ABSTRACT

Elderly, being biologically a vulnerable segment of population requires multiple attention and care; if that remained unreached results in elderly infirmities and extremely challenged health and quality of life. In congruence, the growing number of geriatric population and altering way of life with urbanization are steadily putting a pressure not only on health and quality of life but also on environmental and nutritional requirements. Collectively they result in nutritional deficiencies and in due course contributing to elderly lifestyle diseases. Among all, osteoporosis is desperate enough to wear the crown of being a prime cause of mortality amongst elderly. Osteoporosis develops silently and can wreak havoc if not diagnosed on time and medicated for. In India millions are in clutch of osteoporosis and a surprising proportion of them are not even receiving proper treatment. Such an enormous public health problem is influenced by actually a few very common factors, such as low calcium intake coupled with an extensive prevalence of vitamin D deficiency, inactivity, increasing life expectancy, poor analytical services, early menopause, gender, genetics, poor knowledge of bone health care and avoidance of sun exposure etc. and India possesses unfortunately most of them as risk factors. In India the steadily rising number of elderly population and coexisting vital risk factors together pave a way forward to investigate the magnitude of osteoporosis amongst Indian elderly.

In the current scenario, evidences have favoured the fact that calcium and vitamin D play an important role in osteoporosis and since long Ca and vitamin D have been supplemented to the elderly to improve osteoporosis, however, without addressing the risk factors, especially the non modifiable ones, such as gender, age etc. Besides, very often the long supplementation period tends to terminate the treatment and incompliance makes the supplementation less effective. Also, the unpopularity of strategic treatment to restore the loss of Ca and vitamin D which has already been taken place as the first step, then prevention of further bone loss and rebuild the BMD as second step paves another way to explore strategic supplementation.

The study was formulated with two phases. Phase I consisted screening of 1056 elderly population from five zones of urban Vadodara by organizing BMD

camps. Baseline data collection was comprised of general background, socioeconomic status, physical activity, anthropometry, biophysical profile, dietary and morbidity profile etc. Phase II included 222 elderly subjects suffering from either of osteoporosis and osteopenia and either of vitamin D insufficiency and deficiency. Serum calcium and vitamin D, hemoglobin estimation and physical endurance were addition to the baseline parameters in this phase. Anemia was also assessed as a new immerging domain which is making its connection stronger with osteoporosis. 222 subjects were then divided into four small groups according to the supplemental regime. Group A (n=59) received 1000 mg Ca couple with 500 IU vitamin D/day for 6 months. Group B (n=63) received 1000 mg Ca couple with 2000 IU vitamin D/day for 6 months, group C_1 (n=50) received 1000 mg and Ca 500 IU vitamin D/day couple with daily weight bearing exercise for 3 months, and lastly group C_2 (n=50) received 1000 mg Ca couple with 500 IU vitamin D/day for 3 months without weight bearing exercise. A preliminary mega dose of 600000 IU vitamin D_3/week for two months was supplemented to all four groups. All the parameters assessed at the beginning were reassessed as post interventional data.

In results section subjects are presented BMD classification-wise, age-wise and gender- wise and an attempt was made to see their association with other parameters. A total of 1056 subjects with a mean age of 65.3±3.6 years were enrolled in the study; that comprised 419 (39.7%) males (67.7±7.1 years) and 637 (60.32%) females (63.7±2.6 years). Mean age of young elderly was 62.3 ± 3.32, old elderly was 73.5 ± 2.8 years and oldest elderly was 83.2 ± 3.3 years. BMD T-scores depicted that males had a mean BMD of -1.8±0.88 and females had a mean BMD of - 2.4±0.86. Osteopenia was prevalent among 59.42% males and 47.6% females (total 52.3%); osteoporosis among 23.2% males and 47.6% females (total 37.9%), and BMD was normal only among 17.42% males and 4.9% females (total 9.84%). Age-wise classification depicted that osteoporosis was prevalent among 37.08% subjects in young elderly, 40.78% in old elderly and 39.02% in oldest elderly (P- value 0.01*). Magnitude of osteoporosis significantly increased with age prominently amongst females (p-<0.001).

Other parameters like mean per capita income (p - <0.01) and low socioeconomic status (p - <0.01) were found to be associated with poor bone health. Also,

osteopenia and osteoporosis was significantly less prevalent among the elderly who were working (p - <0.05).

Data regarding physical activity showed that the mean time spent after exercise and yoga was significantly less among the subjects with osteopenia (p - <0.05) and followed by osteoporosis (p - <0.01) and normal BMD.

Parameters to assess nutritional status and their association with BMD described height as a possible risk factor. Osteopenia and osteoporotic subjects presented themselves with significantly less mean height, high hip circumference and WHR (p - <0.001). Moreover, only 33.7% males and 49.3% females could show a consumption of 51- 75% RDA of Ca.

Data on chronic diseases showed 60% males had diabetes. Only 14.4% subjects had normal systolic BP and a high percentage of subjects i.e. 58.61% were laying in the systolic pre-hypertension stage.

Intervention data showed that group B achieved the uppermost significant improvement in mean BMD T-score (-0.97 ± 0.44), increase in both mean serum Ca (10.21 ± 0.48 mg/dl) and vitamin D (42.73 ± 8.99 ng/ml) compared to group A (-1.20 ± 0.72), (10.06 ± 0.55 mg/dl) and (35.90 ± 8.94 ng/ml), respectively. However, both pre and post serum Ca were in normal range. Also, group C_1 efficiency in improving the mean BMD (pre: -2.39 ± 0.49, post: -1.86 ± 0.62), increase in both mean serum Ca (0.29 ± 0.44 mg/dl) and vitamin D (14.86 ± 7.89 ng/ml) compared to group C_2 (BMD pre: -2.42 ± 0.55, post: -2.13 ± 0.61; Ca: 0.20 ± 0.36 mg/dl and vitamin D: 9.41 ± 13.53 ng/ml).

After the intervention, in group A 50.79% subjects shifted to normal BMD category and 33.34% moved out of the osteoporotic category. In group B, 54.24% subjects achieved normal BMD and 40.68% moved out of osteoporotic category. In group C_1, 38% osteoporotic subjects shifted to osteopenic and normal category. In group C_2, only 6% subjects could achieve normal BMD. Post interventional serum vitamin D showed 74.60% and 25.4% subjects in group A, 89.83% and 10.17% in group B, 78% and 12% in group C_1 and 26% and 32% in group C_2 attained normal and insufficiency levels of serum vitamin D. Besides, female participants achieved higher change (post - pre) in mean BMD in all four groups; however it was significant in group A (p - <0.01) and B (p - <0.01). Age-wise division showed young elderly subjects responded more efficiently to the high daily dose of Ca and vitamin D to raise serum vitamin D levels and

percentage shift of subjects from deficiency to normal levels. Gender-wise evaluation of post interventional mean scores illustrated that supplementation coupled with exercise amplified the mean scores of grip strength ($p - <0.01$) and walking speed ($p - <0.05$) significantly more in male subjects. High dose or low dose coupled with exercise or alone could not show any exceptionally varied efficacy on serum vitamin D level of the old elderly subjects.

Hence, the bottom line from this phase of study establishes that the high dose of Ca and vitamin D_3 coupled with mega dose of vitamin D_3, is recommended if a quick treatment is required and if constrictions for exercise are there. Whereas, a low dose coupled with weight bearing exercises is recommended for a long term therapy. However, in both the cases an initial mega dose of vitamin D is recommended. Moreover, a low dose for short tenure without weight bearing exercise is not as efficient as the high dose (short tenure) or low dose with exercise (long tenure) to improve serum vitamin D level of elderly.