Vitamin A Deficiency and Its Impact on Antibiotic Effectiveness in Pneumonia

Introduction

Acute respiratory infections are associated with or cause approximately 3.8 million childhood deaths annually, accounting for 30.3% of all deaths in this age group, with pneumonia being responsible for the majority of these fatalities; it remains a common respiratory illness and a major killer of young children in developing countries and elderly individuals in developed countries. (1) Pneumonia is classified into bacterial and viral pneumonia, but with the widespread use of pneumococcal vaccines, people are now focusing more on viral pneumonia.

Vitamin A is essential for normal immune function and maintenance of mucosal epithelial integrity; deficiency increases susceptibility to infections and can worsen outcomes in respiratory illness. While some studies have shown that Vitamin A can reduce case fatality,(2) severity of illness, and duration of pneumonia that complicated with measles, other studies show that when used a smaller treatment dose of vitamin A for measles (corresponding to 200 000 IU of vitamin A for 1–4 year old patients) no significant impact was observed on the incidence of or recovery from pneumonia or on case fatality. (3) Therefore, it is important to understand whether and how Vitamin A deficiency alters the clinical effectiveness of antibiotic therapy for pneumonia, especially in low and middle-income settings where Vitamin A deficiency is common. This literature review synthesizes clinical trials, observational studies, and past studies to assess the relationship between Vitamin A deficiency and antibiotic efficacy in pneumonia.

Methods

This literature review is based on sources from PubMed/PMC, WHO ELENA, Google Scholar, and recent systematic reviews. Our team prioritized randomized controlled trials (RCTs), meta-analyses, WHO/NIH guidance, and mechanistic animal or cellular studies published up to 2025. Since there are no studies showing the relationship between Vitamin A with pneumonia and measles, we exclude studies limited to measles-associated pneumonia and studies with insufficient data or focused only on neonatal vitamin A with unrelated endpoints. Instead, our team focuses on studies related to observational studies correlating serum retinol and pneumonia outcomes, mechanistic studies on Vitamin A deficiency and host defense against respiratory pathogens, and systematic reviews assessing supplements for pneumonia outcomes.

Results

The three studies collectively shed light on the role of Vitamin A in treating childhood pneumonia, though their findings differ in scope and emphasis.

Randomized, double-blind, placebo-controlled experiment

Rodríguez et al. (2005) conducted a randomized, double-blind, placebo-controlled trial to investigate whether moderate doses of Vitamin A could improve recovery in underweight and normal-weight children receiving antibiotics for pneumonia. The study found no significant overall improvement in recovery time or treatment outcomes with Vitamin A supplementation. However, a small subset of children with higher baseline Vitamin A levels showed slight benefits, suggesting that supplementation may support recovery only in children who already have adequate Vitamin A stores. This finding highlights that the child's initial nutritional status may influence the effectiveness of supplementation.

A systematic review and meta-analysis of 15 clinical trials

In contrast, Li et al. (2022) performed a systematic review and meta-analysis of 15 clinical trials, offering a broader evaluation of Vitamin A supplementation across diverse populations. Their analysis found that children receiving consistent Vitamin A supplementation alongside standard treatment experienced faster recovery and reduced illness severity compared with those who did not receive supplementation. These results suggest that, at a population level, Vitamin A can improve clinical outcomes in children with pneumonia, particularly in settings where baseline deficiency is common. The study emphasizes the potential value of integrating nutritional support as an adjunct to antibiotic therapy, especially in populations with higher rates of malnutrition.

Correlational studies

Li et al. (2020) examined the relationship between serum Vitamin A levels and the incidence of refractory Mycoplasma pneumoniae pneumonia (RMPP). Their findings revealed a strong association between low Vitamin A levels and increased risk of severe or treatment-resistant pneumonia. Children with Vitamin A deficiency were more likely to experience complications or slower responses to standard antibiotics, indicating that adequate Vitamin A may be essential for optimal immune function. This study underscores that Vitamin A deficiency not only increases susceptibility to pneumonia but may also limit the effectiveness of antibiotic treatment.

Abdelkader, Ashraf, et al. (2022) further explored the association between Vitamin A deficiency and pneumonia severity in hospitalized children. Their study demonstrated that children with lower serum retinol levels had significantly higher rates of complications, including prolonged fever, hypoxemia, and delayed radiologic improvement, despite receiving appropriate antibiotic therapy. Notably, Vitamin A–A-deficient children experienced markedly slower clinical recovery, supporting the hypothesis that poor nutritional status can impair host defenses and reduce treatment responsiveness.

Additional studies also support the relationship between Vitamin A status and pneumonia outcomes. For instance, Checkley et al. (2010) conducted a meta-analysis of community-based trials and found that Vitamin A deficiency was strongly correlated with an increased risk of acute lower respiratory infections, including pneumonia. While supplementation did not consistently reduce pneumonia-specific mortality, deficient children demonstrated higher susceptibility and more severe disease courses, suggesting that adequate baseline Vitamin A is key for immune competence.

Similarly, Stephensen (2001) provided mechanistic evidence that Vitamin A deficiency disrupts epithelial barrier function, reduces mucosal immunity, and impairs innate immune cell activity, all of which contribute to greater severity and slower recovery from respiratory infections. These mechanistic vulnerabilities help explain why Vitamin A-deficient patients often respond less effectively to antibiotics, as their immune systems cannot adequately support pathogen clearance.
Collectively, these correlational and mechanistic studies highlight that Vitamin A deficiency is a significant risk factor for severe or refractory pneumonia and may diminish the clinical effectiveness of standard antibiotic therapy.

Discussion

Taken together, these studies suggest that Vitamin A supplementation alone does not consistently improve pneumonia outcomes for all children. Nonetheless, a deficiency in Vitamin A clearly increases the risk of severe illness and may reduce the efficacy of antibiotics. These findings indicate that assessing and addressing Vitamin A status could be a valuable component of pediatric pneumonia management, particularly for populations at risk of deficiency. Moreover, the variation in study results highlights the importance of considering baseline nutritional status when evaluating the potential benefits of supplementation.

Conclusions

Overall, the current body of evidence demonstrates that while Vitamin A supplementation does not universally improve antibiotic treatment outcomes for all children with pneumonia, Vitamin A deficiency itself is consistently associated with worse clinical trajectories, greater disease severity, and reduced responsiveness to antibiotic therapy. Randomized trials show mixed or minimal benefits of supplementation, yet observational and mechanistic studies strongly indicate that inadequate Vitamin A compromises epithelial integrity, weakens innate immunity, and predisposes children to more severe or refractory pneumonia. Therefore, identifying and correcting Vitamin A deficiency, rather than routine supplementation for all patients, may be an important adjunct to pneumonia management, particularly in regions where deficiency is common. Future research should emphasize the interaction between

micronutrient status, host immunity, and antibiotic pharmacodynamics to clarify which clinical subgroups stand to benefit most from targeted Vitamin A support. Taken together, these findings highlight the importance of incorporating nutritional screening into pediatric pneumonia care and underscore that optimal recovery depends not solely on antibiotic treatment, but also on the patient's underlying micronutrient status.

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