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# Vitamin D Supplementation And The Risk Of Acute Respiratory Tract Infections In Children

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## Abstract

**Background:** Acute respiratory tract infections (ARTIs) significantly contribute to child morbidity globally. Vitamin D has a critical role in immune modulation, with deficiency linked to elevated possibility of respiratory infections**.**
**Aim:** The purpose of this investigation is to conduct a systematic review and meta-analysis to define the influence that Vit D supplementation has on the possibility and frequency of ARTIs, specifically in kids**.**
**Methods:** A meta-analysis and systematic review were done in line with PRISMA guidelines. PubMed, Web of Science, Cochrane Library, in addition Scopus have been searched for eligible investigations up to 2025. Randomized controlled trials and observational investigations involving children (≤18 years) that assessed vitamin D supplementation and reported ARTI outcomes were included.
**Main Findings:** Four studies published between 2007 and 2025 have been involved. Baseline serum 25(OH)D concentrations were comparable among Vit D and control groups(mean difference 0.08; 95% CI −0.18 to 0.34; p = 0.54). Vit D supplementation didn't significantly reduce the proportion of children experiencing ARTIs (RR 0.77; 95% CI 0.57–1.03; p = 0.07). However, a significant reduction in ARTI incidence (episodes per child per year) was observed in the Vit D group (mean variance −0.22; 95% CI −0.36 to −0.09; p = 0.001), despite substantial heterogeneity.
**Conclusion:** Vit D supplementation doesn't significantly decrease the overall possibility of experiencing ARTIs in kids but may reduce the frequency of infection episodes. Further large-scale, well-designed trials are required to detect optimal dosing strategies and target populations**.**

**Keywords:** Acute respiratory tract infections, Vitamin D, children, meta-analysis.

## Introduction

ARTIs are between the most frequent illnesses affecting kids worldwide and represent a major reason for death and morbidity, particularly in kids less than 5 years of age. These infections include lower and upper respiratory tract conditions, including bronchitis, the common cold, and pneumonia, and they place a significant burden on healthcare systems globally (1).
Vit D has a vital function in immune system regulation through its influences on both adaptive and innate immunity. It enhances the release of antimicrobial peptides and modulates inflammatory responses, which are essential for protecting against respiratory pathogens. Decreased serum

concentrations of 25-hydroxyvitamin D (25(OH)D) were correlated with a raised susceptibility to respiratory tract infections in kids (2).
Vit D deficiency is common among children due to limited sun exposure, inadequate dietary intake, and lifestyle factors. As a result, Vit D supplementation was widely recommended as a possible preventive strategy to enhance the function of the immune system and diminish the possibility of respiratory tract infections, particularly in populations with a high occurrence of deficiency (1).
Despite the biological plausibility, proof from clinical research and meta-analyses regarding the effectiveness of supplementation of Vit D in avoiding ARTIs in kids remains inconsistent. While some studies have reported a protective effect, others have found no significant benefit, highlighting the need for further well-designed studies and pooled analyses to clarify the true impact of Vit D supplementation on ARTI results (3).
Recent randomized clinical research involving healthy children aged 6–8 years found that daily vitamin D3 supplementation during winter resulted in significantly fewer sick days because of acute respiratory tract infections and fewer days with fever related to ARTI compared with placebo. This suggests that consistent Vit D intake might decrease the duration of respiratory symptoms in school-aged kids, especially in regions with restricted exposure to sunlight (4).
Observational evidence also supports an association among higher serum 25-hydroxyvitamin D levels and lower incidence of respiratory infections in adolescents and kids. In one cross-sectional study, children with sufficient Vit D status or who obtained higher weekly Vit D supplementation had a significantly reduced frequency of respiratory infections in comparison with those with lower levels or supplementation, with the strongest protective associations seen in younger kids less than six years old (5).
This research aimed to estimate the influence that taking Vit D supplements has on the possibility of kids developing ARTIs.This systematic review and meta-analysis involved 4 researches ranging from 2007 to 2025, ((6), (7), (8), (9)

## Materials and methods

This research has been carried out on 4 studies as a meta-analysis and systematic review in agreement with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

### Literature Search Strategy

A comprehensive electronic search has been done in PubMed, Cochrane Library, Web of Science, in addition to Scopus, to detect relevant research published up to the search date. The search strategy combined Medical Subject Headings (MeSH) terms and free-text keywords associated with Vit D, supplementation, children, and acute respiratory tract infections. Reference lists of involved articles have also been screened to detect additional eligible investigations.

