

THE ROLE OF INFECTIOUS DISEASES IN STUNTING INCIDENCE : A LITERATURE REVIEW

Peranan Penyakit Infeksi Dengan Kejadian Stunting: Literatur Review

Luthfia Retno Ramadyani^{1*}, Fauzi Muh.¹, Martini Martini¹

¹ Magister Epidemiologi, Fakultas Kesehatan Masyarakat, Universitas Diponegoro,
Semarang, Indonesia

*Email: luthfiaramadyani@gmail.com

ABSTRAK

Stunting merupakan masalah kesehatan global yang signifikan, terutama di negara berkembang seperti Indonesia, dengan prevalensi yang memprihatinkan. Kondisi ini ditandai dengan tinggi badan anak yang lebih rendah dari standar usianya akibat kekurangan gizi kronis. Penyebab stunting bersifat multifaktorial, salah satunya adalah penyakit infeksi yang berlangsung berulang atau kronis. Penyakit infeksi, termasuk infeksi cacing berkontribusi terhadap stunting melalui mekanisme malabsorpsi nutrisi dan peradangan. Penelitian ini bertujuan untuk mengeksplorasi dan menganalisis secara sistematis hubungan antara penyakit infeksi, terutama infeksi parasit usus dan peradangan kronis dengan kejadian stunting pada anak balita. Penelitian ini menggunakan metode literatur review dengan mengumpulkan artikel dari database GoogleScholar, Scopus, Dimension, dan Base. Kriteria inklusi meliputi publikasi antara tahun 2015-2025, tersedia full text, serta memiliki DOI atau ISSN, ditulis dalam Bahasa Indonesia atau Bahasa Inggris, serta judul dan abstraknya sesuai dengan tujuan penelitian. Analisis dilakukan secara deskriptif dan naratif untuk menyintesis hasil penelitian yang relevan. Sebanyak 314 artikel diidentifikasi, 72 artikel disaring setelah eliminasi duplikat dan seleksi berdasarkan judul serta abstrak, dan akhirnya 11 artikel lolos untuk dianalisis secara menyeluruh. Hasil menunjukkan bahwa infeksi cacing usus, berhubungan erat dengan kejadian stunting pada anak-anak. Eosinophilia sebagai indikator infeksi parasit juga ditemukan lebih tinggi pada anak stunting. Selain itu, kadar C-Reaktif Protein (CRP) yang tinggi berhubungan dengan peradangan kronis yang menghambat pertumbuhan anak. Penelitian ini menegaskan pentingnya pencegahan penyakit infeksi untuk mencegah stunting. Intervensi gizi dan kesehatan yang komprehensif diperlukan untuk mengatasi masalah ini secara efektif. Upaya pencegahan harus mencakup peningkatan akses terhadap layanan kesehatan dan pendidikan gizi bagi keluarga.

Kata kunci: albumin, C-Reaktif Protein, eosinofil, infeksi, stunting

ABSTRACT

Stunting is a major global health issue, particularly in developing countries like Indonesia, where its prevalence remains high. It is characterized by a child's height being below the standard for their age due to chronic malnutrition. The causes of stunting are multifactorial, including recurrent or chronic infectious diseases. This study aims to systematically analyze the association between infectious diseases—especially intestinal parasitic infections—and chronic inflammation with stunting in children under five. A literature review was conducted by collecting articles from Google Scholar, Scopus, Dimension, and BASE. Inclusion criteria were publications from 2015–2025, full-text availability, presence of DOI or ISSN, and relevance of titles and abstracts to the study objectives. A total of 314 articles were identified, 72 were screened, and 11 met the criteria for full analysis. The findings reveal that intestinal worm infections are significantly associated with stunting. Eosinophilia, an indicator of parasitic infection, was found to be higher in stunted children. Furthermore, elevated C-Reactive Protein (CRP) levels were linked to chronic inflammation that impairs growth. These results highlight the importance of managing infectious diseases as part of stunting prevention.

Comprehensive nutritional and health interventions are essential. Efforts should also focus on improving access to healthcare services and nutritional education for families.

Keywords: albumin, C-Reactive Protein, eosinophil, infection, stunting

INTRODUCTION

Stunting is an ongoing public health challenge in developing countries and has been the focus of extensive research in recent years.^{1,2} Interaksi yang kompleks antara penyakit menular dan perkembangan stunting telah menjadi topik yang menarik perhatian para peneliti.^{1,3} Stunting is a condition of stunted growth in toddlers due to chronic malnutrition characterized by a height below average for their age. According to UNICEF, it is estimated that around 144 million children under five in the world are stunted, which has an impact on brain development, learning ability, potential future income, and contribution to society.⁴

