

The Role of Immunoglobulin E and Eosinophils In patients with *Ascaris Lumbricoides*: Literatur review

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Abstract: *Ascaris lumbricoides* infection is a common soil-transmitted helminth infection, particularly in developing countries with inadequate sanitation and limited access to clean water. The host immune response to *A. lumbricoides* is predominantly mediated by Th2 responses, characterized by increased IgE production and eosinophil activation through IL-4 and IL-5. This study provides an overview of the role in the immune response and diagnostic potential of IgE and eosinophils in *A. lumbricoides* infection. Although studies have evaluated IgE and eosinophils in *A. lumbricoides* infection, most have assessed these biomarkers separately or alongside other immune parameters. This research to analyze the role of IgE and eosinophils in patients infected with *A. lumbricoides*. A descriptive literature review was conducted using PubMed, Google Scholar, ScienceDirect, Scopus, and SpringerLink. Relevant studies on *A. lumbricoides*, IgE, and eosinophils were identified, selected, and descriptively analyzed. *A. lumbricoides* infection induces a Th2-mediated immune response characterized by increased IL-4, IL-5, and IL-13, leading to IgE production and eosinophil activation. Elevated total and specific IgE and eosinophilia were commonly observed in infected individuals. However, IgE may also be influenced by atopy and allergen exposure, while eosinophilia showed relatively high specificity but low sensitivity. IgE and eosinophils reflect the immune response to *A. lumbricoides* infection but are insufficient as single diagnostic markers. Their combination with parasitological or molecular methods may improve detection of ascariasis.

Keywords: *Ascaris lumbricoides*, Immunoglobulin E, Eosinophils

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INTRODUCTION

Ascaris lumbricoides infection is one type of worm STH (soil-transmitted helminths) that is often found, especially in developing countries where sanitation conditions are still poor and access to clean drinking water is limited (Adnan Rasheed, 2026). Globally, the number of individuals infected with *A. lumbricoides* has reached more than 1.2 billion people worldwide. Indonesia, as one of the countries in Southeast Asia, has a high incidence rate of *A. lumbricoides* infections. Data shows that 60-69% of all children aged 2-12 years are infected with *A. lumbricoides* (Rahmat et al., 2023).

The host's immune response to *A. lumbricoides* infection begins with the activation of Th2, characterized by a

significant increase in cytokines and a strong response from IgE, eosinophils, and mast cells. The immune reaction to parasitic worm infection is characterized by eosinophilia and an increase in IgE levels. The production of IgE is caused by the worm's ability to stimulate the Th2 subset of CD4+ T cells, which release IL-4 and IL-5. IL-4 stimulates the production of IgE, while IL-5 stimulates the development and activation of eosinophils. Specific antibodies are found in sufficient concentration and affinity, effective in providing protection against the parasite (Darmadi et al., 2015).

Although various studies have been conducted regarding the analysis of IgE levels and eosinophils in patients infected with *A. lumbricoides*, most of these studies only evaluate the increase in IgE levels or the number of

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eosinophils separately or integrating eosinophils with other immune system parameters. Like one of the studies by Darmadi et al. 2015, which analyzed IL-5 levels and eosinophil counts between children and adults infected with *A.lumbricoides*, the research found no difference in IL-5 levels between children and adults infected with *A.lumbricoides*. However, there was a difference in eosinophil counts between children and adults infected with *A.lumbricoides*. There are still few studies that integrate both biomarkers to explain the immune response to *A.lumbricoides* infection. Moreover, most articles only discuss one aspect, such as epidemiology, pathogenesis, or biomarkers. There are still not many literature reviews that connect infection with immune response mechanisms to the processes of stimulation and activation of IgE and eosinophils. This research provides a comprehensive overview of the role of IgE and eosinophils in the immune response to *A.lumbricoides* infection. This research also provides the potential of both as diagnostic markers for ascariasis. Based on this, the objective of this literature review-based research is to analyze the levels of IgE and eosinophils in patients infected with *A.lumbricoides*.

MATERIAL AND METHODS

This study uses a literature review method with a descriptive approach to examine the relationship between *A.lumbricoides* infection and IgE and eosinophil levels. Literature was searched thru PubMed, Google Scholar, ScienceDirect, Scopus, and SpringerLink using the keywords *A.lumbricoides*, IgE, and eosinophils. The selected articles include original research, systematic reviews, or review articles in both Indonesian and English that are relevant to the topic. Duplicate articles, those without full text, irrelevant articles, or those not presenting data related to *Ascaris lumbricoides* were excluded from the study.

