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Vitamin D deficiency among postmenopausal women and its association with obesity

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Abstract
Background: Vitamin D, which is described as 'the Sun light Vitamin', is essential for growth and development of the body. Vitamin D deficiency is a global public health concern. Poor vitamin D status, as indicated by low serum concentrations of 25-hydroxyvitamin D [25(OH)D], has been observed in South Asian populations. Among women, postmenopausal women are more sufferer of vitamin D deficiency. Obesity has been associated with lower levels of serum 25 hydroxyvitamin D. However, limited information is available on the vitamin D deficiency among postmenopausal women and its association with obesity.
Objective: To evaluate the association of vitamin D deficiency with obesity in postmenopausal women.
Methodology: It is a cross-sectional analytical study that was carried out in the department of Obstetrics and Gynecology Sir Salimullah Medical College and Mitford Hospital Dhaka over a period of June 2018 to July 2019. A total 72 postmenopausal women with in 45 to 70 years of age attending in and out patient Department in the above-mentioned Hospital during the study period were included: 34 respondents with BMI ≥ 25 in obese group and 38 respondents with BMI less than 25 in non-obese group. A questionnaire was used to assess dietary pattern, clothing practices and extent to exposure to sun. Estimation of serum Vitamin D level was assessed via measuring serum 25(OH) D by using Roche Electrochemiluminescence. Analyzed data was expressed as percentage and mean ± SD. Analysis was done by unpaired t test and chi square test to compare between two groups and find out the significance of difference in level. A "p" value of <0.05 was considered as significant.
Results: In this study it was observed that maximum patients were vitamin D deficient (75%). Mean age in both groups were almost equal. Majority of the respondents were Muslim housewives in both the groups. Mean BMI and duration of menopause showed significant difference in majority of respondents in between two groups. 47.22% of postmenopausal women were in the obese group. Mean vitamin D level among the study participants was 13.34±4.62 in obese group and 19.54±6.75 in non-obese group, the difference in mean Vitamin D level was statistically significant. This study shows a significant association of vitamin D level with obesity.
Conclusion: This study will help to assess the basal levels of vitamin D, giving an idea regarding prevalence of vitamin D deficiency. Vitamin D deficiency is a very common health problem in Bangladeshi postmenopausal women. It can be concluded that the postmenopausal vitamin D deficiency is associated with obesity in our context. Healthy life style, balanced diet, exposure to sunlight and more outdoor activities can help to achieve optimum vitamin D level. In addition to these, maintenance of optimum body weight is an important factor to maintain desired vitamin D level.

Keywords: Vitamin D, Electrochemiluminescence, postmenopausal women, obesity

Introduction
Vitamin D is popularly known as sunlight vitamin. It is both vital and indispensable for human beings. It caters to skeletal as well as non-skeletal needs of the body. This wonder of a vitamin can be obtained effectively upon exposure to sunlight and also through balanced dietary intake. This sunlight vitamin works with other hormones and aids in optimal functioning of skeletal system as well as other organ systems [1] Vitamin D exists in two forms, the plant source Ergocalciferol (D2) and animal source Cholecalciferol (D3). Major source of vitamin D is vitamin D3 which is synthesized in skin upon exposure to sunlight. First hydroxylation of vitamin D in the liver and then in kidneys yield the active form of vitamin D i.e. 1, 25 (OH) 2D [2].

In Bangladesh (24ºN) hypovitaminosis D was found in women regardless of age, lifestyle and clothing. Also 25(OH)D levels below 37.5nmol/L was observed in 38% from high income group and 50% in women from low income groups [3]. The bond between hypovitaminosis D and obesity has been identified in the selective deposition of vitamin D, a lipophilic molecule, in subcutaneous and visceral adipose tissue. BMI and body fat were inversely related to serum 25(OH) vitamin D in several studies [4, 5]. Found a positive correlation between serum and fat tissue 25(OH) vitamin D concentrations measured by liquid chromatography mass spectrometry in morbidly obese individuals [6]. Obesity is defined as an excess amount of body fat and constitutes a worldwide epidemiological problem. Currently, it is the fifth greatest risk factor for mortality [7]. The identification of associated factors and risk groups related to hypovitaminosis D is critical. But the nature of the association between low it D status and obesity remains unclear. Fat acts as a large capacity depot for the storage and release of vitamin D, accumulating vitamin D proportionally to its serum concentration and releasing it at a much slower rate, proportionally to the quantity of fat. This may significantly affect 25(OH) vitamin D3 bioavailability and biological activity. Obese patients also show a reduced response of serum 25(OH) vitamin D3 levels to UV-B irradiation and to oral vitamin D administration compared with non-obese individuals [8]. Menopause marks an important health transition in a woman's life as well as vitamin D requirement. Menopause is also associated with an increased risk of obesity and a shift to an abdominal fat distribution with associated increase in health risks [9]. Age is a crucial factor in determining cutaneous synthesis of vitamin D. Ageing affects multiple steps of vitamin D metabolism as ageing skin has reduced efficiency to synthesize vitamin D upon exposure to sun [10]. Therefore, postmenopausal women are more vulnerable to vitamin D deficiency owing to their inevitable ageing process coupled with obesity. So, the main aim of this study is to evaluate vitamin D deficiency among postmenopausal women and its association with obesity.

