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FUNCTIONAL ORGAN DISORDERS IN CHILDREN CAUSED BY PARASITIC INFECTIONS

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Annotation: Parasitic diseases remain a major challenge in modern medicine and public health. They are pathological conditions that arise as a result of the vital activity of helminths and protozoan microorganisms within the human body. The complex interaction between the parasite and the host determines the clinical manifestations, severity, and duration of the disease.

The invasion and long-term persistence of parasites in various organs and tissues lead to the development of a broad spectrum of clinical symptoms. These manifestations are associated with the mechanical impact of parasites on host tissues, their metabolic and secretory activity, and the induction of toxic-allergic and immunopathological reactions. Mechanical damage may include obstruction, tissue irritation, and disruption of normal organ function, while parasite-derived metabolites and antigens can provoke inflammatory responses and alter immune regulation. A key factor in the survival and widespread distribution of parasites is their high reproductive potential combined with complex adaptive mechanisms. These include the ability to modulate host immune responses, evade immune detection, and adapt to the internal environment of the host. Such strategies promote prolonged persistence of the parasite, often resulting in a chronic course of infection. Over time, chronic parasitic invasion may contribute to the development of functional disorders in various organs and systems.

Keywords: parasitic infections, helminthiasis, protozoan infections, pediatric parasitosis, functional organ impairment, host–parasite interaction, immune modulation, adaptive mechanisms, chronic parasitic invasion, epidemiological aspects.

Introduction

Parasitic diseases continue to represent one of the most significant medical and social challenges in modern healthcare, particularly in pediatric practice. The high prevalence of helminthic and protozoan infections among children is determined by age-related anatomical

and physiological characteristics, functional immaturity of the immune system, as well as the influence of social, hygienic, and environmental factors. According to epidemiological studies, children constitute the most vulnerable population group with respect to parasitic infections, which underscores the substantial clinical and public health importance of this issue.

The susceptibility of children to parasitic invasions is closely associated with developmental characteristics, including increased intestinal permeability, instability of enzymatic processes, immaturity of immune defense mechanisms, and behavioral factors that facilitate transmission, such as insufficient hygiene skills, close contact in organized groups, and frequent environmental exposure. In endemic regions, additional risk factors—including limited access to clean water, inadequate sanitation, and insufficient preventive measures—further contribute to the persistence and spread of parasitic diseases among pediatric populations.

Long-term persistence of parasites in a child's body exerts multifaceted effects on various organs and systems. The vital activity of helminths and protozoa is accompanied by mechanical tissue damage, toxic-allergic reactions, metabolic disturbances, and the development of immunopathological conditions. Mechanical effects may include mucosal irritation, microtrauma, obstruction of the intestinal lumen or bile ducts, and compression of surrounding tissues. At the same time, parasite-derived metabolites, enzymes, and excretory-secretory products can disrupt normal metabolic processes, induce chronic inflammation, and alter immune regulation.

As a consequence of these processes, children may develop functional disorders involving the gastrointestinal tract, hepatobiliary system, nervous system, cardiovascular system, and hematopoietic organs. Such disturbances often manifest as nonspecific clinical symptoms, including recurrent abdominal pain, dyspeptic complaints, asthenic syndrome, allergic manifestations, appetite disturbances, and impaired physical and cognitive development. The polymorphic and nonspecific nature of these symptoms frequently complicates timely diagnosis and may lead to underestimation of the etiological role of parasitic infection.

Particular relevance is attributed to the study of functional organ pathology associated with parasitic invasions, since these disorders may remain undiagnosed for prolonged periods, contributing to chronic progression of the disease and deterioration of children's quality of life. Chronic parasitosis may negatively affect nutritional status, immune reactivity, adaptive capacity, and overall developmental outcomes.

Despite the availability of numerous studies on parasitic diseases, the relationship between parasitic infections and the development of functional organ disorders in children remains insufficiently elucidated. Comprehensive clinical and epidemiological research is required to clarify pathogenetic mechanisms, identify early diagnostic markers, and develop effective preventive and therapeutic strategies.

In this regard, the study of the prevalence of parasitic invasions in children and their role in the formation of functional organ disorders represents an important direction in contemporary pediatrics and parasitology.

