

## A Study To Create Awareness Of Osteoporosis, To Determine It's Prevalence And Associated Risk Factors

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**Abstract:** Background: Osteoporosis is characterized by a low bone mass and a micro-architectural deterioration of bone tissue. The major symptoms observed in the people suffering from osteoporosis include loss of height, back pain, immobility. Aim & Objectives: The main aim of the study is to know the prevalence, to assess the risk factors, to create the awareness of osteoporosis and improve the quality of life. Methodology: The health camps were conducted in and around Bengaluru, Portable DEXA machine was used to obtain the BMD of the individual. A well-established questionnaire was implemented in the study. Results: An observational study was conducted on 429 persons. Out of which 185 (43.12%) were male and 244 (56.87%) were female. In male category, 26 (14.05%) were osteoporotic, 116 (62.70%) were osteopenic and 43 (23.24%) were normal where as in female category, 45 (22.13%) were osteoporotic, 145 (59.42%) were osteopenic and 45 (18.44%) were normal. Conclusion: The prevalence of osteoporosis was determined and the possible risk factors were assessed in and around Bengaluru. The study conclude that, females are more prone to osteoporosis than males, as the risk factors majorly being menopause and PCOD in female (due to hormonal changes) while smoking and alcohol consumption in male. The implementation of preventive strategies can improve the quality of life and reduce the personal and economic burden of osteoporosis.

**Key words:** BMD, p-DEXA, Osteoporosis, Osteopenia.

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### I. Introduction

In 1994, a WHO expert panel operationalized this concept by defining diagnostic criteria for osteoporosis on the basis of measurement of bone mineral density and relating it to the mean bone mineral density of young adult (T-score): Osteoporosis is bone mineral density more than 2.5 standard deviations below the mean bone mineral density of young adult (bone mineral density T-score <-2.5). In 2003 a highly conservative estimate by a group of experts suggested that 26 million Indians suffer from osteoporosis, and this number is expected to reach 36 million by 2013.<sup>[1]</sup>

**Signs and Symptoms:** Shortened stature (>1.5" loss), Vertebral, hip, wrist, or forearm pain, Pain.

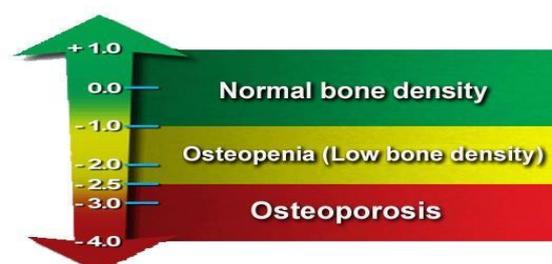
The major factors influencing bone losses are hormonal status, exercise, aging, nutrition, lifestyle, disease states, medications, and some genetic influences. Non-hormonal risk factors are similar between women and men.

BMD values were measured in terms of T-score and Z-score.

- T-score: It is the difference between the individual patients bone mineral density and the mean results obtained in young adult population expressed in units of young population standard deviation.
- Z-score: It is the difference between the individual patient's results and the mean results obtained in an age matched population expressed in units of the age matched population standard deviation.

According to WHO osteoporosis definition, based on T-score results the categories are

- Normal bone mass – T-score greater than -1.0
- Osteopenia – T-score between -1 and -2.5
- Osteoporosis –T-score less than -2.5
- Severe osteoporosis – T-score less than -2.5 with at least one osteoporotic fracture.<sup>[2]</sup>



**Fig 1:** bone mineral density scale.<sup>[3]</sup>

## **II. Material And Methods**

This prospective randomized study which was carried out in the general population through health camps in and around Bengaluru, Karnataka. A total 429 were in this study.

**Study Design:** Prospective randomized study.

**Study Location:** The health camps were conducted in urban and rural areas in and around Bangalore south zone

**Study Duration:** The study was conducted for a period of six months.

**Sample size:** 429 patients.

### **Inclusion criteria:**

1. Female : Age greater than 25 yrs
2. Male : Age greater than 35 yrs

### **Exclusion criteria:**

1. Age below 25 yrs female.
2. Age below 35 yrs male.
3. Pregnant women are not allowed in the study.
4. Individuals who are not willing to consent.

### **Procedure methodology:**

The bone densitometer machine (also known as a portable DXA machine) emits a thin, invisible beam of low-dose x-rays. There are two distinct energy peaks sent through the bones during the exam. The soft tissue absorbs the first peak and the bone absorbs the second peak. A bone densitometer has special software for computing and displaying bone density calculations on the monitor.<sup>[4]</sup> This device is entirely self-contained, portable (<1kg), and handheld, and permits real-time evaluation of the BMD by computing a parameter known as net time delay (NTD). The machine was obtained from The Himalaya Drug Company.

### **Questionnaire:**

A well designed Irish Osteoporosis Society Questionnaire was adapted (permission taken). Data is obtained by patient face to face interview and completing the questionnaire.

The questionnaire have 5 domains. They include

- Patient details
- Exercise history
- Dietary history
- Medical history
- Menstrual history (only for female patient)

### **Procedure:**

- Those patients who meet the study criteria will be enrolled into the study.
- BMI calculation - Height and weight of all the participants were noted and Body mass index (BMI) was calculated using the formula= weight (Kg)/ Height<sup>2</sup> (m).
- *Category of BMI :*
- Underweight < 18.5
- Normal 18.5-25
- Overweight 25-30
- Obese >30

Device used to measure bone mineral density is A PORTABLE DUAL ENERGY X-RAY ABSORPIMETRY (DEXA). The capacity of this device was 80 members per day.

*Procedure to measure BMD* - The patient was made to sit on a chair and the gel was applied to ankle then the patient was asked to place the foot on the machine. The probes were pressed gently upon ankle to measure BMD. The BMD value displayed on machine was noted. This was plotted on BMD chart and calculated for T-score by plotting against age of the patient. According to the T-score, the diagnosis of osteoporosis, osteopenia were made.

**Statistical analysis:**

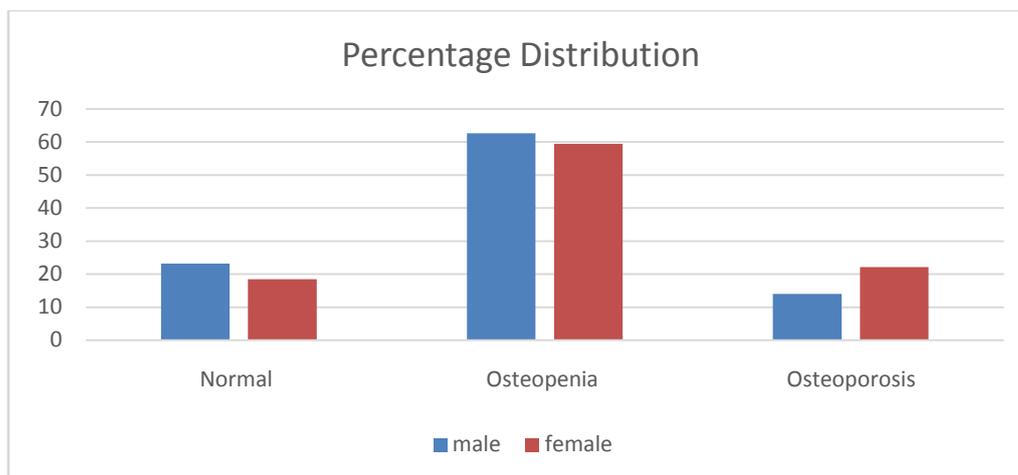
The data was compiled in MS Excel and the Relative Risk, Odds ratio of each factor was calculated.

