), enterobiasis – 17 cases (31.5±6.3 %), with others (trichocephalosis, hymenolepidosis, taeniidoses, etc.) – 12 cases (22.2±5.6 %) were organized.

The received data show that according to gender, the incidence rate of ascariasis in children is 18 cases (25.7±5.2 %), enterobiasis – 9 cases (14.5±4.5 %), among boys, according to the general structure of helminthiasis. (with trichocephalosis, hymenolepidosis, teniidoses, etc.) – 7 cases (19.4±5.2 %) were organized. The obtained data show that according to gender, the incidence rate of ascariasis in children is 27 cases (38.6±4.7 %), enterobiasis – 36 cases (58.1±6.3 %), among girls, according to the general structure of helminthiasis. with others (trichocephalosis, hymenolepidosis, teniidoses, etc.) – 17 cases (47.2±5.2 %) were organized.

Helminthiasis was divided according to the degree of severity as follows: mild degree – in 85 patients (42.3±3.8 %;  $p<0.001$ ), moderate degree – in 71 patients (37.5±3.7 %), severe degree – in 12 patients (20.2±3.1 %;  $p<0.001$ ) (Fig. 2).

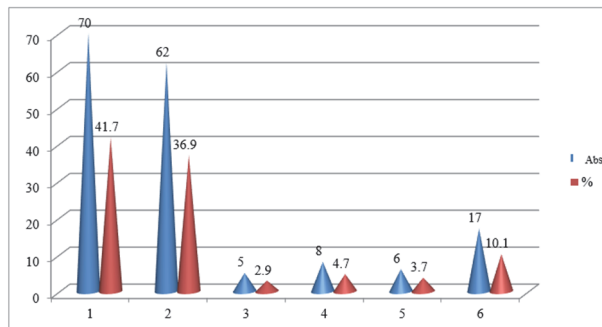


Fig. 1. Etiological structure of disease with helminthiasis among those examined (1 – ascariasis, 2 – enterobiosis, 3 – trichocephalosis, 4 – hymenolepidosis, 5 – teniidoses; 6 – others).

It should be noted that during the study of social factors in the observed patients, statistically significant differences in social status were found ( $p < 0.01$ ). The obtained data show that  $31.5 \pm 3.6\%$  of families of patients of the main group ( $t = 4.45$ ;  $p < 0.01$ ) live in unsatisfactory living conditions. At the same time,  $100.0\%$  of patients in the control group positively evaluated their housing and household conditions. Before forming groups, patients were screened for the presence or absence of helminthiasis.

During the analysis, it was found that the most common allergic diseases among those infected with intestinal infections are: allergic rhinitis ( $44.6 \pm 3.8\%$  of cases), neurodermatitis ( $25.0 \pm 3.3\%$  of cases), acute urticaria ( $21.4 \pm 3.2\%$  of cases). In the comparison group, respectively: allergic rhinitis –  $1.5\%$ , neurodermatitis –  $3.1 \pm 2.1\%$  ( $p > 0.05$ ), acute urticaria was not noted. Among other diseases, enterocolitis in  $22.6 \pm 3.2\%$  of cases ( $3.1 \pm 2.1\%$  in the comparison group), chronic adenotonsillitis in  $14.9 \pm 2.8\%$  of cases ( $4.6 \pm 2.0\%$  in the comparison group), diabetes was noted in  $10.7 \pm 2.4\%$  of cases ( $3.1 \pm 2.1\%$  in the comparison group).

