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Relationship Between Urinary Tract Infection Incidence in Stunting and Non-Stunting Children: A Literature Review

Yasmin Nadia Devina[1], Nur Aisiyah Widjaja[2,3]*, Agung Dwi Wahyu Widodo[4], Meta Herdiana Hanindita[2,3]

[1]Medical Study Program, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia
[2]Department of Child Health, Faculty of Medicine, Universitas Airlangga, Indonesia
[3]Department of Child Health, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia
[4]Department of Microbiology and Parasitology, Faculty of Medicine, Universitas Airlangga, Indonesia

E-mail: yasmin.nadia.devina-2021@fk.unair.ac.id; nuril08@yahoo.com; agungimunologi@gmail.com; hanindita.meta@gmail.com

*Corresponding author details: Nur Aisiyah Widjaja; nuril08@yahoo.com

ABSTRACT

Background: The high prevalence of stunting in Indonesia is associated with an increased risk of Urinary Tract Infection (UTI), which is more common in male infants, but with age, UTI is more common in girls. ***Objective:*** To review the relationship between UTI incidence in stunting and non-stunting children, focusing on how nutritional status influences susceptibility and associated health outcomes based on previous literatures. ***Method:*** Information on relationship between urinary tract infection incidence in stunting and non-stunting children was gathered using ScienceDirect, PubMed, Google Scholar, WHO, and the Ministry of Health. The search utilized keywords such as "Urinary Tract Infections (UTI)," "bacteria", "stunting", "children", and "malnutrition" resulting in a total of 37 articles included in this literature review. ***Result:*** Stunting increase the risk of UTIs in children more than non-stunting ones due to weakened immunity. Addressing stunting and identifying specific bacterial causes are crucial for reducing UTI prevalence and improving child health outcomes.

Keywords: Urinary Tract Infections (UTI); bacteria; stunting; children; malnutrition.

INTRODUCTION

Stunting refers to short stature caused by chronic malnutrition or undernutrition, identified through anthropometric measurements of height-for-age (H/A) or length-for-age (L/A) with results below -2 standard deviations (SD). According to the Basic Health Research (Riskesdas) data, the prevalence of children under five with stunted and severe stunted in Indonesia was 37.2% in 2013, decreasing to 30.8% in 2018 [1]. Furthermore, the Indonesian Nutrition Status Study (SSGI) in 2021 across 34 provinces indicated that the national stunting prevalence dropped from 27.7% in 2019 to 24.4% in 2021. Despite the decline, these figures are still classified as high by WHO standards, as they exceed 20% [2]. Chronic malnutrition in stunting children weakens their immune systems, making them more susceptible to infectious diseases, which can severely impact their health. One such infection linked to chronic malnutrition is urinary tract infection (UTI) [3].

Urinary tract infection (UTI) is a common bacterial infection in children [4]. It affects approximately 1.7% of women globally, with 8.4% of them being girls under seven years old. UTI occurrence during the first year of life is similar in both boys and girls, but over time, it becomes more prevalent in females after the first year [5]. Most pediatric UTIs originate from the entry and ascent of fecal flora that colonizes the perineum or the lower urinary tract, which is easily exposed to the external environment [6]. The most common cause of UTIs is the Gram-negative bacterium Escherichia coli, followed by other bacteria such as Klebsiella, Proteus, Citrobacter, and Enterobacter spp. [7].

It is well-established that there is a reciprocal interaction between stunting and infections, as any type of infection can worsen nutritional status. On the other hand, stunting can impair the immune system, weakening the body's defenses against infections, particularly urinary tract infections in this context. Therefore, early detection and prompt treatment of infections in children with stunting are crucial [8]. Specifically, urinalysis and urine culture are commonly performed to identify the bacteria causing the UTI. Once the bacteria are identified, appropriate therapy can be determined.

Previous studies found a significant frequency of urinary tract infections (UTIs) in stunting children and established a relationship between nutritional status and UTI occurrence, showing a reciprocal interaction between the two [9,10,11,12]. However, some research reported no significant association between infections and stunting [13]. This has motivated the researcher to conduct this review with the aim of exploring and analyzing the relationship between the incidence of urinary tract infections (UTIs) in stunting and non-stunting children. It aims to provide a comprehensive understanding of how nutritional status impacts UTI susceptibility, highlighting potential mechanisms, prevalence differences, and associated health outcomes in these populations.

METHODS

The method in this study uses database sources from journal publications in ScienceDirect, PubMed, Google Scholar, WHO, and the Ministry of Health. The type of data obtained in this literature review is articles, journals, and books accessed through online searches. The keywords used were "Urinary Tract Infection (UTI)", "stunting", "children", "infectious diseases", and "malnutrition". This literature can be accessed in full text in PDF format and in peer-reviewed journals. The data collection strategy used was to collect several journals from the internet and highlight a few sentences from each journal found. From these highlights, we organized them into points.