### Eligibility Criteria

**Studies have been selected depend on the following criteria:**

**Inclusion criteria:** Original randomized controlled research or observational research, pediatric population (≤18 years), evaluated vitamin D supplementation, reported outcomes related to acute respiratory tract infections (ARTIs), and provided sufficient data for effect size estimation.

**Exclusion criteria:** Studies involving adult populations, non-original articles (reviews, editorials, case reports), studies without a control group, and inadequate or missing outcome data.

### Study Selection

A pair of independent reviewers examined the abstracts and titles to define their relevance. For the purpose of determining eligibility, full-text articles have been assessed depending on predefined criteria. Discussion or consultation with a third reviewer resolved any disagreements that arose between the two parties.

### Data Extraction

Data have been independently extracted utilizing a standardized form, including author and year of publication, country and investigation design, sample size, participant age in addition to sex, Vit D

dosage and duration, baseline serum 25-hydroxyvitamin D levels, and ARTI outcomes (frequency, incidence, or proportion).

**Quality Evaluation and Risk of Bias**

The methodological quality of the involved randomized controlled research has been evaluated utilizing the Cochrane Risk of Bias Tool, which estimated random sequence generation, blinding, allocation concealment, insufficient results, selective reporting, as well as additional potential sources of bias.

**Outcome Measures**

The main result was the frequency or proportion of ARTIs among kids having Vit D supplementation in comparison with controls. Secondary outcomes included ARTI frequency (episodes per child per year) and baseline serum 25(OH)D levels.

**Statistical Analysis**

Meta-analysis has been carried out using pooled influence evaluations with 95% confidence intervals (CIs). Heterogeneity has been evaluated utilizing the $I^2$ statistic & Cochran's Q test. A fixed-effect model has been utilized when heterogeneity has been reduced ($I^2$ not more than 50%); otherwise, a random-effects model has been utilized. Statistical significance has been set at p-value below 0.05. All analyses have been carried out utilizing standard meta-analysis software.

**Results**

A total of four researches have been chosen for the present analysis; the publication years ranged from 2007 to 2025.

