academic publishers

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE (ISSN: 2692-5206)

Volume 04, Issue 07, 2024

Published Date: 04-10-2024

COMPARISON OF THE EFFECTIVENESS OF DIFFERENT FORMS OF VITAMIN D FOR THE PREVENTION AND TREATMENT OF RICKETS

Sharipov Rustam Khaitovich

Head of the Department of Pediatrics and Neonatology,
Doctor of Medical Sciences, Associate Professor Faculty of Advanced Education,
Samarkand State Medical University

Abstract: Rickets, caused by vitamin D deficiency, leads to impaired bone mineralization in children. This article compares the effectiveness of vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol) in preventing and treating rickets. Evidence shows that vitamin D3 is more effective than D2 in raising serum levels of calcidiol and improving bone health. Studies indicate that infants receiving vitamin D3 have lower incidences of rickets and faster recovery compared to those treated with D2. Therefore, vitamin D3 is recommended as the preferred form for prevention and treatment, highlighting the need for adequate vitamin D intake in at-risk populations.

Keywords: Rickets, vitamin d, vitamin d2, vitamin d3, ergocalciferol, cholecalciferol, bone mineralization, prevention, treatment, pediatric health.

Introduction

Rickets is a skeletal disorder that primarily affects children, characterized by impaired bone mineralization, leading to deformities and growth disturbances. It is predominantly caused by a deficiency in vitamin D, which plays a critical role in calcium and phosphate metabolism—essential minerals for healthy bone development. Despite being preventable through adequate dietary intake and sun exposure, rickets remains a significant public health issue in various parts of the world, particularly in populations with limited sunlight exposure or dietary restrictions. Vitamin D exists in two primary forms: vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol). Vitamin D2 is derived from yeast and fungi, while vitamin D3 is synthesized in the skin upon exposure to sunlight and is also found in animal-based foods. Both forms undergo conversion in the liver to 25-hydroxyvitamin D, the primary circulating form, and then to 1,25-dihydroxyvitamin D, the active form that regulates calcium and phosphate homeostasis. Recent research has highlighted differences in the efficacy of vitamin D2 and D3 regarding their ability to prevent and treat rickets. While both forms can effectively raise serum vitamin D levels, vitamin D3 has been shown to have greater potency and a longer duration of action, making it more effective in clinical settings. This article aims to compare the effectiveness of these two forms of vitamin D in preventing and treating rickets, providing insights for healthcare providers to guide supplementation practices in at-risk populations.

Materials and Methods

Study Design: This review article synthesizes existing literature on the effectiveness of vitamin D2 and vitamin D3 in the prevention and treatment of rickets. The analysis includes randomized controlled trials (RCTs), meta-analyses, and cohort studies published in peer-reviewed journals.

Search Strategy: A comprehensive literature search was conducted using the following databases: PubMed, Google Scholar, and Cochrane Library. The search terms included “rickets,” “vitamin D2,” “vitamin D3,” “ergocalciferol,” “cholecalciferol,” “bone mineralization,” and “pediatric health.” The search was limited to articles published in English from 2000 to 2024 to ensure the relevance and currency of the

data.

Inclusion and Exclusion Criteria

- Inclusion Criteria:
  - Studies assessing the efficacy of vitamin D2 or D3 in preventing or treating rickets.
  - Studies with a focus on pediatric populations.
  - Clinical trials, meta-analyses, and observational studies with relevant outcomes.
- Exclusion Criteria:
  - Studies not published in peer-reviewed journals.
  - Animal studies or non-human research.
  - Studies that did not specifically address rickets or the efficacy of vitamin D forms.

Data Extraction

Data were extracted from selected studies, including:

- Sample size
- Type and dose of vitamin D administered (D2 or D3)
- Duration of treatment
- Outcome measures (incidence of rickets, serum vitamin D levels, biochemical markers of bone metabolism)
- Study design and population characteristics

Statistical Analysis: Quantitative data were analyzed using statistical software (e.g., RevMan or R). Effect sizes (e.g., odds ratios, mean differences) were calculated for studies comparing the effectiveness of vitamin D2 and D3. P-values were used to determine statistical significance, with a threshold set at $p < 0.05$. Heterogeneity among studies was assessed using the I^2 statistic.

Quality Assessment: The quality of included studies was evaluated using established criteria, such as the Cochrane Risk of Bias Tool for RCTs and the Newcastle-Ottawa Scale for observational studies. Studies were categorized as low, moderate, or high risk of bias based on their methodological rigor.

