ORIGINAL ARTICLE

Evaluation of Vitamin B12 Deficiency Risk in Type 2 Diabetic Patients with Dementia

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Abstract

Background: Dementia is already a significant health and socioeconomic challenge, even in developing nations such as Bangladesh, as a result of the aging population and various associated risk factors. This study has assessed the likelihood of vitamin B12 deficiency among the elderly diabetic population in Bangladesh.

Materials and Methods: The study utilized a cross-sectional observational design. After obtaining informed written consent, data collection was conducted involving 172 respondents or their caregivers through a structured questionnaire derived from the Addenbrooke's Cognitive Examination (ACE-III) to assess cognitive status. Participants were divided into two groups based on their ACE-III score: Group I for diabetic mellitus (DM) with dementia (score ≤70) and Group II for DM without dementia (score >70). The analysis of data was conducted employing both univariate and multivariate statistical methods, as deemed suitable.

Results: In this study, mean± SD of Vitamin B-12 levels showed highly significant difference (p<0.001) between groups. In this study significant positive correlation was found between ACE-III total score with Vitamin B-12 levels (ρ= 0.445; p=0.000). Also by doing multivariate analysis positive association was found between ACE-III total score with vitamin B-12 with p=0.000, 95.0% CI; 0.003 to 0.002, Odds ratio; 10.825.

Conclusions: A deficiency in Vitamin B12 is associated with cognitive function and therapy to replace this vitamin might be a potential approach to enhance cognitive outcomes in patients. Additional research is required to validate and clarify the identified relationships on a broader scale and to assess whether these results will lead to a decrease in cognitive decline.

Keywords: Vitamin B12 Deficiency, Dementia, Alzheimer's disease (AD),Type 2 Diabetic Patients

Introduction

Alzheimer's disease (AD) represents a progressive neurological condition marked by a decline in cognitive function, memory loss, shifts in personality and behavior, and a diminishing capacity to carry out everyday tasks.[1] It is widely acknowledged as the most prevalent neurodegenerative disorder and the primary contributor to dementia worldwide.[2] Approximately 5% of individuals over the age of 65 are estimated to experience dementia, with this figure increasing to between 20% and 40% for those older than 85 years.[3] Annually, approximately 4.6 million new dementia cases emerge globally, with projections indicating that this figure is set to double every two decades.[4] South Asia is home to around 4.8 million individuals affected by dementia, with 3.8 million residing in India, 0.6 million in Bangladesh, and 0.4 million in Pakistan.[5]

A deficiency in vitamin B12 is closely associated with neurological disorders and dementia due to ongoing demyelination.[6] As people age, vitamin B12 levels typically decrease, which leads to a higher occurrence of deficiency among the elderly population.[7] In developing countries such as Bangladesh, individuals from lower socioeconomic backgrounds are particularly affected by vitamin B12 deficiency due to insufficient nutritional intake. Among young adults, one significant factor contributing to vitamin deficiency is the lack of consumption of foods derived from animals.[8] Older individuals, malabsorption may

primarily be responsible for the deficiency. Additionally, conditions such as bacterial overgrowth and prolonged use of certain medications for other health issues (like proton pump inhibitors, H2 receptor antagonists, cancer treatments, and tuberculosis medications) can hinder the release of vitamin B12 from food sources.[9]

Metformin stands out as the most commonly prescribed oral medication for managing diabetes worldwide. It is important to note that diabetic patients who are administered metformin at elevated doses over extended durations may face an increased risk of developing dementia. This condition may arise from the impaired absorption of crucial vitamins such as B6 and B12, which play vital roles as cofactors in the metabolism of homocysteine.[10,11]

As of now, there has been no research conducted in Bangladesh examining the impact of vitamin B12 deficiency on cognitive dysfunction and dementia among individuals with diabetes. This study was conducted in a medium- to low-socioeconomic community in Dhaka, focusing on patients visiting an endocrinology outpatient department who presented with a range of neurological manifestations.

Materials and Methods

This cross-sectional study was conducted at Bangladesh Diabetic Network Ltd. (BDN) in collaboration with the Department of Biochemistry and Molecular Biology. Cognitive assessment was carried out using the Addenbrooke's Cognitive Examination–III (ACE-III), administered through a structured questionnaire. Based on the scoring system, participants were categorized into two groups: Group-I – diabetes mellitus (DM) with dementia (ACE-III score $\leq$ 70) and Group II – DM without dementia (ACE-III score >70).

