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Clinical Efficacy of Vitamin D3 Supplementation in the Elderly: A Systematic Review

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Abstract

Introduction: Vitamin D plays a fundamental role in maintaining the homeostasis of the human organism, acting in an integrated way in the skeletal, muscular, immune, and metabolic systems.

Objective: To systematically evaluate the available scientific evidence on the clinical efficacy of vitamin D3 supplementation in the elderly.

Methods: This study constitutes a systematic review, classified as exploratory and descriptive. The research was conducted using bibliographic research in electronic databases on methods associated with SLR (Systematic Literature Review) and the applications of SMARTER (*Simple Multi-Attribute Rating Technique using Exploiting Rankings*).

Results: A comprehensive systematic literature search yielded a total of 167 articles related to the topic addressed; of these, 24 articles became eligible to compose this systematic review.

Conclusion: This systematic review allowed for a critical analysis of the available scientific evidence regarding the clinical efficacy of vitamin D3 supplementation in elderly

individuals, considering different clinical, functional, and metabolic outcomes.

Keywords: Vitamin D; Nutritional Supplements; Elderly; Effectiveness

Introduction

Vitamin D plays a fundamental role in maintaining homeostasis in the human body, acting in an integrated way in the skeletal, muscular, immune, and metabolic systems (Alam et al., 2025; Bikle, 2022). Traditionally associated with bone health and the regulation of calcium and phosphorus metabolism, recent scientific evidence demonstrates that its action goes beyond these classic mechanisms, influencing muscle function, modulating inflammatory processes, and regulating immune responses (Deepika et al., 2025; Giustina et al., 2024). In elderly populations, these effects become particularly relevant, since vitamin D deficiency has been associated with reduced muscle strength, impaired postural balance, and an increased risk of falls and adverse functional outcomes (Qi et al., 2024; Wang et al., 2025a). Population aging is a global and progressive phenomenon, accompanied by an increase in the prevalence of chronic conditions, frailty, sarcopenia, and fracture risk (Bhattarai et al., 2024; Wang et al., 2025b). In this context, vitamin D deficiency is a prevalent condition in older adults, influenced by factors such as reduced sun exposure, decreased cutaneous cholecalciferol synthesis, altered intestinal absorption, and comorbidities that increase the risk of vitamin D deficiency. This condition has been associated with adverse clinical outcomes, including loss of bone mass and density, muscle weakness, functional impairment, and an increased incidence of falls, reinforcing its role as a modifiable factor in the care of the elderly population (Fuentes-Barría et al., 2025; Santos et al., 2025). Beyond its physical and functional impacts, recent evidence indicates that vitamin D exerts a significant influence on mental health and neuropsychological functioning in older adults. Observational studies show that adequate vitamin D levels are associated with better results on cognitive function tests and fewer depressive symptoms in older populations, suggesting a role in mood and cognition regulation (Chen; Pang; Huang, 2025). Recent systematic reviews and meta-analyses also report positive effects of vitamin D supplementation on overall cognitive function in adults, especially in individuals with baseline vitamin D deficiency (Chen et al., 2024; Harse et al., 2023). The association between low vitamin D levels and a higher prevalence of cognitive impairment and depressive symptoms reinforces its importance for autonomy and quality of life in old age (Dos Santos et al., 2024) . These findings, although observational and correlational, highlight the need for integrated approaches to vitamin D deficiency that consider both neurocognitive and psychological outcomes.

Vitamin D3 (cholecalciferol) supplementation has been widely used as a preventive and therapeutic strategy in the elderly, aiming to correct vitamin D deficiency and reduce risks associated with aging. However, despite its widespread use, controversies persist in the literature regarding the magnitude of its clinical benefits, ideal doses, duration of intervention, and outcomes most sensitive to supplementation (Homann et al., 2024). Additionally, the methodological quality of available studies presents significant variations, which can compromise the interpretation of findings and their applicability in clinical practice. Extensive

reviews of observational literature and clinical trials demonstrate that many of the included meta-studies present a high risk of methodological bias in several domains, such as eligibility criteria, study selection, data evaluation, and synthesis of results, which limits confidence in overall conclusions about the effects of vitamin D (Liu et al., 2022). Similarly, systematic reviews indicate that vitamin D clinical trials often fail to ensure adequate randomization, complete blinding, sufficient follow-up, and transparent reporting of all outcomes, which can introduce selection bias and selective reporting bias (Giustina et al., 2020) and contribute to the heterogeneity in results observed in different studies. These limitations reinforce the need for critical and systematic analyses of the available scientific evidence to guide clinical recommendations based on robust evidence.