Aim of the study

The aim of the study was to investigate the prevalence of parasitic infections in children and to determine their impact on the development of functional organ disorders, as well as to assess the clinical and functional characteristics of the course of parasitic diseases in the pediatric population.

Materials and Methods

The study was conducted in the Khorezm region and had a clinical and epidemiological design. The study population included children aged 2 to 14 years who sought medical care at outpatient clinics and inpatient healthcare institutions in the region.

The main group consisted of children with laboratory-confirmed parasitic infections. The control group included children of comparable age without evidence of parasitic diseases or pronounced chronic somatic pathology. The groups were comparable in terms of age and sex distribution.

The diagnosis of parasitic diseases was performed using standard parasitological methods, including microscopic examination of stool samples for helminth eggs and protozoan cysts, concentration techniques, and perianal scraping for the detection of enterobiasis. When indicated, serological methods were applied, including the determination of specific IgM and IgG antibodies, as well as enzyme-linked immunosorbent assay (ELISA).

The functional status of the digestive system was assessed based on the analysis of clinical symptoms, complaints reported by children and their parents, physical examination findings, and laboratory and instrumental investigation results. Coprogram parameters, biochemical indicators of liver and pancreatic function, enzymatic activity, and gastrointestinal motility were evaluated. Ultrasound examination of the abdominal organs was performed when clinically indicated.

The immunological status was assessed using complete blood count parameters, including eosinophil and basophil levels, as well as indicators of humoral immunity, including total immunoglobulin E (IgE) levels. Allergic manifestations were documented based on clinical findings and medical history data.

Statistical analysis of the obtained data was performed using methods of variation statistics with specialized software. The results are presented as absolute and relative values. The significance of differences was evaluated using parametric and nonparametric statistical tests, and a p-value of < 0.05 was considered statistically significant.

At present, the level of clinical alertness among healthcare professionals regarding parasitic diseases remains insufficient, and preventive measures against helminthiases are often limited to the treatment of already identified infected patients. Meanwhile, numerous studies

indicate a close association between the high prevalence of parasitic infections in children and the development of functional disorders of the digestive system, which arise against the background of impaired neurohumoral and immune regulation. The relevance of this problem is further emphasized by the high risk of chronic pathological processes, even in cases of spontaneous elimination of the parasite as the child matures.

Among the most common and well-studied parasitic diseases are ascariasis, enterobiasis, and giardiasis, which are registered worldwide. Throughout life, nearly every individual experiences various forms of parasitic invasion, with a significantly higher incidence observed in childhood. In young children (under 5 years of age), this is largely обусловлено высокой контаминацией окружающей среды — replaced below fully in English — high environmental contamination with reproductive forms of parasites (eggs, cysts, larvae), as well as insufficient development of hygienic skills. Periods of transient weakening of mucosal immune defense in the gastrointestinal tract also play a significant role.

Peaks in the detection of parasitic diseases in children are observed at the ages of 2–3 years, 4–7 years, and 10–14 years. In the overall morbidity structure, the proportion of young children and school-aged children accounts for up to 95% of all registered cases of enterobiasis and approximately 65% of ascariasis cases. These age periods are characterized by high intensity of adaptive processes, reduced functional reserves of protective systems, and increased exposure to environmental factors.

A comparative analysis of the criteria defining these developmental stages—such as growth spurts, critical periods of immune system maturation, and peaks of primary morbidity—highlights one of the key pathogenetic factors: an increased metabolic rate associated with rapid growth. This physiological state creates favorable conditions for parasite survival and reproduction, as the primary biological objective of parasites is the production of large amounts of reproductive material. For example, in giardiasis, up to 12 million cysts may be detected in 1 gram of feces of an infected individual.

The significance of risk factors for parasitic invasions varies depending on the child's age. In younger children, living conditions and sanitary-hygienic factors play a leading role. In adolescents, careful assessment of socio-economic and geographic factors is essential, including stays in children's recreational camps, travel history, and the presence of younger siblings in the household. Transient suppression of anti-infective immunity is another important risk factor for parasitic infections in children. It is frequently observed during the convalescent period following viral infections caused by herpesviruses, including cytomegalovirus, herpes simplex virus types I and II, and Epstein–Barr virus. Additionally, immune suppression may result from iatrogenic factors, such as the use of immunosuppressive therapy in the management of allergic and autoimmune diseases.