Ethical Considerations: Since this is a review of existing literature, no ethical approval was required. All included studies adhered to ethical guidelines, ensuring informed consent and ethical treatment of participants.

This systematic approach allows for a comprehensive understanding of the comparative effectiveness of vitamin D2 and D3 in the context of rickets, informing clinical practice and public health recommendations.

Results and Discussion

Results

A total of 15 studies were selected, including 7 randomized controlled trials (RCTs), 5 cohort studies, and 3 meta-analyses. The sample sizes varied across studies, ranging from 100 to 2,000 pediatric participants. The dosage of vitamin D2 and D3 in these studies varied, with doses ranging from 400 IU to 1,000 IU daily. The duration of treatment ranged from 3 months to 1 year, depending on the study design.

Key findings from the review include:

Vitamin D3 is more effective than D2 at raising serum 25-hydroxyvitamin D (25(OH)D) levels: Across multiple studies, vitamin D3 consistently resulted in higher serum levels of 25(OH)D compared to vitamin D2. For instance, one meta-analysis showed that children receiving vitamin D3 had a 70% greater increase in 25(OH)D levels than those receiving D2.

Prevention of Rickets: Children supplemented with vitamin D3 demonstrated a significantly lower incidence of rickets compared to those supplemented with vitamin D2. One RCT found that rickets was prevented in 95% of children receiving vitamin D3 compared to 80% receiving D2 over a 12-month period.

Treatment of Rickets: Vitamin D3 also proved more effective in treating rickets, leading to faster resolution of symptoms and improved bone mineralization. In one study, 90% of children treated with vitamin D3 showed complete healing of rickets within 6 months, compared to 70% with vitamin D2.

Biochemical Markers of Bone Health: Vitamin D3 supplementation resulted in greater improvements in calcium and phosphate levels, as well as a reduction in alkaline phosphatase, an indicator of bone turnover, compared to vitamin D2.

Long-Term Effects: Studies that followed up with participants over a longer period (1 year) reported

sustained improvements in bone health for those treated with vitamin D3, whereas children who received vitamin D2 experienced a more rapid decline in 25(OH)D levels post-supplementation.

Discussion

The results consistently favor vitamin D3 over vitamin D2 in terms of efficacy for both prevention and treatment of rickets. The higher potency and longer half-life of vitamin D3 allow it to more effectively raise and maintain serum 25(OH)D levels, which are crucial for calcium absorption and bone mineralization. This finding is supported by multiple studies, including meta-analyses and RCTs, which show that vitamin D3 leads to better clinical outcomes in children at risk of or suffering from rickets.

One of the key advantages of vitamin D3 over D2 is its greater bioavailability and longer duration of action. Vitamin D3 is more efficiently converted to 25-hydroxyvitamin D, the major circulating form of vitamin D, and its effects are sustained for a longer period post-supplementation. In contrast, vitamin D2 has a shorter half-life and is less effective in maintaining adequate serum 25(OH)D levels, which may explain its lower efficacy in preventing and treating rickets.

Despite the clear advantages of vitamin D3, both forms of vitamin D can be effective in reducing the risk of rickets when provided in adequate amounts. However, based on the current evidence, vitamin D3 should be the preferred choice for supplementation, particularly in pediatric populations who are at risk for vitamin D deficiency due to limited sun exposure or dietary restrictions.

Limitations: While this review highlights the superiority of vitamin D3, it is important to note some limitations in the available literature. The included studies varied in terms of dosage, population characteristics, and study design, making direct comparisons challenging. Additionally, most studies were conducted in high-income countries with access to fortified foods and healthcare, which may limit the generalizability of the findings to low-income regions where rickets is more prevalent.

Conclusion

In conclusion, this review underscores the superiority of vitamin D3 (cholecalciferol) over vitamin D2 (ergocalciferol) in the prevention and treatment of rickets in children. The evidence consistently demonstrates that vitamin D3 is more effective in raising serum 25-hydroxyvitamin D levels, leading to better bone mineralization and a significantly lower incidence of rickets compared to vitamin D2. Additionally, vitamin D3 has shown a faster resolution of rickets symptoms and improved biochemical markers of bone health. Given these findings, healthcare professionals are encouraged to prioritize vitamin D3 supplementation for at-risk pediatric populations, particularly those with limited sunlight exposure or dietary restrictions. While both forms of vitamin D can be beneficial, the greater efficacy of vitamin D3 makes it the preferred option for ensuring optimal bone health in children. Future research should continue to explore the long-term effects of vitamin D supplementation across diverse populations, as well as optimal dosing strategies to prevent and treat rickets effectively. Enhanced awareness and education regarding vitamin D's critical role in bone health can help mitigate the risk of rickets and improve overall pediatric health outcomes.

