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SHORT COMMUNICATION

THE ASSOCIATION OF VITAMIN D WITH METABOLIC SYNDROME IN ADULTS WITH PREDIABETES

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Abstract

Background: *Vitamin D may play important role in the pathogenesis of several components of metabolic syndrome (MS). The aim of this study was to observe the association of vitamin D with MS and its components in Bangladeshi adults with prediabetes.* ***Methods:*** *This cross-sectional study was done among 117 newly detected nonpregnant adults with prediabetes [age (years): 36.30±9.99; BMI (kg/m^2): 28.89±4.35, mean±SD; M/F: 23/94] based on American Diabetes Association 2018 criteria. Metabolic syndrome was diagnosed by any three of five criteria: central obesity; elevated blood pressure, fasting blood glucose & triglyceride (TG) and lower HDL cholesterol. Glucose was measured by glucose oxidase, lipid by glycerol phosphate dehydrogenase-peroxidase and vitamin D by high performance liquid chromatography method. Vitamin D <20 ng/ml was considered as deficiency (VDD).* ***Results:*** *Among all the variables only TG was significantly higher in patients with VDD than those without VDD (≥20 ng/ml) [163.0 (135.50, 224.50) vs. 143.50 (101.25, 190.0), median (IQR), p=0.048]. There were no significant correlations [p=NS for all] and associations of vitamin D with MS or its components in linear and logistic regression [p=NS for all].* ***Conclusions:*** *Except TG vitamin D has no associations with MS or its components in Bangladeshi adults with prediabetes.*

Key words: *vitamin D, metabolic syndrome, prediabetes, triglyceride*

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Introduction:

Metabolic syndrome (MS) and prediabetes are two very common conditions among people with Bangladesh (30% & 10.1% respectively)[1,2]. Both the conditions are important modifiable risk factors for cardiovascular diseases. Recent studies suggest that vitamin D deficiency (VDD) is associated with all the components of metabolic syndrome[3]. Vitamin D may play critical role in insulin resistance, pancreatic â-cell dysfunction, meta-inflammation, lipolysis and indirect effects on renin-angiotensin system. These plausible mechanisms are thought to be linked with VDD induced secondary hyperparathyroidism[4,5]. VDD also plays an important role in progression from prediabetes to full blown diabetes mellitus[6]. However, data are limited for Bangladeshi individuals with prediabetes regarding the association of vitamin D with MS. This study was aimed to see the relationships of vitamin D level and status with MS and its components among Bangladeshi adults with prediabetes.

Methods:

This cross-sectional study was done among 117 newly detected and untreated nonpregnant adults with prediabetes [age (years): 36.30±9.99; body mass index (BMI) (kg/m^2): 28.89±4.35, mean±SD]. Prediabetes was diagnosed according to American Diabetes Association 2018 criteria[7]. Participants who were taking or had received vitamin D or calcium within last 120 days of sample collection; taking any medications that alter vitamin D level; having any disorders affecting vitamin D metabolism and pregnancy or lactation were excluded from the study. Participants were recruited consecutively by purposive sampling technique during the period of July 2018 to September 2019. After taking informed written consent, clinical information [age, sex,

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height, weight, waist circumference and blood pressure (BP)] were collected in a pretested, semi-structured data sheet. Fasting venous blood was taken from each individual to measure glucose (FBG), lipid profile and vitamin D. Glucose was measured by glucose oxidase, lipid by glycerol phosphate dehydrogenase-peroxidase method and vitamin D by high performance liquid chromatography method. Obesity was defined by BMI ≥25 kg/m^2 and metabolic syndrome was diagnosed by a combination of any three out of five criteria: central obesity (male ≥90 cm, female ≥80 cm), metabolic syndrome BP (MS-BP) ≥130/85 mm-Hg, metabolic syndrome FBG (MS-FBG) ≥5.6 mmol/L, metabolic syndrome HDL-C (MS-HDL-C) (male <40 mg/dl, female <50 mg/dl) and metabolic syndrome TG (MS-TG) ≥150 mg/dl[8,9]. A modified vitamin D status consisting of only vitamin D deficiency (<20 ng/ml) and without vitamin D deficiency (≥20 ng/ml) was considered[10]. The study protocol was approved by institutional review board of BSMMU (No. BSMMU/2018/4826).

