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THE IMPACT OF PARASITIC INFESTATIONS ON THE DEVELOPMENT OF ALLERGIC DISEASES AND CHANGES IN IMMUNE REACTIVITY IN CHILDREN

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Abstract. Parasitic infestations remain an important pediatric problem because they may influence not only nutritional status and gastrointestinal function but also the maturation and regulation of the immune system. Helminths and several protozoal parasites can stimulate type 2 immune responses characterized by activation of T-helper 2 cells, increased production of interleukins 4, 5 and 13, eosinophilia, mast-cell activation and elevated immunoglobulin E. These mechanisms overlap substantially with the pathways involved in bronchial asthma, allergic rhinitis, atopic dermatitis and urticaria. At the same time, chronic helminth infection may activate regulatory T cells and anti-inflammatory mediators such as IL-10 and TGF-beta, which can suppress or modify allergic inflammation. This thesis summarizes the main mechanisms through which parasitic invasion can alter immune reactivity in children, reviews the clinical associations with allergic disease, and emphasizes the importance of integrated parasitological and allergological assessment in pediatric practice.

Keywords: children, parasitic infestation, helminths, allergy, immune reactivity, IgE, eosinophilia, bronchial asthma.

Introduction

Parasitic diseases continue to be widely encountered in childhood, particularly in settings where sanitation, hygiene and environmental exposure facilitate transmission. Children are especially vulnerable because of behavioral factors, incomplete development of hygiene skills and age-related characteristics of immune regulation. In addition to direct intestinal and systemic manifestations, parasitic infections can influence immune responses in a way that resembles or modifies allergic inflammation. The biological relevance of this interaction is particularly important because both helminth infections and allergic diseases are associated with IgE production, eosinophil activation and type 2 cytokine responses. Uzbek pediatric and parasitological sources emphasize the clinical importance of intestinal parasitoses and the need to consider their systemic effects in children [1-4]. Recent local data also indicate that ascariasis may worsen the course of bronchial asthma and is associated with higher IgE and eosinophil levels [5].

Main Part

The immunological interaction between parasites and the host is complex. During tissue migration and persistence, helminths release somatic, excretory and secretory antigens that stimulate epithelial alarm signals and promote differentiation of CD4+ T lymphocytes toward a Th2 phenotype. Th2 cells produce IL-4, IL-5 and IL-13. IL-4 and IL-13 support class switching of B lymphocytes toward IgE synthesis, whereas IL-5 promotes maturation, recruitment and survival of eosinophils. IgE binds to high-affinity Fc receptors on mast cells and basophils; subsequent antigen exposure can trigger mediator release and symptoms that clinically resemble allergy. This is particularly relevant for Ascaris lumbricoides and Toxocara spp., whose larval migration may provoke cough, wheezing, eosinophilia, urticaria or asthma-like manifestations [5-7].

The relationship is not uniformly pro-allergic. Long-standing helminth infection may also increase regulatory T-cell activity, IL-10, TGF-beta and parasite-specific IgG4, creating an immunoregulatory environment that can reduce responsiveness to environmental allergens. Consequently, the effect of parasites depends on the parasite species, intensity and chronicity of

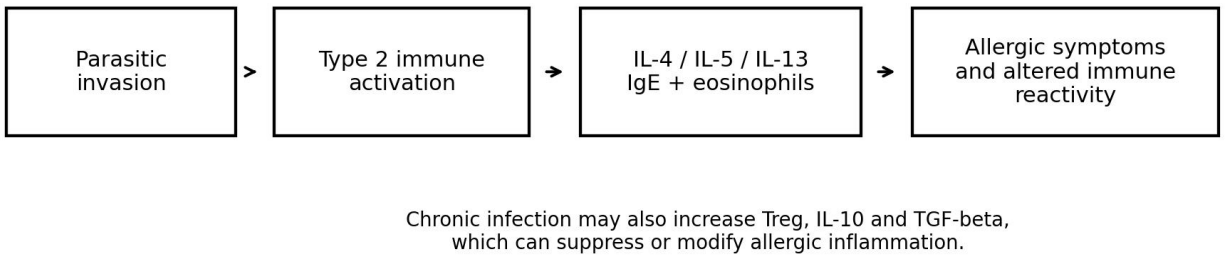
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infection, age at exposure, host genetic background and repeated anthelmintic treatment. International reviews therefore describe the association between helminths and allergy as bidirectional: some infections or parasite allergens may intensify allergic sensitization, whereas others may dampen clinically apparent atopy [6-8].

