RISK FACTORS OF PULMONARY TUBERCULOSIS IN CHILDREN (0-14 YEARS): SYSTEMATIC LITERATURE REVIEW

by Evi Sinaga

Submission date: 08-Apr-2025 09:28PM (UTC+0700)
Submission ID: 2639237020
File name: Anies_RK_Bangkok_presentasi_paper_2025.pdf (358.18K)
Word count: 5872
Character count: 34304

Proceedings of the International Conference of Public Health, Vol. 9, Issue. 1, 2024, pp.1-16

ISSN 2424-6735 online
DOI: https://doi.org/10.17501/24246735.2024.9107

RISK FACTORS OF PULMONARY TUBERCULOSIS IN CHILDREN (0-14 YEARS): SYSTEMATIC LITERATURE REVIEW

Machrumnizar M[1*], Bachtiar A[2], Kusumaratna RK[3], Hidayah N[2], Setyaningtyas RC[2], and Meiyanti[3]

[1]*Doctoral Program, Faculty of Public Health, University of Indonesia, Indonesia*
[2]*Faculty of Public Health, University of Indonesia, Indonesia*
[3]*Faculty of Medicine, Universitas Trisakti, Indonesia*

Abstract: Pulmonary tuberculosis poses a major global health challenge, particularly among children. Accurate and early diagnosis is critical for effective treatment, yet diagnosing pulmonary tuberculosis in children is often complicated by their nonspecific clinical symptoms and the difficulties in collecting samples. This study aims to identify the risk factors and comorbidities associated with tuberculosis in children. The research methodology employed is a systematic literature review (SLR), with data gathered by documenting all relevant international journal articles sourced from four databases such as Google Scholar, PubMed, Scopus, and ProQuest. During the review process using the PRISMA Flow Diagram, only 7 of the 152 records were initially identified after applying inclusion and exclusion criteria. Key results reveal that HIV infection greatly increases the risk of tuberculosis in children due to weakened immune systems. Malnutrition is another significant factor, with undernourished children facing a much higher risk of contracting tuberculosis. Breastfeeding practices were also found to influence tuberculosis rates, with improper practices associated with higher incidences. Additionally, a history of contact with tuberculosis patients and lower socioeconomic status were found to increase the likelihood of developing the disease. Vitamin D deficiency was also identified as a potential factor influencing tuberculosis outcomes in children. This study highlights several key risk factors for pediatric pulmonary tuberculosis. Tackling these issues through comprehensive healthcare measures could improve early detection and targeted interventions, so it has better health outcomes for children at risk. The government's policy strategy regarding End TB 2030 is also the basis for what must be done immediately to prevent an increase in pulmonary tuberculosis mortality rates.

Keywords: children, HIV, malnutrition, pulmonary tuberculosis, risk factors, systematic literature review.

Introduction

Pulmonary tuberculosis (TB) remains a significant global health issue, especially affecting children (Maphalle et al., 2022). Diagnosing and treating TB in children presents unique challenges and is a leading cause of illness and death worldwide (Thomas, 2017). Early and accurate diagnosis is crucial

*Corresponding Author's Email: machrumnizar_md@trisakti.ac.id

for effective treatment and preventing disease progression, yet this is often complicated by nonspecific clinical symptoms and difficulties in obtaining appropriate specimens (Ramos et al., 2017).

Children with pulmonary TB may exhibit symptoms similar to other common childhood illnesses, such as fever, cough, weight loss, and fatigue, making diagnosis challenging. This symptom overlap can lead to delays in diagnosis and treatment, while the difficulty in obtaining suitable specimens, like sputum samples, further complicates accurate diagnosis (Maphalle et al., 2022).

Children from low socioeconomic backgrounds face significant barriers to accessing healthcare (Choi et al., 2023). Moreover, the low level of community awareness and parental knowledge about the importance of pulmonary TB screening contributes to delays in diagnosis and management (Tolossa et al., 2014).

To address these diagnostic challenges, it is essential to identify specific risk factors and comorbidities associated with TB in children. Understanding these factors can aid healthcare providers in developing effective screening and diagnostic protocols for the pediatric population. This study aims to explore these risk factors and comorbidities, enhancing the understanding of TB in children and improving diagnostic processes.

By focusing on the unique aspects of TB in children, this research seeks to uncover patterns that may be less apparent in adults. Identifying these risk factors and comorbidities could lead to earlier detection and targeted interventions, ultimately improving health outcomes for children with pulmonary tuberculosis. The findings could enhance clinical practices and public health policies, advancing the management of pediatric TB globally.

Materials and Methods

The research methodology utilized in this study is the Systematic Literature Review (SLR). This method involves a thorough and structured process to identify, assess, and analyze relevant research articles concerning the risk factors of pulmonary tuberculosis in children aged 0 –14 years. The article references were sourced from four online databases: Google Scholar, PubMed, Scopus, and ProQuest. The search keywords included "risk factors" AND "pulmonary tuberculosis" OR "pediatric" OR "children."

To assess the quality of relevant studies included in the literature review, we used an evaluation scale based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram. Inclusion and exclusion criteria were applied to select studies relevant to the topic under discussion. The inclusion criteria covered cross-sectional, cohort, and case-control studies; participants were pediatric tuberculosis patients aged 0-14 years; articles included tuberculosis diagnostic criteria (both bacteriological and clinical diagnosis), and only articles in English were considered. Exclusion criteria comprised duplicate studies, review articles, animal studies, studies without relevant results, unavailable full texts, conference abstracts, and studies on extrapulmonary tuberculosis. During the review process by the PRISMA flow diagram, 152 records were initially identified, but only 7 studies were included after applying inclusion and exclusion criteria.