Methodology

Study design: Cross sectional analytical study.

Place of Study: This study was carried out in the Department of Obstetrics and Gynaecology, Sir Salimullah Medical College and Mitford Hospital, Dhaka in collaboration with biochemistry department of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh for Biochemical variable.

Duration of study: From July 2018 to June 2019.

Study population: Menopausal women with different benign gynaecological condition attending in and out-patient department of Obstetrics and Gynaecology, Sir Salimullah Medical College and Mitford Hospital Dhaka Bangladesh, during the study period were selected. Patients who fulfill the exclusion and inclusion criteria was requested to participate in the study.

Sample size (N): A total 72 postmenopausal women with in 45 to 70 years of age attending in and out patient Department in the above-mentioned Hospital during the study period were included: 34 respondents with BMI ≥ 25 in obese group and 38 respondents with BMI less than 25 in non-obese group.

Inclusion Criteria

1. Women above the age of 45 years who had at least 12 consecutive months of amenorrhea with no other medical causes.
2. Patients willing to participate in the study.

Exclusion Criteria

1. Premature menopause induced by surgery, chemotherapy or radiation.
2. Coexistence of any other serious illness.
3. Women having hormone replacement therapy.
4. Bed ridden patients.

Sampling method: It is a cross-sectional analytical study that was carried out in the department of Obstetrics and Gynecology Sir Salimullah Medical College and Mitford Hospital Dhaka over a period of June 2018 to July 2019. A total 72 postmenopausal women with in 45 to 70 years of age attending in and out patient Department in the above-mentioned Hospital during the study period were included: 34 respondents with BMI ≥ 25 in obese group and 38 respondents with BMI less than 25 in non-obese group. A questionnaire was used to assess dietary pattern, clothing practices and extent to exposure to sun. Estimation of serum Vitamin D level was assessed via measuring serum 25(OH) D by using Roche Electrochemiluminescence. Analyzed data was expressed as percentage and mean ± SD. Analysis was done by unpaired t test and chi square test to compare between two groups and find out the significance of difference in level. A "p" value of < 0.05 was considered as significant.

Results

Total 72 patients were included in this study, among them 34 were in obese group and 38 were in non-obese group. The results of the study are set as follows in tables and figure.

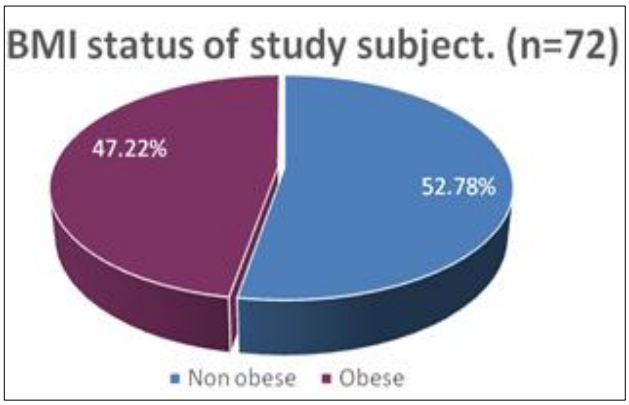

Fig 1: Figure showing that 52.78% of study subjects were non obese and 47.22% were obese in this study.