RESULTS

1. Morphological *A.Lumbricoides*

A.lumbricoides is a nematode that lives in the human small intestine. Its shape is elongated, cylindrical, and both ends are pointed. The body structure of *A.lumbricoides* allows it to migrate to other organs (Bhalodia et al., 2025). The body of *A. lumbricoides* is pale yellow to yellowish-white. The male worm measures 10–31 cm with a diameter of 2–4 mm, has a tapered posterior end that curves ventrally, and two spicules. The female worm is larger, measuring 22–35 cm with a diameter of 3–6 mm, has a straight tail, and a copulatory ring in the anterior third of its body. *A. lumbricoides* has three lips, namely one dorsal lip and two subventral lips. Infection can be identified thru four types of eggs in the feces, namely fertilized, unfertilized, decorticated, and embryonated. Fertilized eggs are oval-shaped, colorless, measuring 45–70 × 35–50 µm, while unfertilized eggs are more elongated, measuring about 80 × 55 µm, and do not have cavities at both poles (Elfred et al., 2016).

2. Etiology and Risk Factors

A.lumbricoides infection is related to poor human factors and environmental sanitation (Jourdan et al., 2018) accompanied by a low socioeconomic status (Wattano et al., 2023). Infection occurs thru the ingestion of infective nematode eggs or the penetration of filariform larvae thru the skin from contaminated soil (Clark & Gilman, 2020). Environmental sanitation factors include the provision of clean water and food, toilet management, bathroom cleanliness, and waste management. Human factors include personal hygiene. The implementation of good personal hygiene requires support from good environmental sanitation. For example, washing hands before eating requires access to clean and safe water (Ministry of Health of the Republic of Indonesia, 2012).

3. Patofisiology

The intensity of a large number of infections can cause intestinal obstruction, leading to pain, vomiting, and life-threatening complications such as volvulus or intestinal perforation. *A.lumbricoides* also causes appendicitis, gastrointestinal bleeding, intussusception, and intestinal perforation. In addition, it can migrate to the bile ducts or pancreas, causing conditions such as: acute cholecystitis, acute pancreatitis, biliary colic, liver abscess, acute or recurrent cholangitis. (Cardoso et al., 2025) (Gigliotti S et al., 2025).

4. Disease diagnosis

Diagnosis of *A.lumbricoides* involves a combination of clinical evaluation, laboratory examination, and imaging techniques. Laboratory diagnosis can be performed thru microscopic examination of stool samples to detect the presence of eggs. This method is the standard diagnosis used primarily in endemic areas. However, this technique has low sensitivity, especially for small quantities of infection, leading to false negatives (Hardjanti et al., 2017). Laboratory diagnosis can also be performed using PCR (Polymerase Chain Reaction) and LAMP (loop-mediated isothermal amplification), which have higher sensitivity and specificity compared to microscopic examination, but are more expensive. Diagnosis must be complemented with a comprehensive examination such as travel history and geographical origin. *A.lumbricoides* infection should be considered in symptomatic patients even if they do not have a travel history to endemic areas (Lamberton & Jourdan, 2015).

Non-invasive imaging is important for determining the location of worms and detecting mechanical complications. Abdominal ultrasonography, especially with a high-frequency probe (5–10 MHz), is the main safe method to visualize worms in the intestinal lumen and assess the involvement of the hepatobiliary tract and pancreas. In complex hepatobiliary ascariasis, MRCP (Magnetic Resonance Cholangiopancreatography) provides high-resolution anatomical images of the bile ducts. Definitive diagnosis can also be made thru direct observation of adult worms expelled thru vomit or feces. Therefore, clinical management requires

a multimodal approach by combining clinical symptoms, stool examination results, and imaging findings (Thakur et al., 2025) (Pérez et al., 2024).

5. Definition and structure of IgE

IgE is an antibody that plays a role in allergic responses and parasitic infections and is only found in mammals. IgE consists of two identical heavy chains and two identical light chains connected by disulfide bonds, forming a Y-shaped structure. Each heavy chain has one variable domain (V) and several constant domains (C), while each light chain has one V domain and one C domain. The Fc region (Cε2, Cε3, Cε4) plays a role in binding both high-affinity and low-affinity receptors and undergoes conformational changes that are important in the allergic response (Eggel & Jardetzky, 2025) (Benjamin et al., 2020) (McCraw et al., 2024) (Deng et al., 2024).