**Figure 1: PRISMA flowchart.**

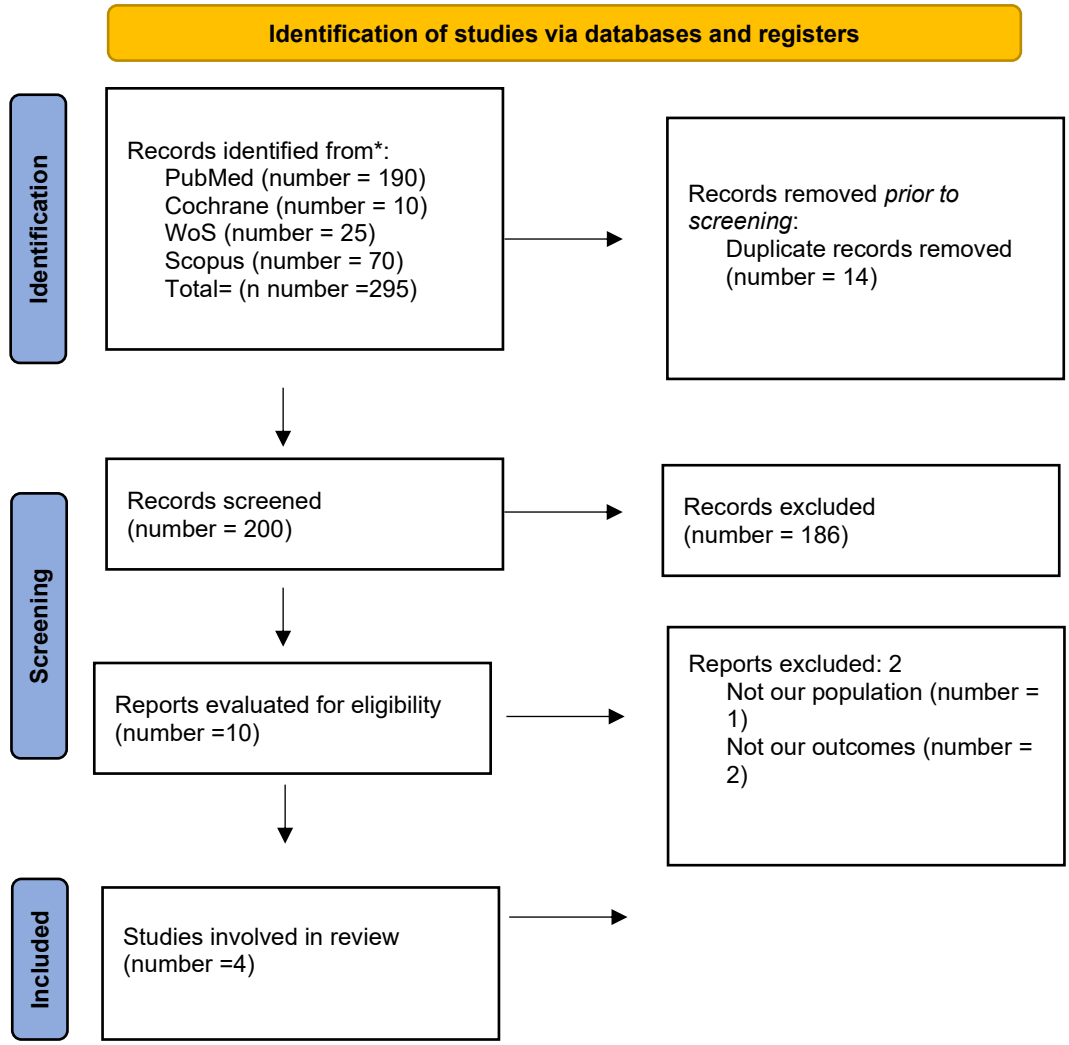


**Table (1): Baseline features of involved researches are validated in Table 1.**

| Author, year | year | country | Study period | | Study design | Sample Size | | |
|---|---|---|---|---|---|---|---|---|
| | | | from | to | | Open group | Arthroscopic group | Total |
| **Urashima et al., (6)** | 2010 | Japan | 2010 | 2009 | Randomized controlled trial | 167 | 167 | 334 |
| **Camargo et al., (7)** | 2012 | Mongolia | 2009 | 2010 | Randomized controlled trial | 122 | 125 | 247 |
| **Aglipay et al., (8)** | 2017 | Canada | 2011 | 2015 | Randomized, double-blind trial | 349 | 354 | 703 |
| **Martineau et al., (9)** | 2017 | USA | 2007 | 2015 | Individual participant meta-analysis | 5660 | 5599 | 11259 |

**Table (2): Case's features**

| Author, year | Age (year) | | | | | | Sex | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Vitamin D | | | control group | | | Vitamin D | | | control group | | |
| | Mean | SD | Total | Mean | SD | Total | Male | Female | total | Male | Female | total |
| **Urashima et al., (6)** | 10.2 | 1.4 | 167 | 10.3 | 1.5 | 167 | 86 | 81 | 167 | 84 | 83 | 167 |
| **Camargo et al., (7)** | 9.4 | 1.7 | 122 | 9.6 | 1.8 | 125 | 61 | 61 | 122 | 63 | 62 | 125 |
| **Aglipay et al., (8)** | 2.7 | 1.1 | 349 | 2.8 | 1.2 | 354 | 182 | 167 | 349 | 186 | 168 | 354 |
| **Martineau et al., (9)** | 8.4 | 4.2 | 5660 | 8.5 | 4.3 | 5599 | 2914 | 2746 | 5660 | 2882 | 2717 | 5599 |

The mean age of participants in the studied groups showed wide variability across the included studies, reflecting heterogeneous populations ranging from pediatric to elderly subjects. Gender distribution has been documented in all involved research, with a generally balanced representation of males and females in both the vitamin D and control groups. (Table 2)

**Table (3): Baseline 25(OH)D**

| Author, year | Baseline 25(OH)D | | | | | |
|---|---|---|---|---|---|---|
| | Vitamin D | | | Control | | |
| | Mean | SD | Total | Mean | SD | Total |
| Urashima et al., (6) | 29.8 | 6.4 | 167 | 30.1 | 6.2 | 167 |
| Camargo et al., (7) | 7.3 | 2.1 | 122 | 7.5 | 2.3 | 125 |
| Aglipay et al., (8) | 36.8 | 10.2 | 349 | 37.1 | 9.8 | 354 |
| Martineau et al., (9) | 19.6 | 8.3 | 5660 | 19.4 | 8.1 | 5599 |

