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Dietary Calcium intake status by Socioeconomic Strata in Peri and Postmenopausal Women of Mumbai, Hyderabad and Bidar- A Population Based Study

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Abstract:

The population-based research was undertaken to study dietary calcium intake per day in 620 perimenopausal and 590 post-menopausal women aged between 40 to 61 years across three socioeconomic strata (SES) in Mumbai, Hyderabad and Bidar. A multi-stage, stratified sampling design was used for the selection of the study population. Validated semi-quantitative food frequency questionnaire (SFFQ)was used to collect information on participant's frequency and quantity of food intake. The sociodemographic information including the SES was gathered using the Kupusamy questionnaire (2019). Descriptive statistics and One- way ANOVA test were conducted using SPSS version 20. A p - value less than 0.05 was considered significant.

The diet diversity score across the three cities ranged from 4.5 to 5.1 Mumbai (5.08), Hyderabad (4.5) and Bidar (4.9), moderate as per FAO (2010) criteria. A consistent decline in mean dietary calcium intake(mg)/ day was observed from high to low-income group in perimenopausal women [(Mumbai- upper socioeconomic strata=667.0±227.1, lower socioeconomic strata=366.3±106.4), (Hyderabad- upper socioeconomic strata=637.0±318.5 and lower socioeconomic strata=469.2±169.7), (Bidar- upper socioeconomic strata=496.8±170.4and lower socioeconomic strata=390.9±124.9)] and in post-menopausal women [(Mumbai- upper socioeconomic strata=551.6±144.1and lower socioeconomic strata=461.2±120.8), (Hyderabad- upper socioeconomic strata=577.5±180.3 and lower socioeconomic strata=458.6±256.6), (Bidar- upper socioeconomic strata=521.0±173.6 and lower socioeconomic strata=427.2±188.4)]. ANOVA test showed significant association in dietary calcium intakes between perimenopausal and post-menopausal women {Mumbai (f= 49.905, p=0.000), Hyderabad (f=3.854, p=0.022), Bidar (f=14.660, p=0.000)}. The association between the dietary calcium intakes and economic status was proved to be highly significant(p=<0.001). The mean dietary calcium intake(mg/day) of subjects in both the groups was found to be grossly deficient (Mumbai (542.4±221.1), Hyderabad (526.3±169.7) and Bidar (442.8±124.9) for perimenopausal women meeting only 70% of EAR and 55 % of RDA and (Mumbai (520.0±141.6), Hyderabad (505.5±129.8) and Bidar (495.4±169.4) for postmenopausal women and meeting only 50% of EAR and 44 % of RDA.

The study highlights the inadequate intake of calcium in the perimenopausal and post-menopausal women across all strata in TIER ONE and TIER TWO cities of different states in India. Hence, there is need for implementing a multifaceted approach to combat dietary calcium deficiency and promote better bone health and overall well-being in communities.

Index Terms: Dietary calcium, perimenopausal, post-menopausal, socioeconomic strata.

I. INTRODUCTION

Menopause and the postmenopausal periods are very important transition period in a woman's life since she will spend more than a third of her life during these periods without significant endogenous estrogen production. Menopause is a physiological process that takes place in all women who reach midlife. It brings about changes in women, and it has an implication for women's health [2]. Menopause is defined as the cessation of the menstrual period and is typically recognized after 12 consecutive months of amenorrhea. [15]. It has been observed the issues of Indian women include an early age of natural menopause, certain genetic causes, and environmental influences, nutritional deficiencies, malnutrition and overnutrition resulting in physiological differences. These factors lead to an increased incidence of noncommunicable diseases like diabetes, cardiovascular disease and osteoporosis, and thyroid dysfunction. Genetic components are important and play a prominent role in these disorders; for example, polymorphisms in estrogen receptors alpha and vitamin D receptors have been implicated in the pathogenesis of osteoporosis [14].

Post-menopausal osteoporosis is an impairment in the normal bone turnover cycle due to estrogen deficiency with a10% BMD reduction. [10] Bone mineral density (BMD) tends to decrease with age, thus primary osteoporosis mainly occurs in women 10–15 years after menopause and in men around 75–80 years old. [16.]. Estrogen-androgen -deficient post-menopausal osteoporosis (PMO) occurs in women within a few years of menopause from loss of trabecular bone tissue and cessation of ovarian production of estrogens. Clinical Practice Guidelines on Postmenopausal Osteoporosis: suggested that the osteoporosis is diagnosed when there is presence of fragility fracture (clinical or radiological) and/ or by bone mineral density (BMD), (T-score below or equal to −2.5) in a postmenopausal woman [13]. Osteoporosis is multifactorial condition. Besides genetic differences and endocrine factors, lifestyle behavior such as physical activity level and dietary composition, especially calcium intake, plays an important role in preventing osteoporosis.

The World Health Organization (WHO) identifies a relative lack of quantitative data from developing countries on the incidence and the prevalence of osteoporosis. It was reported that the prevalence of osteoporosis in India varies widely, ranging from 8% to 62% among women. This significant variation suggests regional and demographic differences in the prevalence of the condition. [9]. It was also reported that the risk of osteoporosis is higher in women than in men, and the prevalence increases with age.

Calcium is the most abundant mineral in the human body, which helps in the maintenance of strength and structure of bones and teeth, along with certain critical metabolic functions. Its deficiency can contribute to osteoporosis, a condition characterized by low bone mineral density (BMD) and increased susceptibility to fractures. [8]. One of the risk factors for bone loss, and the development of osteoporosis, is an inadequate dietary intake of nutrients important to bones. Adequate dietary calcium, protein as well as phosphorus and vitamin D play an active role in bone metabolism [1].

Dietary calcium intake plays a significant role in bone metabolism and bone health. To achieve genetically programmed peak bone mass, maintain skeletal muscle mass, and minimize age-related bone loss, it is essential to improve adequate dietary calcium intake in all age groups, particularly during early stages of life. In addition. the bioavailability of calcium from the diet is indeed a critical factor for the maintenance and development of bone. Even if individuals consume an adequate amount of calcium based on recommended dietary allowances (RDAs), if the calcium is not effectively absorbed by the body, it may not fully contribute to bone health. [3]. Low calcium has been found to be one of the risk factors for osteoporosis amongst Asian women [4]. Additionally, physical activity, and dietary patterns can influence bone health. Therefore, maintaining a balanced diet that includes adequate calcium along with other essential nutrients and engaging in regular weight-bearing exercise are key components of promoting and preserving bone mineral status.