The financial level of the family is considered one of the main factors of the spread of intestinal infections. Thus, in families with very low financial status, the weight of healthy individuals (control group) is small –  $7.7 \pm 3.4\%$ , while the specific weight of infected individuals in these families is very high (main group) –  $25.0 \pm 3.3\%$  ( $\chi^2 = 45.02$ ,  $p < 0.001$ ). A similar situation is noticeable in families with low financial status –  $18.5 \pm 7.3$  and  $56.5 \pm 3.8\%$ , respectively ( $\chi^2 = 47.33$ ,  $p < 0.001$ ). In families with average financial status, the indicators show the opposite –  $29.2 \pm 4.7\%$  and  $11.9 \pm 2.5\%$  ( $\chi^2 = 40.15$ ,  $p < 0.001$ ). In families with high financial status, the specific weight of individuals in the control group was  $44.6 \pm 6.2\%$ , while the specific weight of individuals in the main group decreased at the same rate –  $6.6 \pm 1.9\%$  ( $\chi^2 = 64.03$ ,  $p < 0.001$ ). In total, 48 of 65 healthy individuals ( $73.8 \pm 5.4\%$ ) were from families with medium and high financial status, 137 of 168 individuals infected with helminths ( $81.5 \pm 2.9\%$ ,  $\chi^2 = 1.23$ ,  $p > 0.05$ ) belong to families with very low and medium financial status. We

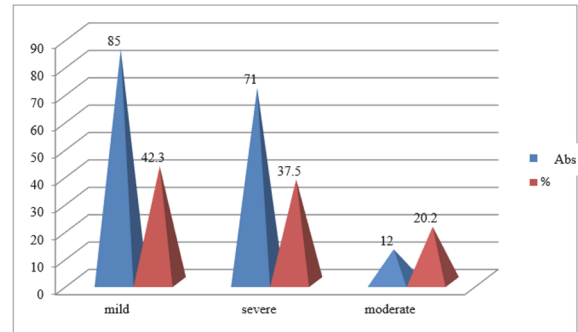


Fig. 2. Disease severity of examined patients with helminthiasis

explain the high percentage of infestation in families with a medium and low financial level by the impossibility of obtaining the necessary amount of anthelmintic drugs, poor living conditions, insufficient caloric nutrition, and detergents. Therefore, when providing medical assistance to the population, first of all, it is necessary to pay attention to families with low financial status. The obtained data show that the most infested families were families with 6 or more members –  $61.91 \pm 3.7\%$ . In families with 4–5 members, the rate of infestation was slightly lower and was  $27.98 \pm 3.5\%$ . In families with 1 to 3 members, helminth infection was  $10.11 \pm 2.4\%$  ( $p < 0.05$ ). This shows that in the group of infected individuals, on average, every third family is a microcenter of helminthiasis, and with the increase in the number of families, the probability of the spread of the infected worm increases rapidly. At the same time, it complicates the fight against helminthiasis and thus ensures the continuous flow of the infectious process for many years.

The analyzed material inevitably gives rise to the idea that the state of the population's immune system has a high influence on the occurrence of helminth infections. It is known that climatic factors also affect the immunological state of the child's body. Especially as a result of a cold, the immune system is severely damaged, it is no coincidence that many inflammatory-infectious diseases often occur in the cold season of the year. To a certain extent, what has been said also applies to helminthoses. Thus, both the specific weight of the total morbidity with helminthiasis and the morbidity with ascariasis and enterobiosis separately change at approximately the same level in winter – from  $15.7 \pm 4.4\%$  to  $22.6 \pm 5.0\%$  ( $\chi^2 = 1.89$ ,  $p > 0.05$ ). In spring, autumn and summer, the specific gravity of ascariasis honestly increases ( $\chi^2 = 5.32$ ,  $p < 0.02$ ) and is  $22.9 \pm 5.0\%$ ,  $26.3 \pm 5.2\%$  and it varies up to  $35.1 \pm 5.7\%$  ( $\chi^2 = 1.33$ ,  $p > 0.05$ ). Morbidity with enterobiosis is at the same level throughout the year in winter, spring and summer ( $\chi^2 = 6.42$ ,  $p < 0.01$ ) and  $22.6 \pm 5.0\%$ ,  $24.3 \pm 5.4\%$  and  $19.6 \pm 1.1\%$ , it varies up to ( $\chi^2 = 2.31$ ,  $p > 0.05$ ). In autumn, an increase of up to  $33.5 \pm 6.1\%$  is observed. If we take into account that school-aged children go to school, and the majority of preschool-

