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# Relationship between Obesity and Serum Vitamin D Levels in Young Women

Dr. Purabi Barman[1*], Prof. Dr. Nowrose Jahan[2], Dr. Proshanta Kumar Pondit[3], Dr. Muhammad Anamul Hoque[4], Dr. Monika Roy[5], Dr. Afsana Akhter[1], Dr. Sushanta Kumar Barman[6]

[1]Lecturer, Biochemistry, Sir Salimullah Medical College, Dhaka, Bangladesh
[2]Professor, Department of Biochemistry, Sir Salimullah Medical College, Dhaka, Bangladesh
[3]Assistant Professor, Department of Neuromedicine, Rangpur Medical College, Rangpur, Bangladesh
[4]Junior Consultant, Department of Nephrology, Shaheed Syed Nazrul Islam Medical College Hospital, Kishoregonj, Bangladesh
[5]Lecturer, Dental Pharmacology, Rangpur Medical College, Rangpur, Bangladesh
[6]Medical Officer (IMO), Rangpur Medical College Hospital, Rangpur, Bangladesh

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***Corresponding author:** Dr. Purabi Barman
Lecturer, Biochemistry, Sir Salimullah Medical College, Dhaka, Bangladesh

**Abstract** **Original Research Article**

***Background:*** The prevalence of obesity rises gradually worldwide and it is a chronic metabolic disease, which is defined by an excessive accumulation of body fat resulting from an imbalance between energy intake and expenditure. Some studies suggested that the level of serum 25(OH)D was associated with obesity. Vitamin D insufficiency or deficiency is closely associated with chronic diseases, such as tumours, cardiovascular diseases, and diabetes. Vitamin D is fat soluble that can be stored in body fat tissues and excessive body fat can reduce 25(OH) D levels in the blood, especially in obese individuals. Many studies revealed that young women are at a high risk of vitamin D deficiency. ***Objective:*** To evaluate the relationship between serum 25(OH)D level and obesity among young women. ***Methods:*** This cross-sectional analytical study was carried out in the Department of Biochemistry of Sir Salimullah Medical College & Mitford Hospital, during July 20- June 21. 100 female subjects aged belongs to 19-29 yrs were selected by purposive sampling. Among them 50 women were obese (BMI ≥25 kg/m²) and 50 women were non-obese (BMI< 25 kg/m²). Initial evaluation was done by history taking and anthropometric indices were measured. Here, used student unpaired t-test, chi square test and Pearson's correlation test to determine the association between vitamin D statuses with different variables. Lipid profile assay were carried out by a semi auto biochemistry analyzer and Vitamin D was estimated by immunoanalyzer. SPSS (22) was used for test of significance and p value <0.05 was considered as statistically significant. ***Results:*** The mean value of weight, BMI, WC, WHR were significantly higher but height was significantly lower ($p<0.01$) in obese young women in comparison to non-obese young women. TC, TAG, LDL-C were significantly higher ($p<0.01$) but HDL-C and vitamin D were significantly low ($p<0.01$) in obese young women as compared to non- obese young women. Vitamin D had a significant inverse relationship with BMI, WC, WHR, TC, TAG and LDL-C but had no significant ($p>0.05$) relationship with HDL-C. Among 50 obese young women 32(64%) women had vitamin D insufficiency and 18(36%) had normal vitamin D. However, 27(54%) of 50 non-obese young women had normal vitamin D and 23(46%) had vitamin D insufficiency. ***Conclusion:*** The serum 25(OH)D levels of young women are inversely associated with obesity. Vitamin D had a negative significant correlation with BMI, WC, WHR, TC, TAG and LDL-C but no significant correlation with age and HDL-C in obese group.

**Keywords:** Obesity, Young adults, vitamin D deficiency.



## INTRODUCTION

Obesity is a complex chronic metabolic disease, which defined by an excessive accumulation of body fat resulting from an imbalance between energy intake and expenditure [1]. Obesity is caused by several reasons, and one of them is the imbalance between calories expended and calories consumed due to changes in physical activity and dietary patterns (WHO, 2019).

