

REVIEW ARTICLE

# Relation between development of positional vertigo (dizziness) and vitamin D deficiency

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## ABSTRACT

Vitamin D insufficiency has been linked to the probable cause of developing positional vertigo or dizziness. Although many studies have been conducted on benign paroxysmal positional vertigo (BPPV), regarded as the most typical form of positional vertigo, there is no accord on the role played by vitamin D deficiency. The study aimed to review articles to provide a consensus on the correlation between vitamin D insufficiency and positional vertigo/dizziness. A comprehensive literature review was undertaken from diverse databases, where articles were selected for review based on the keyword search. A combination of a systematic review and experimental studies were considered, precisely those that touched on types of positional vertigo and vitamin D insufficiency. Out of over 70 studies selected, only 15 were found to be relevant to the study as they focused on the role played by vitamin D among BPPV patients. Furthermore, seven articles were selected for review of the experiment, while the other eight articles were used to support the findings and reach a consensus. From the studies, substantial variances in vitamin D levels were found between BPPV patients and the control groups. In addition, a substantial mean-variance was established between BPPV patients who were on vitamin D supplementation and those that were not on supplementation in follow up treatments. The review found that vitamin D levels helped reduce the recurrence of BPPV / dizziness attacks. However, there was no adequate evidence that vitamin D helped treat BPPV.

**Keywords:** Benign paroxysmal positional vertigo, BPPV, vertigo, vitamin D deficiency.

## Introduction

Vertigo refers to an inner feeling of head motion like movement, an occurrence in which the individual feels like they are spinning around themselves when in actual sense, they are not. In simple terms, individuals will state that they are feeling dizzy. Vertigo that results in perceived head movements is called positional vertigo. The most typical form of peripheral dizziness is benign paroxysmal positional vertigo (BPPV). This BPPV condition is denoted by momentary vertigo incidents that get worsened by taking a much more provoking position. BPPV is an equilibrium disorder that is linked to otoconia. The BPPV is seen to be elicited by deteriorated otoconia spraining into semi-circular canals, which make them sensitive to gravity [1,2]. While the cause of otoconia degeneration remains unknown, several factors are seen to contribute to it, comprising; head trauma, vitamin D insufficiency, high body mass index, advanced age, hyperuricemia, and osteoporosis. Vertigo is quite common and is considered among the top 10 reasons for outpatient appointments within the United States. The

BPPV manifests in dizziness and is reported in more than 5.6 million visits in hospitals within a given year in the United States. Among these visits, BPPV accounts for anywhere around 17% to 49%. In addition, BPPV is classified as the most common vestibular condition in humans. Statistics show that BPPV costs the health care sector more than \$ 2 billion annually and primarily affects females compared to males. Vitamin D is among the primary significant physiological controllers of calcium (Ca), bone metabolism, and phosphorus (P). As a result, vitamin D deficiency can result in many negative impacts

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on different body functions and more so those that depend on bone metabolism. With vitamin D regulating calcium metabolism, a lack of it is likely to result in BPPV development. Several studies have revealed that vitamin D is likely lower for BPPV patients. However, other studies fail to conclude as they fail to replicate earlier results. Given the grey areas, the objective of this study is to undertake a systematic review of available experimental studies and establish a clear association between vitamin D insufficiency and vertigo and, more so as, a cause of dizziness [3-5].

### Literature Review

Researchers undertook a meta-analysis with the aim of resolving the inconsistency found in past literature on the role of vitamin D insufficiency being a risk aspect of BPPV [5]. The literature from different databases such as PubMed, Web of Science, SinoMed, among others, were systematically used in the search for the literature regarding the correlation between BPPV and vitamin D serum levels. The study findings revealed that individuals with BPPV had lower levels of vitamin D (WMD - 2.46, 95% CI -3.79 to -1.12,  $p < 0.01$ ). In addition, the study found out that vitamin D levels tended to be lesser in recurrent compared to the non-recurrent occurrence of BPPV that cut across all nations that partook in the model (WMD 2.59, 95% CI 0.35-4.82,  $p = 0.0023$ ). An analysis of the odds ratio revealed vitamin D to be an independent risk factor for BPPV (OR 1.998,  $p < 0.001$ ). The study established that the leading cause for dizziness was the dislodging and dissolution of otoconia.

The meta-analysis established a clear and comprehensive close link between the development of BPPV and serum levels of vitamin D. However, the results also had a precautionary approach, and limitations were related to the findings. First, the sample sizes were fairly small, accounting for about 18 to 249 BPPV cases. However, the studies established a strong association between vertigo and vitamin D deficiency despite the limitation. However, more research is recommended into other factors that may affect vitamin D, such as weather, lifestyle, and diet, among others. In addition, a look into multi-ethnic groups is highly recommended [5].

