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FULL PAPER

Role of vitamin D supplementation in children with pneumonia: Systematic and meta-analysis

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Pneumonia severity may be correlated with a vitamin D deficiency. In order to combat bacterial and viral respiratory tract infections, vitamin D possesses immunomodulatory and anti-infective qualities. Vitamin D receptors can promote the production of antibacterial peptides. It is unknown, nevertheless, if improving outcomes by combining oral vitamin D therapy with the conventional treatment for pneumonia will be beneficial. Consequently, in order to fully understand how vitamin D supplementation affects the course and recurrence of pneumonia in children, a systematic review and meta-analysis are required. In this review, the differences between children getting vitamin D3 supplementation and placebo in terms of hospital stay duration, mortality rate, and pneumonia recurrence were examined. It was determined from the pooled analysis that vitamin D supplementation had no significant impact on lowering hospitalization duration (pooled MD: -0.49 [95% CI: -1.46, 0.48], p = 0.32), hospitalization mortality rates (pooled logRR: -0.40; RR: 0.68 [95% CI: -0.85, 0.05], p = 0.08), or pneumonia recurrence rates (pooled logRR: -0.21; RR: 0.92 [95% CI: -0.54, 0.12], p = 0.21). Vitamin D supplementation had no effect on lowering the mortality rate, length of hospital stay, or recurrence rate in children with pneumonia. To ensure that supplementation has a substantial effect, more study that examines the variables influencing adequacy and maximizes the role of vitamin D in children should be conducted.

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KEYWORDS

Vitamin D; 25(OH)D; pneumonia; children.

Introduction

For kids under five, pneumonia is a serious health risk that can result in sickness and even death. With a fatality rate of between 5% and 20%, pneumonia is the condition that caused a significant number of hospitalizations in Indonesian children under the age of five in 2015. The country ranked eighth in the world for pediatric pneumonia deaths in 2015. Furthermore, in children from Indonesia, vitamin D insufficiency and pneumonia frequently co-occur [1]. Studies show a connection between children's acute

respiratory infections and the frequency and severity of vitamin D deficiency [2]. Supplementing with vitamin D may lessen the severity of pneumonia in children in underdeveloped countries [3].

Globally, pneumonia remains a pressing issue, particularly in low and middle-income countries like those in Asia and Africa, where the majority of cases occur. In 2010, millions of children under 5 experienced pneumonia episodes, resulting in significant mortality rates [4]. Southeast Asia and the West Pacific regions saw millions of cases, with a notable percentage requiring hospitalization and resulting in deaths. Characteristics of included studies are presented in Table 1 [3]. This Table summarizes the key characteristics of the randomized controlled trials (RCTs) included in the systematic review and meta-analysis, detailing the country of origin, participant demographics, number of subjects in the intervention and control groups, the nature of the vitamin D supplementation intervention, the measured outcomes, and the main conclusions drawn from each study.

Vitamin D supplementation offers a straightforward and potentially beneficial adjunct to standard treatment for childhood pneumonia. It is cost-effective and easy to administer, possibly reducing severity and mortality rates when combined with antibiotics [5].

Vitamin D deficiency and the severity of pneumonia appear to be related [6]; supplementation may reduce the severity and recurrence of respiratory infections in children [3]. By bolstering the body's adaptive and natural defensive systems, vitamin D supplements can hasten healing and shorten hospital stays [7]. Vitamin D has immunomodulatory and anti-infective properties that help fight viral and bacterial respiratory tract infections. Antibacterial peptide synthesis can be stimulated by vitamin D receptors [8]. Comprehensive meta-analyses are necessary to evaluate the effect of vitamin D supplementation on hospitalization duration, death rates, and pneumonia recurrence in children, as the ideal dosage and duration of this treatment are still unknown.

TABLE 1 Characteristics of included studies

Author, year	Country	Participants	No. of subjects		Intervention	Outcome	Conclusion
			Intervention group	Control group			
Manaseki-Holland *et al.*, 2010 [9]	Afghanistan	Age: 1-36 months Pneumonia and severe	224	229	I: Oral Vitamin D3 100.000 IU, single dose on the first day of admission C: Placebo (2 mL olive oil)	Duration of hospitalization, pneumonia recurrence	The intervention group's rate of pneumonia recurrence was found to be considerably lower than that of the control group.

