

Correlation of Body Mass Index with Vitamin D and Parathormone (PTH) in Obese and Overweight Children, Study from a Tertiary Care Hospital of Bangladesh

Kohinoor Jahan Shyamaly^{*1}, Muhammad Rezaul Karim², Baraka Badruddoza Tithi³, Romana Akther⁴, Rokhsana Parvin⁵, Suraiya Begum⁶

Abstract

Introduction with aim and objectives: Childhood obesity and vitamin D deficiency both are emerging health issues. Vitamin D is essential for normal growth and development and frequently found low in obese and overweight children. The aim of this study was to assess serum vitamin D level, calcium, inorganic phosphate, alkaline phosphatase and parathormone (PTH) in obese and overweight children and to see the correlation between BMI, vitamin D and parathormone. **Materials and Methods:** This study was conducted at Pediatric Endocrinology clinic of department of Paediatrics of Bangabandhu Sheikh Mujib Medical University from the period of November 2016 to October 2018. We assessed 50 obese and overweight children for serum vitamin D, calcium, inorganic phosphate, alkaline phosphatase, and parathormone and we also tried to find out the correlations among the parameters in this cross sectional study. **Results:** Endocrine society clinical practice guideline was used to define vitamin D status. Result found that all of the obese/overweight children had low vitamin D (82% had deficiency and 18% had insufficiency). There was a statistically significant negative correlation between BMI and serum vitamin D level and positive correlation between BMI and the parathormone level (p value < 0.05). In this study significant negative association was found between vitamin D level and the PTH level p value < 0.05 . **Conclusion:** All the studied obese and overweight had vitamin D deficiency or insufficiency. There was negative correlation between BMI and serum vitamin D level and positive correlation between BMI and the parathormone level (PTH).

Keywords: BMI, Correlation, vitamin D, PTH, Bangladesh.

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*1. Corresponding Author:

Dr. Kohinoor Jahan Shyamaly, MD

Junior Consultant

Department of Pediatrics, Sadar Hospital, Sherpur.

Email: shamoly40mmc@gmail.com

Mob: 01914857802.

2. Dr. Muhammad Rezaul Karim, MD

Junior Consultant

Upazila Health Complex, Serajdikhan

Munshigonj.

3. Dr. Baraka Badruddoza Tithi, MD

Medical Officer

Kuwait Maitree Hospital, Dhaka.

4. Dr. Romana Akther, MD

Junior Consultant

Sadar Hospital, Rajbari.

5. Dr. Rokhsana Parvin, MD

RP (Pediatrics)

Department of Paediatrics, Khulna Medical College.

6. Prof. Suraiya Begum

MBBS, DCH, FCPS

Professor,

Department of Paediatrics, BSMMU, Dhaka.

Introduction:

Childhood obesity is one of the serious health challenges of 21st century. The problem is steadily affecting in developed as well as developing countries like Bangladesh. In Bangladesh the prevalence of obesity and overweight among Bangladeshi school children was 3.5% and 9.5% respectively¹. Vitamin D has a crucial role in calcium, phosphorus metabolism and bone mineral homeostasis. It has also anti-proliferative, pro-differentiation, anti-bacterial, immune-modulatory and anti-inflammatory properties within the body². Vitamin D deficiency is more prevalent in obese and overweight children and also found inverse association between BMI and vitamin D levels^{3, 4}. Deficiency of vitamin D in obese children have been related to the many obesity related co-morbidities such as insulin resistance and type 2 diabetes⁵, hypertension⁶, dyslipidemia and metabolic syndrome in obese children⁷. This study had been designed to assess vitamin D calcium, inorganic phosphate, alkaline phosphatase, prohormone and to see the correlation between BMI, vitamin D and parathormone.

