<u>ORIGINAL RESEARCH</u>

# A study to correlate Vit D levels and bone mineral density in reproductive and postmenopausal women in north India

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**ABSTRACT**
**Aim**: A study to correlate Vit D levels and bone mineral density in reproductive and postmenopausal women in north India.
**Material and methods:** It is a case control study having the sample size of 80 (40 in each group). Subjects above the age of 30 years of age attending Obstetrics and Gynaecology OPD and undergoing Advanced Well-Women check up were included in the study. This study was conducted to evaluate the correlation of vit D levels and Bone Mineral Density in Reproductive and Postmenopausal women attending out-patient department of Obstetrics and Gynaecology of our institute. Patients were divided equally into two groups. Group A (Case) women above the age of 45 years/ attained Menopause.Group B (Control) women between age group of 30-45 years.
**Results:** Normal BMD in group A was present in 4.55%,9.09%, 40.91%, 45.45% subjects with underweight, normal BMI, overweight, and class I obesity respectively as shown in table 7. 42.86% and 57.14% subjects had osteopenia while as osteoporosis was present in 25%, 25% and 50% subjects with underweight, normal BMI and overweight respectively. p-value = 0.0001(significant). Normal BMD was present in 6.06%, 21.21%, 42.42%, 30.30% subjects in group B with underweight, normal BMI, overweight, and class I obesity respectively as shown in table 7. 28.57%, 57.14% and 14.29% subjects with normal BMI, overweight and class I obesity had osteopenia respectively. p-value = < 0.0001(significant).
**Conclusion:** It is concluded that vitamin-D levels were deficient in one-third of women in both reproductive and postmenopausal age group.
**Keywords:** Vitamin-D levels, Postmenopausal, BMI

## INTRODUCTION

Menopause is defined as the permanent cessation of menses resulting from reduced ovarian hormone secretion that occurs naturally or is induced by surgery, chemotherapy or radiation. Due to menopause ovarian follicles lose its function, which results in decreased production of estradiol and other hormones. Decreased levels of estrogen leads to increased osteoclast formation and enhanced bone resorption, which in turn leads to loss of bone density and destruction of local architecture resulting in osteoporosis.Osteoporosis is a skeletal disease characterised by decreased bone strength and increasing risk of fractures. It is the most common human metabolic bone disorder. It has been defined as "a disease characterized by low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk.[1] Its a silent disorder and major health problem which poses a huge challenge in developing nations like India due to demographic transition and ageing population. WHO has predicted Asians to be largely affected by the year 2050.[2] 30 million women in India suffer from osteoporosis, of

which 50% are postmenopausal.[3] The average age of menopause in Asian women is 46 years. With increasing life expectancy, a healthy 50-year-old woman today spends as much as 40% of her life in Postmenopausal state.[4]

Vit D plays an important role in skeletal development and maintenance. Vitamin D deficiency and consequent secondary hyperparathyroidism are known to cause a decrease in bone mineral density (BMD) and increase in bone turnover.[5-7] A low serum 25-hydroxyvitamin D (25-OH-D) concentration is the hallmark of vitamin D deficiency. As such, serum 25-OH-D is an index of body vitamin D status.[8,9] Cholecalciferol (Vitamin D3) is synthesized in skin from 7-dehydrocholesterol on exposure to sunlight. This is then hydroxylated in the liver to form 25 hydroxycholecalciferol which is again hydroxylated in the kidney by 1-α hydroxylase to form 1,25-dihydroxycholciferol, the active form of vitamin D3. Vitamin D nutritional status is best determined by the measurement of 25(OH)D rather than 1,25(OH)D because 25(OH)D is the main circulating form of vitamin D and day-to-day variation is less due to its long half life.

