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# Bone Health in Urban and Rural College-Going Young Adults of District Gurdaspur, Punjab

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**ABSTRACT** Three hundred and ninety four (394) male (urban: 229; rural: 165) and 606 female (urban: 384; rural: 222) college students in 16-23 years of age were investigated to find out an impact of lifestyle variables like physical activity, exposure to sun and dietary intake along with anthropometric variables on bone health in urban and rural population. There was a significant difference in mean T-score and Z-score among urban and rural females. Bone mineral density was significantly better in rural males (normal, 60.6%; osteopenia, 37.6%; osteoporosis, 1.8%) compared to urban (normal, 54.6%, osteopenia, 38.0%; osteoporosis, 7.4%) males. Rural females (normal, 51.4%; osteopenia, 45.0%; osteoporosis, 3.6%) too had a better bone health than the urban (normal, 47.1%; osteopenia, 44.8%; osteoporosis, 8.1%) females. Physical activity was cited to have a significant correlation with T-score and Z-score. Protein and calcium intake could be significantly correlated with T-score in urban subjects, and with energy, carbohydrates and phosphorus in rural subjects. Z-score had positive correlation with calcium intake in urban individuals and with energy and carbohydrate in rural subjects. However height, weight and BMI had no impact on BMD.

## INTRODUCTION

Bone health is assessed through bone mineral density, a measure of bone mineral per square centimetre of bone and is an indirect indicator of osteoporosis and bone fracture. Osteoporosis is characterized by low bone mass with micro architectural deterioration of bone tissue leading to enhanced bone fragility, thus increasing susceptibility to fracture (Lane 2006). Bone health is important at every age and stage of life and the attainment of a high peak bone density in growing years has an important role in the prevention of osteoporosis later in life (Rizzoli et al. 2001). Bone health may be optimized by creating an environment to achieve peak bone mass during adolescence and maintenance of healthy bone throughout life cycle (Khadilkar and Mandlik 2015). The maximum bone size and strength termed peak bone mass is an interplay of genetic constitution and lifestyle factors like diet and exercise that can influence the potential to achieve full bone mass. Childhood, adolescent and early adulthood are the times when there could be a significant increase in peak bone mass through diet and exercise (AAOS 2012). With regular physical exercise young individuals intend to have normal bone mineral values (Tandon et al. 2003; Uppal and Kaur 2017). Sports training and nutrition played a significant impact on bone mineral density in sports women of 18-21 years in comparison to sedentary control group (Marwaha et al. 2011). Low physical activity and sedentary lifestyle have been assessed as risk factors which are significantly associated with low mineral density resulting in osteopenia and osteoporosis (Javed et al. 2015; Sridevi and Ragi 2016; Soomro et al. 2017). Insufficient calcium intake and insufficient sun exposure were reported to be the factors to cause low bone mineral density in young Saudi women (Zeidan et al. 2016). A systematic review and meta-analysis (Matsuzaki et al. 2015) related that high income countries generally showed higher BMD in rural areas and it may be higher in urban areas in some lower income countries. Since peak bone health is achieved in younger age and is influenced by environmental factors, it becomes imperative to examine the state of bone health of young population who are a potential human resource. Therefore, the present study was designed to investigate the bone health of young adults from urban and rural areas, hailing from same social background, to find out the impact of

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environmental factors like physical activity, exposure to sunlight and nutritional intake on bone density.