Data were analyzed by SPSS software version 22.0. Data were expressed in mean±standard deviation (SD) or median (interquartile range, IQR) (TG) and frequency (percentages, %) as appropriate. Comparison between two groups were done by independent-samples t test or Mann-Whitney U test and among more than two groups by one-way ANOVA or Kruskal Wallis one-way ANOVA test for quantitative variables and Pearson's chi-square/Fisher's exact test for qualitative variables. Correlations of vitamin D with all the quantitative variables were done by Pearson's or Spearman's (TG) correlation test. Linear regression analysis was done with vitamin D level as dependent variable and logistic regression analysis was done with vitamin D status as dependent variable. A two-tailed p <0.05 was considered as statistically significant.

Results:

Table I is showing the characteristics of the study population according to vitamin D status. Age, BMI, WC, systolic & diastolic BP, FBG, TC, LDL-C, HDL-C all were statistically similar between the groups with or without VDD [p=NS for all]. Only TG (mg/dl) was significantly higher in VDD group than non-VDD group [163.0 (135.50, 224.50) vs. 143.50 (101.25, 190.0), median (IQR), p=0.048]. There were no significant differences in sex, general obesity and metabolic syndrome categories including its all components' categories between the vitamin D groups [p=NS for all].

Table-I

Characteristics of the study population according to vitamin D status

Variables	VDD (<20 ng/ml)	Without VDD (≥20 ng/ml)	p
No. (%)	53 (45.3)	64 (54.7)	
Age, years	37.49±9.56	35.31±10.30	0.242†
Sex			
Male	13 (56.5)	10 (43.5)	0.251Â
Female	40 (42.6)	54 (57.4)	
BMI, kg/m^2	29.05±4.15	28.75±4.53	0.710†
Obese (BMI ≥25 kg/m^2)	44 (46.8)	9 (39.1)	0.641Â
Waist circumference, cm			
Male	98.59±13.85 [13]	89.80±14.48 [10]	0.154†
Female	99.08±8.80 [40]	97.78±10.42 [54]	0.524†
Central obesity (M≥90, F ≥80)	51 (47.2)	2 (22.2)	0.180Â
Systolic BP, mm-Hg	120.51±15.42	115.83±14.25	0.091†
Diastolic BP, mm-Hg	81.92±11.22	79.14±8.68	0.133†
MS- BP (≥130/85)	26 (54.2)	27 (39.1)	0.132Â
FBG, mmol/L	5.83±0.58	5.75±0.65	0.492†
MS-FBG (≥5.6)	37 (44.6)	16 (47.1)	0.840Â
HDL-cholesterol, mg/dl			
Male	35.85±8.26 [13]	38.70±6.22 [10]	0.373†
Female	41.78±9.09 [40]	43.80±9.72 [54]	0.307†
MS-HDL-C (M<40, F<50)	43 (49.4)	10 (33.3)	0.142Â
Triglyceride, mg/dl	163.0 (135.50, 224.50)	143.50 (101.25, 190.0)	0.048*
MS-TG (≥150 mg/dl)	30 (50.0)	23 (40.4)	0.354Â
Metabolic syndrome	44 (50.6)	9 (30.0)	0.058Â

Within parentheses are percentages over column total

†Independent-samples T test or *Mann-Whitney U test was done

ÂPearson's chi-square/Fisher's exact test was done as appropriate

The vitamin D level and VDD status of the study population among groups of MS and its different components are shown in Table 2. None of the associations between vitamin D level or VDD status with MS or its any components were statistically significant (p=NS for all).

Vitamin D had no significant correlation [WC: r=-0.084, p=0.366; SBP: r=-0.025, p=0.786; DBP: r=-0.017, p=0.856; FBG: r=-0.013, p=0.893;TG: r=-0.140, p=0.132; HDL-C: r=0.083, p=0.372] or predictive association by multivariate linear regression with any components of MS [WC: β=-0.176, p=0.325; SBP: β=0.062, p=0.672; DBP: β=-0.060, p=0.670; FBG: β=0.066, p=0.517; TG: β=0.028, p=0.804; HDL-C: β=0.093, p=0.372]. Similarly, MS and none of components of MS could predict VDD by multivariate binary logistic regression model [odds ratio (95% confidence interval)- MS: 0.538 (0.108, 2.673), p=0.448; central obesity: 1.903 (0.319, 11.368), p=0.480; MS-BP: 1.471 (0.650, 3.330), p=0.355; MS-FBG: 0.666 (0.245, 1.811), p=0.425; MS-TG: :MS-HDL-C: 1.265 (0.403, 3.968), p=0.687].