6. Total Ig E Levels of *Ascaris lumbricoides* Infection

An increase in IgE levels is an indicator of *A. lumbricoides* infection, whether new or previous, which in the early stages triggers an inflammatory response controlled by CD4⁺ T lymphocytes (Meliance & Honey, 2024). ABA-1, as the main protein of *A. lumbricoides*, triggers the production of IgE and is associated with resistance to infection. *A. lumbricoides* infection can suppress the immune response by reducing antigen recognition and presentation, mast cell and basophil activity, and increasing regulatory T cell activity. B cells also regulate the immune response by producing IgE, IgG4, and anti-inflammatory cytokines such as IL-10 and TGF-β (Zakzuk et al., 2024). The production of IL-10 by B cells is inversely related to the production of IgE specific to ABA-1. Infection with *A. lumbricoides* can trigger anti-inflammatory mechanisms. This indicates that infection has a dual effect on the immune response. Regulatory B cells (Breg) play a role in regulating the immune response due to environmental exposure (Zakzuk et al., 2024). In a other study on Elementary School Children of Lifuleo Village, East Kupang District, it was found that *Ascaris lumbricoides* infection is estimated to cause an increase in antibody production due to the presence of parasitic antigens that stimulate the body's immune response. The more antigens present in the body, the stronger the immune response formed, including an increase in IgE levels (Meliance & Honey, 2024).

7. Total Eosinophil Levels of *Ascaris lumbricoides* Infection

Eosinophil examination is conducted using peripheral blood. Eosinophilia is characterized by an eosinophil count $> 0.45 \times 10^3$ cells/ μ L. The blood is diluted with Dinger's solution (1:20), then eosinophils are counted using the Improved Neubauer counting chamber and a microscope in four leukocyte squares within one hour to reduce errors (Rahmat et al., 2023). The immune response to *A. lumbricoides* infection is influenced by the type of antigen, the location of the worm, and the condition of the immune system. This infection activates Th2 and Treg cells, which

produce IL-4, IL-13, IL-5, and IL-10. IL-4 and IL-13 stimulate the production of IgE, while IL-5 plays a role in the formation and activation of eosinophils and causes eosinophilia (Mely & Karol, 2025).

One study proved that among children infected with *A. lumbricoides*, 87.5% experienced an increase in eosinophil levels, while only 12.5% were within the normal range. On the other hand, the majority of children without infection had normal eosinophil levels (95%), and only 5% showed an increase (Mely & Karol, 2025). This is supported by another study that explains the prevalence of *A. lumbricoides* infection in pediatric patients at the hospital where the research was conducted is 22.2%. *A. lumbricoides* infection in pediatric patients is more commonly found in school-aged female patients. Pediatric patients with *A. lumbricoides* infection more often have normal nutritional status, decreased hemoglobin levels, and increased eosinophil levels (Rahmat et al., 2023).

DISCUSSION

IgE is an antibody found in the blood and plays a role in triggering allergic reactions. When an allergen enters the body and is recognized by IgE on mast cells, this process can trigger the release of histamine, leading to an allergic reaction. Total IgE examination is a blood test to measure the level of IgE antibodies. The normal value for total IgE is generally <100 IU/mL. Levels exceeding the normal value may indicate an excessive body response to allergens. Therefore, the total IgE examination can be used as one of the tests to identify allergic responses (Meliance & Honey, 2024).

IgE has a very strong effector capability, therefore IgE is useful in monoclonal antibody immunotherapy against important clinical targets. The dynamics of IgE receptor binding also exhibit distinctive characteristics. IgE primarily interacts with two receptors: FcεRI, which has structural homology with the FcγR receptor group, and FcεRII/CD23, which is a member of the type C lectin-like superfamily and differs from most other antibody receptors. FcεRI is expressed on various types of cells, including tissue mast cells, basophils in the blood, smooth muscle cells and epithelial cells in the respiratory tract, intestinal epithelial cells, as well as various antigen-presenting cells, monocytes, and macrophages. FcεRI is expressed on various types of cells, including tissue mast cells, basophils in the blood, smooth muscle cells and epithelial cells in the respiratory tract, intestinal epithelial cells, as well as various antigen-presenting cells, monocytes, and macrophages. When an allergen cross-links with allergen-specific IgE bound to mast cells and basophils, it triggers cell degranulation. This process releases pre-formed inflammatory mediators and triggers an immediate hypersensitivity reaction that can become so severe as to cause anaphylactic shock or death. Remarkably, this massive response only requires minimal cross-linking between IgE molecules and FcεRI (Sutton et al., 2019)

The increase in polyclonal IgE levels can reduce allergic reactions in populations with high levels of parasitic infections. Polyclonal IgE can bind to the Fcε receptor on mast cells, thereby inhibiting allergen-specific IgE from binding and preventing degranulation. Another mechanism that can explain the protective effect of *A.lumbricoides* infection against allergies is the IgG4 blocking theory and the modified Th2 theory. In *A. lumbricoides* infection, IgG4 antibodies can prevent effector cell degranulation, thereby helping to reduce the allergic response (Meliance & Honey, 2024).