Stunting is still a big challenge in the health sector in Indonesia. This condition was identified based on the indicator of height by age (TB/U) which is below -2 SD from the WHO standard, and is a reflection of the lack of chronic nutritional intake in children under five. The impact is not only seen on the physical aspect, but also has a long-term effect on children's mental development and productivity.⁵ Based on Riskesdas data, the prevalence of stunting is still high, at 30.8% and requires serious and sustainable interventions.⁶ According to the 2023 Indonesian Health Survey (IHS), the national prevalence of stunting has decreased to 21.5%. Despite the decline, this figure is still above the 2020–2024 RPJMN target of 14% and the WHO standard which sets the threshold below 20%.⁷

The causes of stunting are very complex and multifactorial, including nutritional factors, infections, socioeconomic status, and the environment. One of the main risk factors is the presence of recurrent or chronic infections in children.¹ In tropical areas such as Indonesia, intestinal worm infection is one of the most common types of infections found in children.⁸

This infection can result in deficiencies in nutrients such as protein and iron, which are necessary for the child's growth.¹ Examination of feces and eosinophil levels in the blood is often used to detect the presence of intestinal worm infections, and these infections have long been linked to nutritional problems in children, including stunting.⁹

A key factor studied is intestinal parasitic infections, especially soil-transmitted helminths, which can cause nutrient malabsorption, inflammation, and growth impairment—contributing to stunting. Elevated eosinophil levels, as markers of parasitic infection, are also linked to increased stunting risk. In addition, other infectious diseases such as respiratory infections and diarrhea have also been associated with stunting.^{1,10} Chronic inflammation, evidenced by increased levels of C-Reactive Protein, has been found to be a predictor of stunting that highlights the importance of the body's immune response in growth and development.^{3,11,12}

Malnutrition, which can result from repeated infections has also been shown to worsen the effects of stunting.^{1,13} A number of studies have explored the complex interactions between various factors and stunting.^{2,10} Infectious diseases, such as intestinal worm infections, can contribute to stunted growth through mechanisms such as nutrient malabsorption, chronic inflammation, and reduced appetite.^{2,10} In addition, indicators of inflammation, such as C-reactive protein and albumin levels, have been linked to stunting.² Other factors, including the child's age, gender, birth weight, maternal education, and family income, have also been identified as determining factors for stunting.^{2,10} This study aims to explore and systematically analyze the relationship between infectious diseases, especially intestinal parasitic

infections and chronic inflammation and the incidence of stunting in children under five.

METHODS

This study used a *systematic literature review* approach to examine the role of infectious diseases in the incidence of stunting in children. The articles analyzed were obtained from several scientific databases such as Google Scholar, Scopus, Dimension, and BASE. The search strategy is carried out using keywords in Indonesian and English which are assembled using Boolean operators "AND" and "OR" to narrow down relevant search results. The keywords used include: "penyakit infeksi AND kejadian stunting", "kecacingan AND kejadian stunting", "CRP AND kejadian stunting", serta "albumin AND kejadian stunting".

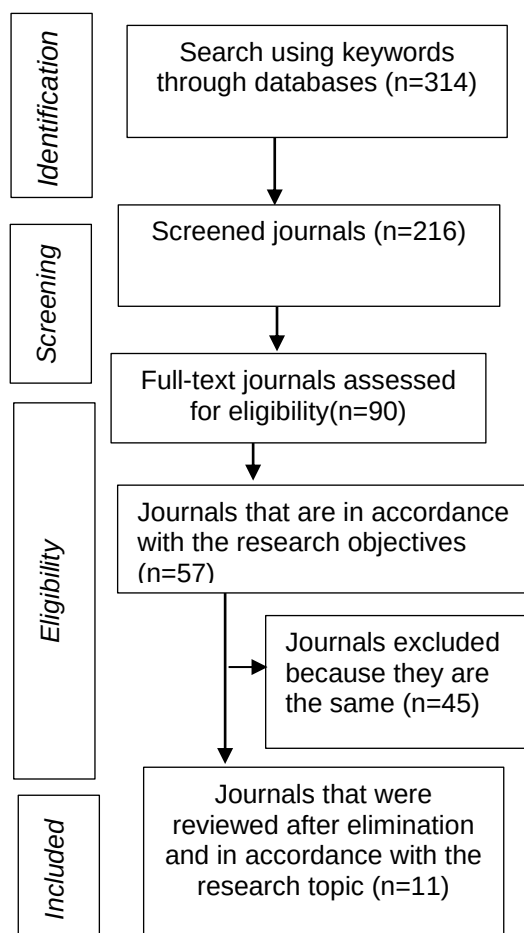


Figure 1. Literature Review Flow Chart

The initial selection was carried out by applying the following inclusion criteria: articles published between 2015 and 2025, available in full-text format, have a DOI or ISSN, written in Indonesian or English, and the title and abstract are in accordance with the purpose of the research. In addition, the quality of the article must reach a minimum of 50% based on the assessment of PRISMA standards. Articles that do not meet any of these criteria are excluded from the review (exclusion criteria). The article selection process is carried out by the main researcher by assessing the suitability of the title and abstract to the research topic. Irrelevant articles are eliminated at this stage. Furthermore, the results obtained were analyzed descriptively and synthesized with a narrative approach to summarize the existing findings into a systematic review. The flowchart in figure 1 illustrates the stages of the literature search and selection process.