Results and Discussion

Results

The PRISMA flow chart demonstrates the systematic approach used to review the literature concerning the risk factors for pulmonary tuberculosis (TB) in children aged 0 to 14 years. The process is divided into several stages: Identification, Screening, and Inclusion. A total of 152 records were identified from various databases, they are Google Scholar (n = 18), PubMed (n = 38), Scopus (n = 65), and ProQuest (n = 31). Before screening, 30 records were removed. This included 4 duplicate records and 26 records that were marked as ineligible by automation tools. Of the 118 records screened, 27 were excluded based on relevance to the study. So, 91 reports were sought for retrieval. However, 21 reports were not retrieved for further assessment. Out of the 70 reports assessed for eligibility, several were excluded for various reasons: 15 reports were unavailable in full text, 37 focused on extra-pulmonary research, and 11 were published in non-English journals. Eventually, 7 reports were included in the systematic review. This thorough and systematic method ensured that only the most relevant and available studies were selected, thus improving the quality and dependability of the review concerning risk factors for childhood pulmonary tuberculosis

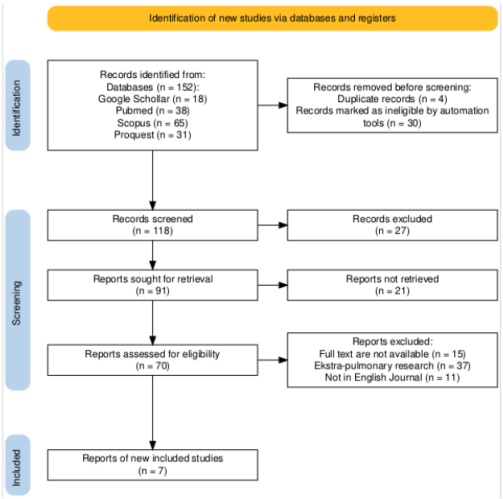

Figure 1. PRISMA Flow Diagram

Discussion

Table 1: Literature Review Results

No.	Title	Author	Year	Location	Desain Study	Sample	Result
1	Prevalence, associated risk factors and rifampicin resistance pattern of pulmonary tuberculosis among children at Debre Markos Referral Hospital, Northwest, Ethiopia	Ayalew, M.L., Yigzaw, W.B., Tigabu, A., Tarekegn, B.G.	2020	Ethiopia	Quantitative, Cross-sectional	384 respondents	1. Children with HIV were 14.78 times more likely to develop TB compared to those without HIV. 2. The rate of pulmonary tuberculosis in children with a history of TB exposure was 11.76% (AOR=14.78, 95% CI: 4.43 -- 49.26), significantly higher than in those without such exposure. 3. Malnourished children were 4.11 times more susceptible to contracting tuberculosis compared to those with adequate nutritional status.
2	Frequency of pulmonary tuberculosis in severely acute malnourished children and its association with inappropriate feeding practice	Bushra Khalil, Mohammad Hussain, Wajiha Taj, Sajid Iqbal, Mohammad Irshad, Muhammad Jamal Khan, Ihsan Ullah	2020	Pakistan	Quantitative, Cross-sectional	222 respondents	1. Out of 222 individuals, 82 (36.9%) were diagnosed with TB. Among these, 58 patients (70.7%) were severely malnourished, and only 2.4% had been breastfed. 2. A significantly lower rate of breastfeeding ($p<0.05$) was linked to a higher incidence of TB. 3. The majority (63.4%) of TB cases began complementary feeding later than the recommended age ($p<0.05$). 4. Factors such as family type, illiteracy, poverty, and lack of immunization

No.	Title	Author	Year	Location	Desain Study	Sample	Result
							were not significantly associated with an increased risk of TB. 5. Malnutrition and poor feeding practices were associated with a higher risk of developing pulmonary tuberculosis.
3	Alert sign and symptoms for the early diagnosis of pulmonary tuberculosis: analysis of patients followed by a tertiary pediatric hospital	Elisa F., Garmen D., Laura L., Elena B., Marta L.C., Antonino R., Paolo R., Alberto V., Massimiliano R., Umberto R.	2022	Rome	Quantitative, Retrospective Cohort	226 patients	Significant risk factors pointed out are contact history with TB and lymphadenopathy
4	Risk of infection and disease with Mycobacterium tuberculosis among children identified through prospective community-based contact screening in Indonesia	Rina Triasih, Collin R., Trevor D., Stephen M.G	2015	Indonesia	Quantitative, Retrospective Cohort	269 children	1. A notable correlation was observed between the prevalence of infection or disease among child contacts and the smear positivity of the index case (chi-squared for trend, 20.29; P<0.001). 2. The solo factors linked to the disease in both univariate and multivariate analyses were whether the child contact was undernourished or had a positive TST.
5	The child ecosystem and childhood pulmonary tuberculosis: A South African perspective	Teresa D., Lesley W., Grant T., Sabine B., Margaretha, Lindy B., Martin P., Keertan D., Mark P., Katherine, Caroline K., Dan J.S., Heather J. Zar	2022	South Africa	Quantitative, Prospective Cohort	1202 children	1. Univariate analyses showed that childhood malnutrition and caregiver smoking were linked to treated or confirmed PTB. 2. In multivariate analyses, factors such as being male and having been hospitalized, along with low socioeconomic status, were associated with PTB.