In a study, patients free from infection, even after receiving repeated anthelmintic treatment, continued to show higher levels of anti-*Ascaris* IgE. The researchers suggested that this condition might be caused by continuous re-stimulation by the developing worm forms, or it may particularly occur in individuals with a genetic predisposition to atopy. Thus, in this context, higher levels of anti-*Ascaris* IgE seem to not only reflect a marker of previous infection but may also play a protective role. Analysis of the isotype profile against the antigenic molecule of *A.lumbricoides* shows that both in uninfected patients and in patients with a low parasitic load, higher levels of specific IgE were found. This suggests the possibility of a protective role of the immunoglobulin isotype (De et al., 2026).

Eosinophils are produced in the bone marrow and only survive in the bloodstream for a few hours before moving to body tissues. When the body is exposed to foreign substances, eosinophils act as detectors and protectors against those threats. An increase in eosinophil levels indicates that the body is in an allergic condition or an active immune reaction. However, beside infections and allergies, there are several other factors that can also cause an increase in the number of eosinophils. These factors include stress, venous inflammation (phlebitis), thrombophlebitis, cancer, kidney diseases such as kidney failure and nephrotic syndrome. Therefore, it is necessary to analyze these factors in addition to focusing on the infection rate in patients with *Ascaris lumbricoides* infection (Mely & Karol, 2025).

High specificity of blood eosinophil examination level may be useful in diagnosing Ascariasis. But even though the specificity is high, its sensitivity is low. This means that the elevation of blood eosinophil level cannot be used as a tool for Ascariasis screening in a population. Diagnostic test for screening purposes must have high sensitivity even its specificity is quite low. The main objective from a diagnostic test is its utilization to confirm the diagnosis. Sensitivity and specificity are not useful to indicate whether if an individual that being examined suffer from a disease or not based on the test result that being used. That is why a probability degree is needed in a test to diagnose a disease. It is called as predictive value. Positive predictive value is a probability an individual really suffer from a disease if the test result is positive. And negative predictive value is the probability an individual does not suffer from a disease if the diagnostic test result is negative (Rahmat et al., 2023).

CONCLUSION

Based on the literature review, *A.lumbricoides* infection can affect the immune response thru Th2 activation, characterized by increased IL-4, IL-5, and IL-13. This response stimulates the production of IgE and increases the number and activity of eosinophils as part of the defense against the infection. Total IgE levels, specific IgE to *A.lumbricoides*, and eosinophils can increase in infected individuals. However, IgE levels are also influenced by atopic tendencies and allergen exposure, while eosinophilia has low sensitivity despite its relatively high specificity. Therefore, IgE and eosinophils cannot be used as the sole markers for the diagnosis of ascariasis, but they can serve as supportive tests. Its combination with parasitological examination or molecular diagnostic methods can provide more comprehensive results in detecting *A.lumbricoides* infection.

STRENGTHS AND LIMITATION

This research provides a comprehensive overview of the role of IgE and eosinophils in the immune response to *Ascaris lumbricoides* infection, particularly thru the Th2 response mechanism. The reviewed literature covers various aspects, from immunological mechanisms, changes in IgE and eosinophil levels, to the potential of both as diagnostic markers for ascariasis. This study can serve as a foundation for further research in evaluating the use of IgE and eosinophils more specifically, both as markers of the immune response and as supportive tests in the diagnosis of *A.lumbricoides* infection.

The limitation of this study is that it has not specifically examined the relationship between *Ascaris lumbricoides* infection and the diseases or clinical manifestations it causes, nor has it deeply analyzed the relationship between IgE levels and *A.lumbricoides* infection in relation to the emergence of those symptoms or clinical manifestations. In addition, the research results obtained depend on the quality, methods, and characteristics of the studies that have been published previously.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to the publication of this article.

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DECLARATION OF USING AI

The authors affirm that artificial intelligence (AI) tools were used to assist in the writing process solely for language enhancement purposes, such as grammar checking, paraphrasing, and improving clarity. No AI tools were employed to generate original content, conduct data analysis, or interpret research findings. The authors take full responsibility for the content, interpretations, and conclusions presented in this manuscript.

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