In the last 40 years, the prevalence of obesity nearly tripled worldwide. Once associated with high-income countries, obesity is now also prevalent in low- and middle-income countries (WHO, 2020). Population-based, cross-sectional survey conducted in

2009 reported that the prevalence of overweight and obesity was 17.7% and 26.2%, respectively, in rural Bangladeshi adults.

The fat-soluble vitamin D is a prohormone and needs to convert to its active form 1, 25-dihydroxyvitamin D for its biological effect. Vitamin D has important roles in the development and maintenance of bone tissue, as well as for normal homeostasis of calcium and phosphorus. Moreover, it is related to differentiation, cell proliferation, and hormone secretion [2].

Nowadays, vitamin D deficiency is a pandemic and has been implicated in several diseases, including CV morbidity and mortality, metabolic syndrome, and T2DM [3]. Holick (2007) mentioned that serum concentrations of 25-hydroxyvitamin D [25(OH) D] are considered as the best indicator of total body vitamin D stores [4]. Many clinical and epidemiological studies reported that obese subjects have lower serum concentrations of 25(OH) D and higher prevalence of vitamin D deficiency with a negative correlation of vitamin D concentrations with waist circumference (WC) and body mass index [5].

In Bangladesh, Kamrul-Hasan *et al.*, (2018) have reported a high prevalence of vitamin D deficiency in various subsets of the population [6]. According to a meta-analysis of studies on vitamin D deficiencies, there are racial or regional differences in vitamin D status [6]. For example, the level of 25-hydroxyvitamin D [25(OH)D], a proxy for vitamin D status, was generally higher in North America than in other countries, such as Europe, the Asia Pacific region, the Middle East, Africa, or South America [7].

From the estabilished database like SCOPUS, Pubmed, Cochrane, HINARI there was no report regarding low serum 25(OH) D level in Bangladeshi obese young female. So, this study was undertaken to investigate the relationship of serum 25(OH) D levels with obesity in Bangladeshi young women.

# OBJECTIVE

### General Objective

To evaluate the relationship between obesity and serum 25(OH) D level among young women.

### Specific Objectives

- To measure anthropometric indices (BMI, WHR) of the study subjects.
- To estimate the components of lipid profiles (TAG, TC, HDL-C, LDL-C) of the study subjects.
- To determine serum 25(OH) D level of the study subjects.
- To compare these variables in between obese and non-obese women.
- To find out the correlation between levels of serum 25(OH) D and lipid profile components in study population.

# METHODOLOGY

### Type of Study

Cross sectional analytical study.

### Study Place and Period

Department of Biochemistry of Sir Salimullah Medical College, Dhaka, Bangladesh. The study was done during the period 1st July 2020 to 30th June 2021.

### Study Population

100 apparently healthy young women aged 19-29 years were included in the study.

### Sample Size

This study was carried out with a sample size of 100 subjects.

### Sampling Technique

Purposive convenient sampling.

### Inclusion Criteria

Apparently healthy young women from 19 yrs to 29 yrs of age.

### Exclusion Criteria

- Underweight and morbid obese.
- Pregnancy.
- Breast feeding.
- Diabetes mellitus.
- Hypertension.
- Renal disorder.
- Thyroid disease.

### Study Procedure

Female subjects were selected from Matlab-North, Chandpur. Ethical permission was taken from the Ethical Review Committee of Sir Salimullah Medical College. After proper counseling aim, objectives, risk and procedure of the study were explained in details to all participants. Only voluntary candidates were recruited as participants of the study. They had the freedom to withdraw themselves from the study at any stage. Written informed consent was taken from all participants. Socio-demographic as well as other relevant data were taken and recorded in the data collection sheet with a prefixed questionnaire. Age and anthropometric measurements of each subjects was recorded following standard procedure. Blood sample was collected for biochemical variables to be measured.

### Data Collection and Processing

Before collecting specimen, each patient was interviewed and relevant information was recorded systematically in a pre-designed standard data sheet. Then data were checked, edited and compiled.