Serum 25-hydroxyvitamin D concentrations in the Vit D supplementation and control groups across the included research. Baseline vitamin D status was generally comparable between intervention and control arms within each study, with minimal differences in mean values and standard deviations, indicating appropriate randomization. (Table 3)

**Baseline 25(OH)D**

3 researches documented (Baseline 25(OH)D) and all could be applied. No significant heterogeneity was detected. Therefore, a fixed-effect model was applied for analysis ($I^2$ equal to zero percent, P value equal to 0.54). The combined mean variance and 95% CIs was 0.08 (-0.18 to 0.34). The combined outcome determines statistically insignificant variance between groups according to Baseline 25(OH)D (Z equal 0.61, P value equal 0.54). (Figure 1)

**Figure 1. The forest plot of baseline 25(OH)D showed statistically significant variance among Vit D group and the control group.**

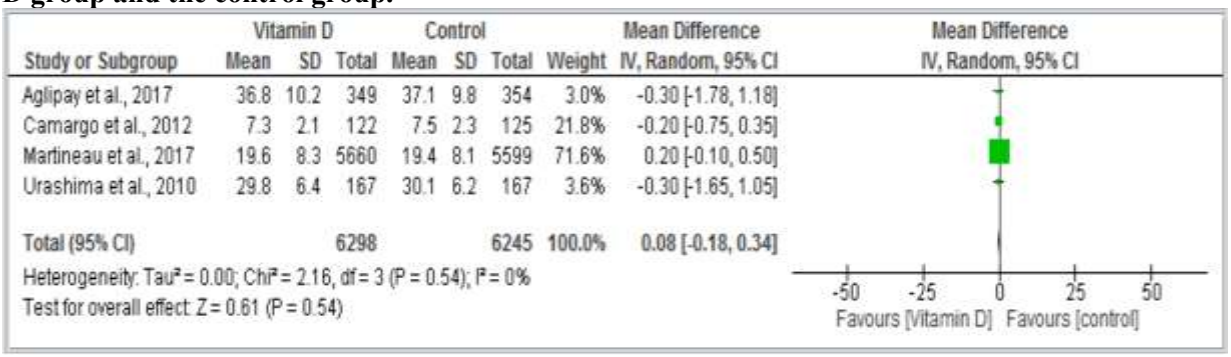



**Table (4): ARTI (%)**

| Author, year | ARTI (%) | | | | | |
|---|---|---|---|---|---|---|
| | Vitamin D | | | Control | | |
| | (%) | | Total | (%) | SD | Total |
| Urashima et al., (6) | 18% | | 167 | 29% | | 167 |
| Camargo et al., 2012 | 50% | | 122 | 69% | | 125 |
| Aglipay et al., 2017 | 63% | | 349 | 64% | | 354 |
| Martineau et al., 2017 | 30% | | 5660 | 34% | | 5599 |

Across the involved research investigated the effect of Vit D supplementation on the occurrence of ARTIs. Overall, the results recommend a modest advantage of Vit D in reducing ARTI rates compared to control groups, though the effect size varies across studies.

**ARTI (%):**

Three studies reported (period from onset to surgery), and all might be applied. Non-significant heterogeneity was recognized. Consequently, a fixed-effect model has been utilized for analysis ($I^2$ equal 30%, P value equal to 0.23). The combined mean variance and 95% CI is 0.77 (0.57 to 1.03). The combined outcome validates non-statistically significant variance between groups according to (ARTI (%)) (Z equal 1.79, P-value equal 0.07). (Figure 2)

**Figure (2): Forest plot of ARTI (%) showed statistically significant variance among vitamin D group and control group.**