Vit D deficiency (<20ng/ml) is quite common in india as reported by various studies and prevalence was found to be around 64.3%.[10] Vit D deficiency, a preventable disorder is a common and important public health problem for female gender and elderly disabled women living in community. Increased age has especially been associated with lower 25(OH)D levels owing to changes in lifestyle factors such as clothing habits and decreased outdoor activities, and owing to reduced cutaneous vitamin D synthesis capacity and dietary intake of vit D. Bone loss in postmenopausal women occurs in two phases. A primary postmenopausal accelerated phase with high bone turnover mediated primarily by oestrogen loss and an ensuing phase of slower bone loss, as a result of both sex steroid deficiency and secondary hyperparathyroidism due to vit D impaired metabolism and low intestinal calcium absorption. Oestrogen deficiency is a significant cause of accelerated bone loss after menopause. In women bone loss begins to accelerate approximately 2 to 3 years before the last menses, and this acceleration ends 3 to 4 years after menopause. For an interval of a few years around menopause, women lose 2% of bone annually. Afterward bone loss slows to about 1% to 1.5% per year.[11,12]

**MATERIAL AND METHODS**

The study was conducted on patients more than 30 years of age attending outpatient department of the Obstetrics and Gynaecology and Advanced Well-Women Health check of SPS Hospitals, Ludhiana from Jun 2017 to May 2018. It is a case control study having the sample size of 80 (40 in each group). Subjects above the age of 30 years of age attending Obstetrics and Gynaecology OPD and

undergoing Advanced Well-Women check up were included in the study. Pregnant and Lactating women, patients with alcohol Intake, women taking following drugs: Hormone replacement therapy(HRT), Long term use of Glucocorticoids, Anticonvulsants, thiazides, Bisphosphonates, Vit D and calcium supplements, diseases of Liver, Kidney, Esophagus, Malabsorption diseases, Gastric banding surgery, Diabetes Milletus, Metabolic bone disease, Primary hyperparathyroidism and uncontrolled hypo or hyperthyroidism were excluded from the study. Women fulfilling eligibility criteria were explained about the study in their local vernacular language and informed consent was taken on a predesigned proforma approved by Ethical committee of SPS Hospital.

This study was conducted to evaluate the correlation of vit D levels and Bone Mineral Density in Reproductive and Postmenopausal women attending out-patient department of Obstetrics and Gynaecology of our institute. Patients were divided equally into two groups.

- Group A (Case) women above the age of 45 years/ attained Menopause.
- Group B (Control) women between age group of 30-45 years.

Demographic profile and detailed history of all patients i.e Menstrual and obstetric, past history, medical and surgical history, family history, diet history, personal history was taken followed by thorough physical and clinical examination, assessment of vital parameters with anthropometric evaluation-Height, Weight and BMI was done and recorded in study proforma designated for study. Investigations include CBC, RBS, Serum creatinine, TSH and VIT-D levels. BMD was measured at lumbar spine(L1-L4) and Hip (Proximal femur and Neck of femur).25-hydroxyvitamin D was measured in the serum by Access-2,Beckmancoulture machine and Reagent used is Access 25(OH) vit-D total. The machineworks on CLIA (Chemiluminescent Immunoassay) principle and exhibits total imprecision of ≤ 10.0% at concentrations greater than 15.0 ng/ml, and total standard deviation(SD) of ≤ 1.5ng/ml at concentrations ≤ 15.0 ng/ml.

**STATISTICAL ANALYSIS**

All data recorded was compiled by MS Excel and analysed using SPSS 16.0 software. Continuous variables between cases and controls was compared using Student t-test of significance. For comparison of continuous variables between more than two groups, one-way analysis of variance (ANOVA) was used. A p<0.05 was considered statistically significant.

**RESULTS**

The study was conducted at Satguru Pratap Singh Hospitals, Ludhiana on 80 patients more than 30 years of age attending out-patient department of Obstetrics and Gynaecology and Advanced Well-Women Health

check from June 2017 to May 2018. 40 women were above the age of 45 years or those who had attained menopause (Case) and 40 women were between the age group of 30-45 years (Control).