No.	Title	Author	Year	Location	Desain Study	Sample	Result
6	Effects of Vitamin D supplementation on resolution of fever and cough in children with pulmonary tuberculosis: A randomized double-blind controlled trial in Indonesia	Lianda Tamara, Cissy B Kartasasmita, Anggraini Alam, Dida A Gurnida	2022	Indonesia	Case Controlled	84 patients	The Indonesian Pediatric Society has created a scoring system to assess and evaluate the diagnosis and treatment of pediatric TB in children. This system includes symptoms such as cough, fever, and nutritional status as key factors in evaluating clinical TB in children.
7	Tuberculosis preventive treatment should be considered for all household contacts of pulmonary tuberculosis patients in India	Paradkar M, Padmapriyadarsini C, Jain D, Shivakumar SVBY, Thiruvengadam K, Gupte AN, et al.	2020	India	Quantitative, Cohort	997 patients	HIV infection and undernutrition are independently associated with the occurrence of incident TBI.

Based on the table above, this is a summary of research studies on childhood pulmonary tuberculosis (TB) conducted in various locations, including Ethiopia, Pakistan, India, Italy, South Africa and Indonesia. The studies, conducted between 2015 and 2022, employ quantitative methodologies such as cross-sectional, retrospective cohort, prospective cohort, and case-control designs. Key findings include a significantly higher likelihood of TB among children with HIV in Ethiopia, the association of malnutrition and inappropriate feeding practices with TB in Pakistan, and the correlation between household TB contact and disease prevalence in Indonesia. In South Africa, malnutrition and caregiver smoking are linked to TB, while in India, HIV infection and undernutrition are independently associated with incident TB. The document underscores the importance of early diagnosis, proper nutrition, and effective contact screening in the management and prevention of childhood TB.

Research gaps related to tuberculosis (TB) in children encompass several important aspects, such as limited epidemiological data in certain regions, a lack of studies on the effectiveness of diagnostic methods for children, and the scarcity of research on specific risk factors affecting this age group. Additionally, there is insufficient understanding of the immune response in children to TB infection compared to adults, which impacts the development of appropriate detection and treatment strategies.

To specifically address these gaps, research could focus on gathering more comprehensive data from underrepresented populations, particularly in countries with a high TB burden. Furthermore, we should prioritize additional studies on the development and validation of more sensitive diagnostic tools for children. By focusing on these aspects, research can provide new insights that support early detection and more effective treatment of TB in children, as well as contribute to the improvement of more targeted health policies.

According to Table 1: Literature Review Results above, there are 6 (six) risk factors of pulmonary tuberculosis in children that will be identified. It is expected that more effective policy strategies or interventions can be developed to prevent and reduce the incidence of tuberculosis in children.

HIV

HIV (Human Immunodeficiency Virus) plays a major role in the onset of pulmonary tuberculosis (TB) in children. By impairing the immune system, HIV makes it harder for the body to combat infections such as TB. Children with HIV are especially at risk due to their still-developing immune systems, and HIV can hasten the progression from latent TB infection to active TB disease (Ayalew et al., 2020).

According to Dodd et al. (2017), research indicates that HIV-infected children face a higher risk of developing TB. Studies have demonstrated that children who are HIV-positive are more likely to contract TB than those who are HIV-negative. This increased susceptibility is due to the immunosuppressive properties of HIV, which interfere with the body's ability to contain Mycobacterium tuberculosis, the bacteria that causes TB.

A study in South Africa, where both HIV and TB are common, revealed that children with HIV experienced a markedly higher rate of TB. The research underscored the necessity for combined HIV and TB treatment programs to tackle the dual challenges of these diseases. It also stressed the critical

role of early HIV testing and antiretroviral therapy (ART) in lowering the risk of TB among HIV-infected children (Venturini et al., 2014).

A study by Fry et al. (2019) conducted in India examined the clinical diagnosis of pulmonary TB in children living with HIV. The study revealed that HIV-infected children often present with atypical TB symptoms, making diagnosis more challenging. It underscored the necessity for healthcare providers to be vigilant and consider TB in HIV-positive children, even when symptoms are not typical. These findings underscore the critical need for comprehensive healthcare strategies that address both HIV and TB in pediatric populations. Early diagnosis, prompt treatment, and continuous monitoring are essential to improve outcomes for children affected by both HIV and TB (Vonasek et al., 2022). Collaborative efforts between healthcare providers, governments, and international organizations are crucial to combating the intertwined epidemics of HIV and TB in children (Olivier & Luies, 2023).

The findings suggest a strong correlation between HIV and increased susceptibility to TB in children, where HIV-induced immunosuppression accelerates the progression from latent to active TB. This interaction highlights the need for integrated HIV and TB management strategies. According to the technical guidelines for managing latent TB infection (2020), Indonesia has implemented Isoniazid Preventive Therapy (IPT) for two high-risk groups: people with HIV/AIDS (ODHA) and children under 5 years old who live with active TB patients but are not diagnosed with TB. However, its implementation remains far from the 40% target set for 2018. According to the Global TB Report (2019), only 16% of ODHA (7,681 individuals) and 8.5% of children under 5 years old (6,080 children) received IPT. Another issue is the low adherence and completion rates of the therapy, partly due to the long duration of treatment. Therefore, this research needs to be revisited in light of the developments in comorbid diseases and an individual's immune system to assess the effectiveness of TB treatment with Isoniazid.