RESULTS AND DISCUSSION

Stunting

- *Definition of Stunting*

Stunting is short or very short stature based on length/height for age that is less than -2 Standard Deviation (SD) on the WHO growth curve, due to chronic malnutrition associated with low socioeconomic status, poor nutritional intake, and maternal health, a history of recurrent illness and inappropriate infant and young child feeding practices [2]. Stunting can cause growth failure and hinder the development of children in reaching physical potential, especially in various important organs of the body including the brain, which is largely irreversible, thus also preventing children from reaching cognitive potential [14]. The growth curve used for stunting diagnosis is the WHO child growth standard curve in 2006 which is the gold standard for optimal growth of a child.

- *Epidemiology of Stunting*

The incidence of stunting in the world has increased in the last 10 years. Based on the data, the number of stunting toddlers in the world is 149 million. Of this number, 81.7 million (55%) stunting toddlers are in Asia, and 39% are in Africa. Southeast Asia is the region with the second highest stunting rate after South Asia at 14.4 million (25.0%) under-fives [15].

The prevalence of stunting in Indonesia is still relatively high when compared to other Southeast Asian countries. Based on the Indonesian Nutrition Status Study (SSGI) in 2021, 24.4% of toddlers in Indonesia still suffer from stunting. According to WHO limits, the stunting rate is said to be very high if the prevalence is ≥ 30%, and high if the prevalence is 20 to < 30%. The World Health Assembly targets a 40% reduction in the number of stunting children under five [16]. Meanwhile, Indonesia has a target of reducing stunting to 14% by 2024, which was set by the President in Presidential Regulation No. 72 of 2021 concerning the Acceleration of Stunting Reduction. Therefore, stunting reduction is one of the national priority programs in the 2020-2024 National Medium-Term Development Plan (RPJMN) [17].

- *Etiology of Stunting*

Stunting always begins with inadequate weight gain (weight faltering). Weight faltering that is not optimally managed will slow the linear growth rate as the body tries to maintain nutritional status [2]. This condition has potential factors that cause stunting, whose interactions are very complex [18]. Thus, stunting can be categorized into several main risk factors, namely genetic factors, economic factors, history of LBW, maternal anemia, chronic infectious diseases, and also nutritional deficiencies [19].

- *Pathophysiology of Stunting*

Pathological short stature can be divided into proportional and disproportional. Proportional short stature includes malnutrition, infectious/chronic diseases, and endocrine disorders such as growth hormone deficiency, hypothyroidism, Cushing's syndrome, growth hormone resistance, and IGF-1 deficiency. IGF-1 directly affects skeletal muscle fibers and cartilage cells in the long bones to increase the absorption rate of amino acids and incorporate them into new proteins, thus contributing to linear growth during infancy and childhood. Disproportionately short stature is caused by bone disorders such as chondrodystrophy, bone dysplasia, Turner, Prader-Willi syndrome, Down syndrome, Kallman syndrome, Marfan syndrome, and Klinefelter syndrome [20].

The main and frequent pathophysiology of stunting is due to environmental enteric dysfunction (EED), which is the malabsorption of nutrients until inflammation causes disturbances in the structure and function of the small intestine that has an impact on impaired absorption of nutrients which will affect the child growth and development and cause malnutrition [21].

In adolescence, adolescent growth spurts occur due to the collaboration of growth hormones with gonadal hormones, namely testosterone in boys and estrogen in girls. There is ample evidence from studies of children with abnormally short stature resulting from environmental factors that disrupt the endocrine system, causing a reduction in the release of growth hormone. However, other hormones are also affected, making the causes of growth disorders complex [21].

Urinary Tract Infection (UTI)

• *Definition of UTI*

Urinary tract infection (UTI) is an infection caused by the presence of microorganisms that grow along the human urinary tract. The human urinary tract itself consists of organs that work to collect and store urine. The urinary tract also acts as a channel that removes urine from the body, the sequence starts from the urethra meatus to the kidneys, along the channel also includes several structures, namely the urethra, bladder, ureter, pelvis, and also the kidney parenchyma. There are also structures that play a role in the occurrence of infection and recurrent infection, namely the prostate, epididymis, and perinephric fascia [22].

Urinary tract infection is also defined as the presence of a significant number of germs in the urine that can be found in clinical signs and symptoms of infection. On urinalysis dipstick examination, the presence of leukocyte esterase indicates pyuria, and nitrite indicates the presence of gram-negative pathogenic bacteria that reduce nitrate to nitrite. Leukocyte esterase examination has high sensitivity but low specificity. In contrast, the nitrite test is not a sensitive marker in infants, and not all urinary pathogens reduce nitrate to nitrite. However, when the nitrate test is positive, it is important as it is highly specific for indicating a UTI. A urine culture is a follow-up examination to confirm the urinalysis results. UTI can be considered positive if a germ count >105/mL is found in the middle portion of urine. However, in symptomatic patients, a germ count >104/mL can already be considered positive for UTI, in urine collection using a catheter, a germ count of 103-105/mL is considered positive, while with suprapubic aspiration, the presence of one germ already states significance [23].

