CHAPTER-6
SUMMARY AND CONCLUSIONS

The present study has been attempted with a view to examine cross-sectionally the age related changes in body composition and bone mineral density among Rural and Urban Bania females of District Panchkula. A total sample of 723 Bania females (Rural = 248, Urban = 475) ranging in age from 30 to 70 years and residing in rural and urban areas of District Panchkula, was collected using purposeful sampling method. Rural sample was selected from villages namely, Shyamtu, Rattewali, Kot, Bhanu, Ramgarh, Barwala, Raipur Rani, Morni, Mallah, Toda and Mauli. Urban sample was selected from the urban towns of Panchkula, Kalka and Pinjore, collectively.

Age in years was obtained from date of birth which most of the urban females could recall and also provide a documentary proof of the same in the form of aadhar card, voter ID, etc, where as in rural females age had to be ascertained in majority of cases by association with some important event like age at marriage, age at first child birth, any important festival, etc. With this cross-questioning, it was possible to ascertain nearly the correct age of the subject.

The data were arranged in eight age groups, each of five years duration except for first age group, which is of six year duration for both rural and urban Bania females, using decimal age calendar given by Tanner et al. (1966). Field work was conducted in different phases from year 2013 to 2014, covering the rural and urban areas of District Panchkula separately.

The data were collected using personal interviews, by taking relevant anthropometric measurements and by measuring bone density. Before the data collection the entire questionnaire was explained in Hindi language to the subjects with the aims and objectives of the study. The procedure for data collections was also explained to them. An informed consent duly signed by the subject was taken before obtaining the data.

A total of four anthropometric measurements namely height, weight, waist circumference and hip circumference were taken on each subject using standard techniques given by Weiner & Lourie (1981). Percent body fat, visceral fat and Basal
metabolic rate (BMR) of each subject was measured with the help of body fat analyser (Omron HBF 302-Japanese Model) based on the bioelectrical impedance method. Besides anthropometric measurements two physiological variables namely, systolic and diastolic blood pressure and pulse rate were also measured using the oscillometric method based digital OMRON Automatic Blood Pressure Monitor MX3 recommended by World Hypertension League. Additional information was obtained on age, caste, sub-caste, family composition, educational status, occupational status, income, place of birth, parity and reproductive history using interview based schedule. The age at menarche among the subjects was calculated using retrospective or recall method. The determination of age at menopause was done using status quo and retrospective methods.

The women were inquired about the continuation or the cessation of menstrual cycle to analyse reproductive senescence, i.e., menopause. Women who had either attained menopause (had no menstruation in the last twelve months) were categorised as postmenopausal and perimenopausal women were those who were passing through the phase to attain menopause. The third category of females were premenopausal i.e. those females who were experiencing their regular menstruation. The subjects were also inquired about the menopausal symptoms experienced by them. The reproductive history, involvement in any type of physical activity, sun exposure, diet preferences, etc. was also recorded for each subject.

The prevalence of menopausal symptoms among subjects was recorded based on a list of menopausal symptoms constituting 11 items, used by Jahanfar and associates (2006) for a study in Malaysia and subsequently recommended by Indian Menopausal Society (Singh, 2007). The symptoms which were experienced by any individual were further classified according to degree of severity as mild, moderate and severe.

Derived indices included body mass index, fat mass index, fat free mass index, waist height ratio, waist hip ratio, conicity index, Body adiposity index and A body shape index.

Bone mineral density of each subject was assessed from the calcaneus using ultrasound based Bone densitometer McCue C.U.B.A. Clinical, a dry ultrasound sonometer which is designed to perform a subject’s measurement in less than 1 minute. It does not produce ionising radiations and operates on the voltage of 90-
240V. It is indeed very easy to operate and completely safe to use on a subject without any side effects. The measurements obtained on the densitometer based on the already existing normative data based on Caucasian population standards include:

a) **Separation** which determines the width of the heel (in mm).

b) **BUA (broadband ultrasound attenuation)** that determines the complexity of bone structure.

c) **% expected** determines the comparative ultrasound analysis with respect to age matched normal mean.

d) **BUA Z-score** of individual gives the number of population standard deviations away from population mean for particular age.

e) **BUA T-score** of individual gives the deviation at peak bone mass (young normal aged 20).