Malnutrition

Malnutrition plays a major role in the onset of pulmonary tuberculosis (TB) in children. The interaction of malnutrition compromises the immune system, hindering the body's ability to combat infections such as TB. In children, malnutrition is especially detrimental as it affects growth and immune function, thereby heightening their vulnerability to TB.

Research by Khalil et al. (2020) found that more than a third of malnourished patients had pulmonary TB. The study showed that the risk of developing TB rose with the extent of malnutrition. This finding underscores the critical role that adequate nutrition plays in preventing TB, particularly in vulnerable pediatric populations. The study's results emphasize the need for nutritional interventions as part of comprehensive TB prevention strategies. Supporting this, Ayalew et al. (2020) found that malnourished children were 4.11 times more likely to develop TB compared to those with adequate nutrition. This heightened risk is linked to the weakened immune systems in malnourished children, which accelerates the progression from latent TB infection to active TB disease. The study underscores the need to address malnutrition to mitigate the TB burden in children.

Additionally, research over the last decade has consistently demonstrated a strong connection between malnutrition and increased TB risk in children. A study revealed that children with severe acute

malnutrition were more prone to TB compared to well-nourished peers, highlighting the importance of incorporating nutritional support into TB control strategies (Robinson et al., 2014). These studies highlight the critical need for comprehensive healthcare strategies that address both malnutrition and TB in children. Addressing malnutrition through improved dietary intake, supplementation, and food security measures is crucial in reducing the burden of TB. Early diagnosis and treatment of TB, combined with nutritional rehabilitation, can significantly improve health outcomes for children affected by both conditions.

Further studies are needed to evaluate the effectiveness of nutritional interventions, such as dietary supplementation or food assistance programs, in reducing the risk of TB in children in high TB-burden areas. This research could reveal whether improved nutritional intake helps strengthen the immune system and prevent TB infection. A randomized controlled trial could compare TB incidence between groups receiving nutritional supplementation and those who do not. The study could also explore the optimal duration of interventions and the most effective types of nutrition while considering environmental factors and children's health status. The results are expected to form the basis for better TB prevention policies.

Breastfeeding

Breastfeeding plays a crucial role in a child's health and has been proven to protect against various infections, including pulmonary tuberculosis (TB). The antibodies and protective factors found in breast milk strengthen the immune system, offering substantial defense against diseases such as TB. The World Health Organization (WHO) advises exclusive breastfeeding for the first six months, followed by continued breastfeeding along with appropriate complementary foods until at least two years of age.

A notable study by Khalil et al. (2020) investigated the link between inadequate breastfeeding practices and the occurrence of childhood pulmonary TB. The research revealed that starting breastfeeding late and not exclusively breastfeeding for at least six months was associated with a higher risk of TB in children. Khalil's findings underscored the crucial role of exclusive breastfeeding in enhancing a child's immune defense and reducing TB risk, emphasizing the need for early initiation and continued exclusive breastfeeding as effective measures for TB prevention in children.

Breast milk contains important immunological factors, such as antibodies, that offer protection against Mycobacterium tuberculosis, the bacterium causing TB. It improves cell-mediated immunity and supports the development of T cells, which are essential for a strong immune response. Additionally, breastfeeding boosts the innate immune system, providing further protection against TB and other infections.

Recent research supports these conclusions. For example, Alhrain et al. (2023) found that children who were not exclusively breastfed for the initial six months had a much higher prevalence of TB. In a study conducted in Surabaya, Indonesia, it was noted that 83.3% of children in the case group were not exclusively breastfed, and there was a significant correlation between exclusive breastfeeding and a lower incidence of TB ($p = 0.003$).

Furthermore, Aziz (2018) reported that children who were not exclusively breastfed had a 9.198 times higher risk of developing pulmonary TB compared to those who were exclusively breastfed. This

research underscored the critical role of exclusive breastfeeding in improving immune development and protecting infants from exposure to infectious diseases and unhealthy environments. The anti-inflammatory components in breast milk also help control inflammation in infants, further contributing to their overall health and resistance to TB.

In conclusion, exclusive breastfeeding is a fundamental practice for ensuring child health and preventing diseases such as pulmonary TB. The immunological benefits of breast milk, including the enhancement of cell-mediated immunity and the presence of anti-inflammatory agents, are crucial for protecting children against TB. Promoting and supporting proper breastfeeding practices can significantly reduce the burden of TB in pediatric populations.

Contact History with TB

Research in TB epidemiology highlights the critical impact of having a history of contact with TB patients on the prevalence of TB in children. Breastfeeding provides essential nutrients and antibodies that help strengthen the child's immune system, offering protection against infections like TB. A lack of adequate breastfeeding, particularly in early infancy, may compromise immune development, leaving children more susceptible to TB. Ayalew's study in Ethiopia found that the rate of pulmonary tuberculosis among children who had been in contact with TB patients was 11.76%, which is notably higher than in those without such exposure. The study reported an adjusted odds ratio (AOR) of 14.78, with a 95% confidence interval (CI) ranging from 4.43 to 49.26, indicating a markedly increased risk of TB for children with exposure to TB patients. This underscores the importance of contact history as a significant risk factor for TB (Ayalew et al., 2020).