The dietary calcium intake in Indian population is less than the RDA. Assessing the calcium intake of Indians would be important to identify individuals at risk so that appropriate intervention programs can be targeted. Thus, assessing the dietary calcium intake of the population is crucial for providing appropriate guidance and counseling on proper calcium intake. Conducting dietary surveys, such as semi-quantitative

food frequency questionnaires or 24-hour dietary recalls, can provide valuable information on the types and amounts of foods consumed by individuals within a population. The limited data on the population-based studies assessing dietary calcium intake among perimenopausal and post-menopausal women across different socioeconomic strata in India leads to the need for more comprehensive research in this area. By addressing the gaps in knowledge through more population-based studies, healthcare providers, and public health experts can develop targeted interventions and strategies to improve calcium intake and promote bone health among perimenopausal and post-menopausal women across different socioeconomic strata in India. This can contribute to reducing the burden of osteoporosis and related health issues in these populations. The present study aimed at assessing the dietary calcium intake of perimenopausal and post-menopausal women from different socioeconomic strata in Mumbai, Hyderabad and Bidar.

II.METHODOLOGY

The present study was designed to assess dietary calcium intake in perimenopausal and post-menopausal women from different socioeconomic strata in Mumbai, Hyderabad and Bidar.

Ethics approval

This study was approved by the Tanvir Hospital-Institutional Ethics Committee for Biomedical and Health Research, Hyderabad. The project was also approved by the District Health Office of Bidar and the Municipal administration Department Government of Telangana state,Hyderabad District.

Study Population

A total of 1210 perimenopausal and postmenopausal women from Mumbai, Hyderabad, and Bidar constituted the study sample.

Rationale for the selection of study sites (Mumbai, Hyderabad, Bidar):

India is a vast country with diverse cultural, social and dietary habits. The consumption of a variety of food groups in a given population has bearing on the nutritional outcomes in women's health. Dietary diversity plays an important role in determining whether a diet is nutritionally adequate. Thus, it is important to study variations in the dietary pattern observed in different regions of India. The rationale of the present study in selecting the study sites from different states of India as a multicentric study was to understand the difference in dietary pattern for the consumption of different food groups with a special 7 reference to calcium rich food (dairy and non-dairy) in the study population from TIER ONE city in two different states of India (Maharashtra, Telangana). The third study site was selected from and TIER TWO city in the state of Karnataka. An attempt was made to study the dietary pattern in TIER ONE and TIER TWO cities from different states of India. India is the largest producer of milk, but it has been found that inadequacy of calcium intake in the diet is attributed to a low intake of milk and milk products. Thus, it is imperative to understand the total calcium intake especially in perimenopausal and post-menopausal women who are at risk of osteoporosis from different regions of India in different TIER cities.

a.Sampling Method

A total of1210 households were screened by multistage stratified sampling procedure

Stage 1: The Ward/ Mandal / CD blocks of the city were selected by simple random sampling by from Mumbai, Hyderabad, and Bidar respectively.

Stage 2: The area was selected from ward/ Mandal /CD blocks by random sampling from Mumbai, Bidar, and Hyderabad respectively.

Stage 3: The location and premises of the city were selected with cluster sampling method.

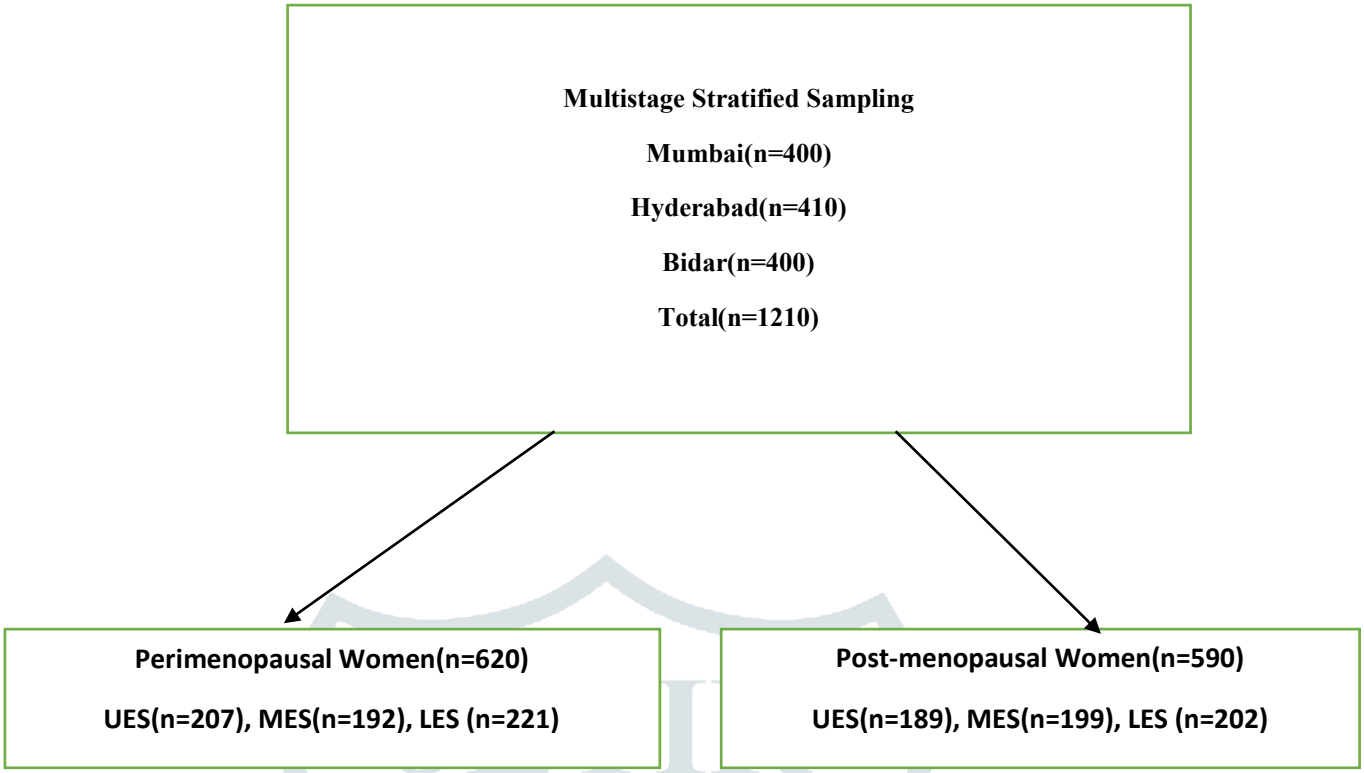

Figure 01. Sampling Method of the total population studied

{upper economic strata (UES), middle economic strata (MES) and lower Economic strata (LES)}.

