

THE EFFECTS OF VITAMIN D ON FALLS AND PHYSICAL FUNCTION IN OLDER ADULTS: A SYSTEMATIC REVIEW

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ABSTRACT

BACKGROUND AND SIGNIFICANCE: Decreased bone mineral density and muscle weakness are generally accepted by the medical community as risk factors for accidental falls in older adults and supplementation of Vitamin D can have positive effects on density and strength. The objective of this review is to establish the effectiveness of vitamin D supplementation on falls and fall risk for community-dwelling older adults.

METHODS: Following PRISMA guidelines, PubMed and Embase databases were searched using criteria for inclusion 1) participants were community-dwelling adults age 65 or older 2) intervention of oral vitamin D supplementation 3) measured fall rates and/or timed up and go (TUG) scores 4) participants with no major medical diagnoses with exception of low serum vitamin D levels 5) published within the last 10 years.

RESULTS: Nine studies met the inclusion criteria: two “moderate” quality, PEDro 6/10, and seven, “high” quality, PEDro 9/10 or 10/10.

DISCUSSION AND CONCLUSION: The majority of the studies demonstrated that oral vitamin D supplementation had no or even detrimental effects on incidence of falls for community-dwelling older adults. There is an absence of convincing evidence to support vitamin D as an appropriate intervention for the reduction of incidence or risk of falls in community-dwelling older adults.

Keywords: Vitamin D, Accidental Falls, Activities of Daily Living, Aged

INTRODUCTION

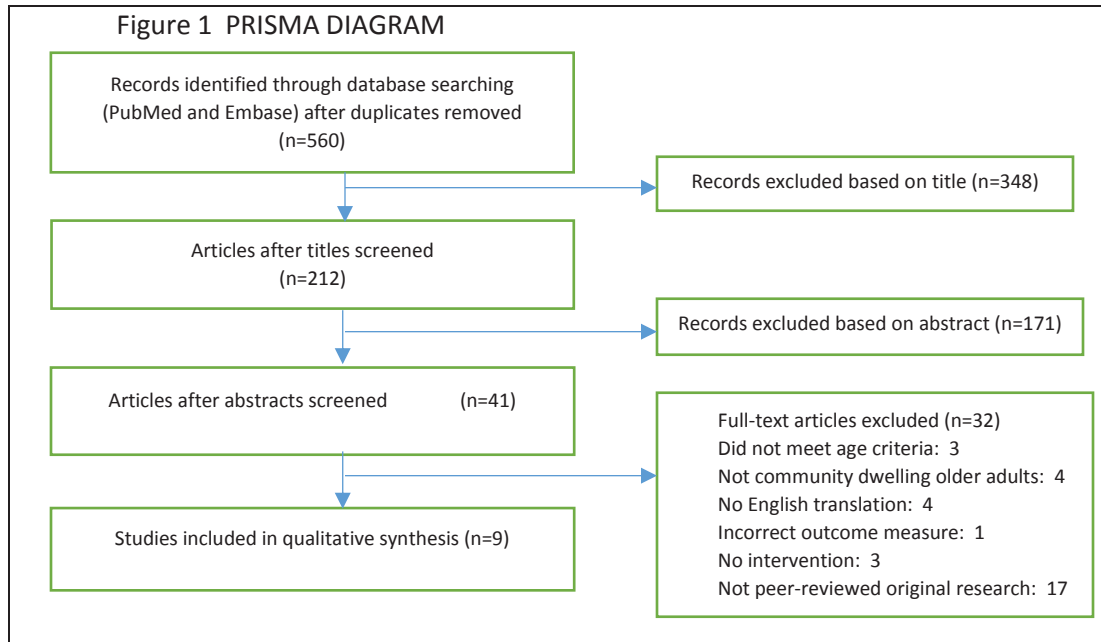
Fall prevention in older adults is of increasing concern as falls attributed to \$30 billion of Medicare spending alone in 2012 in addition to the result of debilitation and injury that often occurs with falls.[1] While decreased muscle strength and bone mineral density are known risk factors for accidental falls in aged individuals, increasing research has demonstrated that higher serum levels of 25-hydroxyvitamin D [25(OH)D] are associated increase bone mineral density as well as increase skeletal muscle strength.[2], [3], [4] Thus, in theory, supplementation of vitamin D could provide a practical and inexpensive means of decreasing fall risks in older adults. The purpose of this systematic review was to establish the effectiveness of vitamin D supplementation alone or in combination with other interventions on falls, fall risks, or physical function in 65+ year old community-dwelling older adults.