A second study was conducted to show that vitamin D insufficiency treatment would decrease the reoccurrence of BPPV [6]. In undertaking the study, the treatment of acute vitamin D insufficiency was administered to the study group. Two criteria were used for inclusion into the study group: idiopathic, unilateral, posterior canal BPPV lacking history that could suggest secondary BPPV and 25-hydroxyvitamin D3 level less or equal to 10 ng/ml. Vitamin D therapy was administered for 3 months to the study group, and vitamin D3 serum was evaluated at the beginning and after 3 months. The group was then subdivided into two groups: those whose serum level was greater or equal to 10 ng/ml (I) and those whose serum elevation was less than 10 ng/ml (II). The study group

was then evaluated, and observation for BPPV recurrence was undertaken.

The study did not find any differences between the two groups regarding sex, distribution, age, and bone mineral density. It was found that the recurrence of BPPV was relatively high in group II (43%) compared to group I (14%). This was also reflected in the average recurrence of BPPV attacks, where the group I was 0.18 and group II was 0.66. The study established that the mean differences were statistically significant ( $p < 0.01$ ). Pertaining to the odds ratio for BPPV recurrence in participants with acute vitamin D insufficiency, it was at 4.54 (95% CI: 1.41-14.58,  $p < 0.01$ ). The study was able to develop a correlation between vitamin D and recurrence of BPPV, where improved levels of vitamin D would increase the reoccurrence of BPPV [6].

Given the lack of understanding of the imbalance of calcium carbonate within the semi-circular canals [7], carried a more current systematic review analysis with the aim of understanding the potential association of vitamin D level and the incidence and or reoccurrence of BPPV disease. To establish a better understanding, a comprehensive literature search was undertaken from different databases and using keywords, articles that looked at possible associations were used. The mean D3 levels from the control and experiment groups were recorded and utilized to establish the mean variances between BPPV patients and the control groups. The effect sizes for the sample sizes were also determined from the 7 studies that met the criteria out of 703 selected studies.

It was established that when diseased groups of BPPV were equated with non-diseased BPPV groups, the difference in vitamin D3 was not statistically significant. However, when the recurrent groups of BPPV were compared against non-recurrent BPPV groups, a substantial decline in vitamin D was established in the recurrence group. In conclusion, the study had conflicting results on whether a deficiency in vitamin D was a key factor in BPPV disease. The meta-analysis found that other confounding factors were also at play as BPPV risk factors. For instance, vitamin D deficiency was more pronounced in BPPV patients who also had osteoporosis and in women, especially those who were premenopausal. Due to conflicting results, the study proposed well-designed case-control or cohort control studies to provide more detailed insight regarding the role of vitamin D deficiency on BPPV diseases [7].

A study was conducted on the premise that vitamin D deficiency resulted in an extensive negative effect on musculoskeletal pain [4]. Based on this premise, the study examined the association between vitamin D insufficiency and myofascial pain syndrome (MPS). The impact of vitamin D on sleep, disability, pain, psychological condition and quality of life were also examined. The study examined 180 cases, 120 of them were patients, while 60 accounted for the control group. The patients were further subdivided based on their

vitamin D levels. Scores on various measures such as visual pain scale, sleep quality, and neck pain were recorded and tested for validity and reliability.

Substantial variance in D levels was established between the group accounting for patients and the group used as control, with the control group having high vitamin D levels. For the physical parameters, the quality of life index was more significant in the group used as the control compared to the patient group. Regarding the patient group, depression and anxiety levels were high compared to the control group. The study concluded that there was evidence of vitamin D insufficiency in patients diagnosed with MPS compared to healthy people. Furthermore, there was evidence that deficiency in vitamin D had a negative effect on mental function and mood and was likely to result in dizziness and attention deficit [4].

In a study to investigate the claim that Vitamin D insufficiency was a possible cause for the development of BPPV as a risk factor for positional vertigo where dizziness is a common occurrence, case-control research was undertaken, where 40 patients were identified to have a posterior canal, BPPV had their serum 25(OH) D quantified during their first visit [5]. The patients were then separated into two distinct groups, where the first group of 20 patients were provided with supplementation of vitamin D adding to canal reposition manoeuvre. At the same time, the other group just received the canal reposition manoeuvre only. After 6 months, the normal serum of 25(OH) D for group A was ( $12.4 \pm 2.4$ ), while that of group 2 was ( $12.2 \pm 1.7$  ng/ml). In addition, it was found that recurring BPPV was considerably lesser in group A than in group B. The study successfully established a correlation between BPPV recurrence and deficiency in vitamin D. While this was established, the study failed to link the role of vitamin D therapy in the treatment of BPPV, and more studies were advised to examine if a relationship existed. In its limitation, the study proposed that vestibular migraine was exceedingly related to the manifestation of BPPV and is also a common causative of positional vertigo that induces dizziness and, as a result, may be confused with recurrent BPPV [5].

A study was conducted to evaluate vitamin D serum and calcium concentration and establish if low levels of vitamin D would be a cause of BPPV deterioration and if the supplementation of vitamin D would decrease the reoccurrence of BPPV [2]. To undertake this research, 60 cases of BPPV were incorporated in the study, with 53 being cases of posterior canal BPPV, while the other 7 were cases of lateral canal BPPV. Before commencement of the experiment, the serum (25-OH D<sub>3</sub>) and calcium were evaluated. For the classification of vitamin D levels, smaller than 20 ng/ml was regarded as low, 21-29 ng/ml as inadequate and at least 30 ng/ml as adequate. The group was divided into two, where one received vitamin D supplementation while the other did not.