**Data Analysis**

Data were analyzed with the help of software SPSS (Statistical Package for Social Sciences) version 22.0 for Windows (SPSS Inc., Chicago, IL, USA). Qualitative data were expressed as frequency and percentage (%). Quantitative data were expressed as mean ± standard deviation and tested by unpaired t-test. Data were normal distribution. Pearson linear correlation was used to observe the correlation between parameters. Chi-square test was done to observe association between qualitative variables. P value of <0.05 was considered statistically significant.

## RESULTS

A total of 100 healthy young women aged 19-29 years were enrolled in this study. Among them, 50 were non-obese and 50 were obese. All the information was collected and tabulated in the following formats:

**Table I: Age distribution of the study subjects (n=100)**

| Age (in years) | Group A (n=50) number (%) | Group B (n=50) number (%) |
|---|---|---|
| 19-21 | 15(30%) | 14(28%) |
| 22-25 | 23(46%) | 17(34%) |
| 26-29 | 12(24%) | 19(38%) |

**Group A:** Non-obese young women, **Group B:** Obese young women.

Table I shows age distribution of the study subjects. Among 50 non-obese young women, 23(46%) were of 22-25 years age group. However, 19(38%) of the 50 obese young women belonged to 26-29 years age group.

**Table II: Comparison of general characteristics between two groups (n=100)**

| General characteristics | GroupA(n=50) Mean±SD | GroupB(n=50) Mean±SD | p value |
|---|---|---|---|
| Age | 23.06±3.15 | 23.8±3.49 | 0.268 |
| Weight(kg) | 53.32±6.77 | 70.44±6.46 | <0.01 |
| Height(m) | 1.6±0.02 | 1.58±0.03 | <0.01 |
| BMI ($kg/m^2$) | 20.9±2.54 | 28.34±2.8 | <0.01 |
| WC (cm) | 91.4±11.7 | 109.0±7.1 | <0.01 |
| WHR | 0.77±0.02 | 0.84±0.01 | <0.01 |

**Group A:** Non-obese young women, **Group B:** Obese young women, **BMI:** Body mass index, **WC:** Waist circumference, **WHR:** Waist hip ratio, p value reached from unpaired t-test

Table II shows comparison of general characteristics between non-obese and obese young women. It was observed that mean value of age did not differ significant in between two groups. It was evident that the mean value of weight, BMI, WC, WHR were significantly higher in obese young women (p<0.01) in comparison to non-obese young women however height was significantly lower (p<0.01) in obese young women in comparison to non-obese young women.

**Table III: Correlation of vitamin D with different variables in study subjects (n=100)**

| Biochemical parameters | r value | p value |
|---|---|---|
| AGE | 0.032 | 0.755 |
| BMI ($kg/m^2$) | -0.264 | 0.008 |
| WC | -0.209 | 0.037 |
| W/H ratio | -0.246 | 0.014 |
| TC (mg/dl) | -0.299 | 0.003 |
| TAG (mg/dl) | -0.276 | 0.005 |
| LDL-C (mg/dl) | -0.257 | 0.010 |
| HDL-C (mg/dl) | 0.110 | 0.274 |

Table III shows analysis was done by Pearson`s correlation. It was evident that vitamin D had no significant (p>0.05) relationship (r=0.032, p=0.755) with age. Vitamin D had a significant inverse relationship (r=-0.264, p=<0.01) with BMI. It was also inversely related to WC (r=-0.209, p=<0.05) which was significant (p<0.05). Vitamin D had a significant (p<0.05) inverse relationship with WHR, TC, TAG and LDL-C (r=-0.246, -0.299, -0.276, -0.257, p= 0.014, 0.003, 0.005, 0.010 respectively). It had no significant (p>0.05) relationship (r=0.110,p=0.274) with HDL-C.