**TABLE 1: DEMOGRAPHIC PROFILE OF PATIENTS**

| S. No. | Parameters | Group A (n=40) | | Group B (n=40) | | Total | %age | p-value |
|---|---|---|---|---|---|---|---|---|
| | | No. | %age | No. | %age | | | |
| 1(A) | **Age (years)** | | | | | | | |
| | Mean Age ± SD | 55.68±8.85 | | 39.83±4.34 | | 47.75±10.49 | | <0.0001 |
| 1(B) | **Religion** | | | | | | | |
| | Sikhs | 22 | 55.00 | 18 | 45.00 | 40 | 50% | |
| | Hindus | 18 | 45.00 | 21 | 52.50 | 39 | 48.75% | 0.130 |
| | Muslims | 0 | 0.00 | 1 | 2.50 | 1 | 1.25% | |
| 1(C) | **Educational level** | | | | | | | |
| | Undergraduate | 31 | 77.50 | 26 | 65.00 | 57 | 71.25% | |
| | Graduate | 5 | 12.50 | 8 | 20.00 | 13 | 16.25% | 0.147 |
| | Postgraduate | 4 | 10.00 | 6 | 15.00 | 10 | 12.5% | |
| 1(D) | **Residence** | | | | | | | |
| | Rural | 14 | 35.00 | 12 | 30.00 | 26 | 32.5% | |
| | Urban | 26 | 65.00 | 28 | 70.00 | 54 | 67.5% | 0.450 |
| 1(E) | **Occupation** | | | | | | | |
| | Housewife | 38 | 95.00 | 27 | 67.50 | 65 | 81.25% | |
| | Working | 2 | 5.00 | 13 | 32.50 | 15 | 18.75% | <0.0001 |
| 1(F) | **Socio-economic status** | | | | | | | |
| | Upper Middle Class | 18 | 45.00 | 26 | 65.00 | 44 | 55% | |
| | Middle Class | 22 | 55.00 | 14 | 35.00 | 36 | 45% | 0.004 |

**TABLE 2: BODY MASS INDEX (KG/M²)**

| Body mass index (kg/m²) | Group A (n=40) | | Group B (n=40) | |
|---|---|---|---|---|
| | Number | Per cent | Number | Per cent |
| Under weight  (<18.5) | 1 | 2.50 | 1 | 2.50 |
| Normal (18.5-24.99) | 5 | 12.50 | 10 | 25.00 |
| Over weight (25.0-29.99) | 16 | 40.00 | 18 | 45.00 |
| Class I obesity (>30) | 18 | 45.00 | 11 | 27.50 |
| Mean BMI ± SD | 29.43 ± 5.47 | | 28.23 ± 5.77 | |

**TABLE 3: DURATION OF MENOPAUSE**

| Range | Duration of Menopause | |
|---|---|---|
| | No. of Patients | Percentage |
| 1  to  5+ | 10 | 25.00 |
| 6  to  10+ | 10 | 25.00 |
| 11 to 15+ | 11 | 27.50 |
| 16  to  20+ | 5 | 12.50 |
| ≥21 | 4 | 10.00 |

**TABLE 4: GROUP COMPARISON FOR VITAMIN D (NG/ML) LEVELS**

| Vitamin D Levels | Group A | | Group B | | p-value |
|---|---|---|---|---|---|
| | No. of Patients | %age | No. of Patients | %age | |
| Normal | 21 | 52.50 | 15 | 37.50 | |
| Insufficiency | 7 | 17.50 | 11 | 27.50 | |
| Deficiency | 12 | 30.00 | 14 | 35.00 | 0.038 |
| Total | 40 | 100.0 | 40 | 100.0 | |

| Mean ± SD | 34.76 ± 19.03 | 26.86 ± 14.14 | |
|---|---|---|---|

### TABLE 5: BONE MINERAL DENSITY AT AP SPINE AND DUAL FEMUR

| BMD | No. of Patients (%) | | Chi – square value | p-value |
|---|---|---|---|---|
| | Group A | Group B | | |
| **AP spine** | | | | |
| Normal | 22 (55.00) | 33 (82.50) | | |
| Osteopenia | 14 (35.00) | 7 (17.50) | 21.33 | <.0.0001 |
| Osteoporosis | 4 (10.00) | 0 (0.00) | | |
| Total | 40(100.0) | 40(100.0) | | |
| **Dual femur** | | | | |
| Normal | 31 (77.50) | 34 (85.00) | | |
| Osteopenia | 9 (22.50) | 6 (15.00) | 1.846 | 0.397 |
| Osteoporosis | 0 (0.00) | 0 (0.00) | | |
| Total | 40(100.0) | 40(100) | | |