In this context, systematic reviews stand out as fundamental tools for synthesizing knowledge, identifying gaps in the literature, and supporting evidence-based decision-making. By gathering and critically evaluating available studies, these reviews allow for a clearer and more reliable understanding of the clinical efficacy of vitamin D3 supplementation in older adults. Thus, the present study aims to systematically evaluate the available scientific evidence regarding the clinical efficacy of vitamin D3 supplementation in the elderly, analyzing its effects on different clinical outcomes and considering the methodological quality of the included studies, in order to contribute to the improvement of clinical practice and care for the elderly population.

Methods

This study is characterized as a systematic literature review, exploratory and descriptive in nature, with a mixed-methods approach (qualitative and quantitative). The research was conducted through a bibliographic survey in electronic databases, based on methods associated with Systematic Literature Reviews (SLRs). The qualitative data analysis was performed inductively, based on a critical interpretation of the selected theoretical framework, while the quantitative analysis consisted of the systematization and synthesis of the findings of the included studies. The bibliographic search was conducted in the following databases: Web of Science, Science Direct, Wiley, Springer Link, Taylor & Francis, and PubMed. Additionally, a manual search was performed in the reference lists of the selected articles, as well as on the Google Scholar platform, with the aim of identifying potentially relevant studies not retrieved from the main databases. The search strategy used standardized descriptors from the Health Sciences Descriptors (DeCS), developed by the Virtual Health Library, in accordance with the Medical Subject Headings (MeSH) of the US National Library of Medicine, allowing the use of controlled terminology in Portuguese, English, and Spanish. The following descriptors were used: *"vitamin D"*, *"vitamin D3"*, *"supplementation"*, *"elderly"*, *"aging"*, and *"clinical efficacy"*, combined using Boolean operators.

Inclusion criteria included studies that: (a) investigated vitamin D3 supplementation in elderly individuals; (b) evaluated clinical outcomes related to the effectiveness of supplementation; and (c) were available in full. Isolated case reports, conference abstracts,