The Prevalence of each risk factor of osteoporosis was calculated.

Chi square test was used for statistical analysis and p value was obtained to find out the significance of the obtained result.

**III. Result**

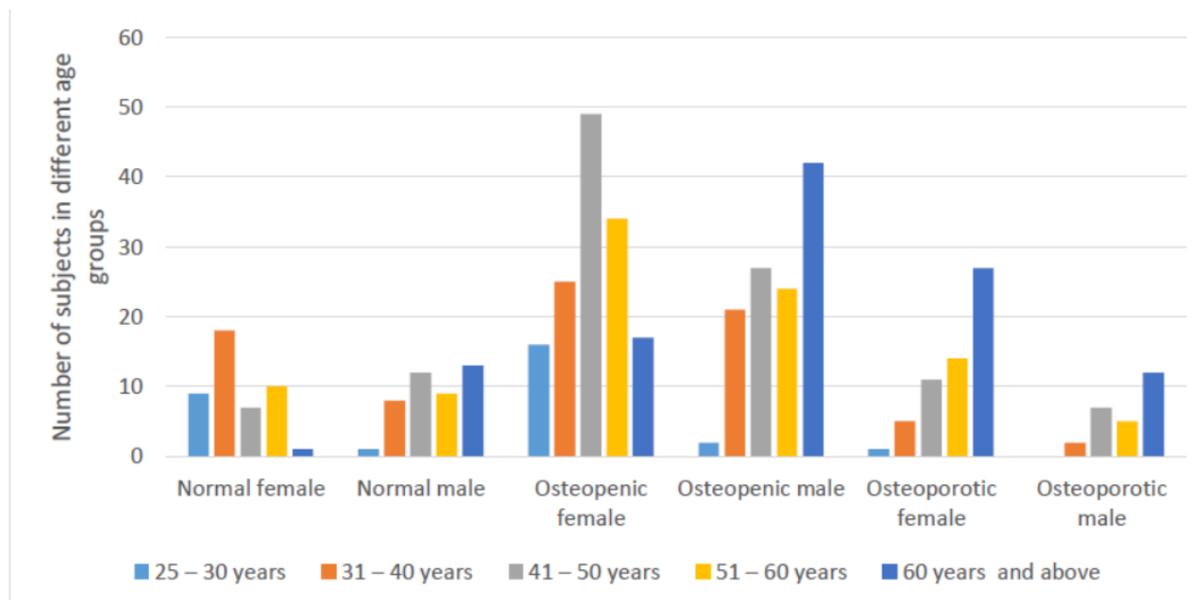
Total of 429 subjects were collected out of which 185(43.12%) were male and 244(56.87%) were female. In male category 26(14.05%) were osteoporotic, 116(62.70%) were osteopenic and 43(23.24%) were normal. In female category 45(22.13%) were osteoporotic, 145(59.42%) were osteopenic and 45(18.44) were normal.



**Figure 2.** The percentage distribution of males and females.

**Table 1:** distribution of bone mineral density (BMD) among different age groups of male (n=185) and female (n=244)

| Age groups in years | total |    | Percentage% |       | normal |    | osteopenia |    | osteoporosis |    |
|---------------------|-------|----|-------------|-------|--------|----|------------|----|--------------|----|
|                     | F     | M  | F           | M     | F      | M  | F          | M  | F            | M  |
| 25 – 30             | 26    | 3  | 10.65       | 1.62  | 9      | 2  | 16         | 1  | 1            | 0  |
| 31 – 40             | 48    | 31 | 19.67       | 16.75 | 18     | 8  | 25         | 21 | 5            | 2  |
| 41 – 50             | 67    | 46 | 27.45       | 24.86 | 7      | 12 | 49         | 27 | 11           | 7  |
| 51 – 60             | 58    | 38 | 23.77       | 20.54 | 10     | 9  | 34         | 24 | 14           | 5  |
| 60 and above        | 45    | 67 | 18.44       | 36.21 | 1      | 13 | 17         | 42 | 27           | 12 |



**Figure 3:** the number of subject in different age groups.

Around 9 risk factors were found to be associated to osteoporosis and osteopenia where 7 factors were related to male and 7 factors to female.

**Table 2:** shows the comparison of risk factors among normal, osteopenic and osteoporotic male individuals and there relative risk value.

| FACTORS                                | TOTAL | NORMAL | OSTEOPENIA | OSTEOPOROSIS | RELATIVE RISK |              |
|--|-------|--------|------------|--------------|---------------|--------------|
|  |       |        |            |              | OSTEOPENIA    | OSTEOPOROSIS |
| Smoking                                | 69    | 3      | 41         | 25           | 14.70         | 5.20         |
| Alcohol                                | 104   | 3      | 79         | 38           | 9.51          | 11.91        |
| Caffeine                               | 88    | 8      | 60         | 20           | 2.60          | 3.94         |
| No exercise                            | 62    | 12     | 25         | 25           | 1.12          | 2            |
| Past history of fracture               | 53    | 7      | 29         | 17           | 1.66          | 4.2          |
| No consumption of other dairy products | 144   | 25     | 95         | 25           | 1.4           | 1.62         |
| BMI:                                   |       |        |            |              |               |              |
| Overweight                             | 77    | 25     | 46         | 6            | 0.65          | 0.10         |
| Obese                                  | 68    | 20     | 15         | 0            | 0.67          | 0            |
| underweight                            | 9     | 1      | 4          | 4            | 1.2           | 3.2          |

*NOTE: The relative risk >1 increased risk of the outcome in exposure, <1 reduced risk in exposed group, =1 no difference, each group is same.*

In case of male population, the major risk factors are smoking and alcohol consumption. Relative risk was found to be more than 1 for all the factors indicating association of the factors to the disease i.e., osteoporosis and osteopenia (table 3). Relative risk for smoking and alcohol was 5.20 and 11.91 for osteoporosis and 14.70, 9.51 for osteopenia indicating high association with the disease.