This disease is a bacterial infection that often occurs in childhood and is classified into three main forms, namely pyelonephritis, cystitis, and asymptomatic bacteriuria [24]. According to the scale of occurrence, UTIs are equally common in males and females during the first year of life and become more common in females after the first year of life [5]. Most pediatric UTIs are caused by gram-negative coliform bacteria from fecal flora colonizing the perineum, which enter and ascend the urinary tract [6].

• *Epidemiology of UTI*

According to the National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC), UTI is the second most frequent infectious disease after Acute Respiratory Tract Infection (ARI) with 8.3 million cases reported per year [25]. In Indonesia, the prevalence of UTI ranges from 5-15% and the number of UTI patients reaches 90-100 cases per 100.000 population per year [26]. Urinary tract infection itself is very likely to attack all age groups, from neonates to the elderly [27].

UTIs in neonates and infants are more common in males than females. The infection often occurs in the first 3 months of life, related to the presence of congenital anomalies in the urinary tract [28]. Urinary tract infections occur more in male infants (2.7%) who do not undergo circumcision than female infants (0.7%), but with age, the incidence rate is reversed to 3% in girls and 1% in boys. Even the incidence of urinary tract infections in adolescent girls increased from 3.3% to 5.8% [29].

• *Etiology of UTI*

Most UTIs are caused by bacteria, although occasionally fungi and viruses are also etiologic agents of UTIs [30]. The bacteria that cause UTIs are generally bacteria that originate from the normal flora of the gut and live commensally in the vaginal introitus, penile prepuce, perineal skin, and around the anus [26]. As the most common organism causing UTIs, the most commonly infecting bacteria is Escherichia coli which is a gram-negative bacterium. About 80-85% of UTIs are caused by these bacteria [28].

Based on the results of urine culture examination, most UTIs are caused by aerobic Gram-negative bacteria commonly found in the digestive tract (Enterobacteriaceae), and rarely caused by anaerobic bacteria. According to the results of a study, the microorganisms that cause the most UTIs are Escherichia coli (31%), Klebsiella pneumonia (24%) and Enterococcus faecalis (9%) [26]. Other germs that can be found include Staphylococcus saprophyticus, Proteus mirabilis, Citrobacter, Pseudomonas aeruginosa, etc. In addition to germs, fungi can also cause UTIs, especially Candida species [28].

• *Pathophysiology of UTI*

UTIs occur when bacteria enter the urinary tract and multiply, involving the bladder, urethra, ureters, and kidneys [31]. Bacteria generally enter through the urethra and catheters, move to the bladder, and can reach the kidneys, causing pyelonephritis. This infection occurs due to an imbalance between the microorganisms that cause infection and the epithelium of the urinary tract. Microorganisms usually originate from the gut flora and can spread to areas such as the vagina, penis, skin, and anus. Bacteria such as Escherichia coli cause most UTIs [32].

UTIs can enter through three ways: ascending, hematogenous (e.g., M. tuberculosis or S. aureus), or lymphatic. Hematogenous infections usually occur in patients with weakened immune systems. Bacteria such as Salmonella and Pseudomonas can spread hematogenously, while lymphogenous infection occurs through nearby infected lymph nodes or organs [31].

The Relationship between Stunting and Infection

According to a study by Karangasem, infectious diseases can disrupt linear growth and, in turn, affect the nutritional status of young children [33]. Another study in Palu on children aged 12-59 months found that toddlers suffering from infectious diseases are 3.4 times more likely to develop stunting.

These infections contribute to malnutrition as sick individuals require more nutrients to combat the illness they are facing [34].

Frequent infections in young children not only affect their weight but also impact their linear growth. Infections also contribute to deficiencies in energy, protein, and other nutrients due to a decreased appetite, leading to reduced food intake [35]. Even if nutritional intake meets the child's needs, untreated infections will prevent the improvement of the child's health and nutritional status [36].

Malnourished children are more susceptible to UTIs than well-nourished children, so the risk increases as nutrition worsens. Malnutrition is associated with immunologic weakness, making affected children more susceptible to infectious diseases such as UTIs. Stunted and malnourished children have low immunity and are therefore susceptible to clinical and subclinical UTIs, as UTI is a serious condition that can progress to sepsis and other life-threatening consequences in children [37].

CONCLUSIONS

The review indicates a significant connection between malnutrition, stunting, and a heightened risk of urinary tract infections (UTIs). Children who are malnourished and stunted are more prone than non-stunting to UTI due to compromised immunity, which increases their susceptibility to infections. Nonetheless, further studies are essential to identify specific bacterial gram types and species involved, enabling more targeted approaches for managing stunting to reduce UTI prevalence and associated complications in children.

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