The Sampling Method for Mumbai is appended below:

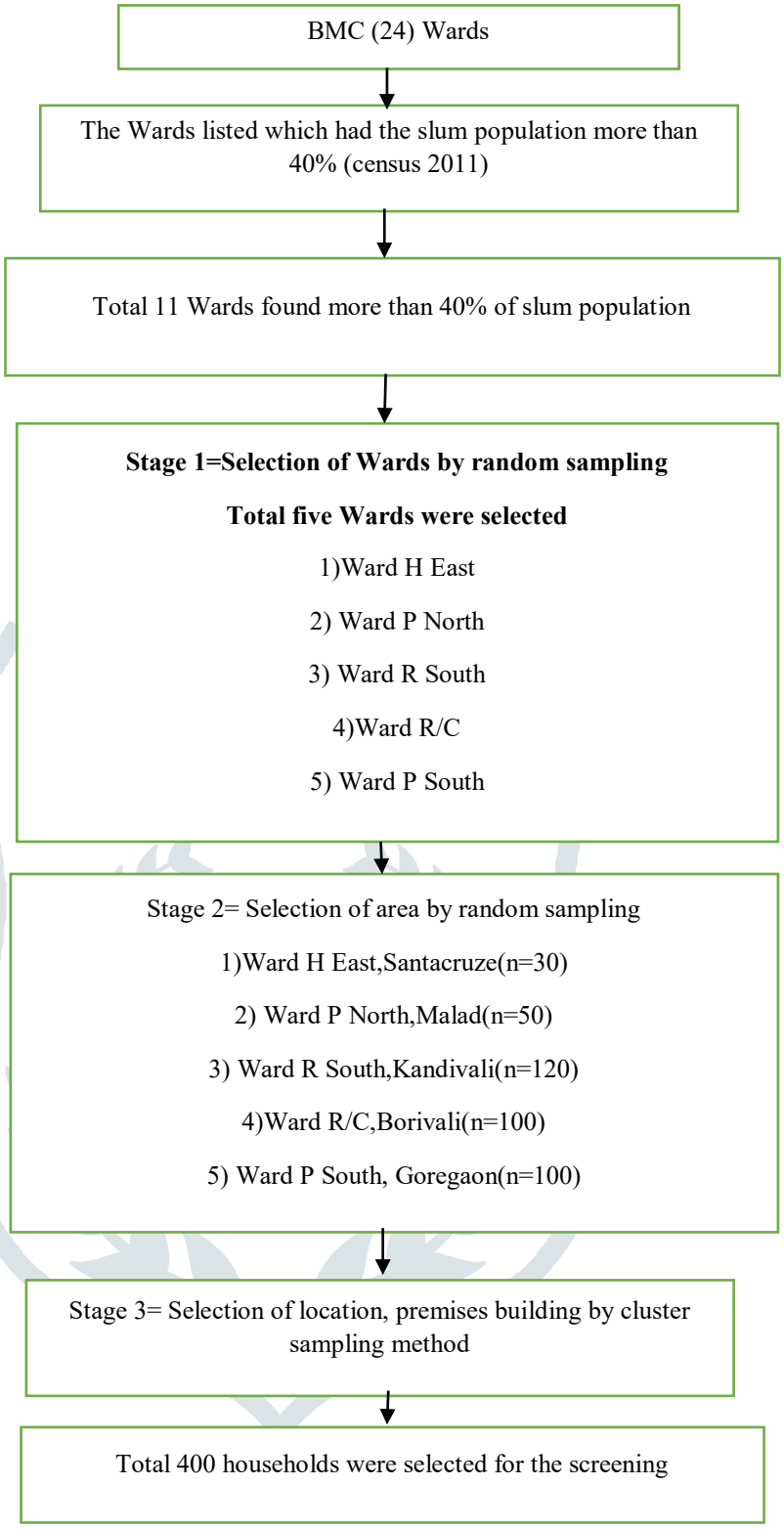

Figure 02. Sampling Method for Mumbai

According to the eligibility criteria from each of the mentioned selected area wards, locations, and buildings about 200 perimenopausal women and 200 postmenopausal women were selected for the survey.

The Sampling Method for Hyderabad is appended below:

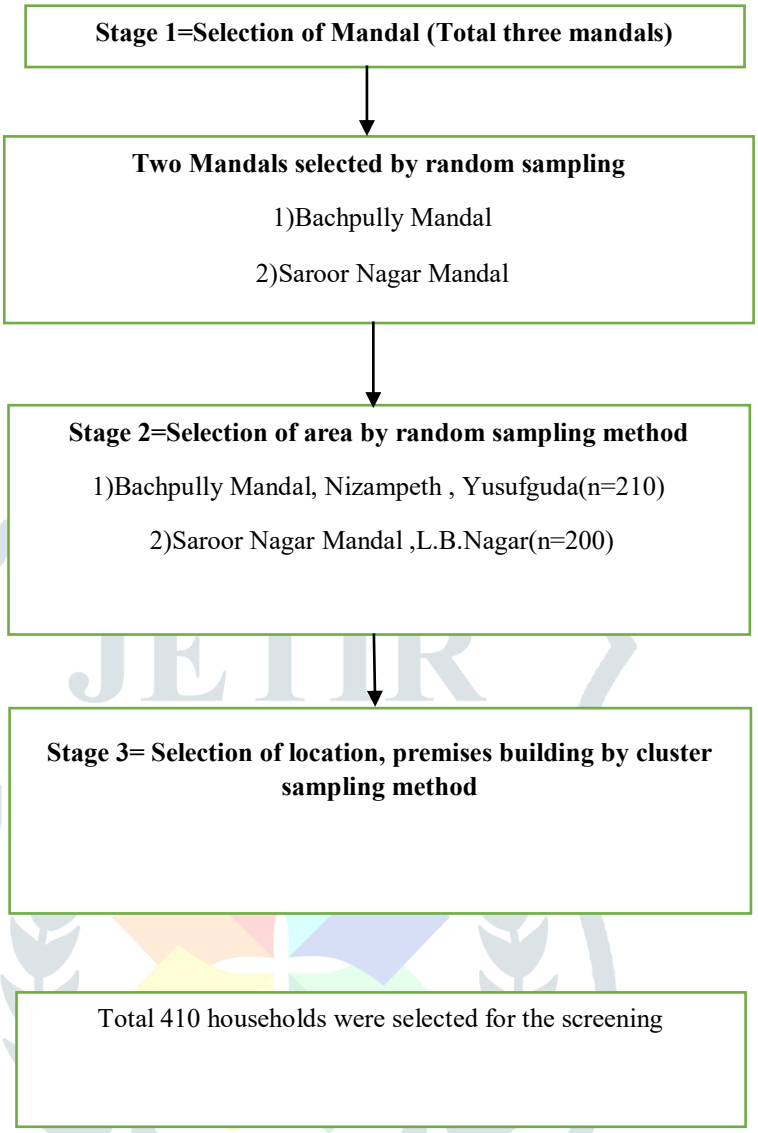

Figure 03. Sampling Method for Hyderabad

According to the eligibility criteria from each of the mentioned selected areas, locations, and buildings 210 perimenopausal women and 200 postmenopausal women were selected for the survey.