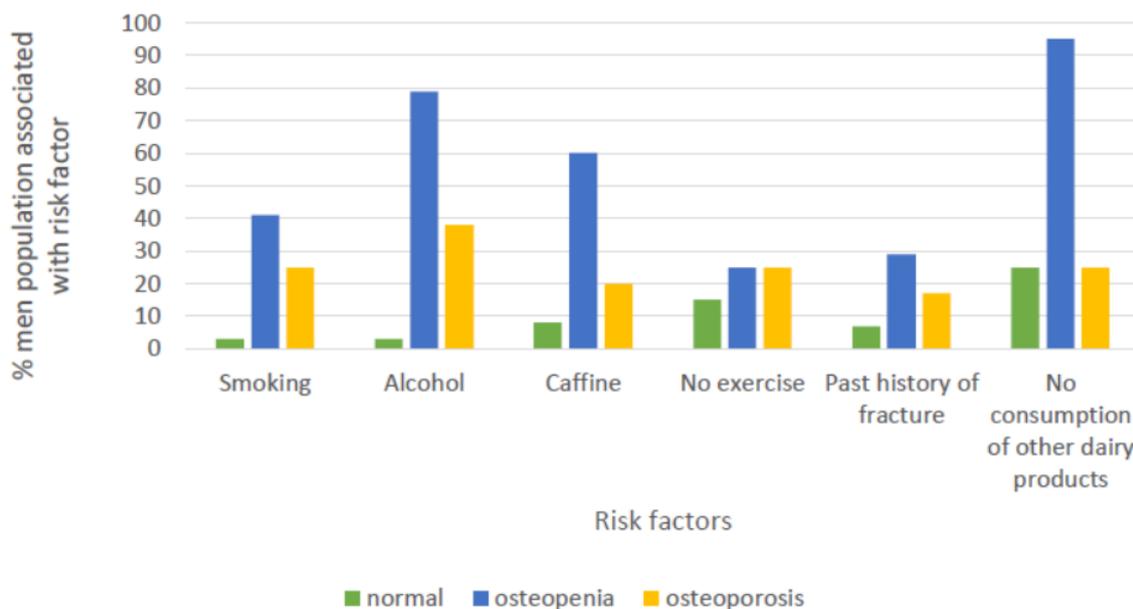


Figure 4: percentage men population associated with the risk factor.

Table 3: shows the comparison of risk factors among normal, osteopenic and osteoporotic female individuals and there relative risk value.

| FACTORS                                | TOTAL | NORMAL | OSTEO<br>PENIA | OSTEO<br>POROSIS | RELATIVE RISK |            |
|--|-------|--------|----------------|------------------|---------------|------------|
|  |       |        |                |                  | OSTEOPOROSIS  | OSTEOPENIA |
| Menopause                              | 128   | 7      | 72             | 49               | 5.308         | 3.188      |
| PCOD                                   | 16    | 2      | 9              | 5                | 1.89          | 1.376      |
| Caffeine                               | 102   | 6      | 54             | 42               | 5.32          | 2.796      |
| No exercise                            | 66    | 8      | 35             | 23               | 2.17          | 1.353      |
| past history of fracture               | 61    | 3      | 23             | 35               | 1.11          | 2.56       |
| No consumption of other dairy products | 214   | 34     | 124            | 56               | 1.27          | 1.123      |
| BMI Overweight                         | 101   | 15     | 61             | 25               | 0.63          | 0.95       |
| Obese                                  | 68    | 17     | 38             | 13               | 0.43          | 1.022      |
| Underweight                            | 5     | 1      | 3              | 1                | 0.68          | 0.88       |

NOTE: The relative risk >1 increased risk of the outcome in exposure, <1 reduced risk in exposed group, =1 no difference, each group is same.

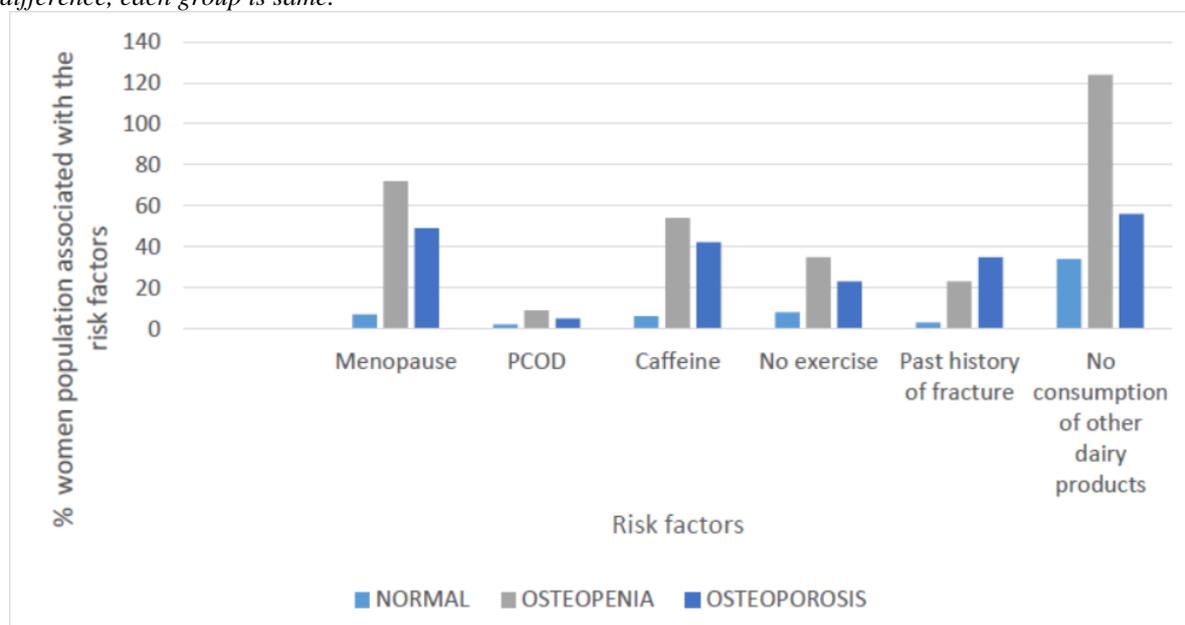


Figure 5: percentage women population associated with risk factors

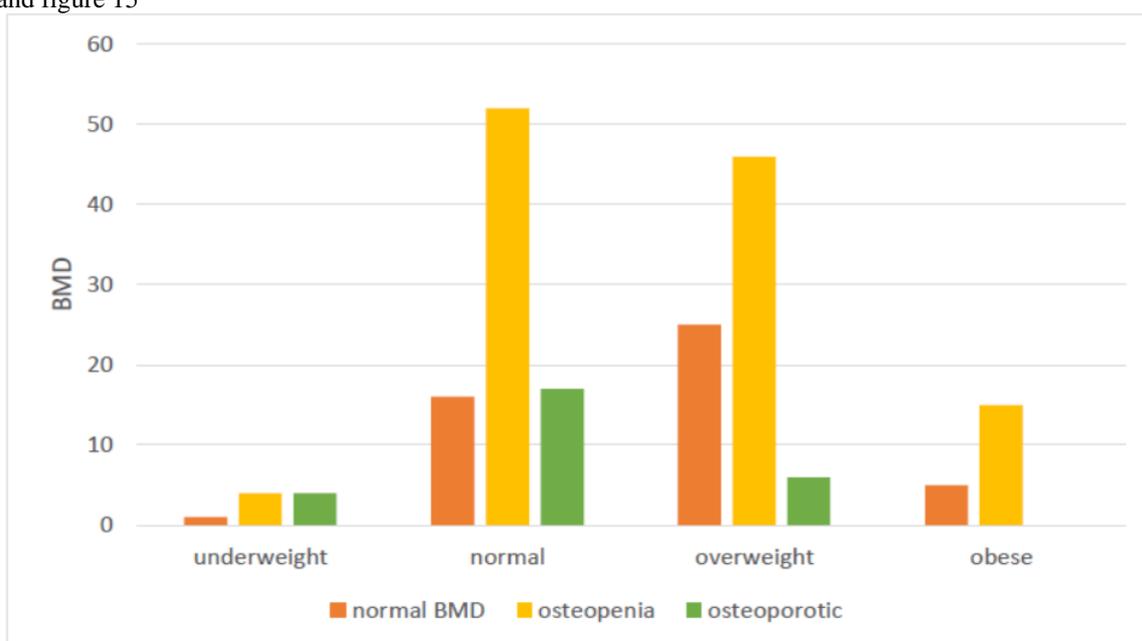
In case of female population, the major risk factors were menopause and caffeine consumption. Relative risk was found to be more than 1 for all the factors indicating association of the factors to the disease i.e, osteoporosis and osteopenia (table 3). Relative risk for menopause and caffeine was 5.30, 3.188 for osteoporosis and 5.32, 2.796 for osteopenia indicating high association with the disease.