RESULT

Some studies show that intestinal worm infections are a major risk factor contributing to stunting. Research by Muslimah confirms that children who experience worms have a higher risk of stunting, especially if supported by other factors such as low maternal education and family income.¹⁴ Eosinophilia, as an indicator of parasitic infection, was also found higher in stunted children, as reported in several articles.

In addition, two studies highlighted the association between C-Reactive Protein (CRP) levels and the incidence of stunting. Research by Pangestika shows that high CRP levels (≥ 3 mg/dL) are significantly correlated with the incidence of stunting, especially in children with congenital heart disease.¹¹ Similarly, research by Yanti supports that increased CRP levels in stunted children can be an indicator of a chronic inflammatory process.¹²

Low albumin levels have also been identified as a factor associated with

stunting. Research by Telussa showed a significant relationship between serum albumin levels and the incidence of stunting ($p=0.028$).¹⁵

Other factors found to be related to stunting include incomplete basic immunization status, maternal education level, family income, and child-feeding patterns.^{16,17} Heriati and Elwindra's research also found that exclusive breastfeeding and access to good health services can significantly reduce the risk of stunting.¹⁸ Overall, the studies

reviewed strengthen the evidence that infectious diseases—particularly intestinal parasitic infections—along with inflammation status and nutritional indicators (albumin and CRP), are significantly associated with stunting. Additionally, social factors and health behaviors also contribute to stunting risk in young children. Table 1 summarizes several studies examining the link between infectious diseases and stunting in children under five.

Table 1. Literature Review Table

No	Researcher/year	Purpose	Method	Result	Conclusion
1	Wanda <i>et al</i> , (2021) ¹⁶ , <i>Riwayat Status Imunisasi Dasar Berhubungan dengan Kejadian Balita Stunting</i>	Assessing the relationship between basic immunization status and the incidence of stunting in toddlers in Hegarmanah Village, Jatinangor. 2020.	Case control - Purposive sampling - 60 anak 24-36 bulan	A significant relationship was found between immunization status and stunting ($p=0.000$). Children without complete immunization are 4.9 times higher risk of stunting than those who are fully immunized (OR = 4.958; CI 2,074–11,852).	There was a relationship between the history of basic immunization status and the incidence of stunting in toddlers in Hegarmanah Village, Jatinangor District with a $p<0.05$ value ($p=0.00<0.05$), and there was a risk of stunting in toddlers with incomplete immunization by 4.9 times higher than in toddlers with complete immunization.
2	Mulyono <i>et al</i> , (2015) ¹⁷ , <i>Faktor yang berhubungan dengan kejadian stunting</i>	Knowing the influence of maternal education, family income, and feeding patterns on stunting.	Cross-sectional - Cluster sampling - 85 anak balita	There was a significant correlation between maternal education ($p=0.003$), family income ($p=0.000$), and children's diet ($p=0.000$) on stunting incidence.	Maternal education, family income, and children's diet were significantly associated with stunting incidence, as indicated by p-values of 0.003, 0.000, and 0.000 respectively. These findings highlight the important role of socioeconomic and nutritional factors in the occurrence of stunting.
3	Pangestika <i>et al</i> , (2022) ¹¹ , <i>The Higher C-Reactive Protein Levels as a Risk Faktor of Stunting in Children with Acyanotic Congenital Heart Disease</i>	Proving high CRP levels as a risk factor for stunting in children with Asian-congenital heart disease aged 6–24 months.	Case control - Purposive sampling - 76 anak (6-24 bulan)	The average CRP level was higher in the stunting group. CRP ≥ 3 mg/dL was significant as a risk factor ($p = 0.031$; aOR = 22.89; CI 1,32–395,39). Other risk factors: male gender, low birth weight, and living in rural areas.	Higher CRP levels are a risk factor for stunting in children with acyanotic congenital heart disease (acyanotic CHD). Other significant risk factors include male gender, living in rural areas, low birth weight, and poor nutritional status.