The Sampling Method for Bidar is appended below:

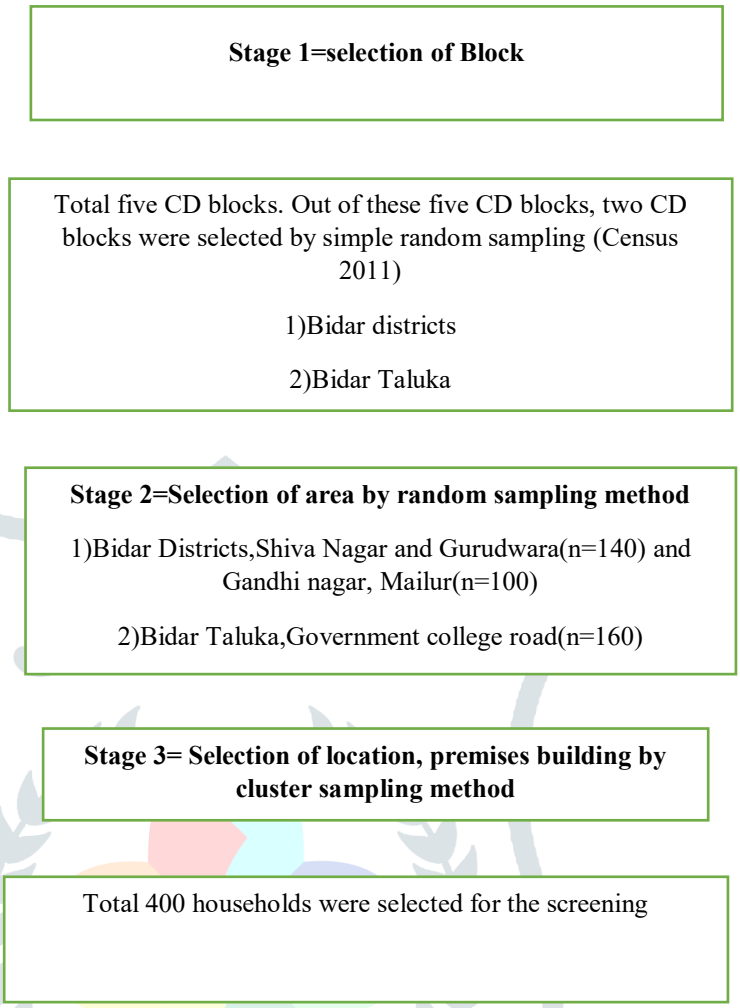

Figure 04. Sampling Method for Bidar

According to the eligibility criteria for each of the mentioned selected areas, locations, and buildings 214 perimenopausal women and 186 postmenopausal women were selected for the survey

Inclusion Criteria for Post-Menopausal Women

Women who have attained menopause that is amenorrhea more than twelve months

Age group 40-61 years

Exclusion Criteria for Post-Menopausal Women

Premature ovarian failure, post-menopausal bleeding

Use of systemic hormonal preparation in the 3 months - Oestrogen, Progesterone, Androgens, (Androstenedione, DHEA), and Testosterone, Tibolone, Hysterectomized women

Inclusion Criteria for Perimenopausal Women

Menstruating – regular or irregular-perimenopausal defined as their last menstrual period within the past year but not within the past 03 months.

Age group – 40 -61 years

Exclusion criteria for perimenopausal

Premature ovarian failure

Use of systemic hormonal preparations in the 03 months – Estrogens, Progesterone, Androgens (Androstenedione, DHEA), and Testosterone, Tibolone

Psychological disorders – Depression, Anxiety, Psychotic disorder hysterectomies women.

Data collection

All the participants of study population were explained the aims, objectives, and the details of the data collection. Consent was taken before data collection from the participants in English, Hindi, Marathi, Telugu, and Kannada language. The following research tools were used in the study. To validate tools, pilot study was conducted.

Research Tools:

1) The basic questionnaire included demographic information, a modified Kuppusamy questionnaire [19]. The demographic information questionnaire was designed to assess general information about the participants. Personal information for all women included information on age, religion, education, marital status, age at marriage, age of menopause, parity, addiction, dietary patterns, nature of work, and total annual income.

2)Dietary Assessment:

Dietary assessment was done by a Validated Semi-quantitative Food Frequency questionnaire [12] and a 24-hour (one day) dietary recall.

Qualitative data was collected using Semi-quantitative Food Frequency Questionnaire (SFFQ).

i. Semi-quantitative Food Frequency Questionnaire (SFFQ):

Validated semiquantitative Food Frequency Questionnaire (SFFQ) [12] was used to estimate the dietary calcium intake of perimenopausal and postmenopausal women. The SFFQ used in this study was adapted in style but revised by adding calcium content of food per 100gm. This validated developed food frequency questionnaire comprised of all the food groups that are rich in calcium per 100gm as well as small, medium, and large portion sizes was provided to the participant. The questionnaire also helped to bring information on the serving size at one time and the frequency of intake of calcium-rich foods. The investigator, a trained dietitian, administered the questionnaire.

Features of Validated Semi-quantitative food frequency questionnaire (SFFQ):

i)The Validated Semiquantitative food frequency questionnaire consisted of two hundred and eighty-six food items commonly consumed by Indians.

ii)The frequency of consumption was recorded as once in a week, twice a week, three times a week, four times a week, five times a week, six times a week and all seven days(daily). Food amounts converted to times/day. The amount of calcium intake was estimated from the portion size of each food consumed per day and multiplied by its calcium content. The calcium content of foods was obtained from the Indian food composition table 2017. The values were then summed up to obtain an estimate of an individual's total daily calcium intake.

iv)The amount/ quantity of recipes/ food items from all food group was also recorded as mentioned in the SFFQ list. Participants were asked to indicate food items in terms of the standardized cups / Vessels For roti, thepla, paratha, and bhakhri, the number and dimensions were recorded.

ii.Quantitative data was collected using 24-hour (one day) dietary recall ii. 24-hour (one day) dietary recall:

24-hour (one day) dietary recall was used to estimate the nutrient intakes of women in past 24 hour. In this method, the individual was asked to recall –in as much as possible of the food intake for the past 24 hours by interviewing the individual.

The dietary intakes were assessed in terms of cooked food with the help of standardized cups vessels, serving spoons, ladles, tablespoons katoris, and glasses plates. Different sizes of standardized cups and vessels, serving spoons, ladles, tablespoons, katoris, and glasses plates were selected to represent the sizes of vessels used in the household. These cups were used to help the respondents to easily recall the quantity

of the food consumed by her. For roti, thepla, paratha, and bhakhri, the number and dimensions were recorded. For ready-to-eat and processed items like Biscuits, and bread, the number consumed was recorded. These household measuring cups were first standardized in terms of volumes.

iii. Diet Diversity Score:

A one day 24-hour recall questionnaire was used to quantify the dietary intake in the study population. The diet diversity score questionnaire (FAO,2010) comprised of ten food groups. The dietary diversity scores consist of a simple count of food groups that an individual has consumed over the preceding 24 hours. The women participants were asked to mention all the foods (meals and snacks) eaten yesterday during the day and night. The responses were recorded as score. A dietary diversity scores then created, which was the sum of the different food groups consumed.