Results of the present study clearly show that mean values for weight among rural and urban females demonstrated an initial general trend of increase till age group 41-45 in rural as well as urban females followed by a declining trend after 60 years of age. t-values did not demonstrate any significant differences between their weights at any age group. The overall decline in weight from initial age group till last age group was 10.06% in rural and 3.19% in urban females. Both rural and urban females exhibited a declining trend in height with advancing age. Urban females were taller than their rural counterparts but significant differences were obtained at age groups 36-40 and 56 through 65 only. The percentage decline in height in rural and urban females was 3.19% and 3.2% respectively.

Rural females had higher mean values for waist circumference as compared to urban females. Significant t-values for rural-urban differences were observed at age groups 30-35, 36-40, 51-55 and 61-65, respectively. Interestingly, urban Bania females revealed considerably higher percentage increase in waist circumference (12.09%) as compared to rural females (5.32%) with the advancing age. Hip circumferences increased till 45 years in rural females and upto 50 years among urban females, a declining trend is seen among rural females after 55 years and among urban females after 60 years. Urban females had the higher values for hip circumferences at all ages except for 30-35 years in comparison with rural females yet the significant t-values were observed only at age groups 46-50 and 61-65. Percentage decline of this
parameter was of higher magnitude in rural females (2.02%) than their urban counterparts (1.02%).

PBF depicted a general increasing age trend among rural females till age group 61-65 except for age group 46-50 and among urban females till age group 56-60, followed by a decrease in both the groups. The maximum value of 40.01% has been obtained at 61-65 years among rural females whereas urban females showed maximum value of 40.59% at age group 56-60. The increase in percentage body fat amounts to 3.35% among rural females and 5.80% among urban females. However, no significant differences were observed among rural-urban females for percentage body fat.

Visceral fat depicted a constant increase in mean values among rural females till the age of 61-65 years with a decrease observed at age groups 46-50 and 66-70. In case of urban females a similar trend of increase was noticed till the age of 56-60 years, followed by a decreasing trend thereafter. The values demonstrate that the visceral fat level rises considerably in females across the age groups amounting to net gain of 2.18 (20.15%) in rural females and 4.55 (35.46%) in urban females.

Fat mass exhibited a general trend of increase among rural Bania females till 55 years and in urban females upto 60 years with minor fluctuations in between followed by declining trend in both. The percent increase in fat mass through ages was observed to be 13.14% in urban females and rural females witnessed 3.17% decrease in fat mass. The t-values were found to be statistically non-significant at all age groups among rural and urban females. Both rural and urban females showed a general trend of decline in fat free mass with advancing age exhibiting non-significant differences between them. Rural females showed a net loss of 5.94 Kg and urban females witnessed only 0.17 Kg loss through ages.

Rural females demonstrated higher BMI values at almost all age groups except for age groups 46-50, 56-60 and 66-70, but there were no significant differences recorded at any of the age groups. The rural females depicted the highest BMI value at 41-45 years (30.33 kg/m²) while the urban sample demonstrated the highest value of BMI (30.64 kg/m²) at 46-50 years. Interestingly, the urban females added 3.71% to their BMI value through ages and among rural females BMI value reduced by 3.90%. Fat mass index demonstrated a regular increase with the advancing age groups. The rural-urban differences were observed to be non-significant at all age groups. Fat free mass
index exhibited an initial increasing trend followed by decreasing trend. The overall values of FFMI decreased through ages by 1.45 Kg/m² and 0.94 Kg/m² in rural and urban females, respectively. Rural and urban females did not reveal significant differences in this index at any age group.