No	Researcher/year	Purpose	Method	Result	Conclusion
4	Herianti dan elwindra, (2017) ¹⁸ , <i>Analisis Faktor Risiko Kejadian Stunting pada Anak Balita di Wilayah Puskesmas Kelurahan Cipinang Melayu Jakarta Timur</i>	Identifying stunting risk factors in toddlers in the Cipinang Melayu Health Center area, East Jakarta.	Cross-sectional - Simple random sampling - 62 anak balita	The majority of toddlers were 24–35 months old, male, and born weighing <3 kg. Most of them have not received exclusive breastfeeding, but have implemented a good parenting style. Exclusive breastfeeding reduced the risk of stunting by 3.755 times (p=0.017). Good access to health services also reduces the risk of stunting (p=0.039; OR=0.335).	Statistical analysis showed no significant association between stunting and age, gender, birth weight, parenting, or infection history. However, exclusive breastfeeding and healthcare access were significantly associated with stunting. Exclusive breastfeeding reduced the risk by 3.755 times, while good healthcare services reduced it by 0.335 times.
5	(Telussa et al, 2022) ¹⁵ , <i>Hubungan Antara Kadar Serum Albumin Dengan Kejadian Stunting Pada Balita Di Desa Tulehu, Kecamatan Salahutu, Kabupaten Maluku Tengah</i>	Examining the relationship between serum albumin levels and the incidence of stunting in toddlers in Tulehu Village, Central Maluku.	Associative research - Total Sampling - 40 children (2-5 years)	Of the 40 respondents, 40% had low albumin levels. There was a significant correlation between low albumin levels and stunting incidence (p=0.028).	there was a significant relationship between serum albumin levels and the incidence of stunting in toddlers in Tulehu. Researchers recommend future studies to record dietary patterns and other factors affecting albumin levels, use different age groups and sampling methods, and apply proper sampling techniques to avoid bias and benefit respondents.
6	Muslimah et al, (2020) ¹⁴ , <i>Multilevel Analysis Association of Soil Transmitted Helminths and Stunting in Children Aged 6-12 Years Old in Pinrang District, South Sulawesi</i>	Explain the relationship between worm infection (STH) and stunting in children aged 6–12 years in Pinrang Regency, South Sulawesi.	Cross-sectional - Stratified multistage sampling - 275 anak (6-12 tahun)	Stunting in children was significantly related to several risk factors, namely worm infection (p< 0.001), low maternal education (p= 0.025), economic condition of underprivileged families (p= 0.039), large number of family members (p < 0.001), short maternal height (p = 0.030), babies with Lower Birth Weight (p = 0.007), reduced birth length (p < 0.001), and inappropriate supplementation (p	The risk of stunting increases in children with worms, mothers with low education, low income, large number of family members, short maternal height, low birth weight (LBW), short birth length, and improper breastfeeding. The risk of stunting decreases with exclusive breastfeeding. The village context factor has a very small influence on stunting incidence.

No	Researcher/year	Purpose	Method	Result	Conclusion
				=0.029). Exclusive breastfeeding reduced the risk of stunting ($p = 0.045$). The effect of the residential environment (village) on stunting was relatively small (ICC = 8.2%)	
7	Yanti et al, (2021) ¹² , <i>Levels of C-Reactive Protein (CRP) in Stunting and Non Stunting Tolls Age 36-60 Months</i>	Measuring CRP levels in toddlers aged 36–60 months who are stunting and those who are not.	Cross-sectional - Simple random sampling - 60 anak (36-60 bulan)	CRP levels were significantly higher in children who were stunted compared to children who were not stunted, with a value of $p=0.045$, indicating a relationship between chronic inflammation and stunting incidence.	High CRP levels in stunted toddlers can be used as a parameter to assess nutritional status.
8	Shumbej T, et al., (2015) ¹⁹ <i>Soil-transmitted helminths and associated factors among pre-school children in Butajira Town, Ethiopia</i>	Assess the prevalence and risk factors of STH in pre-school children	Cross-sectional - Cluster random sampling - 420 anak (36-47 bulan)	The prevalence of Soil-Transmitted Helminths (STH) infections in preschoolers in Ethiopia is 23%, with <i>Ascaris lumbricoides</i> being the dominant species. Risk factors such as not washing hands, not cutting nails, and poor sanitation were significantly associated with high rates of infection and stunting incidence in children ($p < 0.05$). These infections contribute to stunting through nutrient malabsorption and chronic inflammatory mechanisms.	Intestinal worm infection (STH) is a public health problem in preschool children (PSAC) in the study area, so deworming is required every year to control morbidity associated with STH. In addition, existing health education programs also need to be strengthened to prevent reinfection.
9	Asfaw M., et al. (2020) ²⁰ <i>Determinants of soil-transmitted helminth infections among pre-school-aged children in Gamo Gofa zone, Southern</i>	Determining risk factors for STH infection in pre-school children	Case control - Multistage random sampling – 600 anak (1-5 tahun)	Soil-Transmitted Helminths (STH) infection is a significant risk factor for stunting in preschool-age children. Children infected with STH were 2.38 times more likely to be stunting than those who were	Existing preventive chemotherapy needs to be substantially strengthened with WASH and behavioral interventions. Therefore, an urgent call for action is needed to integrate context-specific WASH interventions, especially in rural areas. Barriers