### TABLE 6: VITAMIN D LEVELS AND BMI

| Vitamin D levels | BMI (No. of Patients (%) | | | | Chi-square value | p-value |
|---|---|---|---|---|---|---|
| | Under weight | Normal | Over weight | Class I obesity | | |
| **Group A** | | | | | | |
| Normal (n=21) | 0 (0.00) | 2 (9.52) | 8(38.09) | 11(52.38) | | |
| Insufficiency (n=7) | 0 (0.00) | 1(14.29) | 4(57.14) | 2(28.57) | 32.99 | <0.0001 |
| Deficiency (n=12) | 1 (8.33) | 2(16.67) | 4(33.33) | 5(41.67) | | |
| Total (n=40) | 1 | 5 | 16 | 18 | | |
| **Group B** | | | | | | |
| Normal (n=15) | 1 (6.67) | 4 (26.67) | 8 (53.33) | 2 (13.33) | | |
| Insufficiency (n=11) | 0 (0.00) | 1 (9.09) | 5 (45.45) | 5 (45.45) | 38.39 | <0.0001 |
| Deficiency (n=14) | 1 (7.14) | 4 (28.57) | 5 (35.71) | 4 (28.57) | | |
| Total (n=40) | 2 | 9 | 18 | 11 | | |

### TABLE 7: BONE MINERAL DENSITY AND BMI

| | Bone mineral density | BMI (No. of Patients (%) | | | | Chi-square value | p-value |
|---|---|---|---|---|---|---|---|
| | | Under weight | Normal | Over weight | Class I obesity | | |
| **Group A** | Normal (n=22) | 1 (4.55) | 2 (9.09) | 9 (40.91) | 10 (45.45) | | |
| | Osteopenia (n=14) | 0 (0.00) | 0 (0.00) | 6 (42.86) | 8 (57.14) | 118.50 | <0.0001 |
| | Osteoporosis (n=4) | 1 (25.00) | 1 (25.00) | 2 (50.00) | 0 (0.00) | | |
| | Total(n=40) | 2 | 3 | 17 | 18 | | |
| **Group B** | Normal (n=33) | 2 (6.06) | 7 (21.21) | 14 (42.42) | 10 (30.30) | | |
| | Osteopenia (n=7) | 0 (0.00) | 2 (28.57) | 4 (57.14) | 1 (14.29) | 15.07 | <0.0001 |
| | Total(n=40) | 2 | 9 | 18 | 11 | | |

### TABLE 8: VIT D AND BONE MINERAL DENSITY AT AP SPINE

| Vitamin D levels | Bone Mineral Density (No. of Patients (%) | | | Chi-square value | p-value |
|---|---|---|---|---|---|
| | Normal | Osteo-penia | Osteo-porosis | | |
| **GROUP A** | | | | | |
| **AP spine** | | | | | |
| Normal (n=21) | 15 (71.43) | 5 (23.81) | 1 (4.76) | | |
| Insufficiency (n=7) | 3 (42.86) | 2 (28.57) | 2 (28.57) | 58.68 | <0.0001 |
| Deficiency (n=12) | 4 (33.33) | 7 (58.33) | 1(8.34) | | |
| **Dual Femur** | | | | | |

| Normal (n=21) | 18 (85.71) | 3 (14.29) | 0 (0.00) | | |
|---|---|---|---|---|---|
| Insufficiency (n=7) | 7 (100.00) | 0 (0.00) | 0 (0.00) | 79.46 | <0.0001 |
| Deficiency (n=12) | 6 (50.00) | 6 (50.00) | 0 (0.00) | | |
| Total (n=40) | 31 | 9 | 0 | | |
| **GROUP B** | | | | | |
| **AP spine** | | | | | |
| Normal (n=15) | 15 (100.00) | 0 (0.00) | | | |
| Insufficiency (n=11) | 9 (81.82) | 2 (18.18) | | 43.27 | <0.0001 |
| Deficiency (n=14) | 9 (64.29) | 5 (35.71) | | | |
| Total (n=40) | 33 | 7 | | | |
| **Dual femur** | | | | | |
| Normal (n=15) | 15 (100.00) | 0 (0.00) | | | |
| Insufficiency (n=11) | 10 (90.91) | 1 (9.09) | | 54.22 | <0.0001 |
| Deficiency (n=14) | 9 (64.29) | 5 (35.71) | | | |
| Total (n=40) | 34 | 6 | | | |