METHODS

The online databases PubMed and Embase were searched in October 30, 2017 using search terms related to vitamin D, accidental falls, and age. A ten-year limit was applied for the publication date of resulting studies. The search was limited to articles involving human subjects and publication in English or with English-translated editions.

Inclusion criteria were participants defined as community-dwelling individuals of the age 65 and older, vitamin D supplementation used as an intervention, use of outcomes that objectively measure fall rates and/or fall risks and/or physical function, participants with no major medical diagnosis, with the exception of low serum vitamin D levels, and studies published within the last ten years. Due to the ambiguity of the term “fall”, the authors decided upon the operational definition of fall as “unintentionally coming to rest on the ground, floor, or lower level.” Research articles not in English or without English

translation were excluded. Studies that were not published in peer-reviewed journals or studies without full text were also excluded. The resulting studies were scored using the Physiotherapy Evidence Database (PEDro). The PEDro is a 10-point scale (higher score yields a higher quality study) used for measuring internal validity of physical therapy studies that use randomized control trial design.



RESULTS

For the selected nine studies, the average PEDro score was 8/10. Five studies scored 10/10 (excellent quality) [5, 6, 9, 11, 12], two scored 9/10 (excellent quality) [7, 13] and two scored 6/10 (good quality) [8, 10]. The average PEDro score was of 8/10.

Pfeifer [5] and Prince [6] respectively reported that oral vitamin D supplementation did reduce the incidence of falls, however with a small clinical effect size [0.61 (0.34-0.76); 0.61 (0.41-1.06)] in decreased RR compared to placebo or comparator. Pfeifer [5] had 242 community dwelling senior 70 years or older subjects divided into two subject groups: calcium mono group and calcium plus vitamin D group. The calcium mono group received 1000 mg of calcium each day and the calcium plus vitamin D group received 1000 mg of calcium plus 800 IU of vitamin D per day over a 20 month period. Comparing the two groups concerning falls at month 20, there was a 39 % statistically significant reduction. Prince [6] recruited 302 community-dwelling women aged 70 to 90 years old that were divided into two subject groups with one group receiving 1000 IU ergocalciferol (oral vitamin D) plus 1000 mg citrate and one group receiving a placebo plus 1000 mg calcium citrate one time a day for twelve months. The ergocalciferol group had a lower risk of falling compared to the calcium citrate group, a 19% RR reduction.

Glendenning [7], Kärkkäinen [8], Uusi-Rasi 2015 [9] and Uusi-Rasi 2017 [10] reported no significant difference on reported falls compared to placebo or controls, all of which demonstrated a small clinical effect size. Glendenning [7] conducted a nine month study of 686 community-dwelling women 70 years or older organized into one of two treatment groups to receive either 150,000 IU cholecalciferol every three months or an identical oral placebo. For a three year period, Kärkkäinen [8] randomized 3432 women 65 years of age or older to one of two groups: intervention group given 800 IU cholecalciferol and 1000 mg calcium carbonate and a control group given no supplementation. Uusi-Rasi 2015 [9] developed a two year study comprised of 409 home-dwelling women 70 to 80 years old divided into four groups: vitamin E and exercise, placebo and exercise, vitamin D without exercise, and placebo without exercise. Uusi-Rasi 2017 [10] continued the 2015 study for two more years with the same four group design.

Bischoff [11] reported a significant increase in incidence of falls for intervention groups, but did not report effect size, and Sanders [12] demonstrated a small clinical effect size [1.15 (1.02-1.30)] with an increased incidence rate ratio. The 200 seventy year old or older men and women recruited by Bischoff [11] were divided into three study groups to receive supplements once per month for twelve months: group 1 with 24,000 IU vitamin D₃, group two with 60,000 IU vitamin D₃, and group three with 24,000 IU vitamin D plus 300 µg calcifediol. Sanders [12] studied 2256 women 70 years or older with a two group design with one group receiving 500,000 IU cholecalciferol and one group receiving a placebo over a 3-5 year period.

The timed-up-and-go test (TUG) was used to assess physical function of research subjects. The TUG, an indicator for fall risks, requires both static and dynamic balance with the participant rising from a chair, walking three meters, turning around, walking back to the chair, and sitting down. Uusi-Rasi *et al.* [9] reported a worsening of TUG scores with vitamin D intervention with small effect size [0.23 (-3.51 to 3.96)]. Sanders [12] reported significant improvements to TUG scores, however effect size was determined to be trivial [-0.08 (-0.70 to 0.54)] and Pfeifer [5] reported significant improvements to be small [-0.22 (-0.74 to 0.305)] for respective studies. Glendenning [7] and Uusi-Rasi [10] found no significant difference in between group TUG scores.

