

## Relation of Serum Vitamin D Level with Parkinson's Disease

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### Abstract

**Objective:** Few studies have been conducted globally to find out the relationship between serum vitamin D level and Parkinson's Disease. The recent study was aimed to find out the relation of serum vitamin D level with Parkinson's disease.

**Methods:** This cross-sectional comparative study was carried out in the Department of Neurology, Mymensingh Medical College Hospital, Mymensingh, Bangladesh during January 2019 to December 2020. A total of 55 Parkinson's disease patients diagnosed on the basis of UK Brain Bank criteria and age and sex matched 55 apparently healthy individuals were enrolled in this study. Cases of secondary Parkinsonism, individuals with comorbidities which can affect serum vitamin D level and recent vitamin D supplementation were excluded.

**Results:** Both patient and healthy group were analyzed against different socio-demographic variables. After Hoehn and Yahr staging, most of the cases were in stage 2 and stage 3 (30.91%). In PD group 27 patients (49.09%) and in healthy group 10 individuals (18.18%) had insufficient serum vitamin D level (10-20 ng/ml). 05 patients in case group and 3 individuals in control group had deficient serum vitamin D levels. Significant difference ( $p < 0.001$ ) between mean serum vitamin D levels were found between cases ( $20.86 \pm 9.43$  ng/ml) and controls ( $29.32 \pm 9.96$  ng/ml). There were statistically insignificant progressively lower serum vitamin D levels with increased disease severity.

**Conclusion:** These findings may prompt adjunctive therapeutic decisions about vitamin D supplementation in PD.

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**Keywords:** Serum vitamin D level, Parkinson's disease, Severity of Parkinson's Disease.

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## Introduction

Parkinson's disease is the second commonest neurodegenerative disease, exceeded only by Alzheimer's disease. It is more common in elderly and prevalence rises from 1% in those over 60 years of age to 4% of population over 80.<sup>1</sup> It is clinically characterized by motor (rest tremor, bradykinesia, rigidity and postural instability) and non-motor symptoms.<sup>2</sup>

Epidemiologic studies suggest increased risk of Parkinson's disease with pesticide exposure, rural living and drinking well-water and reduced risk with cigarette smoking and caffeine. Factors that have been implicated in the pathogenesis of neuronal death in Parkinson's disease include oxidative stress, intracellular calcium accumulation with excitotoxicity, inflammation, mitochondrial dysfunction and proteolytic stress. Most Parkinson's disease occurs sporadically (85-90%) and are of unknown cause. The rest are familial and more common in younger patients where genetic factors are more important.<sup>2,5</sup>

Vitamin D is a group of steroid derivatives which deals with calcium and phosphate metabolism. There are increasing evidences which show that vitamin D plays an important role in cell metabolism, such as proliferation, differentiation and immune-regulation.<sup>3</sup> However, it is argued whether low serum vitamin D is related to the etiology of Parkinson's disease.

This study was conducted to embark on measuring serum vitamin D levels of Parkinson's disease patients in Bangladesh. The results of the study may provide possibility of evaluating the risk of Parkinson's disease by using serum vitamin D level as a biomarker. The study might open a new window of future research regarding better treatment and prevention of Parkinson's disease.

## Methods

### *Study design and settings*

It was a cross sectional comparative study conducted at in and out-patient department of Neurology and Medicine, Mymensingh Medical College Hospital, Mymensingh, Bangladesh. Total duration of the study was two years (January, 2019 to December, 2020).

### *Study population*

Patients who visited in and out-patient Department of Neurology and Medicine, Mymensingh Medical College Hospital, Bangladesh with Parkinson's disease. (Diagnosed by UK Brain Bank Criteria) were included in case group<sup>4</sup>. Age and gender matched apparently healthy patient's attendants and hospital staffs were included in control group. Total 110 respondents (55 cases and 55 controls) were enrolled in the study. Purposive type of non-probability sampling method was followed. Patients with atypical parkinsonism, chronic kidney disease, gut pathology impairing vitamin D absorption or on vitamin D supplementation were excluded from the study.