**BMI**

**Table 4:** showing correlation of BMD with BMI in male category

| Variable<br>BMI category<br>(kg/m <sup>2</sup> ) | total | Normal(n=)<br>(T-score >1.0) |       | Osteopenia(n=)<br>(T-score <-1.0 to 2.5) |       | Osteoporosis(n=)<br>(T-score <-2.5) |        |
|--|-------|------------------------------|-------|--|-------|-------------------------------------|--------|
|  |       | no                           | %     | no                                       | %     | no                                  | %      |
| < 18 underweight                                 | 9     | 1                            | 11.12 | 4  | 44.44 | 4                                   | 44.44  |
| 18-25 normal                                     | 79    | 16                           | 20.25 | 52                                       | 72.22 | 17                                  | 21.518 |
| 25-30 overweight                                 | 77    | 25                           | 32.46 | 46                                       | 59.74 | 6                                   | 7.79   |
| >30 obese  | 20    | 5                            | 25    | 15                                       | 75    | 0                                   | 0      |

In case of male population lower BMI showed to be an associating factor for high BMD and can be seen in table 5 and figure 15

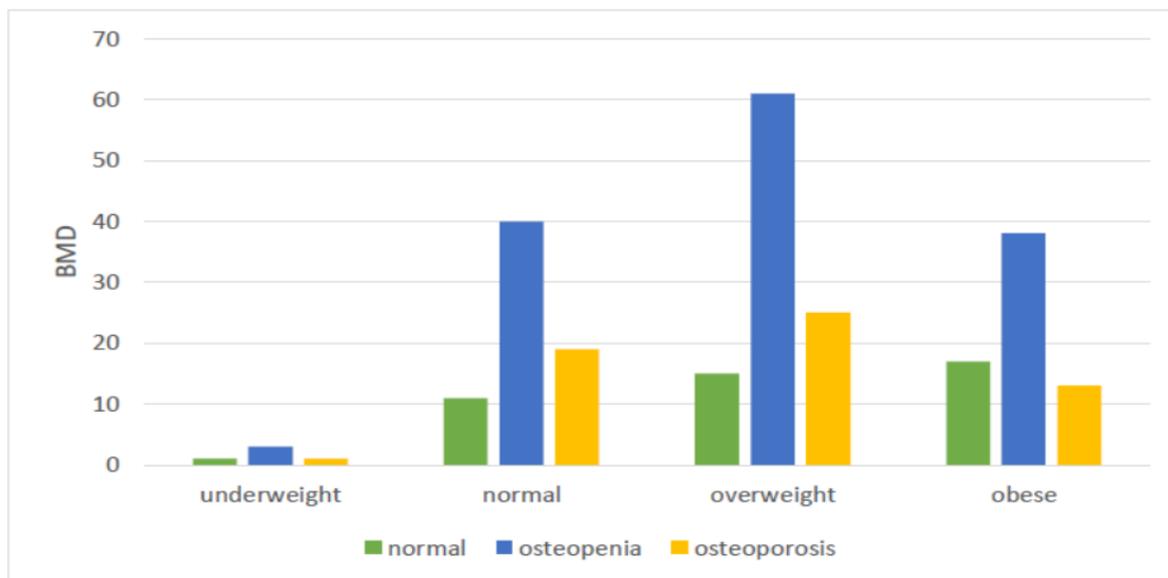


**Figure 6:** correlation of BMD with BMI in male category

Osteoporosis and osteopenia were more common in overweight (25-30kg/m<sup>2</sup>) body mass index (BMI) categories as compared to other BMI groups, in female group. Here over weight showed associating factor for osteoporosis and osteopenia as shown in table 6 and portrait in figure 16.

**Table 5:** showing correlation of BMD with BMI in female category.

| Variable<br>BMI category<br>(kg/m <sup>2</sup> ) | Total | Normal(n=) (T-score >1.0) |       | Osteopenia(n=) (T-score <-1.0 to 2.5) |       | Osteoporosis(n=) (T-score <-2.5) |       |
|--|-------|---------------------------|-------|---------------------------------------|-------|----------------------------------|-------|
|  |       | no                        | %     | no                                    | %     | no                               | %     |
| < 18 underweight                                 | 5     | 1                         | 20    | 3                                     | 60    | 1                                | 20    |
| 18-25 normal                                     | 70    | 11                        | 15.71 | 40                                    | 57.1  | 19                               | 27.14 |
| 25-30 overweight                                 | 101   | 15                        | 14.85 | 61                                    | 60.39 | 25                               | 24.75 |
| >30 obese  | 68    | 17                        | 25    | 38                                    | 55.88 | 13                               | 19.12 |



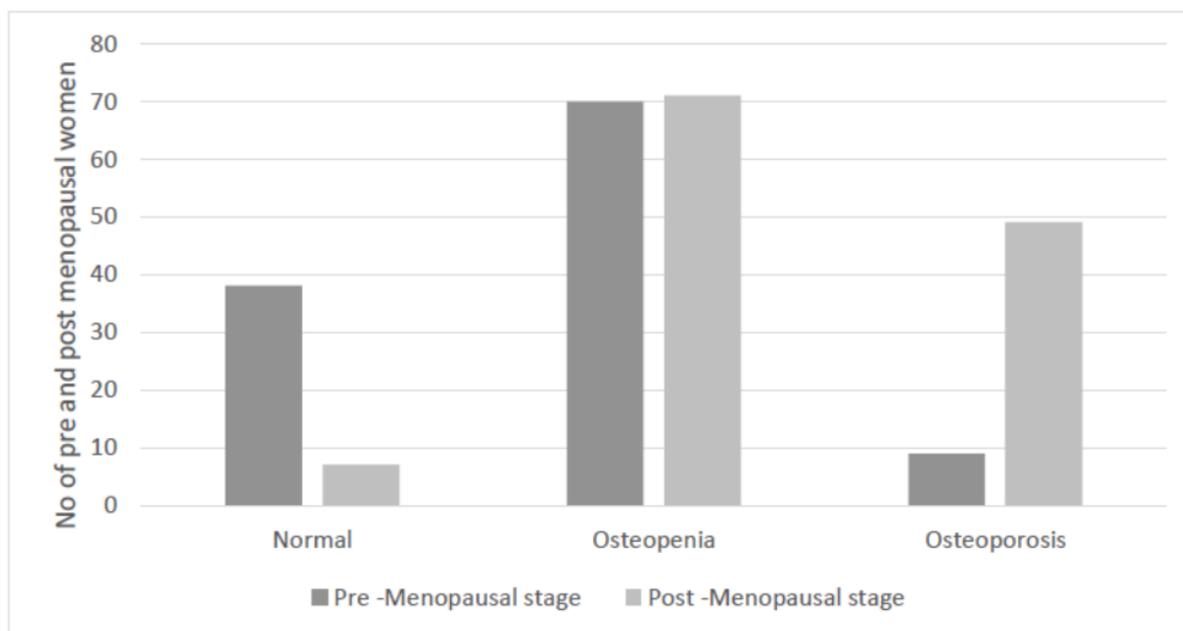
**Figure 7:** correlation of BMD with BMI in female