Supporting these findings, additional research confirms that contact history is a major risk factor for TB in children. Additionally, lymphadenopathy, characterized by swollen lymph nodes, has been recognized as another key risk factor (Thomas, 2017). The accumulation of evidence from these studies emphasizes the need for targeted public health strategies for children with known TB exposure and those showing symptoms such as lymphadenopathy. By prioritizing these high-risk groups, health authorities can better direct resources and implement preventive measures to mitigate TB spread among vulnerable pediatric populations.

These insights underscore the urgency of incorporating detailed contact history assessments in TB screening protocols for children. Enhanced surveillance and early intervention strategies can significantly mitigate the risk of TB transmission, particularly in regions with high endemicity (Cole et al., 2020). The findings from Ayalew et al., (2020) research, along with corroborative studies, provide a compelling case for prioritizing contact history in the fight against pediatric tuberculosis, thereby contributing to more effective public health strategies and improved health outcomes for children.

Socio-economic Status

Research on risk factors for tuberculosis (TB) in children increasingly highlights the importance of financial status in influencing disease prevalence. A study conducted by Teresa in South Africa delved into the multifaceted determinants of pediatric tuberculosis and found compelling evidence linking low socioeconomic status to higher incidences of the disease. The study employed multivariate analyses to discern the impact of various factors on pulmonary tuberculosis (PTB) among children. It was revealed

that proximal factors such as male gender and prior hospitalization were significantly associated with PTB. However, it was the distal factor of low socioeconomic status that emerged as a critical determinant, underlining the intricate interplay between socioeconomic conditions and health outcomes in the context of TB (DeAtley et al., 2021). The correlation between socioeconomic status and the risk of tuberculosis in children is multifaceted and deeply entrenched in the broader social determinants of health. Low socioeconomic status often correlates with a range of conditions that elevate the risk of TB. These include inadequate living conditions, poor nutrition, limited access to healthcare, and higher exposure to environmental risk factors. Children from low-income families are more likely to live in overcrowded housing with poor ventilation, which facilitates the transmission of Mycobacterium tuberculosis. Moreover, financial constraints can hinder access to timely medical care, leading to delays in diagnosis and treatment, thereby increasing the severity and spread of the disease (WHO, 2024).

In addition to these direct associations, low socioeconomic status can indirectly influence TB outcomes through its impact on the immune system. Chronic malnutrition, which is more prevalent in economically disadvantaged communities, compromises immune function, making children more susceptible to infections like TB. Furthermore, the stress associated with living in poverty can have detrimental effects on overall health, exacerbating the vulnerability to infectious diseases (Nidoi et al., 2021).

Another study highlights the urgent need for public health interventions that address the socioeconomic factors influencing health to effectively combat pediatric tuberculosis. Improving living conditions, increasing access to quality healthcare, and ensuring adequate nutrition can help reduce the risk factors linked to low socioeconomic status. These comprehensive strategies are crucial in lowering the incidence of TB among children and achieving broader public health objectives. The findings emphasize the importance of adopting a holistic approach to TB prevention and control, extending beyond medical treatment to include social and economic reforms that support vulnerable populations (Teresa, 2022).

Economic empowerment for people with TB and survivors is a crucial step in supporting their recovery and preventing them from falling back into the cycle of poverty. There are several ways to economically empower them, including training and assistance for small businesses, access to financial resources, decent job opportunities, fundraising, and economic skills training.

Effect of Vitamin D

An area of particular interest is the impact of vitamin D supplementation on alleviating symptoms like fever and cough in children with pulmonary tuberculosis. Research suggests that vitamin D is essential for proper immune function, and its deficiency may hinder the body's ability to fight infections, including TB. Providing children with vitamin D supplements could potentially strengthen their immune response, leading to faster recovery from common TB symptoms, such as prolonged fever and chronic cough.

In Indonesia, the Indonesian Pediatric Society has recognized the importance of a comprehensive approach to diagnosing and evaluating TB in children (Tamara et al., 2022). They have developed a scoring system that incorporates symptoms like cough and fever, along with nutritional status, to assess

clinical TB in pediatric patients. This scoring system reflects the understanding that TB manifests with a range of clinical symptoms and that nutritional health, including vitamin D levels, can significantly impact disease progression and recovery. By integrating nutritional status into the diagnostic criteria, the Indonesian Pediatric Society underscores the potential interplay between vitamin deficiencies and TB, advocating for a holistic approach to patient care.

On an international level, policies regarding vitamin D consumption and its role in preventing and managing tuberculosis in children are gaining attention. Various health organizations are examining the potential benefits of ensuring adequate vitamin D intake as part of TB control strategies (Buonsenso et al., 2022). These policies advocate for routine vitamin D supplementation, especially in regions where deficiency is prevalent, as part of broader public health initiatives to reduce TB incidence. The rationale is that sufficient vitamin D levels may enhance the immune system's capacity to fend off infections, thereby lowering the risk of TB in children. Such policies are informed by a growing body of research suggesting that addressing vitamin D deficiency could be a key component in the fight against tuberculosis.