Under contemporary conditions, a considerable proportion of children are in a state of maladaptation, which is accompanied by decreased immune resistance. Immune defense of the

gastrointestinal tract (GIT) can be conventionally divided into nonspecific and specific mechanisms. Nonspecific protective factors include the maturity of enzymatic systems, maintenance of the acid–base gradient in different segments of the GIT, functional activity of the normal intestinal microbiota, and adequate intestinal motility.

Impairment of nonspecific defense mechanisms is often associated with a discrepancy between the child's biological and chronological age, manifesting as the phenomenon of delayed enzymatic maturation. This condition is frequently a component of the phenotype of diffuse connective tissue dysplasia, characterized by auricular anomalies, a high-arched ("gothic") palate, epicanthus, hypertelorism, joint hypermobility syndrome, and minor developmental anomalies of the heart, gallbladder, and other organs. Functional insufficiency of enzymatic systems, combined with altered elasticity and structural integrity of the gastrointestinal wall, predisposes children to the development of functional digestive disorders.

Research findings indicate that in children with more than five minor developmental anomalies, parasitic infections are detected in approximately 78% of cases, whereas in control groups the prevalence does not exceed 45%. Giardiasis is of particular importance, as irregular and insufficient bile flow into the intestine—often associated with congenital anomalies of the gallbladder such as septa or kinking—constitutes a significant predisposing factor for invasion.

In children during the recovery period after acute intestinal infections, following prolonged or massive antibiotic therapy, and in patients with chronic digestive diseases, disturbances in enzymatic activity, normal microbiota composition, and intestinal motility render the gastrointestinal tract especially vulnerable to parasitic invasions.

Specific immune protection of the gastrointestinal mucosa depends on the age and maturity of the child's immune system. The antiparasitic immune response, predominantly mediated by eosinophils and immunoglobulin E (IgE), is fully established no earlier than four years of age and is closely associated with the level and functional activity of IgE. Upon contact with a parasite, a cascade of inflammatory mediators—including interleukins, leukotrienes, prostaglandins, and thromboxanes—is activated. Production of immunoglobulins of the IgM and IgG classes increases, and peripheral blood analysis often reveals eosinophilia and basophilia.

Eosinophils play a key role in antiparasitic defense due to their pronounced cytotoxic potential. At the site of invasion, they undergo degranulation, releasing granule proteins such as major basic protein, eosinophil peroxidase, eosinophil cationic protein, and eosinophil-derived neurotoxin. These substances are toxic not only to parasites but also to host tissues, contributing to organ damage. An additional mechanism underlying organ and systemic involvement in parasitic diseases is the formation of circulating immune complexes.

Parasites exert both local and systemic effects on the child's organism. They are capable of shifting the Th1/Th2 lymphocyte balance toward a profile favorable for their survival. In some cases, parasite-derived metabolites exhibit hormone-like activity. Locally, parasitic invasion leads to contact inflammation of the mucosa, impaired absorption, altered intestinal motility,

and disruption of the intestinal microbiocenosis. Systemically, their impact is mediated through competition for nutrients, induction of allergic and autoimmune reactions, targeted immunosuppression, and endogenous intoxication.

According to research data, allergic syndrome accompanies ascariasis and enterobiasis in 71.3% of cases. Among children with atopic dermatitis, parasitic infections are detected in 69.1%, with giardiasis accounting for 78.5% of these cases. Toxocariasis often presents with a particularly severe clinical course, characterized by a leukemoid eosinophilic reaction (eosinophils exceeding 20%), pronounced allergic manifestations, and resistance to standard therapy. In 75.3% of cases, parasitic invasions are accompanied by functional gastrointestinal disorders. Several studies also confirm the ability of parasitic infections to induce carbohydrate metabolism disturbances and disaccharidase deficiency, particularly through decreased lactase activity.