## TABLE 9: AGE DISTRIBUTION OF POSTMENOPAUSAL WOMEN

| Study | Year | No. of cases | Mean age (Years) |
|---|---|---|---|
| Deng et al[13] | 2013 | 119 | 62.7 |
| Napoli et al[14] | 2014 | 274 | 57.7 |
| Kirubaharan et al[15] | 2016 | 50 | 75.2 |
| Singh et al[16] | 2016 | 80 | 45.3 |
| Present Study | 2018 | 40 | 55.68 |

## TABLE 10: BODY MASS INDEX IN POSTMENOPAUSAL WOMEN

| Study | Year | No of cases | Body Mass index | | | |
|---|---|---|---|---|---|---|
| | | | Underweight | Normal | Overweight | Obese |
| Hosseinpanah et al[17] | 2008 | 245 | 0.00% | 15.5% | 40% | 44.5% |
| Godara et al[11] | 2017 | 100 | 0.00% | 58% | 22% | 20% |
| Present study | 2018 | 40 | 2.5% | 12.5% | 40% | 45% |

## TABLE 11- BMD IN POSTMENOPAUSAL WOMEN

| Study | Year | No. of cases | Bone Mineral Density | | |
|---|---|---|---|---|---|
| | | | Normal | Osteopenia | Osteoporosis |
| Bhattoa et al[19] | 2004 | 319 | 14.4% | 34.5% | 50.8% |
| Anuk et al[20] | 2012 | 93 | 26.9% | 45.2% | 28% |
| Present study | 2018 | 40 | 55% | 35% | 10% |

## TABLE 12:BMD IN PERIMENOPAUSAL WOMEN

| Study | Year | No. of cases | Bone Mineral Density | | |
|---|---|---|---|---|---|
| | | | Normal | Osteopenia | Osteoporosis |
| Singh et al[16] | 2016 | 80 | 32.5% | 41.3% | 26.3% |
| Present study | 2018 | 40 | 82.50% | 17.50% | 0.00% |

In group A, age ranged between 46-84 years with mean age of 55.68±8.85 years whereas age ranged between 30-45 years in group B with mean age of 39.83±4.34 years.Majority of subjects were Sikhs (55%) followed by Hindus (45%) in group A. Whereas in group B, majority of subjects were Hindus (52.50%) followed by Sikhs (45%) and Muslims (2.50%) as shown in table 1.Maximum subjects were undergraduate in both groups (77.50% in group A and 65% in group B). 12.5% subjects in group A and 20% subjects in group B were graduates as shown in table 1. Whereas only 10% subjects in group A and 15% subjects in group B were post-graduates. Maximum subjects were from urban areas - 65% in group A and 70% in group B. 35% in group A and 30% in group B belonged to rural areas as shown in table 1.Maximum subjects were house-wives in both groups(95% in group A and 67.5% in group B) as shown in table 1. Only 5% subjects in group A and 32.5% subjects in group B were working.Modified Kuppuswami scale was used to assess the socio-economic status of patients. Subjects were mainly of 2 categories,upper middle class and middle class. 45% subjects in group A and 65% subjects in group B

belonged to upper middle class. Whereas 55% in group A and 35% in group B were from middle class socio-economic status as shown in table 1. p-value =0.004(significant).Body mass index is calculated from weight and height of the subjects. It is observed that45% subjects in group A and 27.50% in group B were obese. 40% subjects in group A and 45% subjects in group B were overweight. Normal weight was present in 12.50% subjects in group A and 25% subjects in group B. 2.5% subjects in each group A and group B were underweight as shown in table 2.