**Table IV: Distribution of study subjects accordingly to vitamin D status (n=100).**

| Vitamin D status | Group A (n=50) number (%) | Group B (n=50) number (%) |
|---|---|---|
| Normal | 27(54%) | 18(36%) |
| Insufficient | 23(46%) | 32(64%) |

**Vitamin D levels:** ≥30 ng/ml= Normal, <30 ng/ml= Insufficient.

Table IV shows vitamin D distribution of the study subjects. Among 50 non-obese young women 27(54%) had normal vitamin D and 23(46%) had vitamin D insufficiency. However, 32(64%) of the 50 obese young women had vitamin D insufficiency and 18(36%) had normal vitamin D.

## DISCUSSION

In the present study, mean age was 23.06±3.15 yrs and 23.8±3.49 yrs in non-obese and obese subjects respectively. No age difference was seen between the two groups. This observation was consistent with the study of Lim *et al.,* (2019). Mean values of anthropometric measurements (Body weight, BMI, WC, WHR) except height were significantly higher in obese young women. Paul *et al.,* (2020) also observed similar type of findings [6].

Vitamin D showed inverse relationship with TC, TAG and LDL-C and it had no relationship with HDL-C in the present study (Table III). The serum 25(OH)D levels were inversely associated with TAG and LDL-C and positively associated with TC in Chinese adults as observed by Wang *et al.,* (2016)[8]. Paul *et al.,* (2020) reported that 25(OH) D levels did not correlate with either total cholesterol, HDL-C, or triglyceride levels; only LDL-C showed a significant positive correlation with vitamin D level [6]. Karatus *et al.,* (2013) also observed no correlation of vitamin D with triacylglycerol and HDL-C levels in obese subjects. It was observed through the study that vitamin D had an inverse relationship with BMI, WC and WHR. These findings were consistent with the studies of Paul *et al.,* (2020); Taheri *et al.,* (2012) and Wortsman *et al.,* (2000) [5, 9, 10].

Frequency of vitamin D insuffiency were 32(64%) and 27(54%) in obese and non-obese young women respectively. Jungert, Roth and Neuhauser-Berthold, (2012) and Karatas *et al.,* (2013) reported that the prevalence of 25(OH)D deficiency as 40% to 80% among obese people [11, 12]. Hamza and Hasan (2020) also found vitamin D deficiency was more prevalent in overweight and obese patients [13]. In a meta-analysis Yao *et al.,* (2015) indicated that vitamin D deficiency is more common among obese subjects and the obesity-vitamin D deficiency association is stronger in the Asian population than in the European–American population [14].

It remains unclear whether low vitamin D status is responsible for the development of obesity or whether obesity results in vitamin D insufficiency or deficiency. Paul *et al.,* (2020) mentioned that low serum 25(OH) D is a consequence of obesity not the cause of obesity [6]. The underlying mechanisms of hypovitaminosis D in obesity are not clear. There could be lower vitamin D input because of lower dietary intake, lower sunlight exposure, or impaired skin synthesis of vitamin D [6]. Some studies suggested that vitamin D deficiency can favor higher adiposity by promoting elevated parathyroid hormone levels and more calcium inflow into adipocytes which will increase lipogenesis through which acetyl-CoA is converted to triglyceride for storage in fat and packaged within lipid droplets [2, 15]. Obesity has been shown to be associated with decreased serum 25(OH) D levels [16, 17]. The possible reason for this association backs to the characteristics of Vitamin D itself is a fat-soluble vitamin. Higher body fat decreases the availability of circulating 25(OH) D [18]. On the other hand obese persons have higher fat content, which could block 25(OH) D to be halted into the body tissue and consequently lowers the circulating serum 25(OH) D [13].

## CONCLUSION

It is evident from the study that young obese women have low serum vitamin D level. Vitamin D is inversely related with BMI, WC and WHR. Furthermore it has negative significant correlation with TC, TAG and LDL-C but no significant correlation with serum HDL-C.