**COMPARISION OF PREMENOPAUSAL WITH POST MENOPAUSAL WOMEN**

Table 6 shows the distribution of bone mineral density among pre and post- menopausal women. There were 117(47.95%) women who were in pre- menopausal stage out of which 38(32.48%) were normal, 70 (59.58%) were osteopenic, 9(7.69%) were osteoporotic and 127(52.05%) women were in post -menopausal stage out of which 7(5.51%) were normal, 71(55.9%) were osteopenic and 49(38.58%) were osteoporotic.

**Table 6:** distribution of bone mineral density (BMD) among pre and post- menopausal women.

| Menopausal stage        | Total | %     | Normal | Osteopenia | Osteoporosis |
|-------------------------|-------|-------|--------|------------|--------------|
| Pre - Menopausal stage  | 117   | 47.95 | 38     | 70         | 9            |
| Post - Menopausal stage | 127   | 52.05 | 7      | 71         | 49           |



**Figure 8:** The distribution of bone mineral density (BMD) among pre and post-menopausal women.

**PREVALENCE**

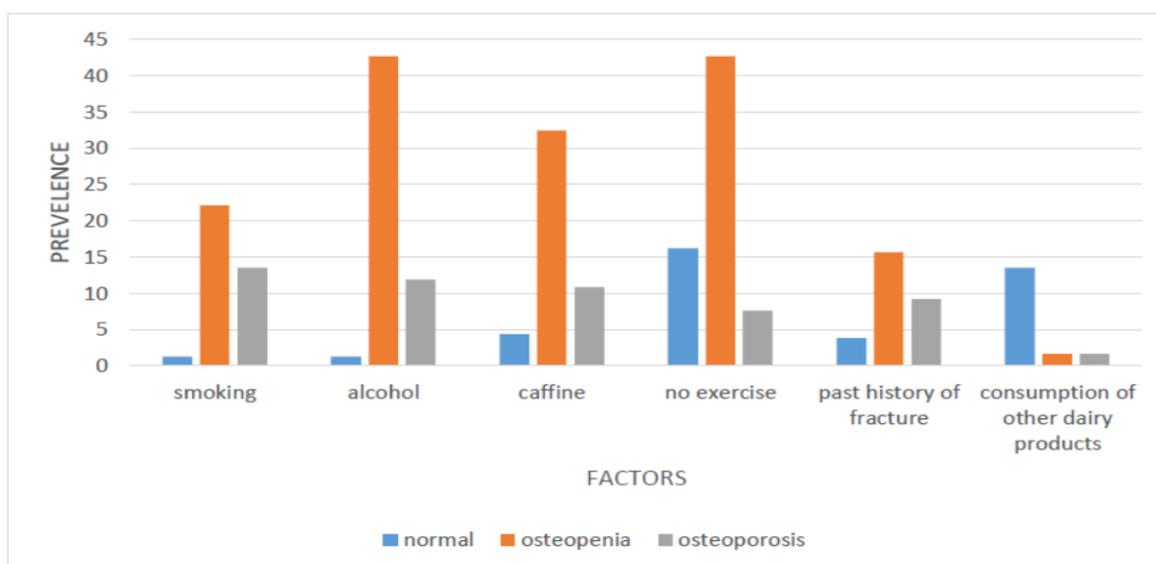
Overall prevalence in male category, 26(14.05%) were osteoporotic, 116(62.70%) were osteopenic and 43(23.24%) were normal. In female category 45(22.13%) were osteoporotic, 145(59.42%) were osteopenic and 45(18.44) were normal. Prevalence of risk factors is given in table 8.

**Table 7:** prevalence of risk factors in normal, osteopenia and osteoporosis in male and female population

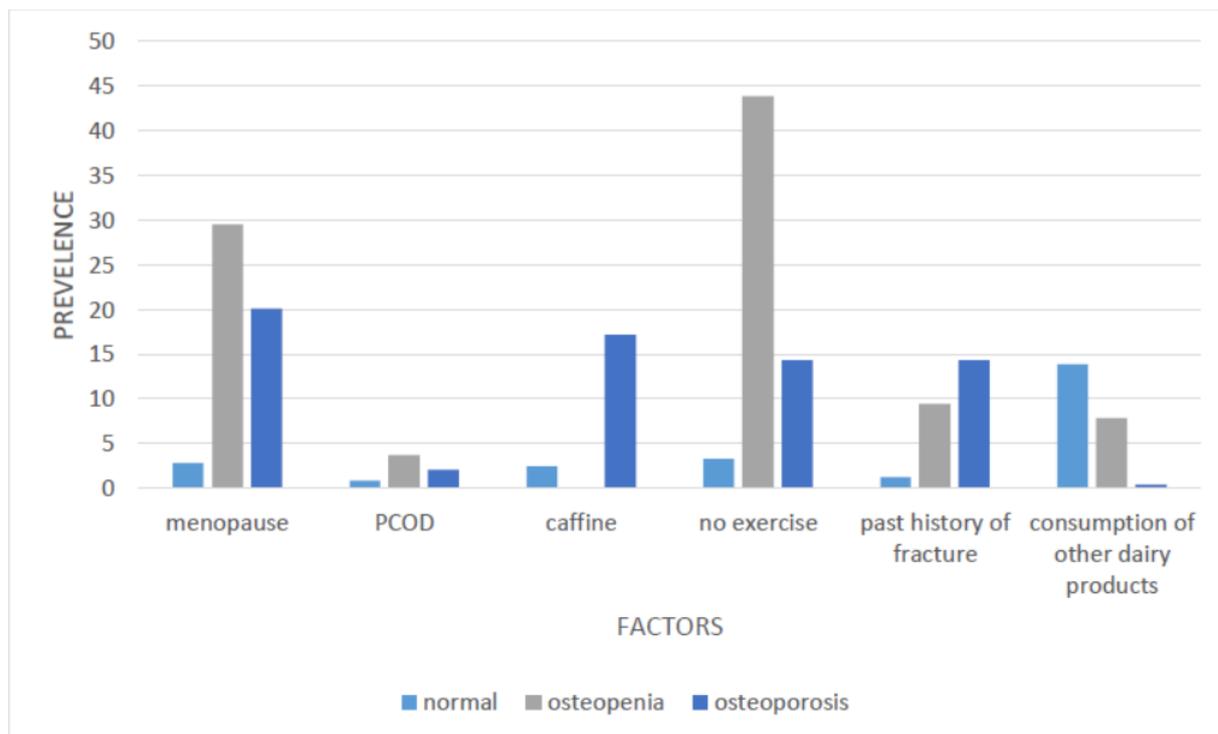
| Factors                             | PREVALENCE |      |            |        |              |        |
|-------------------------------------|------------|------|------------|--------|--------------|--------|
|                                     | Normal     |      | osteopenia |        | osteoporosis |        |
|                                     | M          | F    | M          | F      | M            | F      |
| Smoking                             | 1.26       | NIL  | 22.16      | NIL    | 13.51        | NIL    |
| Alcohol                             | 1.26       | NIL  | 42.70      | NIL    | 11.89        | NIL    |
| Caffeine                            | 4.324      | 2.46 | 32.43      | 22.131 | 10.81        | 17.213 |
| Menopause                           | NA         | 2.87 | NA         | 29.508 | NA           | 20.081 |
| PCOD                                | NA         | 0.82 | NA         | 3.688  | NA           | 2.049  |
| Exercise                            | 16.21      | 3.27 | 42.70      | 43.85  | 7.567        | 14.344 |
| Past history of fracture            | 3.78       | 1.22 | 15.67      | 9.43   | 9.189        | 14.344 |
| Consumption of other dairy products | 13.51      | 13.9 | 1.62       | 7.79   | 1.621        |        |