Materials and Methods:

This study was conducted at Pediatric Endocrinology clinic of department of Paediatrics of Bangabandhu Sheikh Mujib Medical University from the period of November 2016 to October 2018. Study population was 50 obese and overweight children aged 5.5 to 18 years. We excluded the obese children who were taking systemic steroid for

any cause, suffering from genetic, endocrine or any neurological diseases that might lead to overweight or obesity, who had known liver or renal disease and those were getting vitamin D and/or calcium supplementation. Informed written consent was taken from all the participants or parents or guardians. Proper history, physical examination including anthropometric indices like weight, height, BMI were taken. The weight was measured by using electronic weighing machine and height was recorded using stadiometre. BMI was calculated dividing weight (kg) by height (meter) ². Patients were categorized into obese or overweight according to CDC BMI chart for particular age and sex.

Overweight: BMI 85th to < 95th centile

Obese: BMI ≥ 95th centile.

Biochemical assessment:

Observation and Result:

Vitamin D, parathormone and other biochemical parameters were estimated from venous blood of the study population in the Department of Biochemistry of the same university. Here 25(OH) D3 is used to measure the vitamin D level in the body as it is the major circulating form of vitamin D and has a half-life of approximately 2-3 weeks. Estimation of serum 25(OH) D was done by Chemiluminescence microparticle immune assay (CMIA) technique using the analyzer Architect Abott, Ci 4100, USA 2012. Vitamin D level was classified into 3 categories: (According to Endocrine Society Clinical Practice Guideline, Hollick et al. 2011).

Vitamin D deficiency : < 20 ng/ml

Vitamin D Insufficiency: 20 –<30 ng/ml

Vitamin D sufficiency : 30-100 ng/ml

Statistical analysis of data

Statistical calculations were done using the appropriate statistical software SPSS 22.0. Pearson correlation test and scatter diagram was applied to evaluate the association between the variables. P-value less than 0.05 was considered as significant.

Ethical consideration

Ethical clearance was taken from Institutional Review Board of BSMMU.

Result:

We studied 50 overweight and obese children, among them 37 (74%) were overweight and 13 (26%) were obese. Table I showed demographic characteristics of the study subjects, majority of the obese and overweight children were of adolescent age group (10 to 18 years). Males were predominant. Among the study population 12% had hypertension and advanced tanner stage, almost all (98%) of them had acanthosis nigricans and 62% had striae. Result also showed that 82% of the obese/overweight children had vitamin D deficiency, 18% had insufficiency. None of them had sufficient vitamin D level. All of them had normal serum calcium level and most of them had normal level of alkaline phosphatase. Serum inorganic phosphate was normal in 80%

of the cases. Serum PTH was normal in 70% of obese/overweight children and high in 30% of them.

Table I: Demographic and clinical characteristics of the study population (n=50)

Characteristics	Number	Frequency %
Age group		
Childhood	18	36
Adolescent	32	64
Sex		
Male	30	60
Female	20	40
Blood pressure		
Hypertension	6	12
Normal	44	88
Acanthosis nigricans		
Present	48	96
Absent	2	4
Striae		
Present	19	38
Absent	31	62
Tanner stage		
Advanced	6	12
Age appropriate	44	88

Table II: Status of Biochemical parameters in the obese/overweight group (n= 50)

Biochemical parametres	Frequency	Percentage
S. vitamin D (ng/ml)		
Sufficiency (30-100 ng/ml)	0	00
Insufficiency (20-<30 ng/ml)	9	18
Deficiency (<20 ng/ml)	41	82
S. calcium (mg/dl)		
Normal	50	100%
Low	0	0%
S. inorganic-phosphate (mg/dl)		
Normal	40	80%
High	10	20%
Low	0	00%
S. alkaline phosphatase (u/l)		
Normal	49	98%
High	1	2%
S. parathormone (pg/ml)		
Normal	35	70%
High	15	30%

There was a statistically significant negative correlation between BMI and serum vitamin D level, a significant negative correlation between BMI and the parathormone level and p value <0.05 (Figure 1). Result also showed that serum PTH has a negative correlation with vitamin D level (table III). There were no significant correlation of serum calcium, inorganic phosphate and alkaline phosphatase with BMI or vitamin D level.