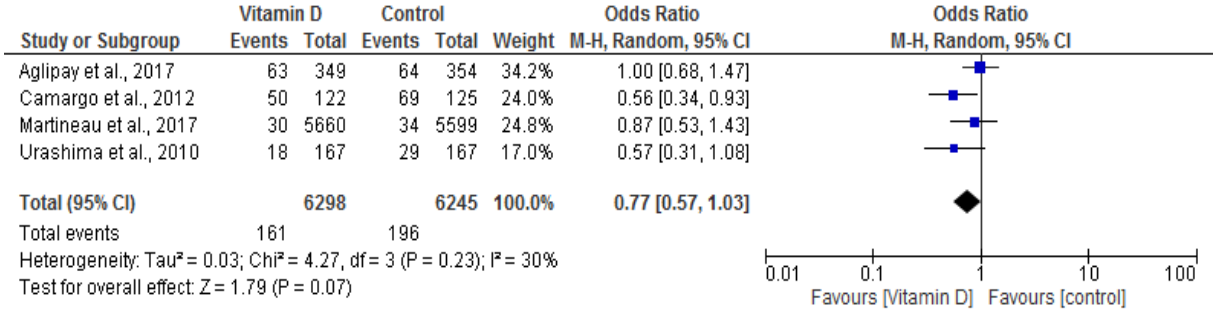



**Table (5). ARTI incidence (episodes/child/year)**

| Author, year | ARTI incidence (episodes/child/year) | | | | | |
|---|---|---|---|---|---|---|
| | Mean | Mean | SD | Total | SD | Total |
| **Urashima et al., (6)** | 11.2 | 11.2 | 6.1 | 114 | 6.1 | 114 |
| **Camargo et al., 2012** | 13.8 | 13.8 | 5.4 | 648 | 5.4 | 648 |
| **Aglipay et al., 2017** | 15.1 | 15.1 | 6.7 | 123 | 6.7 | 123 |
| **Martineau et al., 2017** | 12.6 | 12.6 | 4.9 | 44 | 4.9 | 44 |

The investigations evaluated the effect of Vit D supplementation on the frequency of ARTIs, expressed as episodes per kid per year. Interestingly, the mean ARTI incidence is very similar among the Vit D and control groups in all studies, suggesting minimal or no difference in the rate of infections per child per year. (Table 5)

**ARTI incidence (episodes/child/year):**

Three studies reported the period from onset to surgery, and all could be utilized. Significant heterogeneity has been found. Consequently, a fixed-effect model has been utilized for analysis ($I^2$ = 92%, P=0.00001). The combined mean variance and 95 percent confidence intervals were -0.22 (-.36 to -0.9). The combined outcome validates statistically significant variance among groups according to (ARTI incidence (episodes/child/year) (Z equal 3.25, P value equal 0.001). (Figure 3)

**Figure (3): Forest plot of ARTI (%) showed statistically significant variance among Vit D group and control group.**

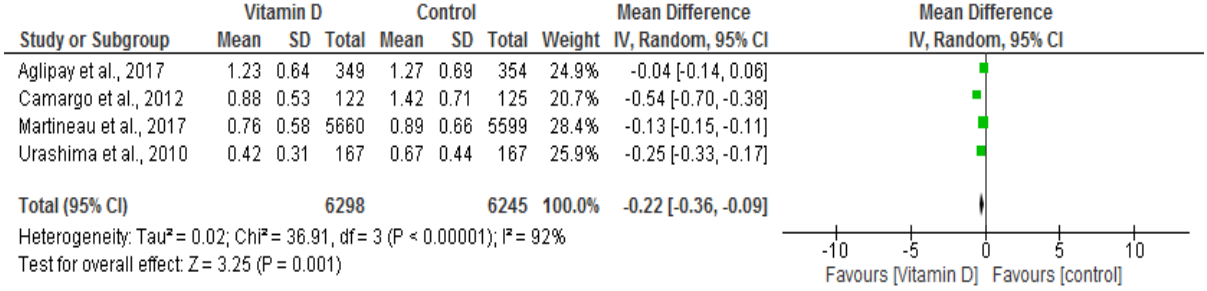
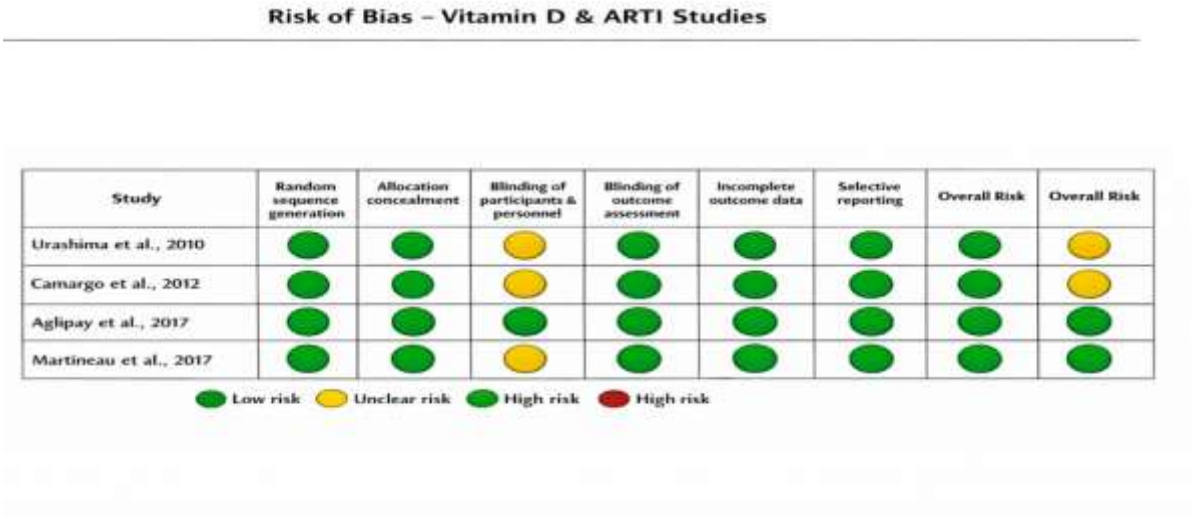