aged children go to special children's institutions, then the possibility of the child's body cooling down and thereby weakening its protective functions is quite real. Even in the winter months, illness with helminthosis, its widespread nosological forms – ascariasis and enterobiosis can be explained precisely by this. Thus, the socio-epidemiological analysis of helminth infections first of all shows that they are socially adapted and subject to epidemiological regularities. A number of socio-epidemiological factors – factors that both favorably affect and limit the spread of helminthiasis among children – have been discovered, which opens up wide prospects for the organization and implementation of the prevention of the above-mentioned mass diseases among the child population.

To determine the rate of carriage of tapeworm eggs under the nails of children of different ages, we examined samples taken from under the nails of 114 children and 54 adults. Analyzing the indicators of the data, it should be noted that 73 (43.45±3.8 %) out of 168 examined people had lice eggs in the samples under the nails.

During the analysis by age groups, we found that in children from 1 to 11 years of age, weevil eggs were found in 57.62±6.4 % of cases, in 12–15-year-old children, in 41.81±6.7 % of cases ( $p<0.05$ ) is defined in samples. The lowest rate (28.12±7.9 %) was noted among people aged 31 and 50 and over. Undoubtedly, timely parasitological examinations, differentiation of various forms of causative agents of helminthiasis and their effective, specific treatment are still considered an important measure of both maintaining the parasitological safety of children and reducing mass morbidity with helminthosis. The obtained data show that the aggravation of the epidemiological situation of intestinal nematodes is conditioned by current social factors, that is, these infestations have become socially dependent in urban conditions. Data collected on the basis of a questionnaire survey of children, their parents and staff of children's preschool institutions show that the spread of helminthiasis is influenced by the financial well-being of families, their housing and communal conditions, and the cultural and hygienic level.

The complex ecological situation of parasitic diseases has caused another problem – the problem of mixed-infestation in unexamined children and schoolchildren who have not been cured of single helminthosis or protozoa. At this time, the second and third parasites easily enter the child's weakened body and create a parasitic mixed-invasion. It should be noted that mixed invasion was found in 28 % of examined children. The detection of mixed infections among the examined children is alarming. At this time, 2 types of parasites were detected in 24.1±1.2 % of children, 3 types of parasites were found in 6.1±0.6 % of examined children, and 4 types of helminths were found in 2.0±0.1 %. Mixed infections were manifested in the following order:

pinworm+giardia, pinworm+ascarida,  
pinworm+ascarida+giardia, ascarida+dwarf  
tapeworm+pinworm and giardia.

The present study demonstrates a considerable prevalence of intestinal helminth infections in Azerbaijan during 2022–2024, with infection rates ranging from 7.7 % to 26.5 %. These findings are consistent with data from other countries. For instance, studies conducted in Nigeria and Ethiopia report comparable prevalence rates among school-aged populations, highlighting the global burden of these infections and their close association with socioeconomic conditions [1, 2].

The predominance of ascariasis, enterobiasis, and hymenolepiasis in our cohort aligns with previously published epidemiological data. Similar parasite spectra have been described in the other regions, where soil-transmitted helminths and parasites, such as *Enterobius vermicularis*, are widely prevalent among children due to behavioral and environmental factors [5, 10, 11].

Our findings indicate that children represent the most affected population group, with notable peaks in girls aged 12–15 years and boys aged 8–11 years. This age-specific distribution may be explained by differences in hygiene behavior, social interactions, and exposure risk. Studies by Aye-Kumi et al. (2016) and Assemie et al. (2021) noted similar age-related patterns, with school attendance and group activities making significant contributions to transmission dynamics. [2, 3].

Clinically, the infections in our study were predominantly associated with gastrointestinal disturbances, general weakness, allergic manifestations, and anemia. These observations are in line with existing evidence demonstrating that helminth infections exert both local (intestinal) and systemic effects. Chronic parasitic infestation is known to impair nutrient absorption, contribute to micronutrient deficiencies, and negatively affect growth and cognitive development in children [8, 11]. The observed allergic skin reactions may be associated with immunological reactions caused by parasitic antigens, which is also confirmed by modern studies of the immunopathogenesis of helminthiasis.