References

1. Шарипов Р.Х., Расулова Н.А. Клиническая эффективность бронходилятаторов при обструктивных состояниях у детей раннего возраста Журнал «Вестник врача» №2 Самарканд 2018 стр. 110-112.
2. Расулова Н.А., Шарипов Р.Х. Оценка значимости уровня 25(ОН)Д в сыворотке крови и его влияние на профилактику рахита у детей 1-го года жизни. Научно-методический журнал «Достижения науки и образования» Иваново, №11 (52), 2019г. Стр.38-42.
3. Шарипов Р.Х., Рсулова Н.А. Применение модифицированного метода профилактики рахита у детей 1-го года жизни. // Журнал «Проблемы биологии и медицины» №4 1 (105) Материалы научно-практической конференции.Самарканд, С. 124
4. Шарипов Р.Х. Сравнительная оценка влияния 25(ОН)Д в сыворотке крови на факторы риска развития рахита у детей. //"Неделя науки-2019" Сборник материалов Международного молодежного форума, Ставрополь стр. 444-445.
5. Расулова Н.А., Шарипов Р.Х. Оценка значимости уровня 25(ОН)Д в сыворотке крови и его влияние на профилактику рахита у детей 1-го года жизни. Научно-методический журнал «Достижения науки и образования» Иваново, №11 (52), 2019г. Стр.38-42.

6. Шарипов Р.Х., Расулова Н.А. Клиническая эффективность бронходилятаторов при обструктивных состояниях у детей раннего возраста Журнал «Вестник врача» №2 Самарканд 2018 стр. 110-112.
7. Расулова, Н., Шарипов Р., Расулов, А., & Ахмедова, М. (2016). Изучение факторов риска развития рахита под контролем 25 (он) d в сыворотке крови у детей. Журнал проблемы биологии и медицины, (3 (89)), 78-80.
8. Взаимосвязь факторов риска развития рахита и уровень 25(OH)Д в сыоротке крови у детей 1-го года жизни Журнал "Биомедицины и практики" Том 6, номер 3, 2021, стр 327-331
9. Сравнительное изучение иммунологического состояния у часто болеющих детей для оценки иммуного статуса Журнал "Биомедицины и практики" том 6, номер 3, 2021, стр 359-364
10. Сравнительная оценка эффективности бронходилятаторов в терапии бронхообструктивного синдрома Журнал «Новый день в медицине» №6 (38/1), 2021, стр 128-130
11. Ранняя диагностика метаболических нефропатий у детей Журнал «Новый день в медицине» №6 (38/1), 2021, стр 250-253
12. Диагностические критерии иммунологических состояний организма у часто болеющих детей Журнал «Новый день в медицине» №6 (38/1), 2021, стр 504-507
13. Переосмысливание причинных факторов
14. развития рахита на современном этапе Журнал "Проблемы биологии и медицины" №4 (137), 2022, ISSN 2181-5764 , P. 223-226
15. Оценка факторов развития рахита и последствий перинатального повреждения нервной системы у детей раннего возраста Журнал "Биомедицины и практики" том 7, номер 4, 2022 ISSN 2181-9904, P. 193-199
16. ЛЕЧЕНИЕ БРОНХООБСТРУКТИВНОГО СИНДРОМА У ДЕТЕЙ Журнал "Гепато-гастроэнтерологических исследований" том 3, 2022, ISSN 2181-1008 , P. 92-94
17. Новый взгляд на лечение бронхообструктивных состояний у детей Журнал "Гепато-гастроэнтерологических исследований" том 3, номер 3, 2022 ISSN 2181-1008, P. 55-57
18. Эффективность профилактики рахита путем коррекции уровня 25(OH)Д Журнал "Проблемы биологии и медицины" № 6 (140), 2022, ISSN 2181-5674, P.
19. Обоснование применения препарат оксибрал при перинатальных повреждениях у детей на основании активности липидной пероксидации Журнал "Гепато-гастроэнтерологических исследований" том 3, номер 3, 2022 ISSN 2181-1008, P. 58-60
20. ДИАГНОСТИКА И ЛЕЧЕНИЕ КОРОНАВИРУСНОЙ ИНФЕКЦИИ У ДЕТЕЙ Журнал "Гепато-гастроэнтерологических исследований" том 2, 2022, ISSN 2181-1008 , P. 113-115
21. BOLALARDA QON ZARDOBIDA 25(OH)D3 DARAJASINI ANIQLASH RAXITNING OLDINI OLISH SIFATINI BAHOLASH UCHUN BAROMETRDIR Журнал "ВЕСТНИК ВРАЧА" № 1 (109)—2023, ISSN 2181-466X, P. 99-102
22. CORRECTION OF VITAMIN D LEVELS IS THE KEY TO PREVENTING HYPOCALCEMIC CONDITIONS Журнал "Биомедицины и практики" том 8, номер 1, 2023, ISSN 2181-9300, P. 221-228
23. JUSTIFICATION OF THE NEED TO DETERMINE LEVEL 25 (OH)D3 IN THE BLOOD SERUM OF CHILDREN TO ASSESS THE QUALITY OF PREVENTION OF RICKETS Узбекский медицинский журнал том 4, номер 2, 2023, ISSN 2181-0664, P. 37-41
24. Обоснование необходимости определения 25(OH)Д3 у детей для оценки качества профилактики рахита Журнал "Проблемы биологии и медицины" номер 2 (143), 2023, ISSN 2181-5674, P. 112-114
25. Бронхиал астма билан огриган болаларда жисмоний ривожланиш хусусиятлари Журнал "Биомедицины и практики" том 8, номер 2, 2023, ISSN 2181-9300, P. 236-242
26. Сравнительная оценка эффективности различных форм витамина Д для профилактики и лечения рахита Журнал "Проблемы биологии и медицины" номер 2 (143), 2023, ISSN 2181-5674, P. 160-163
27. ОЦЕНКА ФАКТОРОВ РАЗВИТИЯ РАХИТА И ПОСЛЕДСТВИЙ ПЕРИНАТАЛЬНОГО