Manaseki-Holland *et al.*, 2012 [10]	Afghanistan	Age: 1-11 months Pneumonia	1524	1522	I: Oral Vitamin D3 100.000 IU, once every 3 months, for 18 months C: Placebo (olive oil)	Incidence and pneumonia severity	There was no discernible difference in the frequency.
Choudhary *et al.*, 2012 [11]	India	Age: 2 months – 5 years	87	86	I: Oral Vitamin D3 1000 IU (Age ≤1 years) and 2000 IU (Age >1 years) for 5 days C: Standard	Duration of hospitalization	The length of hospital stay in the intervention and control groups did not change.
Dhungel *et al.*, 2015 [12]	Pakistan	Age: 2-60 months Pneumonia and	100	100	I: Vitamin D3 100.000 IU intramuscular injection, single dose on the first day of admission	Duration of hospitalization, pneumonia recurrence	Supplementing with vitamin D may shorten hospital stays, while the effect is not statistically significant. The intervention group's rate of pneumonia recurrence was found to be considerably lower than that of the control group.
Gupta *et al.*, 2016 [13]	India	Age: 6 months – 5 years	162	162	I: Oral Vitamin D3 100.000 IU per oral, single dose on the first day of admission	Duration of hospitalization, pneumonia recurrence	Supplementing with vitamin D has the potential to drastically shorten hospital stays. The intervention group's rate of pneumonia recurrence was found to be considerably lower than that of the control group.
Rahmati *et al.*, 2016 [3]	Iran	Age: 2-72 months	50	50	I: Oral Vitamin D3 50.000 IU/day for 2 days C: Placebo (olive oil)	Duration of hospitalization	Subjects in the intervention group spent far less time in the hospital than those in the control group.
Somnath *et al.*, 2017 [14]	India	Age: 2 months – 5	78	76	I: Oral Vitamin D3 100.000 IU, single dose on the first day of	Duration of hospitalization, mortality	The length of hospital stay and death rates did not change
Singh *et al.*, 2019 [15]	India	Age: <5 years Pneumonia	50	50	I: Oral Vitamin D3 300.000 IU, once every 4 months, for one year C: Standard treatment	Incidence and pneumonia severity	The intervention group had a reduced rate of pneumonia
Labib *et al.*, 2020 [16]	Egypt	Age: 1 months – 12 years	93	98	I: Vitamin D3 100.000 IU intramuscular injection, single dose on the first day of admission C: Placebo (*saline*)	Duration of hospitalization, mortality	When comparing the intervention group to the control.

Chowdhury et al., 2021 [2]	Bangladesh Severe pneumonia Age: 2-59 months	97	100	C: Standard treatment I: Oral Vitamin D3 20,000 IU (Age <6 months), 50,000 IU (Age 6–12 months), and 100,000 IU (Age 13–59 months) on the first day, then 10,000 IU/day for 4 days	Duration of hospitalization, mortality	The length of hospital stay and death rates did not change.

Experimental

Search strategies

The Preferred Reporting Items for Systematic Examination and Meta-Analysis (PRISMA) criteria were used in the conduct of this research. The PROSPERO database has the study protocol filed under CRD42023401644. Using medical subject headings (MeSH) and free-text phrases, we systematically search published publications from PubMed, Cochrane, and Google Scholar up until December 12th, 2023: [(((((vitamin D) OR (25-hydroxyvitamin D)) OR (25(OH)D)) OR (cholecalciferol)) OR (vitamin D3)] AND [(severity of pneumonia) OR (pneumonia)] Additionally, [(((children) OR (child)) OR (pediatric)) OR (adolescence)]. Randomized Controlled Trials (RCTs) were included in this review without language restrictions.

Study selection

Independently, two reviewers went through the records. These were the conditions for inclusion: (1) population: children (0-18 years old) having a diagnosis of pneumonia; (2) intervention: vitamin D supplementation, either alone or in combination with other asthma treatments, irrespective of the brand names, dosages, or modes of administration; (3) comparison: either a placebo or control group; (4) Results: length of stay in the hospital, death, and recurrence; RCTs, or randomized controlled trials, are the fifth study design.

Data extraction

Two investigators worked independently to extract data from a previously created collection form. Data gathered from studies included the type of vitamin D supplied. The duration of hospitalization, mortality, and recurrence were the retrieved outcome data.

Outcomes

The primary outcome was the duration of hospitalization, including the mortality rate during hospitalization. Subgroup analysis was done based on the route of supplementation, whether orally or intramuscular injection. The secondary outcome was the recurrence of pneumonia, and subgroup analysis was done based on the severity of pneumonia.