Table 1. *Major parasitic factors potentially related to allergic manifestations in children*

Parasite / group	Dominant immune feature	Possible allergic manifestation	Clinical relevance
Ascaris lumbricoides	High IgE, eosinophilia, Th2 activation	Wheezing, asthma exacerbation, urticaria	Consider testing in recurrent wheeze with eosinophilia
Toxocara spp.	Tissue eosinophilia and persistent antigen exposure	Asthma-like symptoms, urticaria	Serology may be useful when tissue migration is suspected
Strongyloides stercoralis	IgE-mediated basophil and eosinophil responses	Chronic cough, urticaria, asthma-like illness	Important before immunosuppressive therapy
Chronic helminth infections	Treg, IL-10, TGF-beta, IgG4	Possible attenuation of atopy in some settings	Effect varies with species, burden and duration

Figure 1. Conceptual pathway linking parasitic invasion with altered allergic and immune reactivity



From a clinical perspective, parasitic invasion should be considered when a child presents with unexplained eosinophilia, markedly elevated total IgE, recurrent abdominal symptoms, pruritus, urticaria, cough or poorly controlled asthma, especially when epidemiological exposure is plausible. However, total IgE elevation alone is not specific for parasitosis. Evaluation should combine history, complete blood count with eosinophil count, stool microscopy or concentration techniques when intestinal parasites are suspected, and selected serological or molecular methods according to the suspected organism. Allergy assessment may include skin-prick testing and allergen-specific IgE, but interpretation requires caution because parasite molecules can cross-react with environmental allergens. Local research on children with asthma and ascariasis supports combined parasitological and immunological assessment and has shown clinical improvement after deworming in appropriately diagnosed cases [5].

Preventive measures remain essential. Safe drinking water, hand hygiene, washing fruits and vegetables, sanitation, regular epidemiological surveillance and targeted deworming in accordance with clinical and public-health guidance can reduce parasite transmission. At the same time, unnecessary empirical anthelmintic treatment should be avoided when a specific diagnosis is required, because recurrent symptoms may reflect primary allergic disease, parasitic infection, or both. A

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multidisciplinary approach involving pediatricians, infectious-disease specialists, parasitologists and allergists is therefore the most rational strategy for children with overlapping manifestations.

In pediatric practice, the most informative interpretation is obtained when parasitological findings are assessed together with clinical allergy markers. A positive stool test or parasite-specific serology should be correlated with symptoms, eosinophil count, total and specific IgE, and the child's exposure history. This approach helps distinguish true parasite-associated allergic inflammation from coincidental atopy and reduces the risk of both underdiagnosis and unnecessary treatment.

Conclusion

Parasitic infestations can significantly modify immune reactivity in children through mechanisms that overlap with allergic inflammation. Th2 polarization, increased IgE production, eosinophilia and mast-cell activation may contribute to asthma-like symptoms, rhinitis, urticaria and other allergic manifestations, while chronic infections may simultaneously induce regulatory pathways that suppress or reshape allergic responses. The final clinical effect is therefore determined by the parasite species, infection burden, chronicity and host characteristics. In children with persistent allergic symptoms accompanied by eosinophilia, high IgE or epidemiological risk factors, targeted parasitological evaluation should be integrated into the diagnostic algorithm. Early identification and appropriate treatment of confirmed parasitic infection may reduce immune stimulation and improve control of coexisting allergic disease.

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