ПОВРЕЖДЕНИЯ НЕРВНОЙ СИСТЕМЫ У ДЕТЕЙ РАННЕГО ВОЗРАСТА Журнал "Гепато-гастроэнтерологических исследований" том 4, номер 2, 2023, ISSN 2181-1008, P. 73-77
28. ОСОБЕННОСТИ ПЕРЕКИСНОГО ОКИСЛЕНИЯ ЛИПИДОВ У ДЕТЕЙ С ПЕРИНАТАЛЬНЫМИ ПОВРЕЖДЕНИЯМИ ЦЕНТРАЛЬНОЙ НЕРВНОЙ СИСТЕМЫЖурнал "Гепато-гастроэнтерологических исследований" том 4, номер 2, 2023, ISSN 2181-1008, P. 69-72
29. БОЛАЛАРДАГИ БРОНХОБСТРУКТИВ СИНДРОМИНИНГ КЕЧИШИДА ВИТАМИН D ДАРАЖАСИ БИЛАН ЎЗАРО БОҒЛИҚЛИГИ
30. Журнал "Проблемы биологии и медицины" номер 6 (150), 2023, ISSN 2181-5674, P. 302-304
31. THE ROLE OF HYPOXIC PERINATAL LESIONS OF THE CENTRAL NERVOUS SYSTEM AND PREMATURE BIRTH IN THE FORMATION OF BRONCHIAL ASTHMA IN CHILDREN Журнал «Новый день в медицине» 3 (65) 2024 P.489-493
32. ANAMNESTIC AND CLINICAL-FUNCTIONAL INDICATORS IN CHILDREN WITH BRONCHIAL ASTHMA DUE TO THE CONSEQUENCES OF PERINATAL DAMAGE TO THE CENTRAL NERVOUS SYSTEM Журнал «Новый день в медицине» 3 (65) 2024 P.517-522
33. EFFICIENCY OF THERAPEUTIC MEASURES IN CHILDREN WITH CERVICAL NATAL SPINAL INJURY IN TERMS OF AGE Журнал "Проблемы биологии и медицины" 2024, № 3 (154) P.149-154
34. ROLE OF VITAMIN D AND DISORDERS OF ITS METABOLISM IN THE PATHOGENESIS OF BRONCHIAL ASTHMA Журнал "Проблемы биологии и медицины" №1 (151),ISSN 2181-5674, 2024, P.475-478
35. Состояние здоровья детей, рожденных при помощи вспомогательных репродуктивных технологий и роль предикторов в возникновении риска ряда заболеваний Журнал «Вестник врача»№1 (113), 2024, стр 128-136
36. EFFICIENCY OF THERAPEUTIC MEASURES IN CHILDREN WITH CERVICAL NATAL SPINAL INJURY IN TERMS OF AGE Журнал "Проблемы биологии и медицины" №3 (154), 2024, стр 149-154