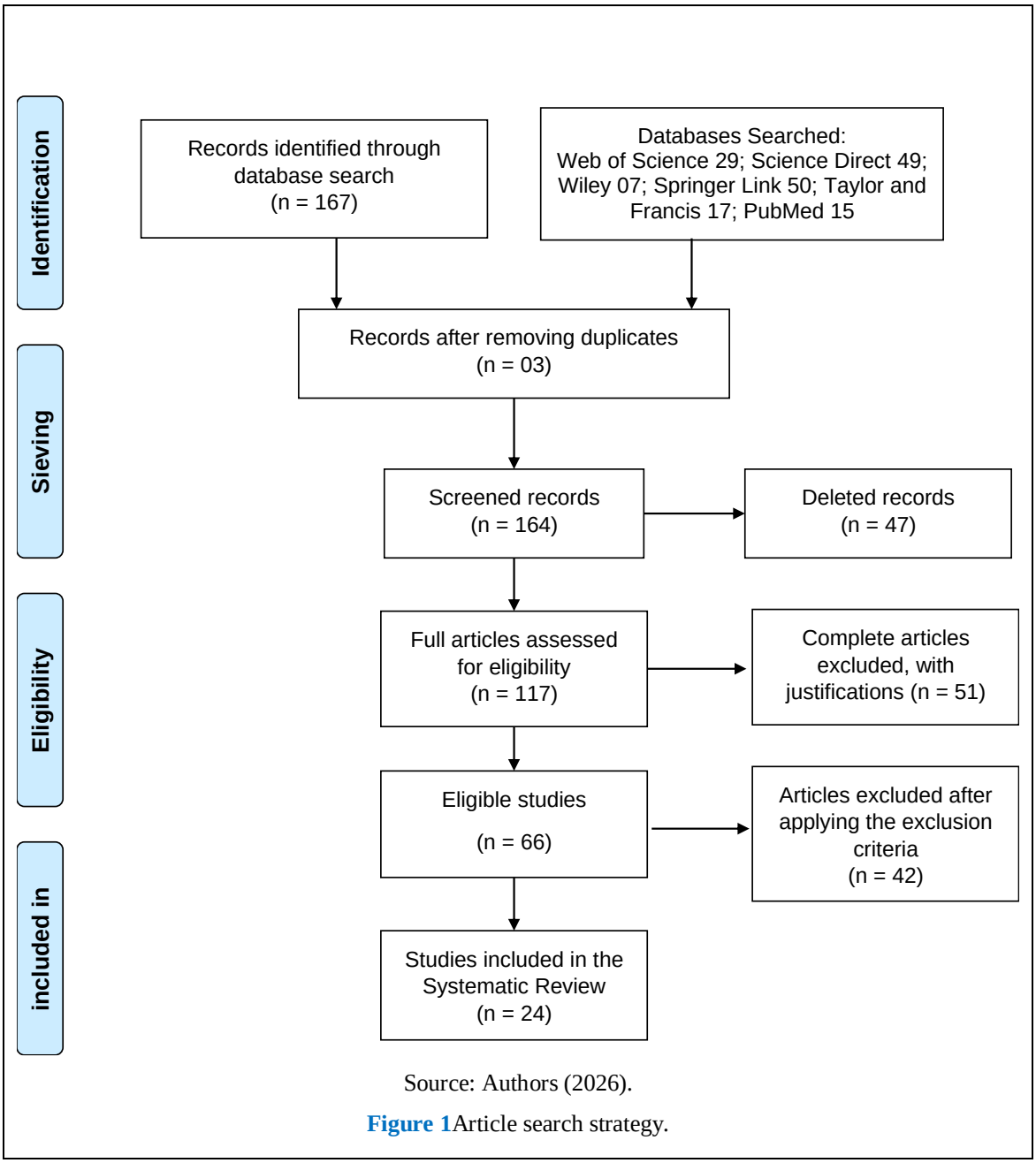
editorials, letters to the editor, and non-peer-reviewed materials were excluded. There was no analysis of confidential data or direct intervention in human subjects; therefore, submission of the study to a research ethics committee was not required.

After applying the eligibility criteria, 24 articles were included in the final review. Data extraction was performed independently by four researchers using a standardized form developed in Microsoft Excel. The information collected included: authors and year of publication, study design, population evaluated, vitamin D3 intervention, clinical outcomes analyzed, main results, limitations, and conclusions. The extracted data were organized and presented in a synthetic form, as shown in **Table 1.**

Results

A systematic and comprehensive literature search on the clinical efficacy of vitamin D3 supplementation in the elderly resulted in the identification of 167 articles in the consulted electronic databases. After the removal of 03 due to duplicate records, the screening process was carried out. With the aim of supporting the prioritization and selection of the most relevant studies, the SMARTER method (Simple Multi-Attribute Rating Technique using Exploiting Rankings) was adopted, which made it possible to identify 117 articles potentially eligible for full-text reading. Of these, 66 Studies were selected for the data extraction stage. After careful evaluation based on previously established inclusion and exclusion criteria, 42 articles were excluded, mainly because they did not evaluate clinical outcomes related to vitamin D3 supplementation in the elderly, because they had an incompatible population, or because they were not relevant primary studies. At the end of this process, 24 the studies met all methodological criteria and were included in the systematic review. The process of identifying, screening, determining eligibility, and including studies is described in the PRISMA flowchart, shown in **Figure 1**, which transparently summarizes all stages of article selection.

The main methodological and clinical characteristics of the included studies are described in **Table 1** – Study Characterization, which presents information regarding author/year; study design; sample; vitamin D3 dose; duration of intervention; outcomes assessed; main results. The methodological quality of the studies was assessed using the Risk of Bias 2.0 (RoB 2.0) tool, considering the domains of randomization, intervention deviations, missing outcome data, outcome measurement, and selective reporting of results, as well as the overall assessment of risk of bias. The results of this assessment are presented in **Table 2** – Risk of Bias Assessment (RoB 2.0). It should be noted that this tool was applied exclusively to the included randomized clinical trials, while observational studies, systematic reviews, meta-analyses, consensus statements, and preprints were classified as inapplicable.