The interplay between vitamin D deficiency and other risk factors, such as malnutrition and socio-economic disparities, exacerbates the vulnerability of children to TB. These insights highlight the need for further research to solidify the connection between vitamin D and TB outcomes. Further research is needed to determine the optimal dose and duration of vitamin D supplementation that is most effective in reducing the risk of TB in children, particularly in areas with high levels of vitamin D deficiency. Additionally, it is important to investigate the role of vitamin D in enhancing the immune response to Mycobacterium tuberculosis in children and assess whether this mechanism differs from that in adults. This research aims to reduce the risk of TB in children. If a strong relationship is established, incorporating vitamin D supplements into TB treatment protocols could become standard practice, offering a simple yet effective way to enhance recovery rates and reduce the global burden of tuberculosis in children.

Conclusion

The prevalence and management of pulmonary tuberculosis (TB) in children are influenced by factors such as HIV infection, malnutrition, breastfeeding practices, contact with TB patients, socioeconomic status, and vitamin D levels. To reduce the incidence of TB in children, comprehensive measures are needed, including early detection, management of comorbidities, social protection, and cross-sector collaboration. Early detection is crucial for quick diagnosis, while the management of comorbidities, particularly TB/HIV, must be prioritized. Social protection and poverty reduction help alleviate the economic burden on affected families. Cross-sector cooperation, along with political commitment and adequate resources, is essential for the sustainability of child TB elimination programs. A limitation of this study is the lack of journals discussing pulmonary TB in children aged 0-14 years, which hampers the collection of sufficient data for comprehensive conclusions.

References

Ayalew, M. L., Yigzaw, W. B., Tigabu, A., & Tarekegn, B. G. (2020). Prevalence, associated risk factors and rifampicin resistance pattern of pulmonary tuberculosis among children at debre

markos referral hospital, Northwest, Ethiopia. Infection and Drug Resistance, 13, 3863–3872. https://doi.org/10.2147/IDR.S277222

Aziz, K. K. (2018). The Relationship of Exclusive Breastfeeding with the Incidence of Pulmonary Tuberculosis in Children. Jurnal Info Kesehatan, 16(2), 236–243. https://doi.org/10.31965/infokes.vol16.iss2.224

Azzahrain, A. S., Afifah, A. N., & Yamani, L. N. (2023). Detection of Tuberculosis in Toddlers and its Risk Factor at East Perak Health Center Surabaya. Jurnal Kesehatan Lingkungan, 15(2), 92–98. https://doi.org/10.20473/jkl.v15i2.2023.92-98

Buonsenso, D., Pata, D., Colonna, A. T., Ferrari, V., Salerno, G., & Valentini, P. (2022). Vitamin D and Tuberculosis in Children: A Role in the Prevention or Treatment of the Disease? In Monaldi Archives for Chest Disease (Vol. 92, Issue 2112, pp. 1–7). Page Press Publications. https://doi.org/10.4081/monaldi.2022.2112

Choi, S.-W., Im, J.-J., Yoon, S.-E., Kim, S.-H., Cho, J.-H., Jeong, S.-J., Park, K.-A., & Moon, Y.-S. (2023). Lower socioeconomic status associated with higher tuberculosis rate in South Korea. BMC Pulmonary Medicine, 23(418). https://doi.org/10.1186/s12890-023-02713-z

Cole, B., Nilsen, D. M., Will, L., Etkind, S. C., Burgos, M., & Chorba, T. (2020). Essential Components of a Public Health Tuberculosis Prevention, Control, and Elimination Program: Recommendations of the Advisory Council for the Elimination of Tuberculosis and the National Tuberculosis Controllers Association. MMWR. Recommendations and reports : Morbidity and mortality weekly report. Recommendations and reports, 69(7), 1–27. https://doi.org/10.15585/mmwr.rr6907a1

DeAtley, T., Workman, L., Theron, G., Bélard, S., Prins, M., Bateman, L., Grobusch, M. P., Dheda, K., Nicol, M. P., Sorsdahl, K., Kuo, C., Stein, D. J., Zar, H. J., Kuo, C., Stein, D. J., & Zar, H. J. (2021). The Child Ecosystem and Childhood Pulmonary Tuberculosis: A South African Perspective. Pediatric Pulmonology, 56(7), 1–19. https://doi.org/10.1002/ppul.25369

Dodd, P. J., Prendergast, A. J., Beecroft, C., Kampmann, B., & Seddon, J. A. (2017). The impact of HIV and antiretroviral therapy on TB risk in children: A systematic review and meta-analysis. Thorax, 72, 559–575. https://doi.org/10.1136/thoraxjnl-2016-209421

Fry, S. H., Barnabas, S., & Cotton, M. F. (2019). Tuberculosis and HIV - An update on the "cursed duet" in children. In Frontiers in Pediatrics (Vol. 7, Issue 159, pp. 1–12). Frontiers Media S.A. https://doi.org/10.3389/fped.2019.00159

Khalil, B., Hussain, M., Taj, W., Iqbal, S., Irshad, M., Khan, M. J., & Ullah, I. (2020). Frequency of Pulmonary Tuberculosis in Severely Acute Malnourished Children and Its Association Acute Malnourished Children and Its Association with Inappropriate Feeding Practices with Inappropriate Feeding P. Journal of Medical Sciences, 28(3), 252–255. Retrieved from https://jmedsci.com/index.php/Jmedsci/article/view/799

Maphalle, L. N. F., Michniak-Kohn, B. B., Ogunrombi, M. O., & Adeleke, O. A. (2022). Pediatric Tuberculosis Management: A Global Challenge or Breakthrough? Children, 9(1120), 1–42. https://doi.org/10.3390/children9081120