Table 1: Distribution of demographic characteristics among study population (N=72)

Variables	Obese (N=34)		Non-obese (N=38)		P-Value
	N	%	N	%	
Age group (in years)					
45-50	8	23.5	12	31.6	
51-55	6	17.6	7	18.4	
56-60	10	29.4	9	23.7	
61-65	6	17.6	4	10.5	
66-70	4	11.8	6	15.8	
Habitat (N, %)					
Urban	9	26.5	13	34.2	0.477 ns
Rural	25	73.5	25	65.8	
Profession (N, %)					
Housewife	31	91.2	36	94.7	0.076ns
Office staffs	0	0.0	2	5.3	
Health staffs	0	0.0	0	0.0	
Teacher	3	8.8	0	0.0	
Monthly income (N, %)					
Low income	16	47.1	30	78.9	0.069ns
Lower-middle income	11	32.4	6	15.8	
Upper-middle income	2	5.9	2	5.3	
High income	5	14.7	0	0.0	
Duration of menopause (n, (in years)					
≤5	17	50.0	11	28.9	0.108 ns
5.1-10	11	32.4	13	34.2	
>10	6	17.6	14	36.8	

P-Value was calculated by chi square test
*significant, NS: Not significant
P-Value was significant at < 0.05

There were no significant difference in between obese and non-obese group regarding age, living area, profession, monthly income and duration of menopause, Table 1.

Table 2: General characteristics of the study subjects (N=72)

Variables	Obese (N=34)	Non-obese (N=38)	P-Value
	Mean ± SD	Mean ± SD	
Age (Years)	57.82±7.31	56.97±8.30	0.648 ns
BMI (kg/m^2)	28.70±3.72	21.75±1.79	<0.001*
Duration of menopause	7.68±5.64	2.55±0.56	<0.001*

P-Value was calculated by unpaired t-test
*Significant, NS: Not Significant
P-Value was significant at < 0.05

It was observed that the mean age of the respondents was almost equal in both groups. Mean BMI and duration of menopause shows significant difference in between two groups and the difference were statistically significant (p<0.05), (Table-2).

Table 3: Distribution of participants according to sun exposure (N=72)

Sun exposure per day	Obese (N=34)		Non-obese (N=38)		P-value
	N	%	N	%	
Not exposed at all	7	20.6	9	23.7	
< 15 minutes exposure	19	55.9	25	65.8	0.335ns
≥ 15 minutes exposure	8	23.5	4	10.5	

P-Value was calculated by chi square test
NS: Not significant
P-Value was significant at < 0.05
There was no significant difference between two groups regarding the duration of sun exposure.

Table 4: Distribution of participants according to dietary pattern (N=72)

Dietary pattern	Obese (N=34)		Non-obese (N=38)		P-value
	N	%	N	%	
Daily intake of milk					
Yes	12	35.29	13	34.21	0.923NS
No	22	64.70	25	65.79	
Daily intake of egg					

Yes	16	47.1	14	36.8	0.383[NS]
No	18	52.9	24	63.2	
Daily intake of fish					
Yes	16	47.05	17	44.7	0.845[NS]
No	18	52.94	21	55.3	

P-Value was calculated by chi square test
NS: Not significant
P-Value was significant at <0.05

Though there were slight difference in the intake of milk, egg and fish, there were no significant statistical difference in between two groups.

Table 5: Frequency of vitamin D status among study population (N=72)

Vitamin D level	Frequency (N)	Percentage (%)
Deficient	54	75
Insufficient	13	18.05
Normal	5	6.94

75% of total postmenopausal women were vitamin D deficient and 18.05% were vitamin D Insufficient.

Table 6: Vitamin D level of study subjects between obese and non-obese group (N=72)

	Obese (N=34)	Non-obese (N=38)	P-Value
	Mean ± SD	Mean ± SD	
Vitamin D level	13.34±4.62	19.58±6.75	<0.001*

P-Value was calculated by unpaired t-test
*significant
P-Value was significant at < 0.05

The mean vitamin D level was statistically significant in between two groups. The P value was < 0.05.

Table 7: Association of Vitamin D status with obesity among postmenopausal women (N=72)

Vitamin D status	Obese (N=34)		Non-obese (N=38)		P-Value
	N	%	n	%	
Deficient	30	88.23	24	63.15	
Insufficient	4	11.76	9	23.68	0.025*
Normal	0	0.0	5	13.15	
Total	34	100.0	38	100.0	

P-Value was calculated by Chi square test
*significant
P-Value was significant at < 0.05

There was significant difference of vitamin D status in between obese and non-obese group (P=0.025).