Quality assessment

Using the checklist for randomised controlled trials and the Joanne Briggs Institute (JBI) Critical Appraisal tools, two reviewers independently assessed each chosen study's quality. Senior researchers (RAS) were consulted if any discrepancies were discovered.

Statistical analysis

Forest plots were used to evaluate the pooled outcomes analyses, and 95% confidence intervals were displayed. The data were examined for heterogeneity and possible publication bias prior to determining relevant factors. Risk ratio (RR) was used to assess mortality and recurrence, whereas pooled standardized mean difference (sMD) was used to assess hospital stay duration. The STATA/MP 17.0 was utilized for data analysis. To prevent methodological errors, statistical analyses were carried out separately by two authors (PP and CD).

Results and discussion

Study selection

The search yielded numerous articles from Pubmed (n = 304), Cochrane (n = 63), and Google Scholar (n = 159) databases. After eliminating duplicates, a total of 456 articles remained. Following title and abstract screening, 56 articles were selected for thorough text review, resulting in 16 articles meeting the criteria. Four articles lacked complete manuscripts, one was not in English, and one was identified as plagiarized. Figure 1 displays the research literature search flow diagram.

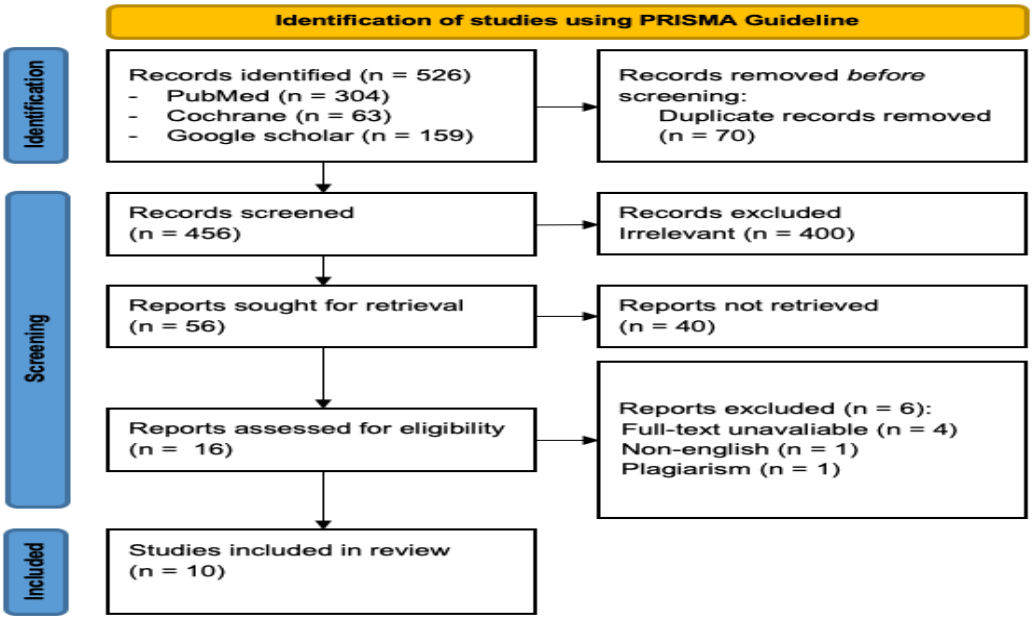


FIGURE 1 the research literature search flow diagram

Study characteristics

This systematic review and meta-analysis found 10 randomized controlled trials (RCTs) that might be included based on the results of the literature search. With 2,465 children in the intervention group and 2,473 in the control group, these trials included a total of 4,938 individuals, ranging in age from one month to twelve years. Oral and intramuscular vitamin D supplementation, given as single doses, continuous doses for five days, or intermittent doses every three or four months, was the mainstay of the therapies. Results including the length of hospital stay, hospitalization mortality rate, incidence and severity of pneumonia, and so on were assessed by the systematic review

and meta-analysis.

The study prioritized RCTs due to their robustness in evaluating intervention effects compared to controls, representing the highest level of evidence on the research pyramid. Bias assessment utilized the Joanne Briggs Institute (JBI) Critical Appraisal tools, specifically the checklist for Randomized Controlled Trials. Overall, all studies demonstrated good quality with low risk of bias. However, three of the analyzed studies lacked detailed explanations regarding participant dropout rates and reasons, while one study did not adequately describe the blinding technique employed, making it unclear whether intervention providers and outcome assessors were aware of the intervention assignment for subjects.