Rural females attained significantly higher values of Waist height index than urban females at almost all ages with exceptions at age groups 46-50, 56-60 and 66-70. The value for this ratio exceeded 0.5 in both the groups of females. Rural females demonstrated significantly higher values of WHR at all ages in comparison with their urban counter parts as is evident from significant t-values at all ages. However, the magnitude of percentage increase was more in urban females (13.95%) as compared to their rural counter parts (8.42%). CI in present sample demonstrated an overall increasing trend with advancing age in the females belonging to rural and urban surroundings. Statistically significant differences were observed between the two groups of females at all ages except for age groups 46-50 and 56-60.

The values of BAI demonstrated a fluctuating trend in this index among rural females. The urban females showed an increasing trend till 46-50 years and a decreasing trend thereafter. The magnitude of percentage increase amounted to 3.93% (1.33) and 6.65% (2.19) in rural and urban sample, respectively. There were statistically significant differences observed at only 46-50 years of age among the two groups of females.

The rural females exhibited statistically significant higher ABSI values at all ages except for age groups of 46-50 and 56-60 in comparison with their urban counter parts. The magnitude of increase in this parameter amounted to 9.5% (0.0078) in rural females and 11.6% (0.0088) in urban females.

The results of one-way analysis of variance (ANOVA) on various anthropometric variables and derived indices demonstrated significant age differences for all the variables chosen in the total sample. Although, the urban females had significant age difference in all parameters but, the rural females did not show significant age differences in weight, hip circumference, fat mass, BMI, visceral fat, FMI, FFMI and BAI.
BMR in Bania females demonstrated a gradual decreasing trend in both samples of females with minor fluctuations. The net decrease amounted to 173.39 (13.52%) and 129.13 (10.12%) in rural and urban sample, respectively. The statistically significant differences in two groups of females were only noticed at 61-65 years.

A general trend of increase in systolic blood pressure was noticed among Bania females of both the groups. Mean values for systolic blood pressure in rural females were greater at all age groups in comparison with their urban counterparts. The two groups depicted significant differences at all ages except for the age groups of 36-40, 41-45 and 51-55. Diastolic blood pressure depicted an increase with age groups in Bania females, leading to a net gain of 6.81 mmHg (8.15%) and 5.08 mmHg (6.30%) in rural and urban females, respectively. Rural females depicted a higher mean values at all ages in comparison to urban counterparts and demonstrated statistically significant t-values at 56-60 years of age only. The rural females possessed higher values of pulse rate at all ages from 30 to 60 years but displayed lesser mean values than urban females in the last two age groups. However, the significant t-values for differences in two groups of females were observed only at age groups 30-35, 36-40 and 56-60.

The F-values for one-way analysis of variance (ANOVA) of the physiological parameters in the present sample demonstrated significant age differences in total sample for all parameters except pulse rate. On separate analysis of two groups the urban females recorded significant age changes for all parameters except DBP while rural females showed significant associations only for BMR and SBP.

The mean age of menarche fluctuated between 13 to 15 years for Bania females of District Panchkula. However, the mean age in rural females was found to be 14.83 ± 1.4 years and in urban females it was 14.30 ± 1.5 years. There existed statistically significant differences for age at menarche among urban and rural females with a t-value of 4.713 (p<0.05).

The mean age at natural menopause was calculated by retrospective or recall method (excluding hysterectomy, oophorectomy, and cessation of menstruation due to any treatment or medication). The mean ages of menopause were observed to be 45.98 ± 5.6 years in rural females and 47.50 ± 5.7 years in urban females. Evidently, the urban
females reported a later mean age at menopause in comparison to their rural counterparts as is shown by significant t-values (t = -2.351, p<0.01). However, the mean age at natural menopause as calculated in the total sample of 332 postmenopausal Bania females belonging to District Panchkula was 46.96 ± 5.7 years.

The probit analysis showed the median ages at menopause for urban females as 44.67 ± 0.03 years and for rural females as 44.67 ± 0.03 years. The median age for the total group of postmenopausal women was obtained as 43.65 ± 0.03 years. Therefore, there existed no significant rural-urban differences in median age at menopause.