Subjects who had 1 to 5 + years of duration of menopause were 10 (25%) in number. Those having 6 to 10+ years of menopause were also 10 (25%). Subjects who had menopause between 11 to 15+ years were 11(27.50%) in number. 5 (12.50%) subjects were in the range of 16 to 20+ years while only 4 (10%) subjects had menopause for more than equal to 21 years as shown in table 3.Normal Vitamin D levels were taken as more than 30ng/ml. Vitamin D Insufficiency was taken as levels between 20ng/ml to 30ng/ml and Vitamin D deficiency was taken as levels less than 20ng/ml.

Normal Vit-D level was seen in 52.50% subjects in group A and 37.50% subjects in group B as shown in table 4. Vitamin D insufficiency was observed in 17.50% subjects in group A and 27.50% subjects in group B where as Vitamin D deficiency was seen in 30% subjects in group A and 35% subjects in group B. This is statistically significant with p-value being 0.038 (significant).Bone mineral density was measured by Dexa scan at both AP Spine and Dual Femur. Normal BMD was taken as T-score above or equal to -1.0 ; Osteopenia as T-score between -1.0 and -2.5; Osteoporosis as T-score below or equal to -2.5.At AP Spine, 55% subjects in group A and 82.5% subjects in group B were having normal BMD. 35% subjects in group A and 17.5% subjects in group B had osteopenia while as osteoporosis was observed only in Group A (10%) at AP Spine as shown in table 5. p-value = <0.0001(significant). At Dual Femur, 77.5% subjects in group A and 85% subjects in group B were having normal BMD. 22.5% subjects in group A and 15% subjects in group B had osteopenia while osteoporosis was not seen in any of the groups at dual femur as shown in table 5. p-value = < 0.397(insignificant).

As far as body mass index is concerned, in group A, normal Vit-D levels were present in 9.52%, 38.09% and 52.38% subjects with normal BMI, over weight and class I obesity respectively as shown in table 7. Vit-D insufficiency was seen in 14.29%, 57.14% and 28.57% subjects with normal BMI, overweight and class I obesity respectively while as Vit-D deficiency was present in 8.33%, 16.67%, 33.33% and 41.67% subjects with underweight, normal BMI, overweight and class I obesity respectively. p-value = <0.0001 (significant). Normal Vit-D levels were present in 6.67%, 26.67%, 53.33% and 13.33% subjects in group B with underweight, normal BMI, over weight and class I obesity respectively as shown in table 6. Vit-D insufficiency was seen in 9.09%, 45.45% and 45.45% subjects with normal BMI, overweight and class I obesity respectively while as Vit-D deficiency was present in 7.14%, 28.57%, 35.71% and 28.57% subjects with underweight, normal BMI, overweight and class I obesity respctively. p-value = <0.0001 (significant).

Normal BMD in group A was present in 4.55%,9.09%, 40.91%, 45.45% subjects with underweight, normal BMI, overweight, and class I obesity respectively as shown in table 7. 42.86% and 57.14% subjects had osteopenia while as osteoporosis was present in 25%, 25% and 50% subjects with underweight, normal BMI and overweight respectively. p-value = 0.0001(significant). Normal BMD was present in 6.06%, 21.21%, 42.42%, 30.30% subjects in group B with underweight, normal BMI, overweight, and class I obesity respectively as shown in table 7. 28.57%, 57.14% and 14.29% subjects with normal BMI, overweight and class I obesity had osteopenia respectively. p-value = < 0.0001(significant).

Subjects with normal Vit-D in group A were 21. Out of these, normal BMD was observed in 71.4%, osteopenia in 23.81% and osteoporosis in 4.76% subjects. Subjects with vit-D insufficiency were 7, out of which 42.8% had normal BMD, 28.5% subjects had osteopenia and 28.5% had osteoporosis. Subjects with vitamin D deficiency were 12, in which normal BMD was seen in 33.33%, osteopenia in 58.33% and osteoporosis in 8.34%. This is statistically significant with p-value being <0.0001 as shown in table 8.At Dual Femur, subjects with normal BMD in group A were 21, out of which 85.71% had normal BMD and 14.29% subjects had osteopenia. Vit-D insufficiency was seen in 7 and all 100% subjects had normal BMD.Vit-D deficiency was present in 12 subjects out of which 50% subjects had normal BMD and 50% had osteopenia. Osteoporosis was not observed in any subject in group A at Dual femur as shown in table as 8. p- value = <0.001 (significant).