Outcomes

Role of Vitamin D supplementation on duration of hospitalization

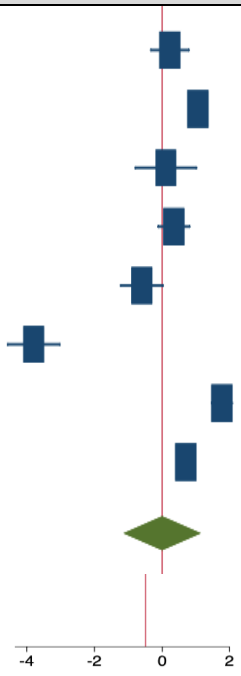
According to the pooled analysis, giving vitamin D supplements to kids who had pneumonia did not considerably shorten their stay in the hospital (pooled MD: -0.49 [95% CI: -1.46, 0.48], p = 0.32). Egger's test revealed that the distribution of the studies was asymmetric (standard error [SE]: 3.668; z = -2.05; p-value = 0.0402). However, sensitivity analysis verified that the results remained stable even when specific studies were excluded.

Whether supplementation was given orally or by intramuscular injection, subgroup analysis revealed no significant impact on hospitalization length (pooled MD: -0.76 [95% CI: -1.94, 0.42], p = 0.21, and pooled MD: 0.35 [95% CI: -1.02, 1.72], p = 0.62, respectively). Furthermore, giving a vitamin D dosage of 100,000 IU had no discernible impact on the length of hospital stay (pooled MD: -0.71 [95% CI: -2.24, 0.83], p = 0.37). A symmetrical study distribution was shown by Egger's test (SE: 7.740; z = -1.35; p-value = 0.1781), and sensitivity analysis verified that the results remained stable even after excluding specific research (Tables 2-4).

TABLE 2 Role of vitamin D supplementation on hospitalization period

Study	Treatment			Control			Mean diff. with 95% CI	Weight (%)
	N	Mean	SD	N	Mean	SD		
Manaseki-Holland *et al.*, 2010	224	4.7	2.2	229	5	2.9	-0.30 [-0.77, 0.17]	12.49
Choudhary *et al.*, 2012	87	4.7	0.3	86	4.3	0.3	0.40 [0.31, 0.49]	12.86
Dhungel *et al.*, 2015	100	5.7	2.7	100	6.1	2.8	-0.40 [-1.16, 0.36]	11.92
Gupta *et al.*, 2016	152	4.4	1.6	156	4.6	1.9	- 0.20 [-0.59,0.19]	12.61
Rahmati *et al.*, 2016	50	3.2	1.3	50	4.2	1.4	- 1.00[-1.53,-0.47]	12.40
Somnath *et al.*, 2017	78	5.2	2.5	76	8.9	1.5	- 3.70 [-4.35, -3.05]	12.16
Labib *et al.*, 2020	93	11.1	0.8	98	10.1	1	1.00 [0.74, 1.26]	12.76
Chowdhury *et al.*, 2021	97	5.1	0.8	100	5	0.7	0.10 [-0.08, 0.28]	12.81
Overall							-0.49 [-1.46, 0.48]	

Heterogeneity : τ^2= 1.89, I^2 = 99.04%, H^2= 104.39
Test of $\theta_i = \theta_j$: Q(7) = 220.21, p = 0.00
Test of θ = 0: z = -1.00, p = 0.32



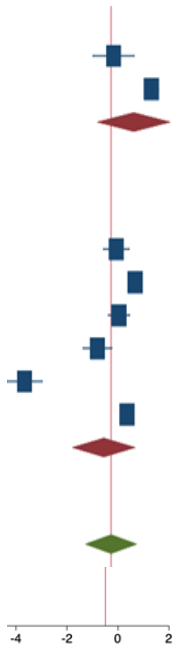
Random-effects REML model

TABLE 3 Risk of bias assessment of included studies

	Manaseki-Holland *et al.*,2010	Manaseki-Holland *et al.*,2012	Choudharty *et al.*, 2012	Dhungel *et al.*, 2015	Gupta *et al.*, 2016	Rahmati *et al.*, 2016	Somnath *et al.*,2017	Singh *et al.*, 2019	Labib *et al.*,2020	Chowdury *et al.*,2021
Was true randomization used for assignment of participants to treatment groups?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was allocation to treatment groups concealed?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were treatment groups similar at the baseline?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were participants blind to treatment assignment?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were those delivering treatment blind to treatment assignment?	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Were outcomes assessors blind to treatment assignment?	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Were treatment groups treated identically other than the intervention of interest?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Y	Y	Y	N	Y	N	Y	N	Y	Y
Were participants analyzed in the groups to which they were randomized?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were outcomes measured in the same way for treatment groups?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were outcomes measured in a reliable way?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the trail design appropriate and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trail?	Y	Y	Y	Y	Y	Y	Y		Y	Y