The values of crude mean age at menopause (including cases of artificial menopause) among rural and urban females were found to be 44.78 ± 6.6 years and 47.15 ± 5.8 years respectively.

The mean age at natural menopause in relation with parity i.e. number of offspring reproduced by females demonstrated that with the increase in parity of a female the onset of menopause was delayed. The relation of mean age at menopause with education and age at menarche did not exhibit any significant association. Overweight and obese (III) females displayed later age at menopause as compared to their normal as well as obese (I & II) counterparts. Age at natural menopause when related with BMD categories showed a slightly later age at menopause for osteoporotic females as compared to normal females but osteopenic females had later age at menopause as compared to normal and osteoporotic females.

In the present study, menopausal status of females has been calculated on the basis of total sample by combining rural and urban females. The peri-menopausal females had highest values for all anthropometric and physiological measurements in comparison with other group of females except for height, PBF and SBP. Of all the groups, premenopausal women were found to be tallest, postmenopausal women displayed the highest values for PBF and SBP. Perimenopausal females exhibited highest values for body mass index, fat mass index, fat free mass index and body adiposity index. The one way analysis of variance (ANOVA) among the different groups of females based on their menopausal transitions exhibited statistically significant differences among three groups in all the anthropometric and physiological variables including derived indices except for pulse rate.
Summary and Conclusions

The age at menarche was also compared within different menopausal transitional groups of females and it was concluded that the presently menstruating females had an early menarche (14.19 years), followed by peri-menopausal group of females (14.59 years) and then postmenopausal group of females (14.70 years).

The menopausal symptoms were observed to be prevalent among 73% of rural females and 78.5% of urban females of present study. However, the degree of severity of prevalence varied in each group of females. The most severe cases prevalent in urban and rural females varied in the decreasing order of severity as given:

Rural = Fatigue & memory problems (31.9%) > Anxiety (29.8%) > Joint & Muscular discomfort (23.4%) > Bladder Problems (22.6%) > Sleep problems (Insomnia) (21.0%) > weight changes (20.2%) > Irritability (19.4%) > mood changes (18.5%) > physical & mental exhaustion (17.3%) > hot flushes & night sweats (16.5%) > Depression (13.3%) > heart discomfort (4.8%).

Urban = Anxiety (22.7%) > Joint & muscular discomfort (17.9%) > fatigue & memory problems (13.1%) > weight changes (12.0%) > physical & mental exhaustion along with hot flushes & night sweats (11.8%) > Bladder problems (10.5%) > Irritability (8.8%) > Sleep problems (6.7%) > Depression (6.1%) > Mood changes (5.7%) > Heart discomfort (2.7%).

Bone density of each subject in the present study was assessed from the calcaneus using ultrasound based densitometer (McCue C.U.B.A. Clinical). The separation variable of McCue C.U.B.A. Clinical measures the width of heel in mm. It was noticed that the urban females possessed higher separation values at each age group in comparison with their rural counter parts with statistically significant t-values observed at 36-40 and 56-60 age groups. The magnitude of percentage increase in separation through ages among rural and urban females was 1.06% (0.51 mm) and 3.19% (1.54 mm), respectively.

The BUA variable of McCue C.U.B.A. Clinical determines the complexity of bone structure of the heel or calcaneous bone (in dB/MHz). The basic principle of any ultrasound measurement is the speed of sound at which ultrasounds propagate in the bone, or the extent of their attenuation (BUA) through the bone is determined by bone density. BUA of calcaneus has been found to correlate with bone mineral density.
(BMD) of femoral neck (Duquette et al. 1997). The mean values of BUA for the females demonstrated that both the groups of females recorded a higher value of BUA at younger ages which increased till 40-50 years and then deteriorated remarkably in the later ages. The rural females demonstrated an overall decline of 18.29 dB/MHz (i.e. 29.24%) and urban females observed a declining percentage of 28.45% (18.3 dB/MHz). There were no significant differences between the two groups of females.