From a broader biological perspective, intestinal helminths may influence host physiology through interactions with the gut microbiota. Data from Mejia et al. (2020) and Reese & Dunn (2018) suggest that parasitic infections can alter microbial composition and metabolic pathways, potentially affecting vitamin synthesis and immune regulation [7, 9]. Although this aspect was not directly investigated in the present study, it may partly explain the variability of clinical manifestations observed among infected individuals.

The dynamic laboratory assessment conducted before and after deworming confirms the importance of timely diagnosis and treatment. Standard

parasitological methods, including stool microscopy and Graham's test, remain practical and effective tools for routine clinical use, especially in resource-limited settings. However, their sensitivity may be limited compared to modern molecular techniques, which should be considered in future studies [10].

The results of this study underscore the ongoing relevance of intestinal helminth infections in Azerbaijan and highlight the need for comprehensive control strategies. Overall, our findings contribute to the regional epidemiological understanding of

helminth infections and support the necessity of strengthening surveillance and prevention programs to reduce their burden.

**Limitations.** The study is limited by the use of conventional microscopic diagnostic methods, which may have lower sensitivity than molecular techniques, and by the relatively small sample size for dynamic follow-up. Additionally, the observational design and restricted geographic coverage may limit the generalizability of the findings.

## Conclusions

1. On the basis of the epidemiological analysis, it was determined that the specific weight of the level of infestation among the examined persons in the territory of Azerbaijan varied between 7.7 % and 26.5 % The etiological structure of helminthosis was represented as follows: in the general structure of helminthosis, the incidence rate of ascariasis – 41.7±2.9 %, enterobiosis – 36.9±2.8 %, trichocephalosis – 2.9 %, hymenolepidosis – 4.7 %, with taeniidoses – 3.7 %, with other helminthoses – 10.1 %. Among the examined persons, the number of infected children was highest in girls aged 12–15 years (36.6±4.6 %) and boys aged 8–11 years (28.6±6.1 %;  $p < 0.001$ ). The highest proportion of infected adults was among men aged 16 to 30 (16.1±4.9 %) and women aged 31–50 (13.4±3.3 %;  $p < 0.001$ ).

2. The analysis carried out during the years 2022–2024 gave reason to say that the level of infection of children (0–14 years old) during intestinal helminthiasis and primary infections reached 85 %. The high level of enterobiosis (71.2 %) is considered as an indicator of population, especially children's helminthosis.

3. Helminthoses were divided according to severity as follows: mild degree – 42.3±3.8 %, moderate degree – 37.5±3.7 %, severe degree – 20.2±3.1 %. The following symptoms and syndromes were noted in the patients we observed: the complex of symptoms of dysfunction of the Gastrointestinal tract (constipation, hard stools, loss of appetite, nausea, abdominal pain) – 83.3±3.4 %, weakness (80.0±5.9 %), dry cough (24.4±6.4 %), headache (15.5±5.5 %), skin rashes – 46.6±7.4 %, decrease in hemoglobin index – 31.0±6.8 %, broken nails – 26.7±6.6 %, subfebrile temperature (13.3±5.2 %), thinning hair and shedding – 8.89±4.1 %.

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**Conflict of interest.** The authors have no conflicts of interest to declare.

**ORCID:** Khalafli Kh.N. <https://orcid.org/0000-0002-6792-0165>, Taghiyeva F.Sh <https://orcid.org/0009-0001-1338-0183>, Rahimov J.A. <https://orcid.org/0009-0003-7930-3775>, Ahmadzada L.A. <https://orcid.org/0009-0005-5495-770X>, Shikhaliyeva A.V. <https://orcid.org/0009-0002-5916-1127>, Huseynova Z.N. <https://orcid.org/0009-0004-0127-0050>.

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