TABLE 4 Role of vitamin D supplementation on duration of hospitalization based on the route of administration

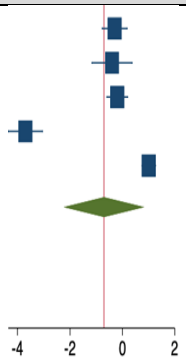
Study	Treatment			Control			Mean diff. with 95% CI	Weight (%)
	N	Mean	SD	N	Mean	SD		
Intramuscular injection								
Dhungel *et al.*, 2015	100	5.7	2.7	100	6.1	2.8	-0.40 [-1.16, 0.36]	11.92
Labib *et* al., 2020	93	11.1	0.8	98	10.1	1	1.00 [0.74, 1.26]	12.76
Heterogeneity : τ^2= 0.90, I^2 =91.40% , H^2=11.63							0.35 [-1.02, 1.72]	
Test of θ_i, = θ_j: Q(1) =11.63, p = 0.00								
Per-oral							-0.30 [-0.77, 0.17]	12.49
Manaseki-Holland *et al.*, 2010	224	4.7	2.2	229	5	2.9	0.40 [0.31,0.49]	12.86
Choudhary *et al.*, 2012	87	4.7	0.3	86	4.3	0.3	- 0.20[-0.59,-0.19]	12.61
Gupta *et al.*, 2016	152	4.4	1.6	156	4.6	1.9	- 1.00 [-1.53, -0.47]	12.40
Rahmati *et al.*, 2016	50	3.2	1.3	50	4.2	1.4	-3.70 [- 4.35, -3.05]	12.16
Somnath *et al.*, 2017	78	5.2	2.5	76	8.9	1.5	0.10 [-0.08, 0.28]	12.81
Chowdhury *et al.*, 2021	97	5.1	0.6	100	5	0.7	-0.76 [-1.94, 0.42]	
Heterogeneity : τ^2= 2.14, I^2 = 99.20%, H^2= 124.59								
Test of θ_i, = θ_j: Q(5) = 184.94, p = 0.00								
							-0.49 [-1.49, 0.48]	
Overall								
Heterogeneity : τ^2= 1.89, I^2 = 99.04%, H^2= 104.39								
Test of θ_i, = θ_j: Q(7) = 220.21, p = 0.00								
Test of group differences = Q_b(1) = 1.45, p = 0.23								



Random-effects REML model

TABLE 5 Role of vitamin D supplementation on duration of hospitalization in group receiving vitamin D supplementation at dose of 100.000 IU

Study	Treatment			Control			Mean diff. with 95% CI	Weight (%)
	N	Mean	SD	N	Mean	SD		
Manaseki-Holland *et al.*, 2010	224	4.7	2.2	229	5	2.9	-0.30 [-0.77, 0.17]	20.11
Dhungel *et al.*, 2015	100	5.7	2.7	100	6.1	2.8	-0.40 [- 1.16, 0.36]	19.52
Gupta *et al.*, 2016	152	4.4	1.6	156	4.6	1.9	-0.20 [-0.59, 0.19]	20.23
Somnath *et al.*, 2017	78	5.2	2.5	76	8.9	1.5	- 3.70 [-4.35, - 3.05]	19.77
Labib *et al.*, 2020	93	11.1	.8	98	10.1	1	1.00[0.74, 1.26]	20.38
Overall							-0.71 [-2.24, 0.83]	



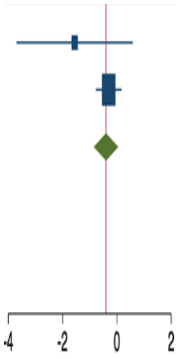
Heterogeneity : τ^2= 3.00, I^2 = 98.31%, H^2= 59.07
Test of $\theta_i = \theta_j$: Q(4) = 183.47, p = 0.00
Test of θ = 0: z = -0.90, p = 0.37

Random-effects REML model

Role of Vitamin D supplementation on mortality rate during hospitalization
Impact on hospitalization mortality rates for children with pneumonia (pooled logRR: -0.40; RR: 0.68 [95% CI: -0.85, 0.05], p = 0.08) (Table 6).