% expected of McCue C.U.B.A. Clinical determines the comparative ultrasound analysis with respect to age matched normal mean (Caucasian reference standard). This parameter of bone density was also observed to follow a trend of initial increase and a particular declining trend in later ages. Although, the urban females depicted higher values throughout ages except for 46-50 years in comparison with the rural group but no statistically significant differences were observed between the two groups of females. The overall degradation in this bone parameter was recorded to be 3.92% and 4.22% among rural and urban group of females, respectively.

McCue C.U.B.A. Clinical also determined the BUA T-score of an individual which gives the deviation at peak bone mass (or in reference with young normal aged 20). The predetermined database of the Caucasian healthy young individual was compared with the testing individual and the T-score was determined. The results suggested an initial rise in T-score followed by a decreasing trend thereafter in later ages in both the groups of females. The percentage decline through ages was observed to be 68.52% (-1.11) and 71.90% (-1.10) among rural and urban group of females, respectively.

BUA Z-score determined by McCue C.U.B.A. Clinical, of an individual gives the number of population standard deviations away from population mean (Caucasian reference population) for the particular age. Both the groups of females showed an initial increase followed by the declining trend till 66-70 age group. The urban group was noticed to be better in Z-scores at each age group except 46-50 years of age than rural group. The concluding decline of percentage value among the two groups was 14.75 % and 14.85% among the urban and rural females, respectively.

The F-values for different parameters of bone density in order to study the age group variation among the females of present study concluded that except for the separation variable or the measurement of heel among rural females, all other parameters were
observed to be statistically significant for rural, urban and total sample of Bania females.

The different parameters of bone density when tested for the Bania women grouped according to their menopausal transition phase depicted that mean values of parameters decreased in postmenopausal women except for separation variable, which increased from pre- to peri- and further in post- as well representing the loss of bone strength with loss of bone complexity.

The prevalence of obesity was assessed with the help of body mass index using criteria developed by WHO Expert Consultation (2004) for Asian Indians. The BMI categories clearly demonstrated that the prevalence of obesity was highest (i.e. BMI > 27.5 Kg/m$^2$) among rural females (65.7%) followed by urban females (63.6%) and 64.3% among the total sample. The overweight women possessed the BMI between 23 Kg/m$^2$ to 27.5 Kg/m$^2$ and reported its prevalence to be 27.2% and 22.6% among the urban and rural group, respectively. Besides these categories, the females were also found to be underweight and possessed BMI <18.5 Kg/m$^2$ amounting to only 0.2% and 2.8% in urban and rural females; leading to a 1.1% underweight in the overall group of Bania females. Only 9% of females in present sample were found to be in normal category. Evidently, obesity increased with age in rural as well as in urban females. Maximum percentage of Bania females were classified in Obese-I category of BMI (39.8%) and followed by obese-II (17.2%) and obese-III (17.3%) categories of BMI.

The prevalence of abdominal obesity was assessed on the basis of waist circumference (WC), percent body fat (PBF), waist height index (WHI) and waist hip ratio (WHR), among the Bania females. The prevalence of central obesity among total Bania females was found to be highest for waist height index (WHI) and percent body fat (PBF) amounting to 95.3% and 95.2%, respectively. All the indices showed higher prevalence of obesity as compared to its prevalence assessed by BMI alone.

The present study used the recommended ultrasound cut-offs (-2.0 SD T-score) for discerning osteoporotic patients with discriminately ability of 90% in ultrasound compared with DEXA measures (Greenspan et al., 1997). It was apparent that the females in osteoporotic category or at a risk of osteoporotic fracture were the highest in number amounting to 38.5% among urban group, 43.9% among rural group and
40.4% in the total sample of females. Besides, the osteopenic condition among urban females showed a prevalence of 36.4% in comparison with 33.5% in rural females and a combined prevalence of 35.4% among total females. There existed a very less percentage of women (24.2%) with normal BMD scores (U=25.1%, R=22.6%).