Discussion

This cross sectional analytical study was carried out in the department of obstetrics and Gynaecology, Sir Salimulla Medical College and Mitford Hospital, Dhaka, Bangladesh, with an aim to evaluate vitamin D deficiency with obesity among postmenopausal women. To attain the objectives of this study 72 menopausal women were selected who fulfill the eligibility criteria for the study. From the current study, it was observed that among 72 participant 52.78% were obese and 47.22% non-obese. Similar observation regarding BMI was also observed in studies conducted [1]. In this present study, the mean age of respondents was 57.82±7.31 years in obese group and 56.97±8.30 years in non-obese group, which was quite similar with the study conducted by Joshi *et al*. [1]. Patient belongings to low income groups were 47.1% in obese and 78.9% in non-obese groups which was similar to Islam *et al*. [11] study. Maximum respondents were from rural area and most of the participants were housewives in both groups. In this study, the mean BMI was 28.70 in obese group and 21.75 in non-obese group. Mean duration of menopause was 7.68 and 2.55 in between obese and non-obese group. Mean BMI and duration of menopause showed statistically significant difference in between two groups. The mean vitamin D level among obese and non-obese group were 13.34±4.62 and 19.58±6.75 which was statistically significant. Within the Asian region, there are not many reports on vitamin D status of the population except pockets of studies among children, pregnant woman or postmenopausal women. In Malaysia, there are few published reports on vitamin D status among the adult population. One published study reported the vitamin D levels of postmenopausal women [12] and another studied on women of child bearing age [13]. The vitamin D status of women from both these studies was better than our female participants. The mean vitamin D level of postmenopausal Malay women in the study by Rahman *et al*. [12] was 44.4 ± 10.6 nmol/L, which was higher than our case participants (27.9±7.13). Green *et al*. [13] reported over 60% of Malaysian women had vitamin D levels below 50 nmol/L compared to ours of approximately 75%. In the current study the vitamin D status in obese group revealed that 88% were vitamin D deficient that means the serum level of vitamin D is < 20ng/ml and there is significant association of vitamin D deficiency with obesity. Several studies worldwide had been showed the relationship of vitamin D level with obesity. Demonstrated the risk of having serum 25 (OH) D level < 50 nmol/L was about 2 times higher in obese than non-obese person. Similarly, 4(11.76%) in obese group, 9(23.68%) participants on non-obese group had serum vitamin D insufficiency respectively. The findings was supported with Holick *et al*. [14] study that also showed an inverse relationship between obesity and vitamin D deficiency. This was explained due to the fact that vitamin D is a fat soluble hormone and normally stored in fat tissue and because the obese subject had more surface area, vitamin D would penetrate more in large body mass of the obese subjects. Abdominal obesity was significantly associated with vitamin D status; similar studies reported elsewhere [15]. This may be due to vitamin D being soluble in fat which is largely sequestered in adipose tissue and is therefore low in serum among obese individuals [16]. This will give rise to reduced bioavailability of vitamin D metabolite. In this current study, it was observed that 20.6% in obese and 23.7% in non-obese respondents were not exposed to sunlight at all. Sunlight exposure were less than 15 minutes in obese and non-obese respondents around 20.6% and 23.7%. The differences was statistically not significant (p>0.05) between two groups. The reason for vitamin D deficiency in both groups may be due to changing life styles, like many women stay at home which is almost closed sunlight. Different study showed that even if

regularly exposed to sun light, elderly women produce 25% less cutaneous vitamin D3 than young adult [17]. More than 90% of the vitamin D requirement for most people comes from casual exposure to sun light. In this study, it was observed that though there were slight difference in the intake of milk, egg and fish, there were no statistically significant difference in between two group. Existing evidence showed that elderly individuals are more likely to have low vitamin D levels [12]. Vitamin D status decreases with age, mainly as a result of restricted sun light exposure, reduced dietary vitamin D intake. Cutaneous synthesis of vitamin D declines with age [17]. Maximum respondents (75%) were vitamin D deficient. In a study done in South India, the prevalence of vitamin D deficiency in postmenopausal women ranges from 50% to 80%. Paul *et al*., [18], another study reported 52% by Kalra *et al*. [19] and 80% deficient was also revealed by Joshi *et al*. [1]. In our study, the patients found with normal levels of vitamin D were 7%, which could probably be due to technical errors/error in sample collection.

Conclusion

Serum vitamin D level was significantly lower in postmenopausal obese women. Moreover, vitamin D deficiency is associated with obesity in postmenopausal subjects.

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