TABLE 6 Role of Vitamin D supplementation on mortallity during hospitalization

Study	Treatment		Control		Log risk-ratio with 95% CI	Weight (%)
	Yes	No	Yes	No		
Labib *et al.*, 2020	1	92	5	93	-1.56 [-3.69, 0.57]	13.38
Chowdhury *et al.*, 2021	23	74	32	68	-0.30 [-0.76, 0.16]	86.62
Overall					-0.40 [-0.85, 0.05]	



Heterogeneity : I^2 = 24.29%, H^2= 1.32
Test of $\theta_i = \theta_j$: Q(1) = 1.32, p = 0.25
Test of θ = 0: z = -1.76, p = 0.08

Fixed-effects Mantel-Haenszel model

Role of Vitamin D supplementation to prevent pneumonia reccurence in children

The impact of vitamin D supplementation on the incidence of pediatric pneumonia as a preventive intervention was examined in a total of 5 studies. According to the pooled analysis, the supplements group and the control group did not significantly differ in the incidence of pneumonia (pooled logRR: -0.21; RR: 0.92 [95% CI: -0.54, 0.12], p = 0.21) (Table 7).

According to subgroup analysis, the intervention and control groups' incidence of

pneumonia did not change significantly (pooled logRR: -0.01; RR: 1.01 [95% CI: -0.07, 0.06], p = 0.85). In addition, there was no discernible difference in the incidence of severe pneumonia between the intervention and control groups (pooled logRR: 0.02; RR: 1.03 [95% CI: -0.35, 0.40], p = 0.90) (Table 8).