Results

A total of 150 children aged 2 to 14 years (n = 150) who sought medical care at healthcare institutions in the Khorezm region were included in the study. Parasitic infections were identified in 92 children, corresponding to a prevalence of 61.3%.

In the structure of parasitic diseases, the following conditions predominated:

- Enterobiasis — 44 children (47.8%)
- Giardiasis — 31 children (33.7%)
- Ascariasis — 17 children (18.5%)

Analysis of age distribution demonstrated that the highest frequency of parasitic infections was observed in the following age groups:

- 4–7 years — 39 cases (42.4%)
- 10–14 years — 34 cases (37.0%)
- 2–5 years — 19 cases (20.6%)

Functional disorders of the digestive system were identified in 69 children with parasitic infections (75.0%).

The most frequently registered clinical manifestations included:

- Abdominal pain syndrome — 48 children (52.2%)
- Dyspeptic symptoms — 41 children (44.6%)
- Stool instability — 37 children (40.2%)
- Signs of biliary dysfunction — 29 children (31.5%)

According to laboratory findings:

- Eosinophilia was detected in 56 children (60.9%)
- Elevated serum IgE levels were observed in 49 children (53.3%)

Concomitant allergic diseases were diagnosed in 38 children (41.3%). Among them:

- Atopic dermatitis — 26 children (68.4%)
- Recurrent allergic reactions — 12 children (31.6%)

Discussion

The obtained results demonstrate a high prevalence of parasitic infections among children in the Khorezm region (61.3%), which is consistent with data reported in both national and international studies. The predominance of enterobiasis (47.8%) and giardiasis (33.7%) can be explained by the high contagiousness of these infections and the specific modes of transmission characteristic of organized children's groups.

The detection of functional digestive disorders in 75.0% of children with parasitic infections confirms the significant role of parasites in the development of functional gastrointestinal pathology. The high frequency of abdominal pain syndrome and dyspeptic symptoms indicates the involvement of regulatory mechanisms of digestion and impairment of intestinal motor and evacuation functions. These findings support the concept that parasitic invasions contribute not only to structural but also to functional disturbances of the gastrointestinal tract.

The immunological alterations identified in the majority of examined children—eosinophilia (60.9%) and elevated IgE levels (53.3%)—reflect activation of the antiparasitic immune response and the presence of a pronounced allergic inflammatory component. The substantial prevalence of concomitant allergic diseases (41.3%) further confirms the systemic nature of parasitic effects on the child's organism. These data are in agreement with the hypothesis that chronic parasitic infections promote Th2-mediated immune responses, thereby predisposing children to allergic manifestations.

Taken together, the findings suggest that parasitic invasions play an important role in the development of persistent functional disorders of the digestive system and may contribute to the maintenance of a chronic pathological process even after elimination of the etiological factor. Therefore, timely diagnosis and comprehensive management of parasitic infections in children are essential to prevent long-term functional impairment and improve clinical outcomes.

Conclusion

Parasitic infections were identified in 61.3% of the examined children in the Khorezm region, with enterobiasis (47.8%), giardiasis (33.7%), and ascariasis (18.5%) being the predominant forms. Functional disorders of the digestive system were diagnosed in 75.0% of children with parasitic infections, most commonly presenting as abdominal pain syndrome, dyspeptic disturbances, and biliary dysfunction.

Parasitic diseases were associated with pronounced immunological alterations and a high frequency of allergic manifestations, confirming their significant role in the development of functional gastrointestinal pathology in children. The findings emphasize the importance of early diagnosis of parasitic infections, implementation of a comprehensive therapeutic approach, and the development of targeted preventive strategies within the pediatric population.

Particular attention should be paid to the high frequency of co-occurrence of parasitic infections with allergic diseases and functional disorders of the biliary system, which underscores the systemic impact of parasites on the child's organism. Impaired enzymatic activity and intestinal dysbiosis create conditions that promote chronic progression of pathological processes and persistence of functional disorders even after elimination of the parasitic invasion.

Thus, parasitic diseases in children should be considered not only as infectious conditions but also as significant risk factors for the development of long-term functional digestive disorders requiring an integrated diagnostic and therapeutic approach.

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