No	Researcher/year	Purpose	Method	Result	Conclusion
	<i>Ethiopia: A case-control study</i>			not infected (AOR = 2.38; 95% CI: 1.30–4.36).	related to the effective implementation of MDA for STH need to be explored in future research.
10	Asfaw M., et al., (2015) ²¹ Prevalence of undernutrition and associated factors among children aged between six to fifty nine months in Bule Hora district, South Ethiopia	To assess the prevalence and factors associated with undernutrition (malnutrition) in children aged 6–59 months in an agro-pastoral community in Bule Hora District, Southern Ethiopia	Cross-sectional - Multistage stratified sampling - 796 anak usia (6-59 bulan)	Children infected with intestinal worms had a 2.27 times higher risk of stunting compared to uninfected children (AOR = 2.27; CI 95%: 1.18–4.37), which shows a significant association between parasitic infections and growth disorders.	The prevalence of stunting, wasting, and underweight is high in toddlers in agro-pastoral communities. The main risk factors include diarrhea, exclusive pre-breastfeeding, boys, illiterate fathers, number of children >4, and not using birth control.
11	Prendergast A., et al., (2015) ³ <i>Stunting is characterized by chronic inflammation in zimbabwean infants</i>	To examine whether inflammation due to enteropathy suppresses growth hormone-IGF and plays a role in the occurrence of stunting in children.	Case control - Total sampling - 202 bayi usia 18 bulan yang tidak terpapar HIV	Stunting begins in the womb and is related to low IGF-1. Stunted babies show higher inflammatory markers (CRP and AGP) from 6 weeks of age, which is associated with a decrease in IGF-1.	Stunting is caused by intestinal damage and chronic inflammation in addition to malnutrition. Low-level chronic inflammation can interfere with the baby's growth.

DISCUSSION

The Effect of Worm Infection on Stunting Incidence

Helminth infections are a major health concern for children in developing countries, leading to nutrient loss, intestinal damage, and growth delays. These infections can cause anemia, digestive issues, and hinder both physical and cognitive development. Studies show a strong link between helminth infections and stunting. Shumbej et al. found that over 23% of preschool children were infected with Soil-Transmitted Helminths, mainly *Ascaris lumbricoides*.¹⁹ Risk factors such as age 36–47 months, not cutting nails, and not washing hands before meals play an important role in increasing the

likelihood of infection. This is consistent with the findings of Asfaw et al, which showed a prevalence of STH of 23.5%, with about 7.4% of children infected with more than one species of worm.²⁰ Another study in Bulukumba Regency recorded a prevalence of worms of 26.3% in stunted children.²¹

The Effect of Eosinophilia on Stunting

Eosinophils are a type of white blood cell that plays a role in the immune response, specifically to parasitic infections. Eosinophilia or abnormal amounts of eosinophils are often associated with parasitic infections, allergic reactions and certain inflammatory conditions.²² In the context of stunting, eosinophilia may indicate

chronic parasitic infections such as intestinal worms, which impair nutrient absorption and contribute to growth delays. Studies show that stunted children often have higher eosinophil counts than non-stunted peers, suggesting a potential link between eosinophilia and impaired growth.¹⁴ Eosinophils are involved in the inflammatory response to parasites and their increased levels may reflect this ongoing immune activation.²²

In addition, the nutritional needs of the immune response during chronic infections can divert resources from growth and development, thereby exacerbating the risk of stunting. Although the exact mechanism is not yet fully understood, the link between eosinophilia and stunting highlights the importance of addressing underlying infectious and inflammatory conditions in the prevention and management of stunting in children.¹⁴ Research conducted by Muslim women shows that eosinophilia is found to be higher in stunted children than in non-stunted children, which indicates the presence of chronic parasitic infections as the main contributor to growth disorders.¹⁴

Influence of nutritional status on humoral and immune cellular

Nutritional status has an important role in supporting immune function. The relationship between nutritional status and immune function has been known for longer. Malnutrition, deficiencies or overnutrition can impair immune function and increase susceptibility to infection. Protein-energy malnutrition is a significant risk factor for infection, especially in children and has been linked to increased morbidity and mortality.²³

Malnutrition, especially protein energy malnutrition can negatively impact cellular and humoral immunity. Malnutrition can lead to decreased antibody production, reduced lymphocyte count and function, disruption of phagocytosis activity and decreased cytokine production.