Nidoi, J., Muttamba, W., Walusimbi, S., Imoko, J. F., Lochoro, P., Ictho, J., Mugenyi, L., Sekibira, R., Turyahabwe, S., Byaruhanga, R., Putoto, G., Villa, S., Raviglione, M. C., & Kirenga, B. (2021). Impact of Socio-economic Factors on Tuberculosis Treatment Outcomes in North-Eastern Uganda: A Mixed Methods Study. BMC Public Health, 21(2167), 1–16. https://doi.org/10.1186/s12889-021-12056-1

Olivier, C., & Luies, L. (2023). WHO Goals and Beyond: Managing HIV/TB Co-infection in South Africa. SN Comprehensive Clinical Medicine, 5(251), 1–13. https://doi.org/10.1007/s42399-023-01568-z

Ramos, S., Gaio, R., Ferreira, F., Leal, J. P., Martins, S., Santos, J. V., Carvalho, I., & Duarte, R. (2017). Tuberculosis in children from diagnosis to decision to treat. Revista Portuguesa de Pneumologia (English Edition), 23(6), 317–322. https://doi.org/10.1016/j.rppnen.2017.06.004

Robinson, H., Calamia, M., Gläscher, J., Bruss, J., & Tranel, D. (2014). Neuroanatomical correlates of executive functions: A neuropsychological approach using the EXAMINER battery. Journal of the International Neuropsychological Society, 20(1), 52–63. https://doi.org/10.1017/S135561771300060X

Tamara, L., Kartasasmita, C. B., Alam, A., & Gurnida, D. A. (2022). Effects of Vitamin D supplementation on resolution of fever and cough in children with pulmonary tuberculosis: A randomized double-blind controlled trial in Indonesia. Journal of Global Health, 12(04013), 1–8. https://doi.org/10.7189/jogh.12.04013

Thomas, T. A. (2017). Tuberculosis in Children. Pediatric Clinics of North America, 64(4), 893–909. https://doi.org/10.1016/j.pcl.2017.03.010

Tolossa, D., Medhin, G., & Legesse, M. (2014). Community knowledge, attitude, and practices towards tuberculosis in Shinile town, Somali regional state, eastern Ethiopia: a cross-sectional study. BMC public health, 14, 804. https://doi.org/10.1186/1471-2458-14-804

Venturini, E., Turkova, A., Chiappini, E., Galli, L., de Martino, M., & Thorne, C. (2014). Tuberculosis and HIV co-infection in children. In BMC Infectious Diseases (Vol. 14, Issue 55, pp. 1–10). BioMed Central Ltd. https://doi.org/10.1186/1471-2334-14-S1-S5

Vonasek, B. J., Rabie, H., Hesseling, A. C., & Garcia-Prats, A. J. (2022). Tuberculosis in Children Living With HIV: Ongoing Progress and Challenges. Journal of the Pediatric Infectious Diseases Society, 11(3), 72–78. https://doi.org/10.1093/jpids/piac060

WHO. (2024). Social Determinants. World Health Organization. http://www.who.int/teams/global-tuberculosis-programme/populations-comorbidities/social-determinants

RISK FACTORS OF PULMONARY TUBERCULOSIS IN CHILDREN (0-14 YEARS): SYSTEMATIC LITERATURE REVIEW

ORIGINALITY REPORT

17%	13%	11%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	publichealthconference.co Internet Source	3%
2	www.researchgate.net Internet Source	1%
3	mental.jmir.org Internet Source	1%
4	ouci.dntb.gov.ua Internet Source	1%
5	pmc.ncbi.nlm.nih.gov Internet Source	1%
6	epe.lac-bac.gc.ca Internet Source	1%
7	Etika Indri Astuty, Lucia Yovita Hendrati. "A DISTRIBUTION MAP OF CHILDHOOD TUBERCULOSIS IN AGE GROUP OF 0-14 YEARS BY THE COVERAGE OF EXCLUSIVE BREAST MILK AND BCG IMMUNIZATION", Jurnal Biometrika dan Kependudukan, 2021 Publication	1%
8	Triasih, Rina, Colin Robertson, Trevor Duke, and Stephen M Graham. "Risk of infection and disease with Mycobacterium tuberculosis among children identified through prospective community-based contact screening in Indonesia", Tropical Medicine & International Health, 2015. Publication	1%
9	bernews.com Internet Source	<1%
10	research-explorer.ista.ac.at Internet Source	<1%

11	ejb.springeropen.com Internet Source	<1 %
12	rollingout.com Internet Source	<1 %
13	ugspace.ug.edu.gh:8080 Internet Source	<1 %
14	www.jpmh.org Internet Source	<1 %
15	Mfundo Mandla Masuku, Nomakhosi Nomathemba Sibisi. "Combating School-Based Violence Using African Indigenous Knowledge Systems - Implications for Educational Safety", Routledge, 2025 Publication	<1 %
16	researchonline.lshtm.ac.uk Internet Source	<1 %
17	scholarworks.waldenu.edu Internet Source	<1 %
18	msh.org Internet Source	<1 %
19	Alifa Salsabila Azzahrain, Anisa Nur Afifah, Laura Navika Yamani. "Detection of Tuberculosis in Toddlers and its Risk Factor at East Perak Health Center Surabaya", JURNAL KESEHATAN LINGKUNGAN, 2023 Publication	<1 %
20	Preeti Kale, Kandepi Swapnik, Kirtish Acharya, Srikar Praneeth Chilla, Aditya Kaushal Paul Reddymas. "Nutritional gaps in pediatric oncology: Addressing vitamin deficiencies for optimal recovery", IP International Journal of Medical Paediatrics and Oncology, 2024 Publication	<1 %
21	Lianda Tamara, Cissy B Kartasasmita, Anggraini Alam, Dida A Gurnida. "Effects of Vitamin D supplementation on resolution of fever and cough in children with pulmonary tuberculosis: A randomized double-blind	<1 %