Note: NA = Not Applicable

In case of female population, prevalence of menopausal condition (20.081) and caffeine (17.213) consumption is the highest factor for osteoporosis and the lowest factor being no consumption of dairy products (0.409).



**Figure 9a:** prevalence of risk factors in normal, osteopenia and osteoporosis in male patients



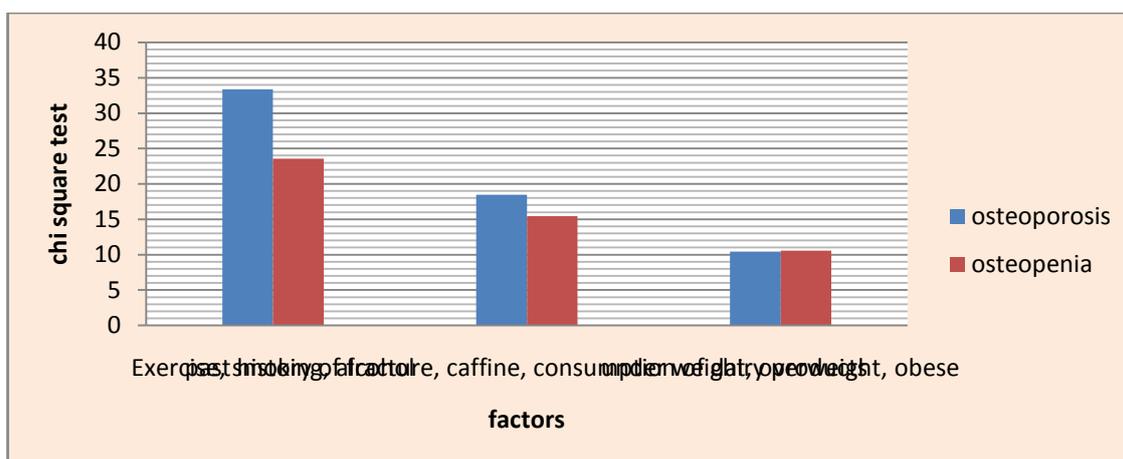
**Figure 9b:** prevalence of risk factors in normal, osteopenia and osteoporosis in female population

**Table 8:** shows male population, considering critical value 5.99 and degree of freedom (DF) for all the factors.

| Factors  | Chi square test value x2 |            | p- value     |            |
|--|--------------------------|------------|--------------|------------|
|  | osteoporosis             | osteopenia | osteoporosis | osteopenia |
| Exercise<br>Smoking<br>Alcohol                               | 33.367                   | 23.545     | <0.0001      | < 0.00001  |
| Past history of fracture<br>Caffeine<br>Other dairy products | 18.4527                  | 15.44      | <0.000101    | 0.000453   |
| Underweight<br>Over weight Obese                             | 10.4283                  | 10.567     | 0.005462     |            |

Note:  $P > 0.10$  not significant,  $P \leq 0.10$  marginally significant,  $P \leq 0.05$  significant,  $P \leq 0.01$  highly significant.

In case of male osteoporotic population chi square test tells that smoking is strongly associated with the disorder and high body mass index (BMI) i.e., is less associated with the disorder. In case of male osteopenic population exercise, smoking and alcohol is strongly associated and BMI is less associated. All the factors used in chi square test is statistically significant. (Table 8 fig 10)

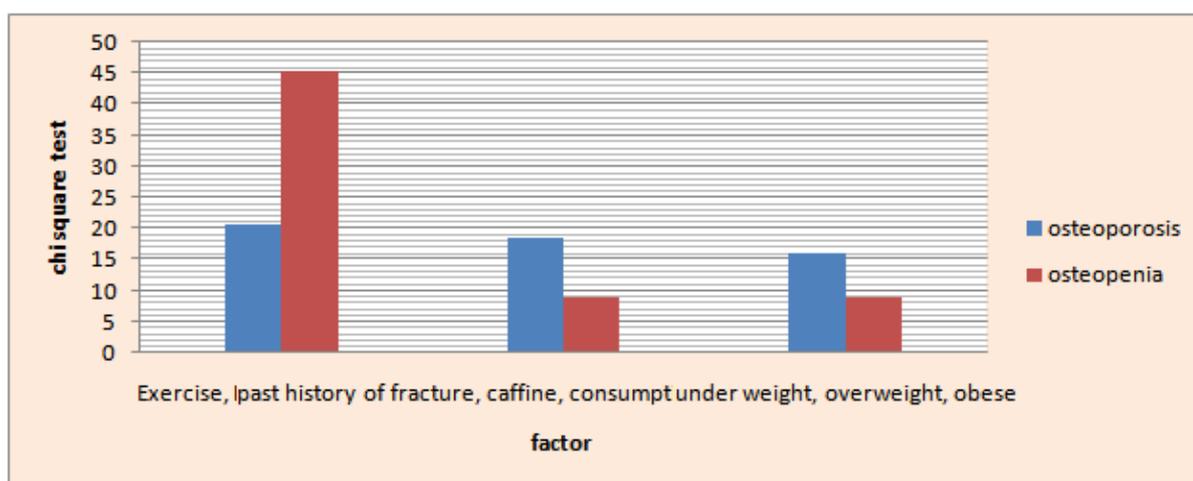


**Figure 10:** relation between factors and disorder in male population.

**Table 9:** shows for female population, considering critical value 5.99 and degree of freedom (DF) for all the factors.

| factors  | Chi square test value x2 |            | p- value     |            |
|--|--------------------------|------------|--------------|------------|
|  | osteoporosis             | osteopenia | osteoporosis | osteopenia |
| Menopause<br>PCOD<br>Exercise                                | 20.632                   | 45.36      | <0.001       | <0.00001   |
| Past history of fracture<br>Caffeine<br>Other dairy products | 18.44                    | 9.0695     | 0.000101     | 0.01073    |
| Underweight<br>Over weight Obese                             | 15.99                    | 8.826      | 0.000353     | 0.012277   |

Note:  $P > 0.10$  not significant,  $P \leq 0.10$  marginally significant,  $P \leq 0.05$  significant,  $P \leq 0.01$  highly significant.