Deficiencies in proteins and micronutrients, such as zinc, iron and vitamin A can also impair immune function.¹³

The results of the study of Black (2013) show that malnutrition can lead to impaired immune system development, resulting in children being more susceptible to infectious diseases, which will ultimately worsen nutritional status. Energy-protein malnutrition has a direct impact on cellular immunity by decreasing lymphocyte proliferation, inhibiting phagocytosis activity and decreasing immunoglobulin production.¹ On the contrary, adequate nutrition can improve immune function. Adequate nutrition can support the development of immune cell function. Prendargast also stated that children who are not stunted have a better humoral immune response than stunted children, especially to vaccination and primary infection.³

Another study from Kwaifa (2020) states that endothelial dysphagia due to inflammation triggered by malnutrition can interfere with blood flow and the delivery of immune cells to target tissues, thereby inhibiting the overall immune response. This reinforces the idea that improved nutrition is not only important for physical growth, but crucial for maintaining the effectiveness of the immune system.²⁴

Effects of Inflammation on Nutrition

Inflammation can have a significant impact on nutritional status. During inflammation, the body diverts energy and nutrients from growth and storage and instead uses them for an immune response. This can lead to loss of muscle mass, poor appetite, malabsorption of nutrients and weight loss.³

Inflammatory conditions such as infections, chronic diseases and autoimmune disorders are often accompanied by malnutrition. Inflammation can increase energy absorption, reduce nutrient intake and interfere with nutrient absorption and utilization.^{3,13} Inflammatory cytokines

released during the immune response can also directly affect appetite, food intake and metabolism.²⁴ Malnutrition can exacerbate inflammatory conditions by interfering with immune function and increasing susceptibility to infection.^{1,13}

Effect of Stunting on CRP Levels

Stunting in children is often associated with chronic inflammation, which can suppress growth hormone activity, especially through its effects on IGF-1 (Insulin-like Growth Factor-1).³ High levels of C-Reactive Protein (CRP), a marker of inflammation, have been linked to stunted growth because high CRP can inhibit IGF-1 production. IGF-1 plays an important role in bone growth and cell differentiation, which is necessary for normal height development. When IGF-1 levels decrease due to chronic inflammation, the risk of stunting increases, especially in environments that are often infected and poorly sanitized.³

The relationship between malnutrition, infection, and stunting is often described as a “vicious cycle,” where poor nutrition increases susceptibility to infections, which in turn worsen nutritional status. Micronutrient deficiencies play a key role in stunting by hindering physical and cognitive development. Socioeconomic factors, especially poverty, contribute significantly by limiting access to nutritious food, safe living conditions, and healthcare. Economically disadvantaged families often rely on low-quality, nutrient-poor foods, further perpetuating malnutrition and vulnerability to infections.^{13,25,26}

In addition, environmental factors such as inadequate sanitation and limited access to clean water increase exposure to infectious diseases, which deplete the body's nutrient reserves and inhibit growth. Studies have shown that these factors, combined with poor health care and low parental education levels, significantly increase the risk of stunting and other developmental problems in children.^{13,26}

Stunting can create an inflammatory cycle that impacts various body systems. Stunted individuals often show increased levels of C-reactive protein (CRP), which is produced by adipose tissue and can impair endothelial function. This damage is related to the inflammatory effects of adipose tissue on the endothelium of blood vessels, where excess adipose tissue leads to an increase in proinflammatory markers.²⁷ Peradangan tersebut merusak fungsi insulin-like growth faktor-1 (IGF-1), hormon pertumbuhan utama yang memengaruhi perkembangan tulang dan organ. Lower levels of IGF-1 due to chronic inflammation, such as increased CRP, interfere with growth and metabolism, thus forming a predisposition to metabolic conditions such as being overweight and obese later in life.²⁸

Chronic inflammation of adipose tissue further worsens endothelial health by interfering with the role of endothelial regulation. This can increase levels of reactive oxygen species (ROS) and interfere with nitric oxide (NO) synthesis, which affects vasodilation and promotes pro-inflammatory states. For reference values, in healthy individuals without inflammation, hsCRP levels generally range from 1.0 to 3.0 mg/L, while values above 10 mg/L indicate significant inflammation.²⁴

Effect of Stunting on Albumin

Children who are stunted often have inadequate nutritional intake, especially protein. Protein is an essential component for albumin synthesis in the liver. When protein intake is low, albumin synthesis is disrupted, resulting in decreased albumin levels in serum. Research shows that children with poor nutritional status have lower albumin levels compared to children who are not stunted.¹⁵

Stunted children are more susceptible to infections due to their weakened immune systems due to malnutrition. Recurrent infections can lead to increased protein needs for

tissue recovery and repair, but if protein intake remains low, this will lead to decreased albumin levels.²⁹ Stunting not only affects physical growth, but can also disrupt the body's overall metabolism. This metabolic disorder can result in changes in the way the body produces and uses proteins, including albumin. Research shows that children with stunting have inefficient metabolisms in using amino acids for protein synthesis, thus inhibiting the recovery and growth process.³⁰ 15¹⁵

CONCLUSION

Stunting is a chronic growth disorder condition that is affected by various factors, including infection, nutritional status, immune response, and chronic inflammation. Based on the results of the literature review, the conclusions that can be drawn are as follows:

The effect of worm infection on stunting incidence

Soil-Transmitted Helminths (STH) infections significantly increase the risk of stunting through nutrient malabsorption mechanisms and chronic inflammation. Parasitic worms take in essential nutrients and damage intestinal tissues, thereby interfering with the growth of the child.