TABLE 7 Role of vitamin D to prevent pneumonia recurrence in children

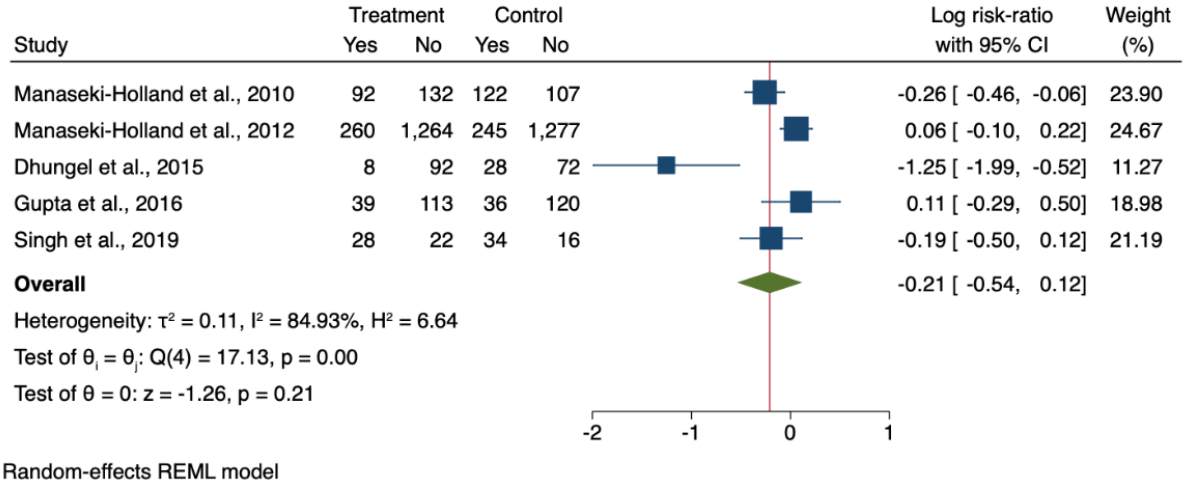
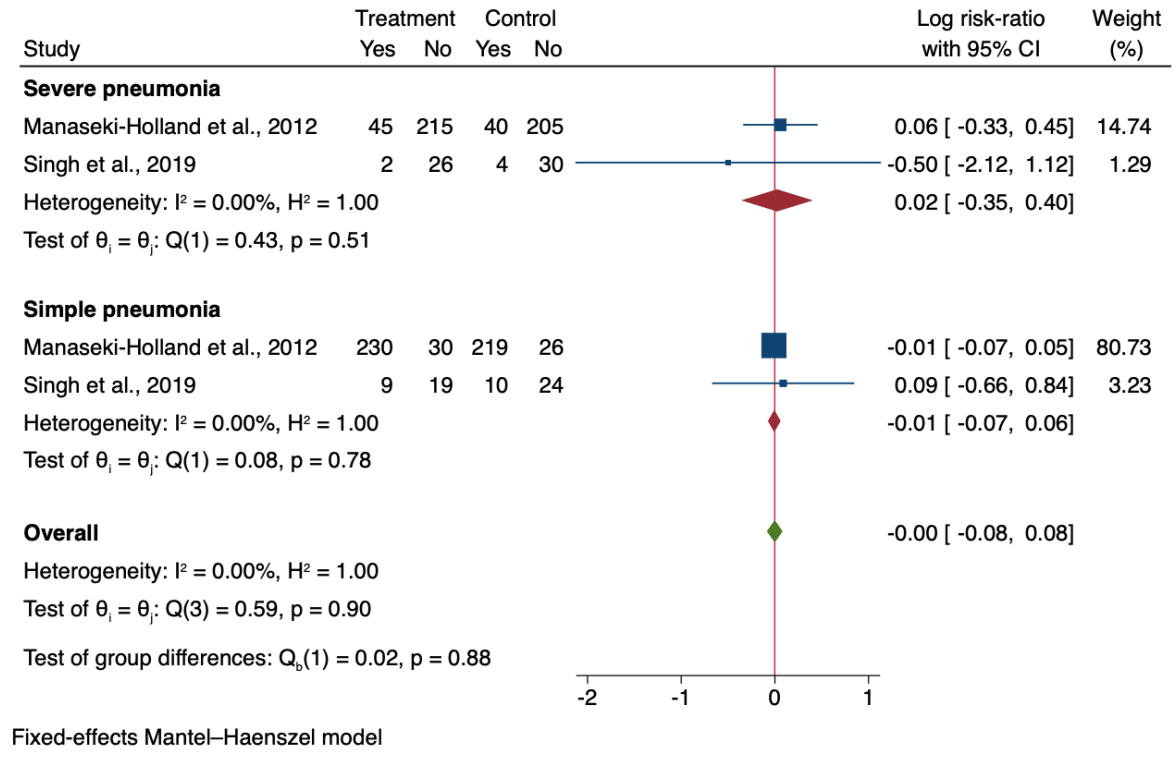


TABLE 8 Role of Vitamin D to Prevent Pneumonia Recurrence in Children Based on The Severity



Discussion

It is well known that vitamin D can reduce excessive inflammatory processes and strengthen mucosal immune defenses [17]. Its effects on immunity include triggering macrophages, suppressing lymphocyte proliferation, encouraging monocyte differentiation, and controlling lymphocyte production of cytokines and antibodies [18-

20]. The whole sequence of the antimicrobial peptide cathelicidin, which is essential for the immunological response during infection, depends on vitamin D [20]. Consequently, acute respiratory tract infections, such as pneumonia, cause the activation of the vitamin D/cathelicidin pathway. According to experimental models, following a streptococcus pneumoniae infection, vitamin D appears to affect aspects of the innate immune response in dendritic cells and decrease the adaptive immune response [21]. Moreover, vitamin D has antiviral characteristics that impact TLRs, including TLR7 [22].

Five of the eight trials included in this comprehensive review showed that pediatric pneumonia patients who got vitamin D supplementation spent less time in the hospital than those in the control group. Nevertheless, the pooled analysis carried out in this investigation showed that giving vitamin D supplements to kids who had pneumonia did not considerably shorten their hospital stay. This paragraph succinctly highlights a crucial finding: the lack of statistically significant impact regardless of the delivery method, be it intramuscular or oral. This paragraph succinctly summarizes a key finding from the study: the mode of administration did not affect the observed outcome, thus confirming the consistency of results regardless of the used delivery method. This observation further strengthens the credibility of the study's results by demonstrating consistency across different modes of administration. Regardless of whether the vitamin D was administered intramuscularly or orally, the absence of a statistically significant effect on the outcome underscores the robustness and reliability of the study's findings. This consistency suggests that the mode of delivery does not influence the efficacy of vitamin D in achieving the intended outcome, adding weight to the generalizability of the study's conclusions. As a result, healthcare practitioners and policymakers can have greater confidence in applying these findings to diverse patient populations and clinical settings, enhancing the relevance and impact of the study on healthcare practices.

