

Prevalence of Vitamin D Deficiency among Post Menopausal Women and Associated Obesity and Cardiovascular Risk

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Abstract

Background: Vitamin D popularly known as sunshine vitamin is both vital and indispensable for human beings. It caters to skeletal as well as non skeletal needs of the body. Evidence is increasing that the vitamin D endocrine system is also linked to obesity. Obesity has been found to be associated with lower levels of serum 25-hydroxyvitamin D. Underlying causes could be less sun exposure in obese people due to their limited mobility and high storage in adipose tissue.

Aims and objectives: The study was conducted with the objective of determining prevalence of vitamin D deficiency among postmenopausal women, its association with obesity and cardiovascular risk.

Materials and methods: A hospital based cross sectional study was conducted in a Tertiary Care Unit of Jammu and Kashmir state, India from July 2012 to December 2012 among 250 post menopausal women between age group of 45 to 70 years. Self designed semi structured questionnaire was used to assess dietary pattern, clothing practices and extent of exposure to sun. BMI was recorded to assess obesity and triglyceride level along with cholesterol was determined to assess cardiovascular risk. Vitamin D level was assessed via investigating 25(OH)D by using Roche electrochemiluminescence.

Results: Out of 250 postmenopausal women vitamin D deficiency was prevalent among 80% of study subjects, 14.8% had insufficiency and 5% had optimum vitamin D level. Study subjects between age group of 51 to 55 of Jammu and Kashmir had BMI ranging between 26.7 ± 6.1 and 29.50 ± 6.1 respectively. An important finding in this study is that high BMI is significantly associated with low vitamin D level $p \leq 0.02$.

Conclusion: Vitamin D deficiency is an alarming issue among postmenopausal women in India. Encouraging women to adhere to healthy lifestyles and maintain optimum BMI is indispensable to achieve optimum vitamin D level.

Keywords: Post menopausal women; Obesity; Vitamin D deficiency

Introduction

Vitamin D popularly known as sunshine vitamin 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 sunshine vitamin works in concert with other hormones and aids in optimal functioning of skeletal system as well as other organ systems.

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 [1].

The extent of exposure to sun is critical in determine the level of vitamin D synthesized in the body. Unfortunately very few foods naturally contain vitamin D and only few foods are fortified with vitamin D. Very few foods naturally contain vitamin D in significant amount like oily fish salmon, mackerel and sardines [2].

Vitamin D has an established role in calcium and bone metabolism. Low vitamin D levels have long been associated with bone diseases such as rickets in children and osteomalacia in adults. Hypovitaminosis D has been implicated as a risk factor for hip fractures in elderly [3].

Recently vitamin D insufficiency has been shown to be associated with increased risk of developing type 2 diabetes mellitus and cardiovascular risk factors such as hypertension and obesity [4].

Evidence is increasing that the vitamin D endocrine system is linked to obesity. Obesity has been found to be associated with lower levels of serum 25-hydroxyvitamin D. Underlying causes could be less sun exposure in obese people due to their limited mobility and high storage in adipose tissue [5].

Vitamin D deficiency can result from inadequate synthesis in the skin or decreased intake from food sources and impaired activation in liver. The cutaneous production of vitamin D is dependent on many factors such as age, season, latitude, time of the day and type of clothing [6].

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 [7]. 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

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to synthesize vitamin D upon exposure to sun [1]. Therefore post menopausal women are more vulnerable to vitamin D deficiency owing to their inevitable ageing process coupled with obesity.

India has diverse culture and traditions. Being a tropical country it receives plenty of sunshine so it is believed that vitamin D deficiency would be uncommon in India. Vitamin D levels decline earlier in women than men as age progresses. Vitamin D deficiency is a common problem in India due to several factors like food fads and food habits, high fiber diet containing phosphates and phytates which can deplete vitamin D stores, genetic factors, and preference for staying indoors has increased in the urban Indians. Increased pollution along with cultural and traditional habits prevalent in certain religions significantly contributed to vitamin D deficiency [8].

Aims and Objectives

The study was conducted with the objective of determining prevalence of vitamin D deficiency among postmenopausal women, its association with obesity and cardiovascular risk.