DISCUSSION

Although a few studies [5, 6] found conflicting results regarding vitamin D intervention in reducing incidence of falls, six [7, 8, 9, 10, 11, 12] of the nine studies demonstrated that oral vitamin D supplementation had no or even detrimental effects on incidence of falls for community-dwelling older adults. Of the available studies [5, 6] in support of Vitamin D as an intervention, clinical effect size was determined to be small. Vitamin D supplementation also did not present as an appropriate intervention to improve scores on the TUG, an accepted indicator of fall risk.

CONCLUSION

There is an absence of convincing evidence to support vitamin D as an appropriate intervention for the reduction of incidence or risk of falls in community-dwelling older adults.

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DISCLOSURES

Joy C. Kuebler and J. Tyler Stewart have no conflicts of interest or financial ties to disclose.

REFERENCES

- [1] E. R. Burns, J. A. Stevens, and R. Lee, "The direct costs of fatal and non-fatal falls among older adults – United States," *Journal Safety Research*, vol. 58, pp. 99-103, Sept. 2016.
- [2] O. Benichou and S. R. Lord, "Rationale for strengthening muscle to prevent falls and fractures: A review of the evidence," *Calcified Tissue International*, vol. 98, no. 6, pp. 531-545, June 2016.
- [3] C. Beaudart, et al., "The effects of vitamin D on skeletal muscle strength, muscle mass, and muscle power: A systematic review and meta-analysis of randomized controlled trials," *Journal Clinical Endocrinology and Metabolism*, vol. 99, no. 11, pp. 4336-4345, Nov. 2014.

- [4] S. C. F. Prato, et al., "Frequency and factors associated with falls in adults aged 55 years or more," *Revista de Saúde Pública*, vol. 51, p. 37, Apr. 2017.
- [5] M. Pfeifer, et al., "Effects of a long-term vitamin D and calcium supplementation on falls and parameters of muscle function in community-dwelling older individuals," *Osteoporosis International*, vol. 20, pp. 315-322, Feb. 2009.
- [6] R. L. Prince, et al., "Effects of ergocalciferol added to calcium on the risk of falls in elderly high-risk women," *Archives Internal Medicine*, vol. 168, pp. 103-108, Jan. 2008.
- [7] P. Glendenning, et al., "Effects of three-monthly oral 150,000 IU cholecalciferol supplementation on falls, mobility, and muscle strength in older postmenopausal women: A randomized controlled trial," *Journal of Bone and Mineral Research*, vol. 27, pp. 170-176, Jan. 2012.
- [8] M. K. Kärkkäinen, et al., "Does daily vitamin D 800 IU and calcium 1000 mg supplementation decrease the risk of falling in ambulatory women aged 65-71 years? A 3-year randomized population-based trial (OSTPRE-FPS)," *Maturitas*, vol. 65, pp. 359-365, Apr. 2010.
- [9] K. Uusi-Rasi, et al., "Exercise and vitamin D in fall prevention among older women: A randomized clinical trial," *Journal of American Medical Association Internal Medicine*, vol. 175, pp. 703-711, May 2015.
- [10] K. Uusi-Rasi, et al., "A 2-Year follow-up after a 2-year RCT with vitamin D and exercise: effects on falls, injurious falls and physical functioning among older women," *Journals of Gerontology A Biology Sciences and Medical Sciences*, vol. 72, pp. 1239-1245, Sept. 2017.
- [11] H. A. Bischoff-Ferrari, et al., "Monthly high-dose vitamin D treatment for the prevention of functional decline: A randomized clinical trial," *Journal of American Medical Association Internal Medicine*, vol. 176, pp. 175-183, Feb. 2016.
- [12] K. M. Sanders, et al., "Annual high-dose oral vitamin D and falls and fractures in older women: a randomized controlled trial," *Journal of American Medical Association*, vol. 303, pp. 1815-1822, May 2010.
- [13] H. Sakalli, D. Arslan, and A. E. Yucel, "The effect of oral and parenteral vitamin D supplementation in the elderly: a prospective, double-blinded, randomized, placebo-controlled study," *Rheumatology International*, vol. 32, pp. 2279-2283, Aug. 2012.