### *Laboratory methods*

With aseptic precaution 3 ml venous blood was collected from ante-cubital vein. Serum was separated from blood by centrifugation at 3200rpm for 10 minutes. Serum samples were stored in a deep freezer at -20°C in the laboratory. Estimation of serum vitamin D level done on the same day of blood sample collection (preferably within 3 hours). Enzyme-linked immunosorbent assay (ELISA) for quantitative determination of total Vitamin D in serum was done in Dialab ELx808 (Made in Germany). Normal serum vitamin D was considered: >20ng/ml, whereas insufficient: 10-20 ng/ml and deficient: <10ng/ml.<sup>6</sup>

### *Data collection and analysis*

Data were collected by the principal investigator. After explaining the purpose of the study and with written consent, data were

collected in a semi-structured case record form through face-to-face interview, physical examinations and relevant investigations from hospital treatment sheet. Serum Vitamin D level was measured both in cases and controls. The case record form was developed after consulting with respected experienced teachers in this field, biochemist and epidemiologist. After collection, all data were checked for inadequacy, irrelevancy and inconsistency. All irrelevant and inconsistent data were corrected or discarded methodically. Data were analyzed by SPSS software version 25. Association between categorical variables were done with Chi square test while, quantitative variables were assessed by unpaired student t test or Mann Whitney U test. A probability (p) value of <0.05 was considered statistically significant.

#### *Ethical aspects*

Blood samples were collected through minimally invasive venipuncture procedure. All respondents were informed regarding the potential risks of blood collection. No intervention was done in patient or control group. The study was done with prior approval from “Institutional Review Board (IRB)” of Mymensingh Medical College Hospital. There was no conflict of interest.

#### **Results**

Table I illustrates that majority of the respondents were found in the age group (60-64) years, which were 17 (30.90%) patients in case and 16 (29.09%) respondents in control group. The mean age ( $\pm$ SD) was found

63.69 $\pm$ 6.81 years in case group with age range (51-75) years and 62.67 $\pm$  6.18 years in control group with age range (52-75) years. Male female ratio was 1.38: 1 in case group. Majority of the respondents were urban, which were 31(56.36%) in case and 32(58.20%) in control. Then rest of the respondents were rural that were 24(43.64%) in case and 23(41.80%) in control group. Both case and control groups were statistically similar in terms of occupation. There was no significant statistical difference between two groups regarding smoking status (p=0.197).

Table II demonstrates that in case group, 27 (49.09%) patients were measured insufficient and 5 (9.09%) patients were measured deficient vitamin D level and the rest were normal. Whether in control group, insufficient vitamin D level was found only 10 (18.18%) respondents and deficient level found in 3 (5.45%) respondents. The differences were statistically significant (p=0.003).

Table III illustrates that mean vitamin D level ( $\pm$ SD) in control group was 29.32 $\pm$ 9.96 ng/ml and in case group was 20.86 $\pm$ 9.43 ng/ml which is significantly lower (p<0.001).

Table IV shows distribution of Parkinson’s disease patients according to staging. Most of the patients 17 (30.91%) were in stage 2 and 3 each. Mean vitamin D level measured in different stages of Parkinson’s Disease based on Hoehn and Yahr staging. The differences were not statistically significant (p=0.495).