Materials and Methods

A hospital based cross sectional study was conducted in a tertiary care unit i.e. Government Medical College and Hospital of Jammu Kashmir. Study period was from July 2012 to December 2012. The Study was conducted among 250 postmenopausal women between age group of 45 to 70 years. Systematic Random sampling technique was employed to select the study subjects. Since hospital records revealed that 1000 postmenopausal women were attending Gynecology O.P.D. every year, the sampling fraction was 4 and it was decided to select first study subject on random basis and subsequent study subjects were picked up at evenly spaced interval i.e. every 4th woman was included in the study. Study tools comprised of self designed semi structured questionnaire. History of dietary habits, intake of milk along with other vitamin D rich food items (fish, eggs, butter, cheese), exposure to sun and symptoms of vitamin D deficiency were recorded via interactions and interviews. Usual type clothing practices were assessed in order to determine the extent of skin exposed to sun. Vitamin D deficiency was investigated by recording level of 25 (OH) D by Roche electro chemiluminescence.

As per Guidelines issued by Endocrine Society in 2011, 25(OH) D level less than 20 ng/ml was considered deficiency, between 20-30 ng/ml was considered Insufficiency and more than 30 ng/ml was the desirable range.

Obesity was recorded by measuring Body Mass Index (BMI). Weight was recorded in kilograms. Height was measured in meters. BMI was calculated by dividing weight in kilograms by height in meter square. As per WHO, BMI between 18.5-22.9 is normal. Between 23-24.9 is considered as Overweight and BMI>25 is Obese. Cardiovascular risk was assessed via investigating serum triglyceride level, cholesterol level as well as history of obesity. Total Cholesterol->200 mg/dl and Triglyceride level->140 mg/dl was considered as cardiovascular risk.

- Inclusion criteria: Women who had naturally attained menopause and who were between 45-70 years of age were included in the study.
- Exclusion criteria: Women who had undergone hysterectomy or suffering from chronic debilitating diseases and bedridden patients were excluded from the survey.

Ethical consideration

Verbal consent of the study subjects was taken prior to the study and those who were not willing to participate in the survey were excluded from the study.

Data analysis

Data was analyzed using SPSS Version 20 (IBM, Chicago, USA). To find out the association between attributes, Chi-Square test/student's t/ One way ANOVA tests were applied. P value of <0.05 was considered to be statistically significant.

Results

Calculated sample size was 280. 20 females refused to participate in the study and 10 did not complete the questionnaire so total 250 females were included in the study. Majority of the study subjects who had vitamin D deficiency complained of muscle fatigue (77%), 66% complained of lack of energy followed by muscle weakness in 62 % of the participants.

Socio demographic profile of the study subjects is depicted in Table 1. Total 250 post menopausal women were included in the study out of which 118 women were Hindus from Jammu region and 132 were Muslims from Kashmir. Majority of the post menopausal women are falling between age group of 45-50. As age is increasing number of study subjects are decreasing.

Table 2 represents vitamin D levels among study subjects. Out of 250 postmenopausal women vitamin D deficiency was prevalent among 80% of study subjects, 14.8% had insufficiency and only 5.2% had optimum vitamin-D level p value=0.004 shows that vitamin D deficiency is significantly related to age. Deficiency was higher among Kashmiri Muslim females (82%) as compared to females from Jammu region (74%).

Table 3 represents the dietary pattern adopted by study subjects of Jammu and Kashmir. People in Muslim dominated Kashmir valley prefer eating sumptuous non vegetarian meals. These dishes are prepared from red meat and are cooked in excess oil. Therefore these dishes have high content of saturated fats. Thus Kashmiris are classified as non vegetarians. People of Jammu region are inclined towards

Age group	Jammu region (%)	Kashmir region (%)	Total (%)
45-50	61(51.6)	87(66)	148(59.2)
51-55	24(20.3)	18(13.6)	42(16.8)
56-60	14(12.7)	15(11.3)	29(11.6)
61-65	11(9.3)	7(5.3)	18(7.2)
66-70	08(6.7)	05(3.7)	13 (5.2)
Total	118(47.2)	132(52.8)	250(100)

Chi square-6.28; p value=0.18 (statistically not significant)

Table 1: Distribution of study subjects as per age.