Assessment of Nutrient intakes:

b. Data Analysis:

All the collected data were recorded and coded on Microsoft Excel sheet. Statistical analysis was done by SPSS version 20. Descriptive data analysis was done by mean and SD. ANOVA (analysis of variance) and post hoc Bonferroni test was performed to check association of dietary calcium intake with socioeconomic strata in the population surveyed. A p - value less than 0.05 was considered significant.

III.RESULTS AND DISCUSSION:

a. Demographic details of the study population

The demographic details of the study population from all study sites (Mumbai, Hyderabad, and Bidar) are given in Table 01.

Table 01. Demographic details of the study population.

Characteristic	**Perimenopausal (n=620)**			**Postmenopausal (n=590)**		
	Mumbai (n=200)	**Hyderabad (n=206)**	**Bidar (n=214)**	**Mumbai (n=200)**	**Hyderabad (n=206)**	**Bidar (n=214)**
Age(years) Mean ±SD	43.5±3.1	43.6±4.4	42.4±4.3	55.4±4.8	51.7±6.0	52.4±4.3
Age of menopause Mean ±SD	-	-	-	46.1 ±8.0	45.2 ±6.0	44.9 ±5.4
Marital Status Married n (%)	186(93 %)	196(95.1 %)	206(95.8 %)	191(95.5 %)	154(75.5 %)	174(93.5 %)
Parity Two children, n (%)	78(39%)	117(56.8 %)	115(53.5 %)	154(77%)	100(49.9 %)	51(27.4%)
Three children n (%)	28(14%)	50(24.3%)	14(18.6 %)	9(4.5%)	44(21.1 %)	80(43%)

Religion						
Hindu, n (%)	171(85.5 %)	190(92.2 %)	107(49.8 %)	196(98%)	199(97.5 %)	109(58.6 %)
Muslim, n (%)	22(11%)	4(1.9%)	15(7.0%)	1(0.5%)	4(2%)	7(3.8%)
Sikh, n (%)	2(1.0%)	9(4.4%)	39(18.1 %)	2(1.0%)	1(0.5%)	21(11.3.%)
Dietary Pattern						
Vegetarian, n (%)	143(71.5 %)	26(12.6%)	83(38.6 %)	130(65.5 %)	12(5.9%)	50(21.3%)
Non-vegetarian n (%)	57(28.5 %)	180(87.4 %)	132(61.4 %)	67(33.5%)	192(94.1 %)	136(78.7 %)
Type of family						
Nuclear family, n (%)	146(73.3 %)	205(99.5 %)	210(97.7 %)	182(91%)	200(99.6 %)	183(98.4 %)
Joint family, n (%)	52(26%)	1(0.5%)	2(1.2%)	18((9%)	6(0.4%)	2(1.1%)
Total annual income						
39,033–78,062 n (%)						
29,200 –39,032 n (%)	100(50.5 %)	65(31.6%)	66(30.7 %)	66(33%)	60(29.4 %)	36(19.4%)
19,516–29,199 n (%)	21(10.5 %)	-	40(18.6 %)	66(33%)	63(30.9 %)	37(19.9%)
11,708–19,515n (%)	44(22%)	-	10(4.7%)	4(2%)	-	9(4.8%)
3,908–11,707 n (%)	5(2.5%)	81(39.9%)	27(12.6 %)	44(22%)	-	47(25.3%)
	8(4.0%)	-	22(10.2 %)	7(3.5%)	81(39.7 %)	7(3.8%)
Nature of work						
Homemaker, n (%)	110(55 %)	81(39.3%)	17(7.9%)	70(30.5%)	114(55.9 %)	27(7.9%)
Working, n (%)	86(43%)	125(60.7 %)	193(89.8 %)	130(65%)	89(43.6 %)	160(92.8 %)

Among the women studied, the mean age of perimenopausal was 43.5±3.1, 43.6±4.4, and 42.4±4.3 in Mumbai, Hyderabad, and Bidar respectively and the mean age of post-menopausal was 55.4±4.8, 51.7±6.0, and 52.4±4.3 in Mumbai, Hyderabad, and Bidar, respectively. The average age at menopause in post-menopausal women was 46.1 ±8.0, 45.2 ±6.0, and 44.9 ±5.4 in Mumbai, Hyderabad, and Bidar, respectively. The majority of participants from Hyderabad (perimenopausal =87.4%, post-menopausal=94.1%) and three- fourth of the participants from Bidar (perimenopausal =61.4%, post-menopausal=78.7%) were non-vegetarian, whereas only one- third of the participants from Mumbai (perimenopausal =28.5%, post-menopausal=33.5%) were non-vegetarian. For the nature of work-related perceptions, the majority of participants from Bidar (perimenopausal =89.8%, post-menopausal=92.8%) were working.

b. Study population distribution:

The total population surveyed was divided into two groups: perimenopausal (n=620) and post-menopausal (n=590) with three socioeconomic strata: upper economic strata (UES), middle economic strata (MES) and lower Economic strata (LES).

The distribution of socioeconomic strata in all study sites is appended below:

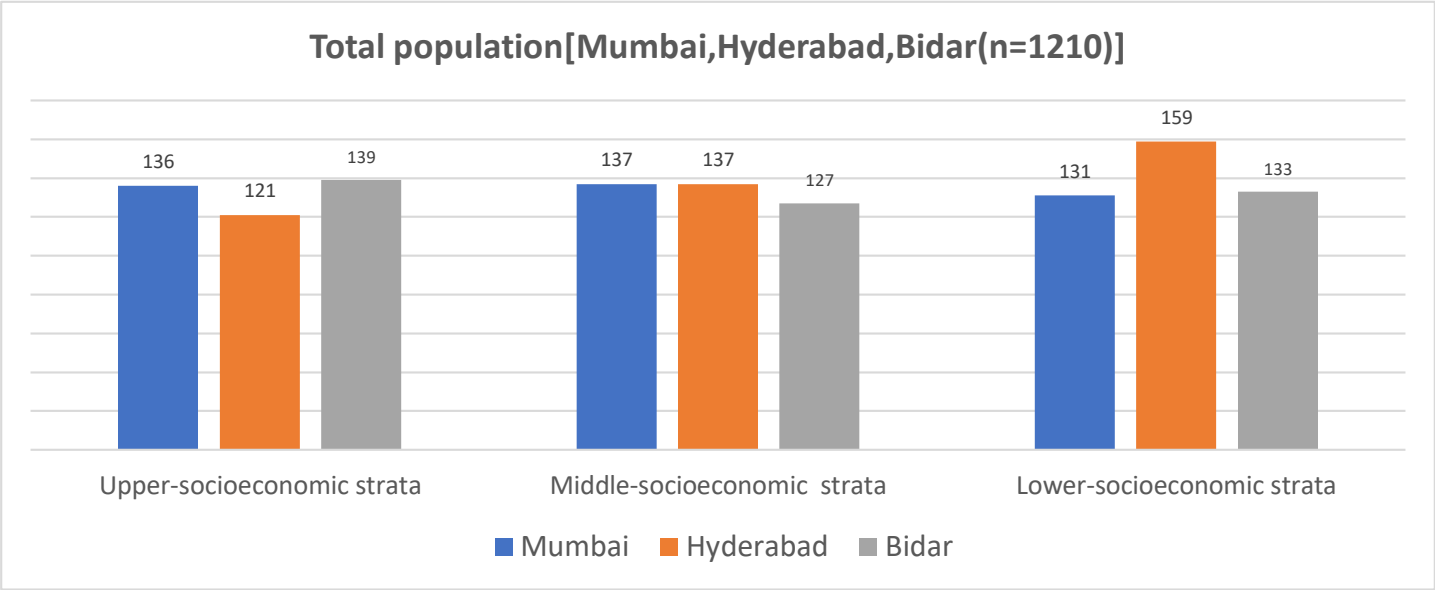

Figure 05. Distribution of socioeconomic strata in the total population surveyed.

Figure 05. depicts the distribution of number of participants from each socioeconomic strata (UES, MES, LES) in the population surveyed in Mumbai [(UES, n=136), (MES, n=137), (LES, n=131)], Hyderabad [(UES, n=121, MES, n=137, LES, n=159), and Bidar [(UES, n=139, MES, n=127, LES, n=133)].

c.Diet diversity score in the total population surveyed in all study sites (Mumbai, Hyderabad, Bidar).

In the present study, a one day 24-hour recall questionnaire was used to quantify the dietary intake in the study population.

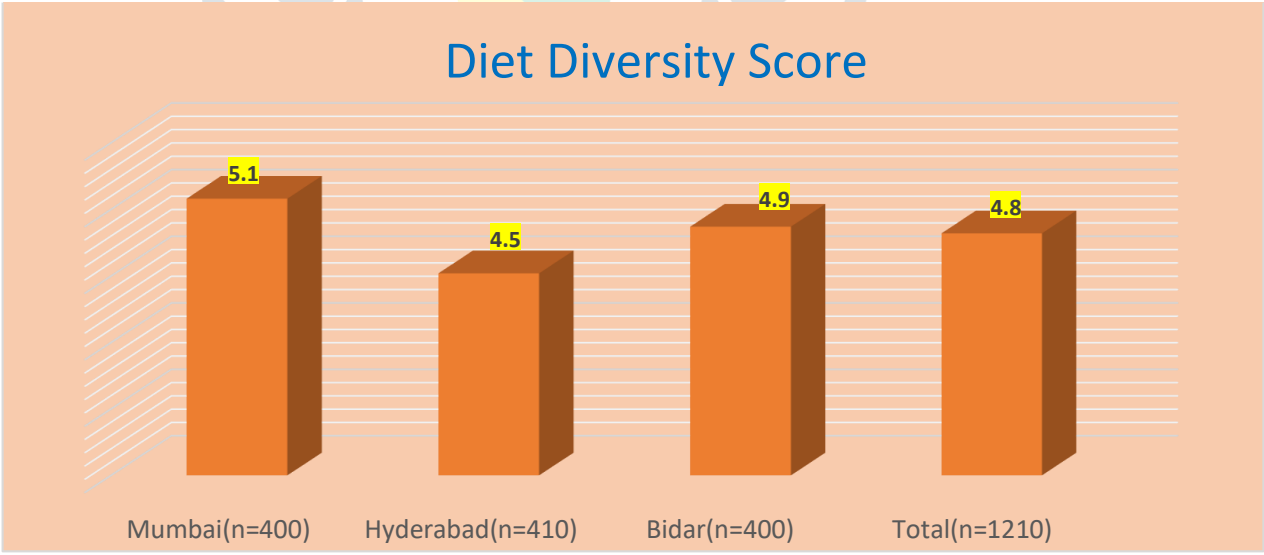

Figure 06 Diet diversity score in the total population surveyed

Figure 06 depicts the diet diversity score in perimenopausal and post-menopausal women in the population surveyed in Mumbai (5.08), Hyderabad (4.5) and Bidar (4.9) and total was (4.8).

The diet diversity score across the three cities ranged from 4.5 to 5.1 Mumbai (5.08), Hyderabad (4.5) and Bidar (4.9). As per the classification of diet diversity score (FAO,2010) the study population had the scores in moderate category.

d.Diet diversity score (FAO,2010) was calculated and statistically analysed by ANOVA and post-hoc Bonferroni method.

Table 02. Diet Diversity Score in the population surveyed.

Study sites	**Diet diversity score Mean±SD**	**F, p value**
Mumbai(n=400)	5.1±1.0	31.930, 3.1*
Hyderabad(n=410)	4.5±0.9	
Bidar(n=400)	4.8±0.9	
Total (n=1210)	4.8±1	

***Indicates statistical significance at (p<0.05)**

It was observed that diet diversity score in Mumbai was (5.1±1), Hyderabad (4.8±0.9) and Bidar (4.8±1.). No statistically significant difference was found in the diet diversity score in the population surveyed between cities, Mumbai, Hyderabad, and Bidar (F=31.930, p=3.1). Post-hoc Bonferroni revealed that there is significant association in diet diversity score between Mumbai and Bidar(p=0.009), Hyderabad and Bidar(p=0.000), whereas there is no significant association in diet diversity score between Mumbai and Hyderabad(p=1.8).

e. Mean calcium intake(mg) per day in the total population surveyed in all study sites (Mumbai, Hyderabad,Bidar).

The detail description of mean calcium(mg)/day intake across all socioeconomic strata in perimenopausal and post-menopausal women is described in the following (Table 03).

Table 03 Mean calcium intake (mg) per day in perimenopause and postmenopausal women across all three socioeconomic strata in the population surveyed.

Socioeconomic strata	Mean calcium intake(mg) per day in perimenopausal (n=620)			Mean calcium intake(mg) per day in post-menopausal (n=590)		
	Mean±SD					
	Mumbai (n=200)	Hyderabad (n=206)	Bidar (n=214)	Mumbai (n=200)	Hyderabad (n=204)	Bidar (n=184)
Upper	667.0±227.1	637.0±318.5	496.8±170.4	551.6±144.1	577.5±180.3	521.0±173.6
Middle	593.9±187.2	496.3±160.1	440.8±164.2	544.0±142.1	498.3±242.6	463.3±143.1
Lower	366.3±106.4	469.2±169.7	390.9±124.9	461.2±120.8	458.6±256.6	427.2±188.4
Total calcium intake(mg)/day	542.4±221.1	526.3±169.7	442.8±124.9	520.0±141.6	505.5±129.8	495.4±169.4

In the present study, it was observed that the mean dietary calcium intake(mg) per day across all socioeconomic strata (UES, MES, LES) in perimenopausal and post-menopausal group showed a consistent decline across all study sites (Mumbai, Hyderabad, Bidar).