To identify the nature of relationship between different anthropometric variables and derived anthropometric indices correlation coefficient (r) was calculated. The total correlation values for rural Bania females of present study revealed negative but significant associations of height with WHI (-.336), WHR (-.206), CI (-.156 at p<0.05) and BAI (-.396); weight with CI (-.161 at p<0.05) and ABSI (-.527); hip circumference with WHR (-.343), CI (-.147 at p<0.05) and ABSI (-.479); PBF with ABSI (-.241); VF with ABSI (-.380); FM with ABSI (-.447); FFM with WHR (-.134 at p<0.05), CI (-.249) and ABSI (-.522) at p<0.01. Besides these, all other variables had positive significant relationships with each other. On the other hand, the total correlation values for urban Bania females revealed no significant associations of height with BMI, FMI and FFMI; CI with weight, HC and FFM; ABSI with PBF and VF; FFM with WHR. All other associations were found to be statistically significant with negative significant relationships observed for height for WHI (-.236), WHR (-.133), CI (-.146) and BAI (-.358); HC with WHR (-.138) and ABSI with height (-.143), weight (-.236), HC (-.219), FM (-.133) and FFM (-.337).

Therefore, the total correlation values among both the groups of females revealed a high significant association of BMI with both VF and FM. It is pertinent to note that BMI also exhibited significant and positive association with BAI (R = 0.782, U = 0.815) while a significant and negative relation with ABSI (R = -0.647, U = -0.392) among both the groups of females at p<0.01.

The result of multiple regressions to obtain the impact of various independent variables on PBF as dependent variable in sample females indicated that out of all the variables fourteen variables have significant impact on PBF namely FMI, FFMI, VF, ABSI, CI, WC, WHI, BMR, FM, DBP, WHR, HC, BMI and pulse rate, with collective ability of predicting 99.4% variance in PBF. However, FMI alone had the best predictive ability of 80.4% in the present sample of females.
The ROC curve analysis was performed to define obesity among females of the present study (PBF > 30%) and find out optimal cut-off points for various bone density variables (Separation, BUA, % expected, Z-score and T-score) and anthropometric variables (Waist circumference, hip circumference, fat mass, fat-free mass, BMI, VF, WHI, WHR, CI, FMI, FFMI, BAI and ABSI). Results of ROC analysis revealed that all the variables significantly defined obesity with an exception of ABSI, which was found to be non-significant with curve area of 0.523. FMI was found to be the best predictor and had the largest area under the curve (AURC=0.993), with a cut-off value of 7.23 kg/m$^2$ with highest sensitivity (96.4%) and highest specificity (97.1%). And out of all the bone density variables, Separation variable that determined the heel width (in mm) was best for defining obesity.

The nature of relationship of physiological variables with different anthropometric variables and derived indices was evaluated using correlation coefficient ($r$). The total correlation values for rural group of Bania females revealed that BMR was significantly and positively related with all anthropometric variables, except with WHR, CI and ABSI, where negative association was observed with ‘r’ values significant at $p<0.01$ (WHR= -.164, CI= -.265, ABSI= -.543). On the other hand, the total correlation values for urban group of Bania females revealed that BMR was significantly and positively related with all the anthropometric variables except WHR and CI and a negative significant relation observed with ABSI (-.328). Of all the physiological variables, BMR was significantly and positively related with various anthropometric variables at all age groups.

The relationship between various anthropometric variables, physiological variables and derived indices with BUA was also tested using correlation coefficient ($r$) among urban and rural Bania females. The total correlation values for urban and rural females revealed a statistically significant correlation between all the variables except for DBP. The highest significant positive correlation among anthropometric variables was observed between BUA and FFM for both the groups of females ($R= 0.383, U= 0.428, p<0.01$) in the present study. However, the decreasing order of positive correlation of BUA among urban and rural Bania females of present study may be summarised as follows:
Summary and Conclusions

Rural: BMR>FFM>Weight>FFMI>HC>BMI>FM>Height>FMI>VF>BAI>Pulse

Urban:
BMR>FFM>Weight>FFMI>BMI>FM>HC>FMI>Height>VF>WC>PBF>WHI

Multiple regression analysis to determine BUA as dependent variable concluded that only four variables have significant impact on its predictive variability, that include BMR, ABSI, SBP and DBP, with collective ability of predicting 20.5% of variance in BUA. However, BMR alone had the highest predictive ability of 18.1% among present females. The formulation of regression lines revealed that the variance explained in BUA values with advancing age was similar among the females and the constant observed in the different cases was negative indicating the declining trend with increasing age.