After evaluation of vitamin D levels, the study established that 40 incidences had unusually reduced

levels of the vitamin. A significant correlation was also established between the mean vitamin D levels for all BPPV incidences and serum calcium. The significant variance was established in BPPV recurrence for the group under supplementation after a follow-up of 1 year. The study concluded that there was a link between vitamin D with the occurrence and BPPV relapse, and the supplementation of vitamin D was connected with the decrease in the reoccurrence of BPPV [2].

In another study, the researchers aimed at assessing whether vascular risk factors and serum vitamin D levels would help differentiate between diverse types of positional vertigo [3]. A total of 78 cases were encompassed in the study. The group was further divided into two sub-groups: central positional vertigo (CPV) and BPPV. Vascular risk aspects and serum 25-hydroxyvitamin D levels were then compared between the two groups. Other factors such as patient demographics were also recorded to rule out any confounding factors that would affect the study results.

The results revealed a higher percentage of men in the CPV group compared to the BPPV group. No independent distinguishing aspects were found between the two groups. It was also revealed that the difference between the numbers of risk factors between the two groups was statistically substantial. However, the variance in the mean levels of 25-hydroxyvitamin D level and the proportion of vitamin D insufficiency between the two groups were not significant. The study concluded that risk factors would likely suggest CPV than BPPV and that vitamin D levels, although associated with both groups, were not a suitable criterion for differentiating between different positional vertigo types, which induces dizziness [3].

## Discussion

The systematic reviews establish a close link between serum vitamin D levels insufficiency and positional vertigo or dizziness [5]. This study concurs with past research where the benefit of taking both vitamin D and calcium twice a day has been seen to alleviate the chances of recurrence in vertigo in individuals who have been predisposed to it before [8]. BPPV has been described as one of the most typical forms of vertigo and has been extensively covered by researchers. The most common type of treatment for dizziness has always involved a series of head movements whose aim is to shift particles in the ear responsible for the dizziness [9]. However, this approach had always witnessed the frequent recurrence of BPPV, which has prompted more research to ascertain the efficiency of vitamin D supplementation in the treatment of positional vertigo.

The study established that the recurrence of positional vertigo, BPPV was relatively low in individuals with high vitamin D levels [6]. This finding echoes another finding where it has been found that when patients are supplemented with vitamin D after diagnosis of BPPV, the recurrence rates are significantly reduced. In addition, results from previous studies link a high predominance

of vitamin D insufficiency or deficiency among patients diagnosed with BPPV compared to non-BPPV patients. A similar study revealed that vitamin D concentrations significantly affected the long-term reoccurrence rate of BPPV without restricting findings age, sex, or semicircular canal location [10-12].

The study proposes that vitamin D insufficiency could be one of the major causes of BPPV, the most typical type of positional vertigo. The findings are supported by studies that have previously considered the country of origin a confounding factor. It has been found that BPPV incidences increase in seasons when there is reduced exposure to sunlight [1,13]. This seasonal variation in BPPV cases due to sunlight exposure has been detected in the United States and Iraq. More recent comparative studies in the different types of vertigo or dizziness have evaluated and concluded that a decrease in serum vitamin D levels is a risk aspect of BPPV. In those studies, it was concluded that indeed BPPV patients have lesser vitamin D levels and that its deficiency contributes to increased incidences of recurrence [14].

In 2013, a study further provided evidence of low serum vitamin D in patients with BPPV compared to healthy controls. A combination of calcium and Vitamin D supplementation has been found to reduce BPPV relapse. The increased incidence advises BPPV among the aged who have reduced bone density. Another study confirmed the correlation of BPPV recurrence and calcium metabolism alterations as evidenced in conditions such as osteoporosis. Studies have suggested that for people with positional vertigo, taking vitamin D supplements and calcium is a simple, low-risk way of preventing dizziness from recurring. However, more research into the association between calcium and vitamin D supplement is highly encouraged in most studies [14,15].

## Conclusion

Through a comprehensive review of different studies, the available evidence has been able to establish a clear link between vitamin D deficiency and the occurrence of BPPV, regarded as the most typical form of positional vertigo or dizziness. The study has established that the deficiency of vitamin D in BPPV cases is highly associated with higher recurrence rates. While there is overwhelming evidence of the connection between vitamin D insufficiency or deficiency and BPPV recurrence, there is barely any evidence of the effectiveness of vitamin D in the treatment of positional vertigo. More experimental studies are required to examine the effectiveness of vitamin D in treatment. However, the review found evidence in the use of Vitamin D and Calcium supplementation to reduce the recurrence of positional vertigo.

## List of Abbreviations

BPPV Benign paroxysmal positional vertigo  
CPV Central positional vertigo

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