	controlled trial in Indonesia", Journal of Global Health, 2022 Publication	
22	pakmedinet.com Internet Source	<1 %
23	jmedsci.com Internet Source	<1 %
24	ku.ac.ke Internet Source	<1 %
25	Rezania Asyfiradayati, S.KM., M.PH.. "Factors Associated With Pediatric Pulmonary Tuberculosis Incidence In Surakarta City Health Office Work Area", Journal of Public Health Research and Community Health Development, 2021 Publication	<1 %
26	assets.researchsquare.com Internet Source	<1 %
27	Umberto Pelosi, Roberta Pintus, Salvatore Savasta, Vassilios Fanos. "Pulmonary Tuberculosis in Children: A Forgotten Disease?", Microorganisms, 2023 Publication	<1 %
28	eprints.ums.ac.id Internet Source	<1 %
29	journal2.unusa.ac.id Internet Source	<1 %
30	newsblaze.com Internet Source	<1 %
31	"Topic Sessions - Part 1", Pediatric Pulmonology, 2018 Publication	<1 %
32	Alan Santos-Mena, Oscar E. González-Muñiz, Yolanda M. Jacobo-Delgado, Bruno Rivas-Santiago. "Shedding light on vitamin D in tuberculosis: A comprehensive review of clinical trials and discrepancies", Pulmonary Pharmacology & Therapeutics, 2024 Publication	<1 %

33	Chiwook Chung, Kyu Na Lee, Kyungdo Han, Junhee Park, Dong Wook Shin, Sei Won Lee. "Association between alcohol consumption and risk of developing tuberculosis in patients with diabetes: a nationwide retrospective cohort study", Respiratory Research, 2024 Publication	<1 %
34	P J Dodd, A J Prendergast, C Beecroft, B Kampmann, J A Seddon. "The impact of HIV and antiretroviral therapy on TB risk in children: a systematic review and meta-analysis", Thorax, 2017 Publication	<1 %
35	Yuniske Penyami, Moh Projo Angkasa, Sumarni Sumarni. "Using storybooks to enhance health awareness among schoolchildren at risk of tuberculosis", Malahayati International Journal of Nursing and Health Science, 2025 Publication	<1 %
36	bmchealthservres.biomedcentral.com Internet Source	<1 %
37	irep.iium.edu.my Internet Source	<1 %
38	jpns-journal.com Internet Source	<1 %
39	Elizabeth Whittaker, Elisa López-Varela, Claire Broderick, James A. Seddon. "Examining the Complex Relationship Between Tuberculosis and Other Infectious Diseases in Children", Frontiers in Pediatrics, 2019 Publication	<1 %
40	Kendalem Asmare Atalell, Ribka Nigatu Haile, Masresha Asmare Techane. "The magnitude of tuberculosis and its associated factors among under-five children admitted with severe acute malnutrition at public Hospitals in Dire Dawa city, Eastern Ethiopia 2021. Multi-centered cross-sectional study", IJID Regions, 2022 Publication	<1 %

41	Mohammod Jobayer Chisti, Tahmeed Ahmed, Abu S. M. S. B. Shahid, K. M. Shahunja et al. "Sociodemographic, Epidemiological, and Clinical Risk Factors for Childhood Pulmonary Tuberculosis in Severely Malnourished Children Presenting With Pneumonia", Global Pediatric Health, 2015 Publication	<1 %
42	Mulusew Liyew Ayalew, Wubet Birhan Yigzaw, Abiye Tigabu, Baye Gelaw Tarekegn. " Prevalence, Associated Risk Factors and Rifampicin Resistance Pattern of Pulmonary Tuberculosis Among Children at Debre Markos Referral Hospital, Northwest, Ethiopia ", Infection and Drug Resistance, 2020 Publication	<1 %
43	Sri Umijati, Susilowati Andajani. "Model of care risk factors associated with tuberculosis in children", AcTion: Aceh Nutrition Journal, 2024 Publication	<1 %
44	"HIV and Tuberculosis", Springer Science and Business Media LLC, 2019 Publication	<1 %
45	Adrian F. Gombart. "Vitamin D - Oxidative Stress, Immunity, and Aging", CRC Press, 2019 Publication	<1 %
46	Amare Kassaw, Worku Necho Asferie, Molla Azmeraw, Demewoz Kefale et al. "Incidence and predictors of tuberculosis among HIV-infected children after initiation of antiretroviral therapy in Ethiopia: A systematic review and meta-analysis", PLOS ONE, 2024 Publication	<1 %
47	Made Agus Nurjana, Gunawan Gunawan, Dwi Hapsari Tjandrarini, Olwin Nainggolan. "The Relationship between External and Internal Risk Factors with Pulmonary Tuberculosis in Children Aged 0-59 Months in Slums in	<1 %

Indonesia, 2013", Global Journal of Health Science, 2020
Publication

48	journal2.uad.ac.id Internet Source	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		