## REFERENCES

1. El-Sayed Moustafa, J. S., & Froguel, P. (2013). From obesity genetics to the future of personalized obesity therapy. *Nature Reviews Endocrinology*, *9*(7), 402-413.
2. Pereira-Santos, M., Costa, P. D. F., Assis, A. D., Santos, C. D. S., & Santos, D. D. (2015). Obesity and vitamin D deficiency: a systematic review and meta-analysis. *Obesity reviews*, *16*(4), 341-349.
3. Soskić, S., Stokić, E., & Isenović, E. R. (2014). The relationship between vitamin D and obesity. *Current medical research and opinion*, *30*(6), 1197-1199.
4. Holick, M. F. (2007). Vitamin D deficiency. *New England journal of medicine*, *357*(3), 266-281.
5. Taheri, E., Saedisomeolia, A., Djalali, M., Qorbani, M., & Madani Civi, M. (2012). The relationship between serum 25-hydroxy vitamin D concentration and obesity in type 2 diabetic

patients and healthy subjects. *Journal of Diabetes & Metabolic Disorders*, *11*(1), 1-5.
6. Paul, A. K., Kamrul-Hasan, A. B. M., Chanda, P. K., & Nandi, D. C. (2020). Vitamin D status of overweight and obese Bangladeshi adults. *Journal of Family Medicine and Primary Care*, *9*(7), 3444.
7. Hilger, J., Friedel, A., Herr, R., Rausch, T., Roos, F., Wahl, D. A., ... & Hoffmann, K. (2014). A systematic review of vitamin D status in populations worldwide. *British journal of nutrition*, *111*(1), 23-45.
8. Wang, Y., Si, S., Liu, J., Wang, Z., Jia, H., Feng, K., ... & Song, S. J. (2016). The associations of serum lipids with vitamin D status. *PLoS One*, *11*(10), e0165157.
9. Wortsman, J., Matsuoka, L. Y., Chen, T. C., Lu, Z., & Holick, M. F. (2000). Decreased bioavailability of vitamin D in obesity. *The American journal of clinical nutrition*, *72*(3), 690-693.
10. Wortsman, J., Matsuoka, L. Y., Chen, T. C., Lu, Z., & Holick, M. F. (2000). Decreased bioavailability of vitamin D in obesity. *The American journal of clinical nutrition*, *72*(3), 690-693.
11. Jungert, A., Roth, H. J., & Neuhäuser-Berthold, M. (2012). Serum 25-hydroxyvitamin D3 and body composition in an elderly cohort from Germany: a cross-sectional study. *Nutrition & Metabolism*, *9*(1), 1-9.
12. Karatas, S., Hekimsoy, Z., Dinc, G., Onur, E., & Ozmen, B. (2013). Vitamin D levels in overweight/obese adults with and without metabolic syndrome. *Journal of Endocrinology and Metabolism*, *3*(3), 47-56.
13. Hamza, P. J., & Hasan, M. K. (2020). The association between Vitamin D level and body mass index in a sample of childbearing age women in Erbil. *Medical Journal of Babylon*, *17*(2), 165.
14. Yao, Y., Zhu, L., He, L., Duan, Y., Liang, W., Nie, Z., ... & Fang, Y. (2015). A meta-analysis of the relationship between vitamin D deficiency and obesity. *International journal of clinical and experimental medicine*, *8*(9), 14977.
15. Wood, R. J. (2008). Vitamin D and adipogenesis: new molecular insights. *Nutrition reviews*, *66*(1), 40-46.
16. McCarty, M. F. (2009). Poor vitamin D status may contribute to high risk for insulin resistance, obesity, and cardiovascular disease in Asian Indians. *Medical hypotheses*, *72*(6), 647-651.
17. Moy, F. M., & Bulgiba, A. (2011). High prevalence of vitamin D insufficiency and its association with obesity and metabolic syndrome among Malay adults in Kuala Lumpur, Malaysia. *BMC public health*, *11*(1), 1-7.
18. Rahman, S. A., Chee, W. S. S., Yassin, Z., & Chan, S. P. (2004). Vitamin D status among postmenopausal Malaysian women. *Asia Pacific journal of clinical nutrition*, *13*(3).