Age group	Deficient (%)	Insufficient (%)	Optimum (%)	Total
45-50	118(59)	25(67.5)	01(7.6)	144
51-55	31(15.5)	04(10.8)	02(15.3)	37
56-60	27(13.5)	02(5.4)	4(30.7)	33
61-65	14(7)	04(10.8)	3(23)	21
66-70	10(5)	02(5.4)	3(23)	15
Total	200(80)	37(14.8)	13(5.2)	250

Chi square-22.3; p value=0.004

Table 2: Distribution of vitamin D level among study subjects..

Dietary pattern	Jammu region (%)	Kashmir region (%)
Vegetarian	77	0
Non-veg	23	100
Daily intake of milk	72	46
Daily intake of eggs	17	36
Intake of fish	12	42
Intake of cheese	32	14
Intake of butter	44	11
Intake of multivitamins	22	34

Table 3: Dietary pattern among study subjects.

Age group	BMI of Study Subjects from Jammu	BMI of Study Subjects from Kashmir	P value
45-50	27.50 ± 5.7	31.60 ± 4.5	0.0001
51-55	26.70 ± 6.1	29.50 ± 5.5	0.0002
55-60	24.70 ± 4.5	27.50 ± 5.7	0.0001
61-65	22.80 ± 2.1	24.50 ± 2.7	0.0001
66-70	21.50 ± 3.4	23.50 ± 1.7	0.0001

(t-test)

Table 4: BMI of study subjects as per age.

vegetarianism. The table clearly shows that intake of vegetarian food, milk, cheese and butter was high among participants from Jammu, where as intake of non-vegetarian food, fish and eggs was high among Kashmiri women.

Table 4 represents body mass index of different study subjects as per age and variation in BMI among study subjects belonging to two different regions. BMI is high in both premenopausal and postmenopausal women. There is a statistically significant difference in body mass index of postmenopausal women of Jammu and Kashmir. BMI of women residing in Jammu is comparatively low as compared to Kashmiri females as there is variation in dietary pattern among females of two regions. BMI of Kashmiri Muslim females is high and this difference is statistically significant. Mean BMI between age group of 51-55 among subjects from Jammu and Kashmir were 26.7 ± 6.1 and 29.50 ± 5.5 (p=0.0002) respectively. Kashmiris adopt a non vegetarian pattern of diet which is prepared in red meat and rich in saturated fat where as people of Jammu region prefer vegetarian dietary pattern. This high intake of food rich in saturated fat leads to increase in BMI among Kashmiri females and high prevalence of obesity.

Figure 1 represents the relationship between BMI and vitamin D level. It shows difference in BMI among study subjects of Jammu and Kashmir. It is clearly evident that as BMI is increasing, vitamin D level is declining. There is a statistically significant difference in vitamin D level of among study subjects belonging to two different regions. Participants from Kashmir have high BMI and low vitamin D level as compared to participants residing in Jammu. This difference is statistically significant. Obese people are more prone to vitamin D deficiency as subcutaneous fat which stores vitamin D, sequesters more cutaneously synthesized vitamin D. Therefore, results in less release of vitamin D from skin into circulation. Thus obesity creates a vitamin D deficient state.

Table 5 depicts the control group with optimum BMI. It is clearly evident from the table that the control group had comparatively low BMI and desirable 25 (OH) D levels.

Table 6 shows triglyceride level as per BMI. The table clearly reveals difference in triglyceride level among two different types of study subjects who exhibit regional and dietary variation. Study subjects having BMI within range of 26-30 residing in Jammu and Kashmir had mean triglyceride level of 340 ± 3.1 and 450 ± 3.4 (p=0.0001)

respectively. Kashmir is at a higher altitude as compared to Jammu and does not receive plenty of sunshine. Also people in Kashmir are fond of eating red meat and diet rich in fatty food. These factors justify high prevalence of obesity and high BMI in Kashmiri women as compared to women living in Jammu. It is clearly evident from this table that Kashmiri participants have higher range of triglyceride owing to high BMI which indicates obesity and cardiovascular risk as compared to participants from Jammu. This difference is statistically significant.