Statistical analysis was performed using SPSS version 23.0. Data were expressed as mean ± standard deviation (SD). Comparative analyses were conducted using appropriate statistical tests, including the Pearson correlation test, independent sample Kruskal–Wallis test, multivariate analysis, and multiple logistic regression, as applicable. A p-value <0.05 was considered statistically significant.

Results

Table-I : Comparison of Vitamin B-12 status between groups

Variables	Group I (n=86) Mean± SD	Group II (n=86) Mean± SD	p value
Severe Vitamin B-12 (pg/ml)	126.93± 39.91	297.23 ± 67.62	<0.001

Group-I: DM with Dementia

Group-II: DM without Dementia

Statistical analysis was done by Independent t- test to compare among groups. Values are expressed as the mean± SD. *= significant. *p<0.05, **p<0.01, ***p<0.001.

Table-I shows Mean± SD of Vitamin B-12 levels had highly significant difference (p<0.001) between groups.

Table-II : Correlation of ACE-III total score with Vitamin B-12 (n=172)

Variables	Group I (n=86) Mean± SD	p value
Vitamin B-12	0.445**	0.000

Note: = Spearman correlation coefficient,

**Correlation is significant at the 0.01 level (2-tailed).

Table-II Shows correlation of ACE-III total score with Vitamin B-12. In this study significant positive correlation was found between ACE-IIItotal score with (= 0.445; p=0.000).

Table-III : Multinomial regression of parameter estimate (n=172)

Variables	Beta	P-value	95.0% Confidence Interval
Vitamin B-12	0.394	0.000	0.003 to 0.002

Table-III Shows association of ACE-III total score with Vitamin B-12. In this study positive association was found between ACE-III total score with vitamin B-12 (p=0.000). So, level of Vitamin B-12is independently associated with developing Dementia in our diabetic population.

Table-IV : Parameter estimate of Multinomial logistic Regression

Variables	Odds Ratio	p value
Vitamin B-12	10.825	0.000*

Note: *= values are statistically significant; the reference category is DM with ND (Non Dementia).

The probability of Vitamin B-12 deficiency in DM with Dementia group with respect to ND group is 10.825 times higher than that of subjects with normal Vitamin B-12 level(Table-IV).

Discussion

This hospital-based cross-sectional study took place at Bangladesh Diabetic Network Ltd. (BDN) from January 2023 to December 2023, aiming to assess the risk of vitamin B12 deficiency among patients diagnosed with type 2 diabetes mellitus (T2DM) and dementia. A total of 172 participants, representing both sexes and meeting the inclusion criteria, were recruited from the Endocrinology outpatient department. The study included individuals aged 60 and older diagnosed with T2DM, with cognitive impairment evaluated through the Bengali adaptation of the Addenbrooke's Cognitive Examination–III (ACE-III).

Type 2 diabetes and dementia stand as two of the most widespread disorders across the globe, each carrying a heavy burden of morbidity and mortality. Numerous clinical studies provide compelling evidence that T2DM is linked to a two-fold heightened risk of developing dementia. Moreover, vitamin B12 deficiency is commonly observed as a comorbidity in individuals with diabetes.[12]

In this study, significant positive correlation was found between ACE-IIItotal score with Vitamin B-12. In this study significant positive correlation was found between ACE-IIItotal score with (ρ= 0.445; p=0.000). Many previous studies had found significant relationship between vitamin B12 deficiency increased the incidence of cognitive decline as well as dementia.[13,14]

This study further carried out multiple logistic regression analysis of factor influencing dementia that showed significant positive association of ACE-III total score with Vitamin B-12 (p=0.000). So, level of Vitamin B-12 is independently associated with developing Dementia in our diabetic population. A recent study also found a significant association of vitamin B12 with dementia.[15,16]

In this study, odds ratio (OR) of vitamin B-12 was high in DM with Dementia than DM with ND subjects. The probability of risk Vitamin B-12 deficiency in DM with Dementia group with respect to ND group is 10.825 times higher than that of subjects with normal Vitamin B-12 level. Some previous studies also showed similar odds ratio of vitamin B12 with dementia.[17,18]

However, this study showed a significant association of dementia with Vitamin B12 level in blood. So low level of Vitamin B12 in blood could be strong predictor for screening of dementia in diabetic population.

Conclusion

A significant contributor to their cognitive decline could be a deficiency in Vitamin B12. If the diagnosis is not made, treating B12 deficiency with the correct dosage and method of administration could provide advantages for elderly patients, especially when combined with antidiabetic medications. By implementing this approach properly, there is potential to not only prevent further decline but also possibly modify ongoing deterioration and even achieve some reversal of early symptoms.

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