Table I: Demographic variables of study population

	Age (in years)	Case (%) n=55	Control (%) n=55	p value
Distribution of the respondents by age	<55	05 (9.09)	04 (7.27)	-
	55-59	10 (18.18)	13 (23.64)	
	60-64	17 (30.90)	16 (29.09)	
	65-69	12 (21.18)	14 (25.46)	
	>70	11 (20.00)	08 (14.55)	
	Mean±SD	63.69±6.81	62.67± 6.18	
	Range	(51-75)	(52-75)	
Gender distribution of the respondents	Gender	Case (%) n=55	Control (%) n=55	-
	Male	32 (58.18)	33 (60.00)	
	Female	23 (41.82)	22 (40.00)	
Distribution of the respondents by residence	Residence	Case (%) n=55	Control (%) n=55	0.327
	Urban	31 (56.36)	32 (58.18)	
	Rural	24 (43.64)	23 (41.82)	
Distribution of the respondents by occupation	Occupation	Case (%) n=55	Control (%) n=55	0.524
	Business	12 (21.82)	09 (16.36)	
	Farmer	13 (23.64)	15 (27.27)	
	Housewife	17 (30.91)	20 (36.36)	
	Service	09 (16.36)	08 (14.55)	
	Others	04 (7.27)	03 (5.45)	
Distribution of the respondents by smoking status	Smoking	Case (%) n=55	Control (%) n=55	0.197
	Smoker	14 (25.45)	16 (29.09)	
	Non-smoker	41 (74.55)	39 (70.91)	

p values were obtained by Chi-square test.

Table II: Status of serum vitamin D level among cases and controls

Vitamin D status (Vitamin D level)	Cases (%)	Controls (%)	p value
Normal (>20 ng/ml)	23 (41.82)	42 (76.36)	0.003*
Insufficient (10-20 ng/ml)	27 (49.09)	10 (18.18)	
Deficiency (<10 ng/ml)	05 (9.09)	03 (5.45)	

p value was measured by chi-square test. \* Statistically insignificant result.

Table III: Comparison of vitamin D level between cases and controls

Vitamin D level (ng/ml)	Cases (n=55)	Controls (n=55)	p value
Mean $\pm$ SD	20.86 $\pm$ 9.43	29.32 $\pm$ 9.96	<0.001*
Median	18.10	30.30	
Range	8.60-35.10	8.60-45.10	

p value was obtained by unpaired t test. \* Statistically significant result.

Table IV: Distribution of the patients of PD or cases according to stages of Parkinson's disease (n=55) (Based on Hoehn and Yahr staging)

Stages of Parkinson's disease	Number of patients (n=55) (%)	Mean vitamin D level (ng/ml) $\pm$ SD	p value
Stage: 1	08 (14.55)	21.85 $\pm$ 8.64	0.495
Stage: 2	17 (30.91)	20.75 $\pm$ 9.75	
Stage: 3	17 (30.91)	21.79 $\pm$ 8.73	
Stage: 4	10 (18.18)	19.43 $\pm$ 11.31	
Stage: 5	03 (5.45)	18.27 $\pm$ 12.78	

p value was obtained by ANOVA test. \* Statistically significant result.

## Discussion

This cross-sectional comparative study was designed to determine the relationship between serum vitamin D level and Parkinson's disease in a group of Bangladeshi people. Eyles et al (2005) and Jenner P. (2003) showed that inadequacy of serum vitamin D may be related to development and progression of Parkinson's disease by both genomic and non-genomic ways.<sup>7,8</sup> Respondents in both patient and healthy group were comparable in terms of age. Male to female ratio was 1.38:1 which corresponds with global data. More respondents in case group were measured insufficient serum vitamin D level than healthy group which was statistically significant (p=0.003). This finding matches with some previous studies performed by Mujtaba et al and Jamali et al.<sup>9,10</sup> Mean serum vitamin D level was significantly lower in case group (p<0.001). This matches with the study by Knekt et al.<sup>11</sup>

Serum vitamin D levels were measured progressively lower with advancing Hoehn and Yahr staging but the differences were not statistically significant. This finding goes against the findings by Chistaz et al.<sup>12</sup> With the

advancement of healthcare services in Bangladesh, average life expectancy as well as risk of PD is increasing. Low serum vitamin D level may have synergistic effect with other probable risk factors for disease onset and rapid progression. Early detection of vitamin D deficiency and measures to correct it may be an important preventive step for PD.

## Conclusion

This study showed that serum vitamin D level was significantly lower in Parkinson's disease patients' group than apparently healthy population group. No significant difference found between mean serum vitamin D levels in different stages of disease. Screening of serum vitamin D level may be logical in every Parkinson's disease patient.

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