Effect of eosinophilia on stunting

Eosinophilia, as an indicator of the presence of chronic parasitic infections, is often found in children who are stunted. High levels of eosinophils reflect an immune response to parasites, which can divert the body's resources from growth to immune defenses.

Effect of nutritional status on humoral and cellular immunity

Malnutrition, especially energy-protein and micronutrient deficiencies, negatively affects the humoral and cellular immune systems. This leads to a decrease in antibody production, lymphocyte activity and phagocytosis, thereby increasing susceptibility to infections that worsen stunting.

Effects of inflammation on nutrition

Chronic inflammation due to infection leads to increased metabolic needs, decreased appetite, and interferes with nutrient absorption. This condition worsens the nutritional status of children and creates a cycle of malnutrition that worsens stunting.

The effect of stunting on CRP levels

Stunted children show higher levels of C-Reactive Protein (CRP) as a marker of chronic inflammation. High CRP is associated with decreased production of IGF-1, a hormone essential for bone and tissue growth, thereby inhibiting linear growth.

Effect of stunting on albumin

Children with stunting tend to have lower serum albumin levels, both due to inadequate protein intake and due to chronic infections that increase the body's protein needs. Metabolic and hormonal disorders due to stunting also affect albumin synthesis in the liver.

Overall, infections, inflammation, malnutrition, and immune disorders reinforce each other in the stunting cycle. Prevention must include handling parasitic infections, improving nutrition, and improving access to health services and nutrition education.

REFERENCE

1. Black RE, Victora CG, Walker SP, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet*. 2013;382(9890):427-451. doi:10.1016/S0140-6736(13)60937-X
2. Kusumajaya AAN, Mubasyiroh R, Sudikno S, et al. Sociodemographic and Healthcare Factors Associated with Stunting in Children Aged 6–59 Months in the Urban Area of Bali Province, Indonesia 2018. *Nutrients*. 2023;15(2). doi:10.3390/nu15020389
3. Prendergast AJ, Rukobo S, Chasekwa B, et al. Stunting is characterized by chronic inflammation in zimbabwean infants.

- PLoS One*. 2015;9(2). doi:10.1371/journal.pone.0086928
4. UNICEF. Child Malnutrition. 2023. Accessed January 23, 2025. <https://data.unicef.org/topic/nutrition/malnutrition/>
5. World Health Organization. *Global Nutrition Targets 2025: Stunting Policy Brief (WHO/NMH/NHD/14.3)*; 2014.
6. Kementerian Kesehatan Republik Indonesia. *Hasil Riset Kesehatan Dasar (Riskesdas) Tahun 2018*; 2018.
7. Kementerian Kesehatan RI. *Laporan Tematik Survey Kesehatan Indonesia Tahun 2023: Potret Indonesia Sehat*; 2024. Accessed May 10, 2025. <https://www.badankebijakan.kemkes.go.id/laporan-tematik-ski/>
8. World Health Organization. Soil-transmitted helminth infections. January 18, 2023. Accessed January 19, 2025. <https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections>
9. Hall A, Hewitt G, Tuffrey V, De Silva N. A review and meta-analysis of the impact of intestinal worms on child growth and nutrition. *Maternal and Child Nutrition*. 2008;(4):118-236.
10. Huriah T, Fitriami E, Rahman A, Erviana. The Prevalence and Associated Factors of Stunting Children in Rural Area, Yogyakarta, Indonesia. In: *Third International Conference on Sustainable Innovation 2019 – Health Science and Nursing (IcoSIHSN 2019)*. Atlantis Press; 2019:134-138. doi:10.2991/icosihsn-19.2019.30
11. Pangestika NPW, Putra IGNS, Sidiartha IGL, et al. The Higher C-Reactive Protein Levels as a Risk Factor of Stunting in Children with Acyanotic Congenital Heart Disease. *Open Access Maced J Med Sci*. 2022;10(B):1795-1800. doi:10.3889/oamjms.2022.9551
12. Yanti R, Sinrang AW. Levels of C-Reactive Protein (CRP) in Stunting and Non Stunting Tolls Age 36-60 Months. *International Journal of Health & Medical Sciences*. 2021;4(1):150-154. doi:10.31295/ijhms.v4n1.1667
13. Siddiqui F, Salam RA, Lassi ZS, Das JK. The Intertwined Relationship Between Malnutrition and Poverty. *Front Public Health*. 2020;8. doi:10.3389/fpubh.2020.00453
14. Muslimah PA, Salimo H, Lanti Y, Dewi R. Multilevel Analysis Association of Soil Transmitted Helminths and Stunting in Children Aged 6-12 Years Old in Pinrang District, South Sulawesi. *Journal of Epidemiology and Public Health*. 2020;(03):372-383. doi:10.26911/jepublichealth.2020.05.03.11
15. Telussa FFF, Mahani , Maligana A, Syawal , Kaimudin A. Hubungan Antara Kadar Serum Albumin Dengan Kejadian Stunting Pada Balita Di Desa Tulehu, Kecamatan Salahutu, Kabupaten Maluku Tengah. In: *Prosiding Rapat Kerja Nasional Asosiasi Institusi Perguruan Tinggi Teknologi Laboratorium Medik Indonesia*. Vol 2. ; 2023.
16. Dilina Wanda Y, Elba F, Indra Susanti A, Ruluwedrata Rinawan F. Riwayat Status Imunisasi Dasar Berhubungan Dengan Kejadian Balita Stunting. *Jurnal Kebidanan Malahayati*. 2021;7(4):851-856. <http://ejurnalmalahayati.ac.id/index.php/kebidanan>
17. Mulyono, Fauzia L, Kadir A. Faktor Yang Berhubungan Dengan Kejadian Stunting. *Jurnal Ilmiah*