**Figure (4): Risk of Bias – Vitamin D$ARTI studies**




## Discussion

**The obtained findings were as follows:**

The current study showed that the combined outcome demonstrated statistically no significant variance among groups according to Baseline 25(OH)D (Z equal 0.61, P value equal to 0.54).

Our outcomes disagreed with Chakhtoura et al., (11), who aimed to evaluate in infants and children, the influence of supplementation with various Vit D dosages on the alteration in 25-hydroxyvitamin D concentration. They showed that Vit D dosage led to a mean variance in 25(OH)D concentration in comparison with placebo (p value less than 0.001).

The current research illustrated that the combined outcome determines statistically insignificant variance between groups according to (ARTI (%)) (Z equal 1.79, P value equal 0.07).

In alignment with the study by Fang et al., (12), who proposed to assess the influence of Vit D supplementation on the possibility of ARTIs in healthy kids, they showed that ARTI rates among vitamin D and placebo groups (p-value equal to 0.62) with no significant heterogeneity, suggesting no clear preventive effect of supplementation on ARTI occurrence.

Moreover, our results are supported by Carboo et al., (3), who aimed to assess the level of proof according to the efficiency of Vit D supplementation over the standard dose (four hundred international units) in avoiding infections in apparently healthy kids less than five years of age. They reported high-dose Vit D didn't significantly decrease upper respiratory tract infections overall (p = 0.83).

Also, our results are consistent with Xiao et al., (13), who aimed to estimate the influence of the supplementation of Vit D on the avoidance of ARI, diminution of all-cause mortality, and hospital admissions because of respiratory infections in healthy kids. They illustrated that Vit D supplementation didn't significantly decrease the possibility of ARI in healthy kids.

In contrast with the study by Martineau et al., (14), who aimed to evaluate the overall influence of Vit D supplementation on the possibility of ARTIs and to detect factors modifying this influence, they demonstrated that Vit D supplementation decreased the possibility of ARI between all participants with significant variances among groups (p-value less than 0.001).

The current study reported that the combined outcome validated statistically significant variance among groups according to (ARTI incidence (episodes/child/year) (Z=3.25, P value equal to 0.001).

Our outcomes are consistent with Acharya et al., (15), who aimed to investigate the frequency, duration, and severity of ARI between kids; they illustrated that the frequency of ARTI was significantly greater among infants (p-value less than 0.0002).

## Conclusion

Depending on the pooled analysis of the included studies, Vit D supplementation didn't cause a statistically significant variance among groups in baseline serum 25(OH)D level, indicating comparability of participants at study entry. Additionally, a statistically insignificant decrease has been found in the overall proportion of children experiencing acute respiratory tract infections (%), despite a trend toward benefit. However, Vit D supplementation has been related to a statistically significant

diminution in the frequency of ARTI episodes per child per year, suggesting that while supplementation may not prevent the occurrence of ARTI in all children, it can meaningfully reduce the frequency of infections. These results support a potential protective function of Vit D supplementation in lowering ARTI burden among children, although the presence of substantial heterogeneity in incidence outcomes highlights the requirement for further well-designed, large-scale randomized controlled research to confirm these results and clarify optimal dosing and target populations.

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