The data showed limited use of calcium rich sources in the diet of both peri and postmenopausal women. Lack of awareness seems to be a factor for less use of the non-dairy foods which were rich sources of calcium and easily available.

Additionally, lower income group was accompanied by poor educational background of self and family which hampers their nutritional awareness regarding bone health. Lower income group restricts the purchasing capacity and forces the purchase and consumption of cheap available food. All these factors make the women from low-income group more vulnerable to be having less consumption of calcium rich food from milk and milk products.

A similar study on healthy adults from the suburban areas around Porur, Chennai between 40-60 years of age [7] also concluded using the same validated semi-quantitative food frequency questionnaire as that of the present study showed that low dietary calcium intake, 425.30±101.71 mg/day among males and 407.14±107.96 mg/day for females was prevailing in their study population also. The study also showed that dietary calcium intake was positively correlated with low socio-economic status.

On average, approximately 700 mg of calcium is lost from the body daily through various routes, including urine, feces (stools), bile, and sweat However, the body can adapt to low calcium intake by reducing excretion to maintain calcium balance. However, considering only 50% of bioavailability of dietary calcium sources [5], the inadequacy of calcium intake observed in this study, reveals that there is a there is a there is a deficit of 300-400mg/day calcium. This cumulative deficit would exert an adverse effect on the rate of bone accretion and hence increased the risk of fragile bone and osteoporosis risk in the study population.

f. One- way ANOVA was conducted for comparison of mean calcium intake (mg) per day in perimenopausal and postmenopausal women across all strata in the population surveyed in all study sites (Mumbai, Hyderabad, and Bidar).

Table 04. Association of mean calcium intake (mg) per day in perimenopausal and postmenopausal women across all strata in the population surveyed.

City	Mean calcium intake(mg) per day in perimenopausal (n=620)	Mean calcium intake(mg) per day in post-menopausal (n=590)	F, p value
	Socioeconomic strata (UES, MES, LES)	Socioeconomic strata (UES, MES, LES)	
	Mean±SD		
Mumbai	542.4±221.1	520.0±141.6	49.905, 0.000*
Hyderabad	526.3±169.7	505.5±129.8	3.854, 0.022*
Bidar	442.8±124.9	495.4±169.4	14.660, 0.000*

***Indicates statistical significance at (p<0.05)**

The data on mean calcium intake (mg/day) reflects that there was a decrease in mean calcium intake (mg/day) in perimenopausal and postmenopausal women across all strata in all study sites (Mumbai ,Hyderabad, Bidar).The findings of the present study indicate a statistically significant difference in mean dietary calcium intake (mg) per day in perimenopausal (Mumbai=542.4±221.1, Hyderabad=526.3±169.7, Bidar= 442.8±124.9 and post-menopausal (Mumbai=542.4±221.1, Hyderabad=526.3±169.7, Bidar= 442.8±124.9) across all strata in the population surveyed in (Mumbai,f=49.905, p=0.000,Hyderabad, f=3.854, p=0.022,Bidar ,f=14.660 ,p=0.000).

Similar findings were observed [(1)] where the calcium intake of subjects in both the groups was found to be grossly deficient (534.31±183.7 and 421.62 ±164.9 for perimenopausal and postmenopausal subjects respectively) and meeting only 50-60% of the requirement.

Further, post hoc Bonferroni test was conducted to know association of dietary calcium intake(mg) per day between socioeconomic group in the population surveyed in Mumbai, Hyderabad, Bidar.

Post hoc Bonferroni revealed statistically significant association (p=<0.001) in mean dietary calcium intake between upper income group and lower income group in all study sites (Mumbai, Hyderabad, Bidar), where (p<0.05) indicates the statistical significance.

Similar findings were observed [(6)] in the study that postmenopausal women belonging to upper income group had a higher intake of calcium and a significant protective effect against osteopenia/osteoporosis.

Table 05. Percentage EAR and RDA of calcium intake per day in perimenopause and postmenopausal women in the population surveyed.

	Mean calcium intake(mg) per day in perimenopausal (n=620) Mean±SD			**Mean calcium intake(mg) per day per day in in post-menopausal (n=590) Mean±SD**		
	Mumbai (n=200)	**Hyderabad (n=206)**	**Bidar n= (214)**	**Mumbai (n=200)**	**Hyderabad (n=206)**	**Bidar (n=184)**
Mean±SD						
Mean± SD	547.4±221.1	526.3±112.7	442.8±169.4	520.0±141.6	505.5±129.8	495.4±169.4
EAR (800mg)				**EAR (1000mg)**		
% Of EAR	68.4%	65.7%	55.3%	52%	48.4%	49.5%
RDA (1000mg)				**RDA (1200mg)**		
% Of RDA	54.7%	52.6%	44.2%	43.3%	40.3%	41.2%

Overall, mean dietary calcium intake (mg)/day in perimenopausal (Mumbai=542.4±221.1, Hyderabad=526.3±169.7, Bidar= 442.8±124.9) was approximately, 70% of EAR and 55 % of RDA. and post-menopausal (Mumbai=542.4±221.1, Hyderabad=526.3±169.7, Bidar= 442.8±124.9)] was approximately, 50% of EAR and 44 % of RDA.

