Is Vitamin D Deficiency Associated with an Increased Risk of Alzheimer’s Disease in the Elderly?

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ABSTRACT

Background: Alzheimer’s Disease is the most prevalent neurodegenerative disease amongst the elderly, affecting 6% of individuals aged 65 years and older, and it also causes inevitable physical and psychological dependency. Symptoms progress slowly and include impairment of memory and executive function, speech and comprehension difficulties, as well as psychological symptoms such as hallucinations, delusions, and depression. Although the exact causes of AD are currently unknown, research has shown that both genetic and environmental factors, including diet, play a role. Specifically, there has been a greater interest in whether vitamin D deficiency increases the risk of developing Alzheimer’s disease in the elderly population. Processes that are affected in Alzheimer’s include calcium homeostasis, neurotransmitter and tau protein accumulation, oxidative stress, and inflammation, which are all influenced by vitamin D levels.

Objective: To evaluate the association between vitamin D deficiency and the risk of developing Alzheimer’s disease in the elderly.

Methods: A structured literature review was conducted using the PubMed and Scopus databases. Relevant studies were obtained using the following keywords: “Alzheimer’s Disease”, “vitamin D”, “deficiency”, “elderly”, and “risk”. Only peer-reviewed articles published within the last 15 years were used.

Results: The keyword searches identified 43 potentially relevant reports, which were screened against the exclusion criteria to obtain 8 articles which were analyzed, including 4 meta-analyses.

Conclusions: The evidence strongly supported an association between vitamin D deficiency and an increased risk of developing Alzheimer’s disease. In individuals aged 65 years and older. Further research is required to confirm the relationship and assess the potential advantages of vitamin D supplementation in reducing the risk of developing Alzheimer’s. Disease.

BACKGROUND

Dementia is an umbrella term that encompasses several brain diseases that cause a decline in cognitive function and disruption to everyday life. Currently, 47.5 million people worldwide suffer from dementia, with Alzheimer’s disease (AD) accounting for 60-70% of cases [9]. Alzheimer’s Disease is the most prevalent neurodegenerative disease amongst the elderly, affecting 6% of individuals aged 65 years and older, and causes inevitable physical and psychological dependency [10]. The pathogenesis of the disease involves the proliferation of neurofibrillary tangles and amyloid plaques in the brain, which are two abnormal protein structures [11].

METHODS

Study Population

Shen et al. (2015) - 3 study populations from 3 studies

Lipton et al. (2014) - population-based study

Lipton et al. (2014) - Prospective cohort study

Baez et al. (2015) - 316 elderly receiving home care

Annweiler et al. (2015) - 449 community-dwelling women

Bukilic et al. (2015) - 10 observational studies (9 case-controls, 1 cohort)

Annweiler et al. (2015) - 10 observational studies (10 case-controls, 1 cohort)

Table 1. Results of the structured literature review of the association between Alzheimer’s disease and vitamin D deficiency in the elderly

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Methodology &amp; Design</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shen et al. (2015)</td>
<td>3 study populations from 3 studies</td>
<td>- In elderly Asian populations, a lower percentage of 25(OH)D concentrations was found in elderly with AD compared to controls</td>
<td>- Subjects with deficient vitamin D status had an increased risk of developing AD, compared to those with 25(OH)D level &gt;50 nmol/L.</td>
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<tr>
<td>Lipton et al. (2014)</td>
<td>population-based study</td>
<td>- Determined serum 25(OH)D concentrations in 691 community-dwelling older adults in 1989-1990</td>
<td>- Adjusted hazard ratios for AD increased as levels of 25(OH)D decreased</td>
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<tr>
<td>Lipton et al. (2014)</td>
<td>Prospective cohort study</td>
<td>- Assessed AD status up follow-up in 1988-1989</td>
<td>- Association between plasma 25(OH)D levels and increased risk of Alzheimer's disease</td>
</tr>
<tr>
<td>Baez et al. (2015)</td>
<td>316 elderly receiving home care</td>
<td>- Participants of the Nutrition and Memory in Elders (NAME) study</td>
<td>- Patients with AD had lower levels of 25(OH)D, as compared to healthy controls</td>
</tr>
<tr>
<td>Annweiler et al. (2015)</td>
<td>449 community-dwelling women</td>
<td>- Only used papers comparing descriptive analysis of individuals with AD against healthy populations</td>
<td>- Summation standardized mean difference of -1.39, 95% CI 0.17 to 2.60</td>
</tr>
<tr>
<td>Bukilic et al. (2015)</td>
<td>10 observational studies (9 case-controls, 1 cohort)</td>
<td>- Only included studies with vitamin D supplementation</td>
<td>- Summary standardized mean difference of -1.39, 95% CI -2.79 to 0.01</td>
</tr>
<tr>
<td>Annweiler et al. (2015)</td>
<td>10 observational studies (10 case-controls, 1 cohort)</td>
<td>- Only included studies with vitamin D supplementation</td>
<td>- Study exclusion criteria for data confirmation of the association</td>
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</table>

RESULTS

• 47.5 million people worldwide suffer from dementia, with Alzheimer’s disease (AD) accounting for 60-70% of cases [9]. Alzheimer’s Disease is the most prevalent neurodegenerative disease amongst the elderly, affecting 6% of individuals aged 65 years and older, and causes inevitable physical and psychological dependency [10]. The pathogenesis of the disease involves the proliferation of neurofibrillary tangles and amyloid plaques in the brain, which are two abnormal protein structures [11].

• Vitamin D deficiency is associated with increased risk of Alzheimer’s disease and dementia syndromes.

Discussion

Key Findings

- Deficiency in 25(OH)D serum concentration is associated with a higher prevalence of Alzheimer’s disease.

- Vitamin D sufficiency is suggested to be protective.

- Higher vitamin D intake is inversely associated with the onset of Alzheimer’s disease.

- Vitamin D may be protective against AD.

- Vitamin D deficiency is associated with increased risk of Alzheimer’s disease.

- Vitamin D supplementation may be beneficial in reducing the risk of developing Alzheimer’s disease.

Limitations

- Confounding variables (gender differences in AD incidence, skin pigmentation, anti-AD drugs, genetic factors, amount of sunlight exposure, lifestyle factors) → overestimation or underestimation of association

- Association cannot causality – individuals with AD are less likely to spend time outdoors and more likely to stay indoors → lower vitamin D levels

- Miscategorization → measurement of vitamin D status is not consistent between all of the chosen studies

- Confirmation bias → search for data to confirm the association rather than disprove it

- Future research should investigate:

- Potential advantages of vitamin D supplementation in reducing the risk of developing Alzheimer’s disease in healthy individuals, as well as in showing the progression in diagnosed individuals

- Benefits of vitamin D administration as part of a treatment plan

- Other dietary factors that may interact with vitamin D deficiency to further exacerbate the disease

CONCLUSION

Results of the structured literature review, n = 8, showed that there is an association between vitamin D deficiency and an increased risk of developing Alzheimer’s disease amongst the elderly.

REFERENCES