The comparison of prevalence of obesity on the basis of BMI revealed that the urban and rural females of the present study showed higher prevalence of obesity (R=65.7%, U=63.6%) and comparatively lower prevalence of overweight (R=22.6%, U=27.2%). The prevalence of obesity as assessed by central obesity indices (WHI, WHR, WC) revealed higher prevalence of central obesity among the females of present study, with almost equally high percentages observed for waist height index (WHI) i.e. 95.3% and percent body fat (PBF=95.2%). The results exhibited higher prevalence of central obesity among rural females in comparison with urban Bania females.

It is apparent from the findings of the present study that there is a high prevalence of general and central obesity among the Bania females of present study as is evident from the percentage prevalence of obesity based on different anthropometric indices. This may increase the prevalence of obesity related co-morbidities in them. The increased fat deposition in sample females may be attributed to genetic factors along with sedentary life style, reduced BMR, reduced fat free mass and dietary habits.

To evaluate the prevalence of osteoporosis, Bania females of the present study were categorised as normal, osteopenic and osteoporotic based on QUS measurements. A total of 40.4% Bania females were suffering from osteoporosis out of which 43.9% were from rural areas and 38.5% were urban females. Osteoporosis was observed to be more common in older age groups in comparison with younger age groups. In 66-70 age group 78.2% of females were found to be in osteoporotic category against a 16.7% of females in osteopenic group. A high prevalence of osteoporosis was
observed among the rural females (43.9%) in comparison with urban females (38.5%).

The significant factors associated with osteoporosis among the present females were evaluated using odds ratios. The results obtained for odds ratios revealed that mineral or vitamins supplementation intake (OR=1.6, 95% CI= 1.096-2.275, p=0.018*), sun exposure (OR=1.4, 95% CI= 1.038-1.938, p=0.029*), mid meal intake (OR=0.7, 95% CI= 0.533-0.967, p=0.039*), soya products consumption (OR=0.7, 95% CI=0.529-0.983, p=0.042*) and dry fruits consumption (OR=0.7, 95% CI= 0.513-0.932, p=0.019) were statistically significant protective factors against the prevalence of osteoporosis among the females of present study.

However, the observed percentage prevalence of osteoporosis among the urban (38.5%) and rural (43.9%) Bania females are rather alarming. Although the previous studies have shown an association of obesity with increased bone mineral density and decreased osteoporosis and hip fracture in older men and women and the relation between fat mass and BMD is stronger in women. But some studies have shown contradictory results and suggest that larger lean mass is related to larger muscles, which typically convey larger or more frequent mechanical loading to the skeleton and reduces osteoporosis. In our study also the highest significant positive correlation was observed between BUA and BMR (R=390, U=446) followed by BUA and FFM for both the groups of females (R= 0.383, U= 0.428, p<0.01) Moreover, the values of $R^2$ clearly reported that BMR alone has the highest predictive ability of 18.1% and was found to be the best predictor of BUA in the present study. The reduced BMR and decline in fat free mass points towards their sedentary lifestyle. Vitamin D deficiency and dietary habits also significantly contribute towards osteoporosis. Regular weight bearing exercises reduce bone resorption. Therefore, including walking along with weight bearing exercises is particularly important during aging to prevent osteoporosis. In addition inadequate dietary calcium and vitamin D contributes to bone resorption. Therefore, there is a need to create awareness about risk of osteoporosis, its prevention, and highlight the role of physical activity and dietary habits related to healthy ageing. The results of this study also suggest that efforts should be made to reduce obesity by losing fat mass and gaining fat free mass which in turn will help in increasing bone mass, and thus protect against osteoporosis.