Table-II

Vitamin D level and status among different components of metabolic syndrome

Variables	Categories	Vitamin D, ng/ml mean±SD	p†	VDD, no. (%)*	p*
Waist circumference	Centrally obese (n=108)	20.42±10.59	0.094	51 (47.2)	0.180
	Nonobese (n=9)	26.57±9.12		2 (22.2)	
Blood pressure	MS-BP (n=48)	20.18±10.57	0.546	26 (54.2)	0.132
	Optimal (n=69)	21.39±10.63		27 (39.1)	
Fasting blood glucose	MS-FBG (n=83)	21.24±10.51	0.584	37 (44.6)	0.840
	Normal (n=34)	20.05±10.84		16 (47.1)	
HDL- cholesterol	MS-HDL-C (n=87)	20.34±10.58	0.332	30 (34.5)	0.354
	Less risk (30)	22.52±10.57		23 (76.7)	
Triglyceride	MS-TG (n=60)	20.16±10.17	0.441	43 (71.7)	0.142
	Optimal (n=57)	21.67±11.03		10 (17.5)	
Metabolic syndrome	Present (n=87)	20.13±10.43	0.182	44 (50.6)	0.058
	Absent (n=30)	23.12±10.85		9 (30.0)	
Metabolic syndrome	MS + Obese (n=76)	19.58±10.69	0.336	39 (51.3)	0.270
with obesity interaction	MS – obese (n=11)	23.88±7.83		5 (45.5)	
	– MS+obese (n=18)	22.82±11.38		5 (27.8)	
	– MS–obese (n=12)	23.58±10.48		4 (33.3)	
Number of component	One (n=12)	26.98±7.69	0.271	1 (8.3)	0.057
of metabolic syndrome	Two (n=17)	19.58±11.66		8 (47.1)	
	Three (n=29)	20.64±11.73		13 (44.8)	
	Four (n=42)	19.46±9.80		24 (57.1)	
	Five (n=17)	21.91±10.56		7 (41.2)	

Within parentheses are percentages over row total

†Independent-samples t test or one-way ANOVA test was done

*Pearson's chi-square test/Fisher's exact test was done as appropriate

Discussion:

This cross-sectional study included 117 newly detected and untreated nonpregnant adults with prediabetes. Among them 53 (45.3%) had VDD and 87 (74.4%) had MS. Dutta et al.2013 also found a similar percentages of VDD (43.3%) in patients with predabetes[11]. However, we found a higher prevalence of MS among adults with prediabetes than other studies. This is most likely the lower cut-off value we used to define WC (Asian) that is lower than those studies[12,13].

Patients with VDD had higher level of TG than patients without VDD. There were no other significant correlations and predictive associations between vitamin D with MS. Similar findings were also found by a study conducted among prediabetic patients of West Bengal, India[11]. While Tian et al. 2019 found significant associations of vitamin D with all the components of MS in participants with prediabetes, Kwon and Lim, 2016 found association only with HDL-C[12,13]. We did not find association of vitamin D with MS. This is similar to the observation of Kwon and Lim in Korean population and Wieder-Huszla et al. 2019 in women of Poland[12,14]. Vitamin D was not found as an independent predictor of fasting lipids in a British Bangladeshi adults[15]. Therefore, the associations of vitamin D with MS and its components in patients with prediabetes are not consistent. Even the association of vitamin D with the mediator of prediabetes and MS i.e. insulin resistance was also not observed in a previous study among Bangladeshi adults with prediabetes[16]. Although the association between vitamin D with MS was found in cross-sectional studies, it was not found in longitudinal studies[17]. Furthermore, vitamin D supplementation did not improve insulin sensitivity and metabolic parameters in patients with MS[18]. These study findings indicate that the role of vitamin D in mediating the components of MS is minimal. However, our study sample size was small and it was a cross-sectional study. Further longitudinal study can be done with larger sample size to find out the actual relationship between vitamin D with MS in patients with prediabetes.

Conclusions:

VDD and MS are common in Bangladeshi adults with prediabetes. Hypertriglyceridemia is associated with VDD but it is not an independent predictor of vitamin D level or VDD. Vitamin D has no other associations with MS and its components in adults with Prediabetes.

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Conflict of interest:

None of the authors has any conflict of interest to declare

Ethical consideration:

The study was conducted after approval from the ethical review committee. The confidentiality and anonymity of the study participants were maintained.

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