For individuals with serious disorders, vitamin D should be taken into consideration as an adjunct to established therapy rather than as a replacement. The study's theoretical approach suggests that a short course of vitamin D administration (two thousand international units per kilogram, which could help treat common viral respiratory infections like influenza and other common illnesses [23].

Depending on the severity indicator used, observational studies provide inconsistent data [4]. This cautious stance acknowledges the importance of rigorous research to guide recommendations and ensure optimal health outcomes for individuals considering vitamin D supplementation [1].

Acute and chronic inflammation may be the cause of vitamin D insufficiency, according to some research, while other studies contend that vitamin D status is unaffected during these stages. Theoretically, vitamin D suppresses the generation of inflammatory cytokines that lead to severe pulmonary inflammation and reduced oxygenation by regulating host defense mechanisms that influence immunological responses. Pathogen clearance is enhanced by cathelicidin, an antibacterial peptide that is directly controlled by the vitamin D receptor. However, in a randomized controlled trial, high-dose vitamin D (100,000 IU) did not significantly improve clinical outcomes or change the expression of cathelicidin in the serum two weeks after supplementation [1].

When it comes to protecting the body from respiratory tract infections, vitamin D is very important for immunological response. The respiratory epithelium's increased synthesis of antimicrobial peptides like cathelicidin and defensins is one way it accomplishes this. By damaging the cell membranes of pathogens, such as viruses and bacteria, and preventing their multiplication, these peptides contribute to the direct fight against them. Furthermore, vitamin D inhibits the synthesis of pro-inflammatory cytokines, which can worsen infection and cause tissue damage, by modulating the inflammatory response.

Vitamin D strengthens the body's defenses The capacity of vitamin D to improve immune cell function, notably that of T lymphocytes and macrophages, is another important component of this vitamin's defense against respiratory tract infections. Macrophages act as front-line defenders, engulfing and eliminating invasive germs, whereas T lymphocytes are essential in coordinating the immune response against infections. Vitamin D helps these immune cells mature and become activated, which enhances their capacity to identify and eradicate infections. Furthermore, vitamin D maintains the delicate equilibrium between the pro- and anti-inflammatory responses, allowing the immune system to react to infection in a way that minimizes tissue damage. Vitamin D strengthens the body's defenses against respiratory infections and supports general respiratory health by enhancing immunological function. By inhibiting lymphocyte proliferation and promoting monocyte differentiation, vitamin D regulates natural antibodies. This regulatory role is crucial in preventing respiratory tract infections, as it helps maintain a balanced immune response [23].

The methodologies utilized in research examining the impact of vitamin D on respiratory tract infections have demonstrated considerable heterogeneity, frequently resulting in conspicuous deficiencies. As the gold standard in clinical research, randomized controlled trials (RCTs) are utilized in some studies to evaluate the efficacy of vitamin D supplementation. Small sample sizes, insufficient control groups, and brief follow-up periods may, nevertheless, undermine the dependability and applicability of the results. However, none of these trials produced fruitful outcomes [2].

The results showed a significant association, meaning that infants who were supplemented with vitamin D had a decreased risk of developing severe bronchiolitis as opposed to infants who were not. This finding emphasizes the need of getting enough vitamin D throughout infancy for respiratory health and raises the possibility that vitamin D may protect newborns from serious respiratory infections. These results highlight how crucial it is to take into account vitamin D supplementation in this susceptible population as a preventive intervention against serious respiratory infections. To completely understand the processes underlying the observed link between vitamin D supplementation and a lower incidence of severe bronchiolitis, more research is yet necessary, even in light of the encouraging results. Until then, medical professionals should carefully assess the advantages and disadvantages of vitamin D supplementation for newborns, taking into account individual aspects like age, health, and surroundings [15].

Conclusion

There was no discernible effect of vitamin D supplementation on the length of hospital stay or death rate in pediatric pneumonia patients. In the similar vein, giving children vitamin D supplements did not show promise in avoiding pneumonia or lessening its severity. Furthermore, to get the most effective vitamin D supplementation dosage for children, more extensive randomized clinical trials must be carried out.

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Authors' Contributions

PPS and RAS designed the study, participated in data collection and literature search. PPS designed the keywords and screening all articles. PPS, RAS, CKW analyzed the results and drafted the manuscript. All authors have

agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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