Subjects in group B with normal vit-D were 15. Out of these, normal BMD was observed in 100% and none of the subjects had osteopenia. Subjects having vit-D insufficiency were 11 out of which 81.82% had normal BMD and 18.18% subjects had osteopenia. Subjects with vitamin deficiency were 14, in which normal BMD was seen in 64.29% subjects and osteopenia in 35.71%. This is statistically significant with p-value being <0.0001 as shown in table 8.

At Dual Femur, subjects in group B with normal BMD were 15, out of which 100% had normal BMD and none of the subjects had osteopenia. Vit-D insufficiency was seen in 11, in which 90.91% had normal BMD and 9.09% had osteopenia. Vit-D deficiency was present in 14 subjects out of which 64.29% subjects had normal BMD and 35.71% subjects had osteopenia as shown in table 8. p- value = <0.001 (significant).

Body Mass Index of women has been taken into account in various studies. Hosseinpanah et al[17] conducted study on 245 postmenopausal subjects and observed that 40% were overweight and 44.5% were obese. Godara.A (2017)[11] studied 100 postmenopausal women and found that 58% had normal BMI and 22% were overweight. In our study, 40% subjects were overweight and 45% subjects were obese while as 12.5% subjects were having normal BMI. Our study was comparable to Hosseinpanah et al[17].

In the present study, normal Vit-D levels were present in 9.52%, 38.09% and 52.38% subjects with normal BMI, over weight and class I obesity respectively. Vit-D insufficiency was seen in 14.29%, 57.14% and 28.57% subjects with normal BMI, overweight and class I obesity respectively while as Vit-D deficiency was present in 8.33%, 16.67%, 33.33% and 41.67% subjects with underweight, normal BMI, overweight and class I obesity respectively. However, BMI had significant correlation with vit-D levels in our study.Pedro et al[1] studied 161 postmenopausal women and observed that 51.6% non- osteoporotic (normal bone mass or osteopenia) subjects had mean BMI of 30.4±4.4 while as 48.4% osteoporotic subjects had mean BMI of 28.9±3.9 and reported to have significant linear correlation between BMD and BMI. In our study, normal BMD was present in 4.55%,9.09%, 40.91%, 45.45% subjects with underweight, normal BMI, overweight, and class I obesity respectively. 42.86% and 57.14% subjects had osteopenia while as osteoporosis was present in 25%,25%,and 50% subjects with underweight, normal BMI and overweight respectively. Jose et al[18] had 36.5% subjects with vit-D deficiency, 42.9% had vit-D insufficiency and 20.6% had sufficient vit-D levels. In the present study, 40 postmenopausal subjects were studied and it was observed that 52.50% subjects had normal vit-D levels, 17.5% had vit-D insufficiency and 30% had vit-D deficiency which is statistically significant and comparable to Jose et al[18].Bhattoa et al[19] had 14.4%, 34.5% and 50.8% subjects having normal BMD, osteopenia and osteoporosis at lumbar spine respectively while as at femoral neck 21.9%, 39.5% and 38.6% subjects had normal BMD, osteopenia and osteoporosis respectively. Anuk et al[20] studied 93 subjects and observed that at Lumbar spine, 26.9% had normal BMD, 45.2% had osteopenia and 28% had osteoporosis while as at Femoral neck, 10.8% had normal BMD, 54.8% had osteopenia and 34.4% had osteoporosis. In our study, at AP spine, 55% subjects had normal BMD, 35% had osteopenia and 10% had osteoporosis whereas at Dual femur, normal BMD was seen in 77.50%, osteopenia in 22.5% while as none of the subjects had osteoporosis. The results of our study correlates with that of Anuk et al[20].Singh et al[16] studied 80 perimenopausal women and observed that 26.3% subjects had osteoporosis, 41.3% subjects had osteopenia and 32.5% had normal BMD. In our study, 40 subjects were studied and observed that 82.50% had normal BMD and 17.50% had osteopenia which is quite unlike Singh et al[16] study.