80% of the study subjects had triglyceride level between 140 to 400 mg/dl and only 16% had level < 140 mg/dl. 3% had level >400 mg/dl.

Table 7 depicts vitamin D level in relation to triglyceride level. There exists a significant difference in triglyceride level among study subjects of Jammu and Kashmir. Women of Jammu have comparatively low triglyceride level as compared to Kashmiri women. The table clearly reveals that vitamin D deficient state in relation to triglyceride level is more prevalent among Kashmiri females (4.8 ± 3.1) than women living in Jammu (8.3 ± 2.9) and this difference is statistically significant (p=0.0001) showing that vitamin D deficiency is linked to cardiovascular risk. Vitamin D level is proportionately decreasing with rise in triglyceride level. Lack of vitamin D is linked to rise in TNF-α and Interleukin-6 which cause inflammation and cardiac hypertrophy.

Table 8 represents different range of cholesterol. It shows relationship of vitamin D level with cholesterol. Also difference in vitamin D level between participants of Jammu and Kashmir is statistically significant in relation to different ranges of cholesterol. Cholesterol level <200 mg/dl is desirable. Level beyond desirable range indicates risk of obesity

Age group	BMI	Vitamin D level
45-50	23.1 ± 2.3	33.2 ± 2.2
51-55	17.8 ± 1.9	34.4 ± 1.6
56-60	19.4 ± 2.5	29.4 ± 1.2
61-65	17.0 ± 1.1	27.8 ± 3.3
66-70	20.1 ± 1.9	29.6 ± 3.8
*p values	0.04	0.04

One way ANOVA Table

Table 5: Depicts the control group with optimum BMI. It is clearly evident from the table that the control group had comparatively low BMI and desirable 25 (OH) D levels.

BMI	Triglyceride level		p value
	Study subjects of Jammu	Study subjects of Kashmir	
18-20	144 ± 2.1	250 ± 2.9	0.001
21-25	260 ± 2.7	310 ± 3.2	0.0001
26-30	340 ± 3.1	450 ± 3.4	0.0001

(t-test)

Table 6: Triglyceride level as per BMI.

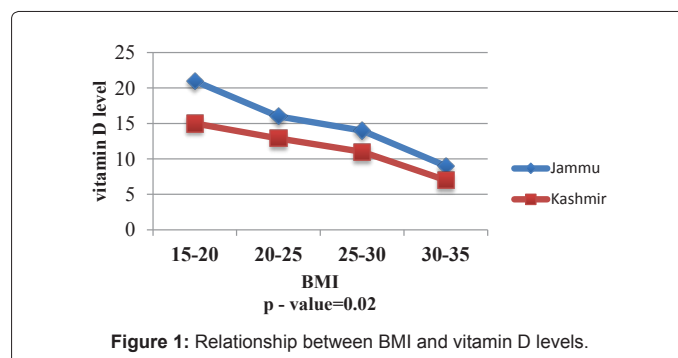


Figure 1: Relationship between BMI and vitamin D levels.

Triglyceride level	Vitamin D level		p value
	Study subjects of Jammu	Study subjects of Kashmir	
140	29 ± 2.4	22.6 ± 2.1	0.0001
141-400	15.4 ± 2.7	9.5 ± 1.9	0.0001
401-1000	8.3 ± 2.9	4.8 ± 3.1	0.0001

paired t-test

Table 7: Vitamin D level in relation to triglyceride level.

Cholesterol level	Vitamin D level		p value
	Study subjects of Jammu	Study subjects of Kashmir	
200	22 ± 2.9	18 ± 1.8	0.0001
200-400	16.4 ± 2.5	10 ± 1.9	0.0001
>240	14 ± 1.7	8 ± 2.5	0.0001

paired t-test

Table 8: Values showing different range of cholesterol.

and cardiovascular diseases. Participants having high cholesterol level have low vitamin D level. Level of vitamin D is significantly low (8 ± 2.5) in Kashmiri women as compared to females who belong to Jammu (14 ± 1.7). p=0.0001.