**Figure 11:** relation between factors and disorder in female population.

In case of female osteoporotic population, chi square says that menopausal condition is more associated with the disorder and having lower bone mineral density is less associated with the disorder. In case of female osteopenic population, not regular exercising is the factor more associated with the disorder and having lower bone mineral density is less associated with the disorder. All the factors used in chi square test is statistically significant. (Table 9 fig 11)

#### IV. Discussion

**Prevalence:** The prevalence of osteoporosis is high in our city (Bangalore, Karnataka), in our study participants 26(14.05%) were osteoporotic, 116(62.70%) were osteopenic in male and 45(22.13%) were osteoporotic, 145(59.42%) were osteopenic in female and other studies conducted in our neighbouring states and our country showed similar result.<sup>[5,6]</sup> A preliminary survey done in India, reported that the prevalence of osteoporosis and osteopenia among Indian women at the age of 45 is 20.3% and 36.8% respectively and this prevalence increases to 100% after 65.<sup>[7,8]</sup>

**Age of the Participants:** In our study increasing age showed a positive association with osteoporosis, in both male and female highest number of osteoporotic were found to be in the age category above 60 years (table 1). Where -2.5T score was used as a threshold value for diagnosing osteoporosis as per WHO's classifications. In women aged between 25 – 30years (n=26), 9(34.61%), 16(61.53%), 1(3.84%) were found to be normal, osteopenic and osteoporotic respectively. And in age group of 41 – 50years showed to have highest osteoporotic/osteopenic i.e., (n=67), 18(17.24%), 49(73.13%), 11(16.14%) were found to be normal, osteopenic and osteoporotic respectively. While in men aged between 25 – 30years (n=3), 2(66.66%), 1(33.34%), 0(0%) were found to be normal, osteopenic and osteoporotic respectively. And in the age group of 61years and above showed (n=67), 13(19.40%), 42(62.68%), 13(19.40%) normal, osteopenic and osteoporotic respectively as shown in Table 1, as proved by other studies.<sup>[9]</sup> As age increases the bone becomes thinner, this decrease in bone mineral density with age is because of decreased kidney function, vitamin D deficiency, increase in the parathyroid hormone, decrease testosterone levels in male and decreased estrogen levels in females leading to decreased uptake and absorption of calcium from the system to the bone.<sup>[7,8]</sup> After the age of 65 years, there was an almost 100% incidence of either osteopenia or osteoporosis.<sup>[10]</sup> Risk for osteoporosis increases with age. Hui et al conducted a study on women and found that increasing age was predictive of increased fracture risk.<sup>[11,12]</sup>

**Sex:** Among our study population 185(43.12%) were male and 244(56.87%) were female. In male category 26(14.05%) were osteoporotic, 116(62.70%) were osteopenic, in female category 45(22.13%) were osteoporotic, 145(59.42%) were osteopenic were represented in fig. 2. In both osteopenic and osteoporotic condition, female's were more prone to osteoporosis and osteopenia than male's, which was similar to a study conducted Haris et al.<sup>[8]</sup> Osteoporosis is considered to be the disease of postmenopausal women, this perception persist because this disease manifest 10 years early in women than men. Additionally the mortality associated with these fragility fractures is three folds in men and two fold in women.<sup>[8,13]</sup> Thus this disease is equally important for male and female. However, the pubertal increase in BMD is more in men when compared to women due to a greater cross sectional area in view of increased periosteal apposition under the influence of androgens. Bone remodeling with aging leads to trabecular thinning in men, whereas trabecular connectivity is lost in women.<sup>[14]</sup> The reason behind the female population on upper hand in getting osteoporosis, is due to the menopausal condition, where there is an accelerated and rapid bone loss in women due to sudden decrease of estrogen level.

**Body Mass Index (BMI):** In case of male osteoporotic population 44.44% were underweight, 21.518% were normal, 7.79% were overweight and 0% were obese as shown in Table 4 and represented in fig.6. In case of female osteoporotic population 20% were underweight, 27.14% were normal, 24.75% were overweight and 19.12% were obese as shown in Table 5 and represented in fig.7. This shows that in male population with lower BMI was statistically significant risk factor to BMD.<sup>[12]</sup> In female population overweight was statistically significant risk factor to BMD.<sup>[8]</sup> This result is contrary to the previous studies in our country and male population study in which low BMI was a significant risk factor for osteoporosis.

A study by Ravn et al (1994) confirmed that low BMI constitutes a potential risk factor for osteoporosis. Sharon et al observed that BMD was closely associated with increasing quantities of each weight measures (total weight, BMI, lean mass, fat mass) and percentage of fat mass than with other body size measures (waist hip ratio, height). Similarly our study showed that obese and overweight women with high BMI are at higher risk for osteoporosis as compared to lean women.<sup>[15,16]</sup> Several studies have shown the positive correlation between BMI and BMD. An increase in body mass index had a significant impact on BMD. This is explained by a higher gravitational load on the femur neck, increased peak bone mass, and higher circulating estradiol level.<sup>[15,17]</sup>

**Menstrual Factors:** Primary osteoporosis results from estrogen deprivation and constitutes 95% of all cases. The mechanism of estrogen deprivation in bone mass is well describe in previous studies. Exposing by estrogen in longer time is associated with lower risk of osteoporosis. Thus menstrual factors such as late menarche age, early menopause, and amenorrhea have been shown as risk factors of osteoporosis in previous studies. Estrogen helps to regulate bone cells called osteoclasts, which are responsible for building new bone. When estrogen levels drop, fewer cells are produced and bone is lost, but not replaced. In our study there were 117(47.95%) women who were in pre- menopausal stage out of which 38(32.48%) were normal, 70(59.58%) were osteopenic, 9(7.69%) were osteoporotic and 127(52.05%) women were in post -menopausal stage out of which 7(5.51%) were normal, 71(55.9%) were osteopenic and 49(38.58%) were osteoporotic as shown in Table 6 and represented in fig. 8. Thus shows that the higher cases of osteoporosis were found in post- menopausal women having low estrogen levels. Menopausal condition and lower estrogen level was said to be the risk factor and was statistically significant. This was also supported by another study conducted by Neelam Agarwal et al that Out of 200 women studied, 106 were found to have low BMD (osteopenia and osteoporosis).<sup>[18]</sup>