## DISCUSSION

The study was conducted in 80 patients more than 30 years of age attending out-patient department of Obstetrics and Gynaecology and Advanced Well-Women Health check at Satguru Pratap Singh Hospitals, Ludhiana. The mean age of women has been calculated in various studies with varied results as shown in table 9. Deng et al[13] studied 119 postmenopausal subjects and observed that mean age of subjects was 62.7 years. The mean age was 57.7 years in the study by Napoli et al[14] who studied 274 postmenopausal subjects. However, a study by Kirubaharan et al[15] observed the highest mean age of 75.2 years while as Singh et al[16] had a mean of 45.3 years. The mean age of subjects in present study was 55.68 years which is comparable to the study by Napoli et al[14] as shown in table 9.

Whereas in the study by Lavanya et al[21], 20% had osteoporosis, 70% had osteopenia and 10% had normal bone density in pre-menopausal women while as in postmenopausal women 65.6% had osteoporosis, 34.4% had osteopenia and none had normal bone mineral density. In the present study, at AP Spine, 55% subjects in group A had normal BMD, 35% had osteopenia and 10% had osteoporosis while as in group B, 82.5% had normal BMD, 17.5% had osteopenia and none of the subjects had osteoporosis which was statistically significant. In our study, at Dual femur, 77.5% subjects in group A had normal BMD, 22.5% had osteopenia and none of the subjects had osteoporosis while as in group B, 85% had normal BMD, 15% had osteopenia and none of the subjects had osteoporosis and no statistical significance was found. In the present study, we had higher percentage of normal BMD in both premenopausal and postmenopausal subjects whereas in Lavanya et al[21], osteopenia and ospteoporosis was higher in both groups.Jose et al[18] studied 250 women and observed that 43.1% subjects with normal BMD, 34.2% with osteopenia and 38.5% subjects with osteoporosis were vit-D deficient while as 37.9%, 48.3% and 43.6% subjects had vit-D insufficiency and 19%, 17.5% and 18% subjects had vit-D sufficiency respectively. He reported that there is no significant correlation between vit-D and BMD. In our study, in group A, at AP spine, out of 21 subjects having normal vit-D levels 71.4% had normal BMD, 23.8% had osteopenia and 4.7% had osteoporosis. Subjects having vit-D insufficiency were 7, out of which 42.8% had normal BMD, 28.5% subjects had osteopenia and 28.5% had osteoporosis. Subjects with vitamin D deficiency were 12, in which normal BMD was seen in 33.33%, osteopenia in 58.33% and osteoporosis in 8.34%.At Dual Femur, subjects with normal BMD were 21, out of which 85.71% had normal BMD and osteopenia in 14.29% subjects. Vit-D insufficiency was seen in 7 (100%) subjects.Vit-D

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deficiency was present in 12 subjects out of which 50% subjects had normal BMD and 50% subjects had osteopenia while none had osteoporosis. In group B, at AP Spine, out of 15 subjects with normal vit-D levels, normal BMD was found in 100% subjects had normal BMD and none had osteopenia whereas out of 11 subjects with vit-D insufficiency, 81.82% had normal BMD and 18.18% had osteopenia. 64.29% subjects with normal and 35.71% subjects had osteopenia. At Dual femur,subjects in group B with normal BMD were 15, out of which 100% had normal BMD and none of the subjects had osteopenia. Vit-D insufficiency was seen in 11, in which 90.91% had normal BMD and 9.09% had osteopenia. Vit-D deficiency was present in 14 subjects out of which 64.29% subjects had normal BMD and 35.71% subjects had osteopenia. Unlike Jose et al[18], our study found significant correlation between vit- D and BMD both at AP Spine and Dual femur.

## CONCLUSION
It is concluded that vitamin-D levels were deficient in one-third of women in both reproductive and postmenopausal age group. In postmenopausal subjects who were vitamin-D deficient, half of the women had osteopenia both at AP spine and Dual femur while osteoporosis was found only at AP spine. However, in reproductive age group, one-third of vit-D deficient women had osteopenia at both levels but none had osteoporosis. Thus, vitamin D along with bone mineral density will be a better predictor of bone health.

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