Source: Authors (2026).

Figure 1 Article search strategy.

Table 1: Characterization of the Studies.

Author/Year	Study design	Sample	Duration	Outcomes assessed	Key results
Alam et al., 2025	Narrative review	General population	Not applicable	Biological functions, deficiency	It highlights the systemic role of vitamin D throughout the life cycle.
Bhattarai et al., 2024	Narrative review	Elderly people with chronic	Not applicable	Frailty, multimorbidity	It demonstrates a bidirectional relationship

		diseases			between frailty and chronic diseases.
Bike, 2022	Narrative review	Experimental and clinical studies	Not applicable	Immune function	Vitamin D regulates innate and adaptive immune responses.
Chen H. et al., 2025	Cross-sectional study	American seniors	Transversal	Cognition, mental health	Higher vitamin D intake is associated with improved cognitive performance.
Chen W.-Y. et al., 2024	Systematic review and meta-analysis	Adults and seniors	≥6 months	Cognition	Modest benefits, most evident in disabled individuals.
De Souza et al., 2024	Meta-analysis of RCTs	>70,000 healthy seniors	1–5 years	Fractures	It did not reduce complete fractures; possible increased risk in subgroups.
Deepika et al., 2025	Narrative review	General population	Not applicable	Chronic non-communicable diseases	Association with metabolic and inflammatory outcomes.
Dos Santos et al., 2024	Observational study (ELSI-Brazil)	Brazilian seniors	Transversal	Depression, functional disability	Insufficiency associated with depressive symptoms and functional limitation.
Fu J. et al., 2024	Meta-analysis of RCTs	Elderly people with depressive symptoms	≥8 weeks	Depressive symptoms	A slight, yet significant, reduction in symptoms.
Fuentes-Barría et al.,	Narrative review	Elderly	Not applicable	Sarcopenia	Evidence of vitamin D's role

2025					in muscle function.
Giustina et al., 2024	International consensus	General population	Variable	Vitamin D status	Guidelines for assessment and supplementation.
Giustina et al., 2020	International consensus	General population	Variable	Clinical controversies	Disagreements regarding extra-osseous benefits.
Harse et al., 2023	Observational meta-analysis	Adults and seniors	Transversal	Cognition	Dose-response association between serum levels and cognition.
Homann et al., 2024	Systematic review	Elderly people with movement disorders	Variable	Efficacy and safety	Limited evidence for neurological benefits.
Ling et al., 2021	Meta-analysis of RCTs	Elderly people with disabilities	≥12 months	Falls	Reducing the risk of falls in disabled individuals.
Liu et al., 2022	Umbrella review	Adults and seniors	Variable	Multiple outcomes	Inconsistent evidence for global benefits.
Meshkin et al., 2024	Meta-analysis	Elderly	Not applicable	Prevalence of disability	High global prevalence of vitamin D deficiency.
Paraskevas et al., 2025	Systematic review and meta-analysis	Frail elderly	Variable	Fragility	Subtle benefits of supplementation
Qi et al., 2024	Retrospective matched study	Adults and seniors	Variable	Muscular strength	Slight increase in muscle strength
Santos et al., 2025	Systematic review and meta-analysis	Brazilian seniors	Not applicable	Vitamin D deficiency	High prevalence of insufficiency and deficiency
Sosa et al., 2025	Critical review (preprint)	Clinical population	Not applicable	Clinical management	Questions definitions and strategies of

					supplementation
Torres-Lopez et al., 2025	Systematic review and meta-analysis	Elderly people in the community	≥12 months	Falls	There was no significant reduction in the unselected population.
Wang JJ-D. et al., 2025a	Systematic review	Elderly people after surgery	Variable	Muscular strength	Possible benefit in functional recovery
Wang X. et al., 2025b	Retrospective study	Elderly	Retrospective	Hip fracture	Muscle function mediates association with vitamin D.

Source: Authors (2026)

Table 2: Risk of Bias Assessment of Included Studies according to RoB 2.0.