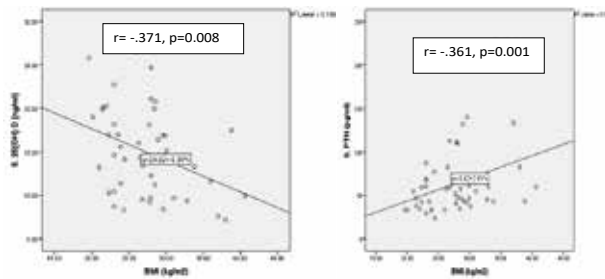


Figure 1: Correlation of BMI with serum vitamin D and parathormone in studied subjects.

Table III: Correlation of Vitamin D with other lab parameters in study population

Lab parameters	Pearson's correlation	
	r-value	p-value
S. Calcium (mg/dl)	-0.018	0.900
S.iPO ₄ (mg/dl)	0.141	0.330
S. ALP (U/L)	0.215	0.137
S. PTH (pg/ml)	-.425	0.002

Discussion:

Vitamin D deficiency is a current health issue. It is estimated that worldwide as many as one billion people suffer from vitamin D deficiency or insufficiency and this was shown to be prevalent across all age groups, genders, and geographic regions⁸. Present study included a total of 50 obese and overweight children. The study revealed that low vitamin D was in 100% (82% plus 18%) of these children. Most of the study in recent and in the past got the high prevalence of hypovitaminosis vitamin D in obese children. Dura-Trave et al. 2017 found in a study among 546 children that vitamin D deficiency was present 68.2 % of the obese children⁵. Study done in Indian children is also consistent with our study⁴. In this study vitamin D level showed strong negative correlation with BMI ($r = -.371$, $p = 0.008$). In a cross sectional study done in 301 Turkey children, similar result was found¹⁰. Turer et al. 2013 also found the negative correlation between BMI and vitamin D level in american children³. The inverse association between higher body mass and lower vitamin D levels may have been attributed to sequestration of the fat-soluble vitamin D within the adipose tissue¹¹. Several confounding factors such as sedentary lifestyle causing limited sun exposure, poor dietary habit and there by low dietary vitamin D intake have also been cited as possible cause of lower vitamin D in children with higher BMI^{11,12}. We found that serum PTH was showed the positive correlation with BMI ($r = 0.371$, $p = 0.008$). The value of parathormone increased as the BMI increased. Several study done in obese children showed that serum PTH is elevated in obese children. Reinehr along with colleagues conducted a study on 133 obese children and found PTH was positively related with BMI. They observe PTH level before and after weight loss in 67 obese children and found that the level of PTH normalizes after weight loss. So they postulated that high PTH is a consequence of obesity¹⁵. In this study the

negative association was found between vitamin D level and the PTH level in obese/overweight group ($r = -.425$, $p = 0.002$). In a study done in Turkey children serum 25-OHD levels and iPTH levels were measured and evaluated. They found that the PTH level rises when the vitamin D level decreases¹⁴. Raised PTH may be due to secondary hyperparathyroidism as vitamin D deficiency causes less absorption of serum calcium leading to hypocalcaemia which in turns leads to increase PTH secretion. This study found no significant correlation between vitamin D level or BMI with serum calcium, inorganic phosphate (iPO₄), alkaline phosphatase (ALP) in the study subjects. Serum calcium and alkaline phosphatase was normal in most of the obese/overweight children. Majority of the study done in obese children found normal level of serum calcium, inorganic phosphate (iPO₄), alkaline phosphatase (ALP)¹⁶. Low serum 25(OH) vitamin D levels usually not associated with a concomitant reduction in serum calcium because secondary hyperparathyroidism increases mobilization of calcium from the skeleton and increased calcium reabsorption in the kidney¹⁷. Thus, it is expected that calcium levels will not decline in patients with vitamin D deficiency until most of the calcium has been depleted from the skeleton which may also rise alkaline phosphatase level.

Conclusion

The study showed that 100% of the obese/overweight children had low vitamin D level. It also showed the negative relationship between BMI and 25 (OH) D levels in obese/overweight children. Serum parathormone showed a positive correlation with BMI and negative correlation with vitamin D level.

Conflict of Interest: None.

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