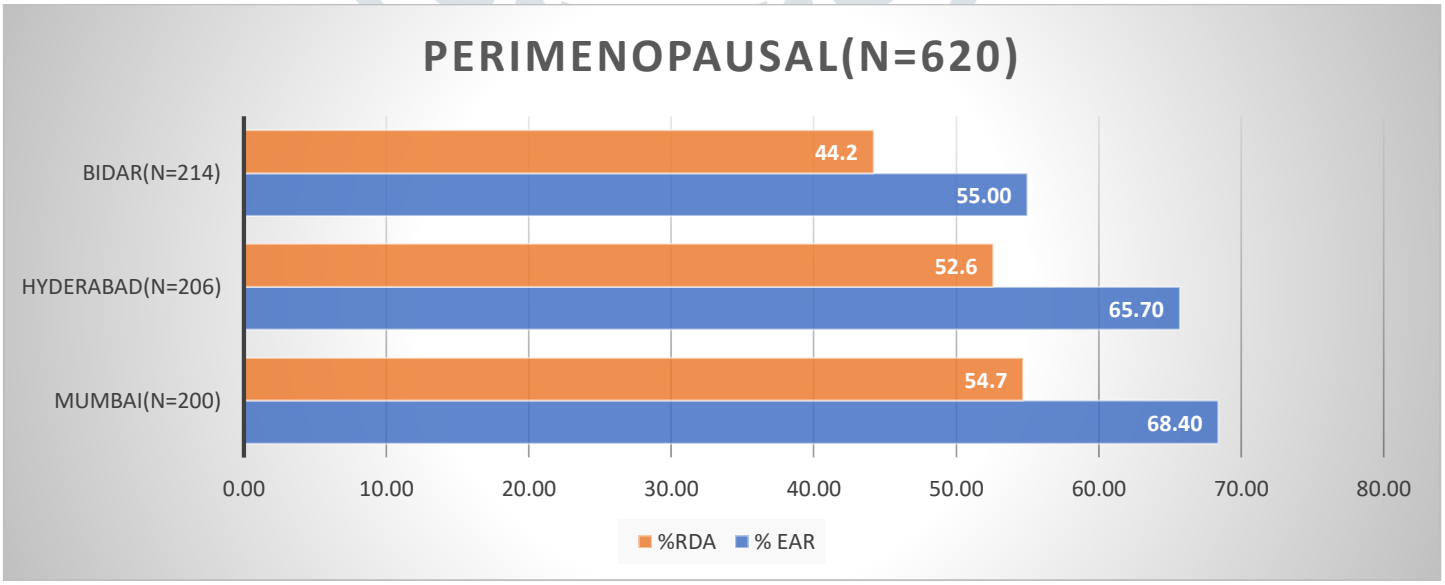

Figure 07. Percentage EAR and RDA of calcium intake per day in perimenopausal women in the population surveyed.

Figure 07. depicts mean dietary calcium intake (mg)/day in perimenopausal (Mumbai=542.4mg, Hyderabad=526.3mg, Bidar= 442.8mg) was 68.4%, 65.7% and 55 % of EAR in Mumbai, Hyderabad and Bidar respectively

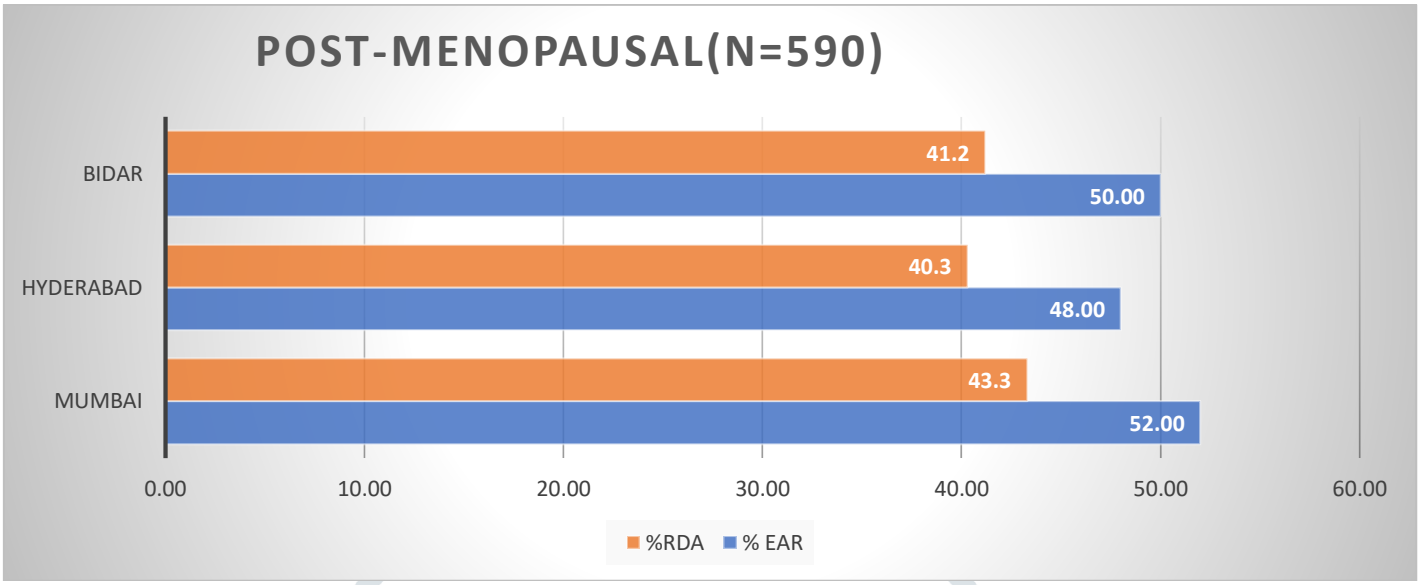

Figure 08. Percentage EAR and RDA of calcium intake per day in postmenopausal women in the population surveyed

Figure 08. depicts mean dietary calcium intake (mg)/day in perimenopausal (Mumbai=542.4mg, Hyderabad=526.3mg, Bidar= 442.8mg) was 68.4%, 65.7% and 55 % of EAR in Mumbai, Hyderabad and Bidar respectively

Similar findings were observed in a study [8] in Tamil Nadu, India on 106 postmenopausal women suggested that the average DCI of 632.72 ± 28.23 mg/day was below the RDA for calcium, with 74.5% of postmenopausal women in this South Indian city having dietary deficiency of calcium. This supports the need for increased education regarding dietary calcium during the peri-menopausal and post-menopausal period to prevent morbidity and mortality associated with osteoporosis and other disorders associated with calcium deficiency.

IV. Conclusion:

The observations in the present study indicate that dietary calcium deficiency is more predominant in postmenopausal women of lower socioeconomic strata. However, the study findings highlight inadequacy of calcium intake among both peri and post-menopausal women in TIER ONE and TIER TWO cities of different states in India (Mumbai, Hyderabad, Bidar). The mean dietary calcium intake(mg/day) of subjects in both the groups was found to be grossly deficient (Mumbai (542.4±221.1), Hyderabad (526.3±169.7) and Bidar (442.8±124.9) for perimenopausal women meeting only 70% of EAR and 55 % of RDA and (Mumbai (520.0±141.6), Hyderabad (505.5±129.8) and Bidar (495.4±169.4) for postmenopausal women and meeting only 50% of EAR and 44 % of RDA. The data shows that the calcium intake in perimenopausal and postmenopausal women of low socioeconomic strata was significantly lower than high socioeconomic strata. This could be attributed to a low diversity score especially in low socioeconomic strata in Two Tier cities. The dietary diversity score observed in different cities were Mumbai=5.1, Hyderabad=4.5 Bidar=4.9 respectively. The study highlights the need to focus targeted dietary intervention and nutrition education regarding locally and seasonally available calcium rich sources in combinations of food preparations which favours calcium absorption. Lower income group consume fewer dairy sources as they are expensive. Dairy products are important natural sources of dietary calcium and are valued for their ability to provide high levels of absorbable calcium in a single serving. Women from lower socioeconomic strata should be encouraged to consume restricted amounts of dairy product especially curds (one serving per day) along with non-dairy calcium rich sources which are less expensive and affordable such as ragi, amaranth flour, sesame seeds, horse gram, cluster beans etc. These food sources can be subjected to processing like soaking, roasting, germination and fermentation to improve calcium availability.

V.Study limitation:

It was a population-based study and thus scope of intervention was limited due to constraints of funding and time. The study did not use any therapeutic measures.

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