Author/Year	Randomization	Deviations from the Intervention	Outcome Data Missing	Outcome Measurement	Selective Report	Risk of Global Bias
Alam et al., 2025	NA	NA	NA	NA	NA	NA
Bhattarai et al., 2024	NA	NA	NA	NA	NA	NA
Bike, 2022	NA	NA	NA	NA	NA	NA
Chen et al., 2025	NA	NA	NA	NA	NA	NA
Chen et al., 2024	Low	Low	Some concerns	Low	Low	Some concerns
De Souza et al., 2024	Low	Low	Low	Low	Some concerns	Low
Deepika et al., 2025	NA	NA	NA	NA	NA	NA
Dos Santos et al., 2024	NA	NA	NA	NA	NA	NA
Fu et al., 2024	Low	Some concerns	Low	Low	Some concerns	Some concerns
Fuentes-Barría et al., 2025	NA	NA	NA	NA	NA	NA
Harse et al.,	NA	NA	NA	NA	NA	NA

2023						
Giustina et al., 2024	NA	NA	NA	NA	NA	NA
Giustina et al., 2020	NA	NA	NA	NA	NA	NA
Homann et al., 2024	NA	NA	NA	NA	NA	NA
Ling et al., 2021	Some concerns	Some concerns	Low	Low	Some concerns	Some concerns
Liu et al., 2022	NA	NA	NA	NA	NA	NA
Meshkin et al., 2024	NA	NA	NA	NA	NA	NA
Paraskevas et al., 2025	Low	Some concerns	Low	Low	Some concerns	Some concerns
Qi et al., 2024	NA*	NA*	NA*	NA*	NA*	NA*
Santos et al., 2025	NA	NA	NA	NA	NA	NA
Sosa et al., 2025	NA	NA	NA	NA	NA	NA
Torres-Lopez et al., 2025	Low	Low	Low	Low	Low	Low
Wang et al., 2025a	NA	NA	NA	NA	NA	NA
Wang et al., 2025b	NA	NA	NA	NA	NA	NA

Source: Authors (2026)

*Not applicable (NA)

***** **Qi et al. (2024) is a retrospective study with propensity score matching, therefore it is not eligible for RoB 2.0.*

Discussion

Current evidence on vitamin D supplementation in older adults presents inconsistent results. Meta-analyses of randomized clinical trials, such as that conducted by Torres-Lopez et al. (2025), indicate that, in general, supplementation does not significantly reduce the incidence of falls or fractures in community-dwelling older adults, with estimates close to null for both outcomes (OR = 0.99 for falls; OR = 1.01 for fractures). These findings suggest an absence of relevant clinical effect of supplementation in unselected populations.

Although supplementation alone often does not show overall benefits in heterogeneous trials, there is evidence that individuals with serum

25(OH)D deficiency (<50 nmol/L) may experience a reduced risk of falls when adequately supplemented, highlighting the importance of baseline vitamin D status in treatment response (Ling et al., 2021). A recent meta-analysis conducted by De Souza et al. (2024), which included more than 70,000 healthy elderly individuals, evaluated the effects of isolated vitamin D supplementation on bone outcomes and did not identify a significant reduction in the overall incidence of fractures. Furthermore, the authors observed an increased risk of hip fractures in women, a finding that raises concerns about the indiscriminate use of this strategy. These results suggest that vitamin D supplementation, when performed without co-administration of calcium or without prior risk profile stratification, may not offer clinical benefits and, in certain subgroups, may even be associated with adverse effects. Clinical studies vary widely in terms of dosing regimens (doses and frequency), duration of intervention, and inclusion criteria, which contributes to the heterogeneity of findings and makes direct comparisons between trials difficult. High-dose, daily-dose, or intermittent interventions may produce different responses without a universally identified optimal regimen (Sosa et al., 2025). Despite limitations in physical outcomes, recent reviews indicate that vitamin D supplementation may have positive, albeit modest, effects on overall cognitive function in older adults, particularly those with baseline vitamin D deficiency, highlighting the importance of baseline status in cognitive outcomes (Chen et al., 2024).