**PCOD:** PCOD is a condition where the younger age female population are on the higher risk of osteoporosis due to the reduced amount of estrogen production. Both thin and obese women may develop PCOD. The relatively high prevalence of PCOD and its manifestation early in life render this disorder of particular importance in assessing the influence of androgens and androgen-estrogen balance on the attainment of maximal bone mass and subsequent development of osteoporosis later in life.<sup>[19]</sup> Our study involved 244 women, 16 were suffering from PCOD out of which 2 were normal 9, were osteopenic, and 5 were osteoporotic as shown in Table 3 and represented in fig. 5. The deleterious effect of estrogen deficiency on bones in PCOD is not balanced by androgen overproduction. A study conducted by Dalsky Gp et al revealed women with PCOD had significantly lower BMD of the lumbar spine.<sup>[20]</sup>

**Physical Activity and Exercise:** Exercises have been shown as a protective factor in both countries. Some forms of physical activity may maintain or even increase BMD in selected population.<sup>[21,22]</sup> Weight bearing exercise and muscle contraction combined have been shown to effectively increase bone density in the spine. It is recommended that an individual perform 20 to 30 minutes of aerobic exercise 3 to 4 times weekly to increase bone mass. Simple exercises such as walking can help strengthen bones and muscles there is strong evidence that physical activity begun early in life contributes to higher peak bone mass.<sup>[23]</sup> In a study conducted in Iran, on Iranian women with no regular walking were at higher risk of osteoporosis. There was no significant protective role in walking or the time and duration of walking in Indian subjects. Other kinds of exercises like aerobic, swimming, weight lifting and others have been shown as a protective factor in Iran.<sup>[24]</sup> Among our study participants 29.8% were not involved in physical activity on regular bases, rest were regularly or

occasionally working-out, out of which 37.5% were osteoporotic and 46.87% were osteopenic as shown in Table 2 and represented in fig. 4 for male and in Table 3 and represented in fig.5 for female. Thus this was a pertaining factor, related to osteoporosis and was statistically significant.

**Smoking:** Nicotine and toxins in cigarettes affect bone health from many angles. Cigarette smoke generates huge amount of free radicals that attack and overwhelm the body's natural defences. The result is a chain reaction of damaging the cells, organs and hormones involved in keeping the bone healthy.<sup>[25]</sup> Cigarette smoking is a risk factor for vertebral, forearm and hip fractures. Women who smoke enter menopause 1 to 2 years earlier and lose bone more rapidly than non- smokers.<sup>[22]</sup> In our study there were no female smokers. In case of male population there were 69 smokers out of which 3(4.34%) were normal, 41(59.42%) were osteopenic and 25(36.23%) were osteoporotic as shown in Table 2 and represented in fig. 4. This study approves that smoking is one of the strongest risk factor for osteoporosis and the study was highly statistically significant.

**Alcohol:** The exact mechanism by which alcohol influences bone density is not clear. Putative biological mechanisms for a beneficial effect of alcohol on bone density include increases in the concentration of serum estradiol.<sup>[26,27]</sup> and liver estrogen receptors.<sup>[28]</sup> However, it has been suggested regarding other beneficial effects of moderate alcohol consumption, the observed benefit may reflect confounding by unmeasured healthy behaviors.<sup>[29]</sup> Our study it is shown that men consuming alcohol on regular basis are on the higher part of the risk in getting osteoporosis. Almost all men who were alcoholic were osteoporotic or osteopenic, out of 104 alcoholic men, 3(2.88%), 79(75.96%), 20(19.23%) were normal, osteopenic and osteoporotic respectively as shown in Table 2 and represented in fig. 4. Alcohol being one of the risk factor for osteoporosis was statistically significant.

**Caffeine:** Caffeine leaches calcium from bones, sapping their strength. You lose about 6 milligrams of calcium for every 100 milligrams of caffeine ingested. Hallström et al.<sup>[30]</sup> reported that high coffee consumption, over 4 cups a day, had 4% lower BMD at the proximal femur compared with low or non-consumers of coffee in elderly men, but not in women. In this study there was a significant association between the high caffeine consumption osteoporosis in both male and female population, which is similar to the results from the investigation done by Helena Hallström. Our result is contrary to other results by other research journals, which says that there is no positive association between caffeine consumption and osteoporosis. Out of 88 caffeine consuming men, 8 were normal, 60 were osteopenic and 20 were osteoporotic as shown in table 2 and represented in fig. 4. Out of 102 caffeine consuming women, 6 were normal, 54 were osteopenic and 42 were osteoporotic as shown in table 3 and represented in fig. 5.

**Consumption of Dairy Products:** The role of nutrition is perhaps the most controversial area in the causation of Osteoporosis. Calcium, phosphate, and vitamin D are essential for normal bone structure and function, but several other micronutrients also have essential roles in bone mass. Non nutrients such as phytoestrogens may also improve the status of bone tissue.<sup>[31]</sup> To prevent negative calcium balance, premenopausal women require 1000 mg and postmenopausal women 1200 mg of total elemental calcium daily.<sup>[32]</sup> In our study, maximum study participants were not consuming dairy products regularly as this is one of the source of calcium in our daily diet and also not taking calcium and vitamin d supplement. Low calcium diet is also a factor for osteoporosis. Out of 144 men who did not consume sufficient dairy products, 25 were normal, 95 were osteopenic and 25 were osteoporotic (as shown in Table 2 and represented in fig. 4), similarly in 214 women, 34 were normal, 124 were osteopenic and 56 were osteoporotic (as shown in Table 3 and represented in fig. 5). It was statistically significant and the result was similar to study conducted by Keramat et al. which showed a protective role of regular consumption of cheese, milk, chicken, egg, fruit, tea 7 cups per day and more were found to be significant protective factors in Iran. Calcium supplementation more than 1 year and regular consumption of Soya, almond, fish, fruits and milk/tea 4 cups per day and more appeared to be significant protective factors in India.<sup>[33]</sup>

## V. Conclusion

The study revealed , low BMD and low T- Score has been demonstrated as an important predictor of future fracture risk both in men and women. Osteopenia patients can be treated prophylactically to prevent osteoporosis in future. We have also evaluated from this study the potential clinical risk factors related to osteoporosis.

Significant reduction in BMD was observed in elderly and in post menopausal women. In PCOD women, there was reduction in BMD and it was statistically significant.

Prevalence of Osteoporosis was more in women compared to men; in women having high BMI (overweight) and men having low BMI (underweight).

In individuals who do not regularly exercise, those who consumed alcohol and more amounts of caffeine and in smokers showed less BMD.

Patients having bone related complaints like past history of fracture, stooped posture, loss of height, back pain had less BMD.

Thus, identification of people at risk of osteoporosis by population based screening programmes and implementation of preventive strategies are the measures to improve health related quality of life and reduce the personal and economic burden of osteoporosis. Future prospective studies are therefore necessary to gather more accurate information in this regard.

We created widespread awareness regarding osteoporosis among the individuals who participated in the health camps which proved to be beneficial in helping them understand better about the disorder and its preventive measures

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