Discussion

Menopause not only marks an end of a woman's reproductive life but is also embraces various other changes like increased risk of cardiovascular diseases, mood swings, osteoporosis and many other negative health outcomes which have to be taken care of well in time. This crucial period also marks an important transition in vitamin D requirement as ageing skin is unable to effectively absorb sunlight and synthesize the required amount of vitamin D.

The study was conducted in Jammu and Kashmir which lies in Northern India. Jammu and Kashmir location is between 32.17° and 36.58° North altitude and East to West, the State lies between 73.26° and 80.30° longitude. In case of latitude, Jammu and Kashmir matches up with South Carolina (North America), Fez, Damascus, Baghdad and Peshawar (Pakistan).

The current study reveals the vitamin D status among postmenopausal women residing in the state of Jammu and Kashmir. 80% of study subjects were suffering from vitamin D deficiency, 14.8% had insufficiency and only 5.2% had optimum vitamin-D level. p value=0.004 shows that vitamin D deficiency is significantly related to age. One of the studies conducted in South India regarding vitamin D status among post menopausal women and women in reproductive age group documents similar trend. It showed that vitamin D deficiency and insufficiency was prevalent among 70% and 23% postmenopausal women respectively [9]. Another study conducted in Haryana by Kalra et al. [10] reports that 52.37% postmenopausal women had vitamin D deficiency. This clearly indicates that low vitamin D level at extreme of age is due to reduced capacity of ageing skin to effectively synthesize vitamin D.

This study depicts that majority of the study subjects of Jammu region between age group of 51 to 55 had BMI ranging between 26.7 ± 6.1. Participants of same age group from Kashmir valley had BMI 29.50 ± 6.1. An important finding in this study is that high BMI is significantly associated with low vitamin D level p≤0.02. This can be supported by another study conducted by Snijder et al. [5] which documents that high BMI is linked to low vitamin D level and total body fat is inversely

associated with 25 (OH)D [2]. Similar trend was reported by study conducted by Holick [2] in USA which highlighted that obese subjects had significantly low basal 25 (OH)D than non obese. The reason why high BMI is related to low circulating 25 (OH) D is that vitamin D is a fat soluble vitamin which is stored in adipose tissue and is sequestered in pool of fat. This causes low circulating level of vitamin D in the body [11].

When triglyceride level was assessed it was found that participants who had high BMI showed high triglyceride level especially natives of Kashmir owing to their dietary pattern which comprised more of red meat and rich in fat content. Deviation from desirable range triglyceride and cholesterol level is suggestive of cardiovascular risk. Many studies have linked vitamin D deficiency with metabolic syndrome which includes high blood pressure, obesity, high cholesterol, and insulin resistance. Similar results were found in a study conducted among Malay adults in Malaysia which documented that triglyceride level was high among vitamin D insufficient group. Also vitamin D insufficiency was linked higher metabolic risk scores (p=0.009).

Holick [2] in one of the studies reported that people living in lower latitude are less prone to chronic diseases. Hypertension is linked to vitamin D deficient state and vitamin D repletion has shown to decrease blood pressure and through its action on renin angiotensin system. Lack of vitamin D leads to the activation of inflammatory factors like IL-6 and TNF-α which are responsible for cardiac hypertrophy [1].

Conclusion

Vitamin D deficiency is an alarming issue among postmenopausal women in India. It is related to numerous negative health outcomes as vitamin D is not only responsible for safeguarding skeletal integrity but takes care of various extra skeletal functions of the body like cardiac function, mood elevation, protective against cancers owing to anti proliferative effect on cells. India being a tropical country receives plenty of sunshine but at the same time exhibits rising vitamin D deficiency as India embraces diversity in cultural practices and regional differences along with distinct dietary pattern.

Limitations

Since the study was conducted in a tertiary care unit of Jammu and Kashmir, a community based study would have given generalizable results. Also due to time constraints and limited resources more specific tests like BMD and PTH could not be performed.

Recommendation

Encouraging women to adhere to healthy lifestyles, eat balanced diet. Exposure to sunlight and indulging in outdoor recreational activities can help achieve optimum vitamin D level. Keeping this in mind, equally important is losing weight in order to maintain desired vitamin D level.

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