- Mahasiswa & Penelitian Keperawatan. 2023;3(5):2023.
18. Herianti F. Analisis Faktor Risiko Kejadian Stunting pada Anak Balita di Wilayah Puskesmas Kelurahan Cipinang Melayu Jakarta Timur. *Jurnal Persada Husada Indonesia*. 2017;4(14):74-83.
 19. Shumbej T, Belay T, Mekonnen Z, Tefera T, Zemene E, Ferron ES. Soil-transmitted helminths and associated factors among pre-school children in Butajira Town, south-central Ethiopia: A community-based cross-sectional study. *PLoS One*. 2015;10(8):1-11. doi:10.1371/journal.pone.0136342
 20. Asfaw MA, Wegayehu T, Gezmu T, Bekele A, Hailemariam Z, Gebre T. Determinants of soil-transmitted helminth infections among pre-school-aged children in Gamo Gofa zone, Southern Ethiopia: A case-control study. *PLoS One*. 2020;15(12 December). doi:10.1371/journal.pone.0243836
 21. Asman, Salnus S, Suswani A, Hasanuddin ARP. Gambaran Telur Cacing Balita Stunting Menggunakan Pewarnaan Antosianin Dari Ekstrak Ubi Ungu Metode Flotasi Di Kabupaten Bulukumba. *Jurnal TLM Blood Smear*. Published online 2020.
 22. Setya AK. *Parasitologi: Praktikum Analisis Kesehatan*. EGC; 2014.
 23. Unawekla J V, Sy Moeis E, Langi YA. Hubungan antara Status Gizi dan Sistem Imun Seluler pada Subyek Penyakit Ginjal Kronik Stadium V Hemodialisis di Instalasi Tindakan Hemodialisis RSUP Prof. Dr. R. D. Kandou Manado. *Journal e-Clinic*. 2018;6:16-21.
 24. Kwaifa IK, Bahari H, Yong YK, Md Noor S. Endothelial dysfunction in obesity-induced inflammation: Molecular mechanisms and clinical implications. *Biomolecules*. 2020;10(2). doi:10.3390/biom10020291
 25. World Health Organization. *Stunted Growth And Development, Causes and Consequences (WHO/NMH/NHD/17.7).*; 2017.
 26. Ijaiya MA, Anjorin S, Uthman OA. Individual and contextual factors associated with childhood malnutrition: a multilevel analysis of the double burden of childhood malnutrition in 27 countries. *Glob Health Res Policy*. 2022;7(1). doi:10.1186/s41256-022-00276-w
 27. Kirichenko T V., Markina Y V., Bogatyreva AI, Tolstik T V., Varaeva YR, Starodubova A V. The Role of Adipokines in Inflammatory Mechanisms of Obesity. *Int J Mol Sci*. 2022;23(23). doi:10.3390/ijms232314982
 28. Li M, Qian M, Kyler K, Xu J. Adipose Tissue-Endothelial Cell Interactions in Obesity-Induced Endothelial Dysfunction. *Front Cardiovasc Med*. 2021;8. doi:10.3389/fcvm.2021.681581
 29. Marni Tangkelangi, Supriati Wila Djami, Agnes Rantesalu. Pemeriksaan Kadar Total Protein dan Albumin Sebelum dan Sesudah Pemberian Makanan Tambahan Pada Balita Stunting di Kelurahan Penfui, Kota Kupang. *Jurnal Nusantara Berbakti*. 2023;1(4):116-121. doi:10.59024/jnb.v1i4.250
 30. Safira A, Dalfian, Mandala Z, Hermawan D. Perbedaan Laboratorium Kadar Protein Albumin dan Globulin Pada Anak Stunting dan Anak Tidak Stunting Di Kabupaten Tanggamus Lampung Tahun 2024. *Jurnal Review Pendidikan dan Pengajaran*. 2024;7(2):5156-5165.