Beyond the traditionally studied physical and functional effects, vitamin D supplementation has been investigated in relation to psychological outcomes in older adults, such as depressive symptoms, anxiety, and mental well-being. Recent meta-analyses indicate that, although the results are heterogeneous, supplementation may reduce depressive symptoms in specific subgroups—especially in individuals with low 25(OH)D levels—while other studies have not found consistent significant benefits in large samples of older adults, reflecting the complexity of this association and the influence of factors such as baseline levels, dosage, and psychosocial contexts (Fu et al., 2024). Given the global prevalence of vitamin D deficiency in older adults and its consistent association with adverse outcomes, even small or specific results can have relevant public health implications, especially in populations with very low vitamin D levels or coexisting clinical conditions (Meshkin et al., 2024). The presence of risk of bias, differences in randomization methods, loss to follow-up, and selective reporting of outcomes in some analyses reinforces the need for trials with more robust and standardized designs, as well as rigorous systematic reviews that consider these factors in assessing the quality of evidence (Paraskevas et al., 2025). Some studies suggest that vitamin D supplementation is more effective when combined with calcium, especially in reducing falls or fractures in specific contexts, which may be a valid strategy for selected subgroups, such as those in institutional settings or those at increased risk of osteoporosis (Ling et al., 2021). Recent research conducted by Sosa et al. (2025), has deepened the investigation of the biological mechanisms by which vitamin D can influence inflammatory processes, modulate the immune response, and address aspects related to cellular aging. The authors demonstrate that these effects broaden the understanding of

vitamin D's role beyond bone metabolism, reinforcing the need for more consistent future studies focused on elucidating the mechanisms involved, especially in elderly populations, in order to clarify how such processes can translate into measurable clinical benefits.

Taken together, the findings discussed throughout this study demonstrate that, although vitamin D3 supplementation has a plausible biological rationale and widespread clinical use, its benefits in elderly populations remain heterogeneous and dependent on multiple factors, such as baseline vitamin D levels, clinical profile, dose, and duration of intervention. These results reinforce the importance of individualized and evidence-based approaches, as well as conducting clinical trials and systematic reviews with greater methodological rigor, adequate risk stratification, and clinically relevant outcomes. Therefore, advances in understanding the mechanisms involved and in identifying subgroups that may benefit from supplementation are fundamental to guiding more precise and safe recommendations in the care of the elderly population.

Final Considerations

This systematic review allowed for a critical analysis of the available scientific evidence regarding the clinical efficacy of vitamin D3 supplementation in elderly individuals, considering different clinical, functional, and metabolic outcomes. The results indicate that, although vitamin D deficiency is highly prevalent in this population and is associated with multiple adverse outcomes, the benefits of supplementation are not uniform and vary according to the individual's profile, baseline vitamin D levels, administered doses, and duration of the intervention. In general, current evidence suggests that isolated vitamin D3 supplementation has a limited impact on reducing falls and fractures in community-dwelling older adults, especially when applied indiscriminately. On the other hand, potential benefits may be observed in specific subgroups, such as individuals with severe vitamin D deficiency, frailty, clinical comorbidities, or increased risk for bone and functional outcomes, highlighting the importance of individualized therapeutic strategies. Beyond musculoskeletal outcomes, evidence is emerging that vitamin D may exert relevant effects on inflammatory, immunological, and neuropsychological processes, thus broadening its potential impact on overall health and quality of life in old age. However, these findings still require confirmation through studies with greater methodological rigor and clinically significant outcomes, especially regarding mental health and healthy aging.

The methodological limitations identified in the included studies, such as heterogeneity of designs, variability in dosing regimens, risk of bias, and inconsistency in the outcomes assessed, reinforce the need for caution in interpreting the results and extrapolating them to clinical practice. In this sense, well-conducted systematic reviews and high-quality randomized clinical trials remain essential for advancing knowledge in this area. Thus, the findings of this review contribute to a critical understanding of the role of vitamin D3 supplementation in the care of the elderly population and highlight the need for recommendations based on solid evidence, avoiding the indiscriminate use of supplementation. Future investigations should prioritize risk stratification, assessment of

potentially benefited subgroups, and elucidation of the biological mechanisms involved, in order to guide safer, more effective clinical practices aligned with the needs of the aging population.

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