## METHODOLOGY

The study was conducted on 1000 individuals in age range of 16-23 years (mean age: 19.35±2.27 yrs.) attending local educational institutes in the township of Batala belonging to urban and rural areas of near and far vicinity in the year 2016-17. Six hundred and thirteen urban (male: 229; female: 384) and three hundred and eighty seven rural (male: 165; female: 222) apparently healthy subjects were undertaken for study after having obtained a written consent. The exclusion criteria included chronic or any other infectious ailment. The subjects were studied for their physical activity level, exposure to sunlight, food habits, dietary intake, anthropometric measurement and bone mineral density. Physical activity level was assessed by referring to WHO global physical activity questionnaire (GPHQ).The participants were enquired about exposure to sunlight and number of hours spent in direct sun were notified. Apart from vegetarian and non-vegetarian food habits the respondents were evaluated for their dietary intake of calories, carbohydrates, proteins, fats, iron, calcium, phosphorous, and calcium-phosphorous ratio through 24-hour recall method (Gopalan et al. 2000). Standard methodology of Weiner and Lourie (1981) was implied to measure height and weight. Body Mass Index (BMI) was calculated based upon WHO (2000) criteria. Bone density (BMD) measurements were taken out on right calcaneum with bone densitometer (Furno's CM-200 light ultrasound bone densitometer; Furno Electric Co. Ltd, Japan) in terms of T-score and Z-score. T-score is expressed as the number of standard deviation relative to standard speed of sound value of the young age group whereas Z-score is the number of standard deviation with respect to the standard speed of sound value of the matched age group. According to WHO definition (WHO 2004), T-score > -1 is normal bone density, T-score between -1 and -2.5 is osteopenia and T-score < -2.5 is osteoporosis.

### Statistical Analysis

Statistical analysis was performed using standard descriptive statistical tests with the help of SPSS software through chi-square, Anova and Pearson's correlation coefficient.

## RESULTS

As displayed in Table 1, physical activity level showed a difference among the subjects from rural and urban background where 27.9 percent of rural and 53.3 percent of urban males were moderately active while 70.9 percent of rural and forty-five percent of urban males were tabulated to be low in their physical activity with a significant difference ($\chi^2$= 26.235; p=0.000). A large number, of rural (92.8%) and urban (89.1%) females had low physical activity level and only 10.9 percent and 6.8 percent were moderately active. The number of hours spent in direct sunlight were higher in urban individuals rather than the rural and were significantly higher in urban males ($\chi^2$=12.371; p=0.006). A major percentage of the subjects were vegetarian in dietary consumption however, urban males were non-vegetarian in their food habits with a significant difference than their rural counterparts ($\chi^2$=4.047; p=0.036). Mean intake of various nutritional components was almost same for urban and rural subjects with significantly higher intake of energy (2212. 185±564.608 kcal) and carbohydrate (384.071± 125.644 gm) in urban subjects compared to their rural peers (energy: 2072.087±589.996 kcal; carbohydrate: 351.091±111.218 gm) while mean calcium intake was higher in rural individuals (urban: 877.763±475.462 mg; rural: 948.635± 629.538 mg) (Table 2). Rural boys (169.840±7.576 cm) had higher mean height than urban (168.785±7.287 cm) boys and it was significantly (f =27.306; p=0.000) higher in rural females (158.09±6.640 cm) compared to urban females (155.42±5.691 cm) (Table 3). Mean weight measurement was almost same in urban and rural male individuals while rural females (51.985±10.221 kg) were significantly heavier than their urban (50.312±9.535 kg) females. BMI for urban and rural subjects in males as well as females was in close approximation. There was no significant difference in mean bone density T-score and Z-score amidst urban and rural males, but T-score was significantly (f=3.966; p=0.047) different between urban (-0.306±0.850) and rural (-0.455±0.950) females and so was Z-score (f=4.031; p=0.046) among urban (-0.421±0.804) and rural (-0.623± 0.912) females (Table 4). Using T-score as a criteria for bone mineral density, more of rural subjects both males

**Table 1: Number and percentage distribution of urban/rural college-going males and females w.r.t. their lifestyle variables**

| *Variables* | *Frequency distribution* | | | | ÷$^2$- *value* | *p-value* |
|---|---|---|---|---|---|---|
| | *Urban* | | *Rural* | | | |
| | *N* | *%* | *N* | *%* | | |
| *Physical Activity* | | | | | | |
| *Male* | | | | | | |
| Low | 103 | 45.0 | 117 | 70.9 | 26.235* | 0.000 |
| Moderate | 122 | 53.3 | 46 | 27.9 | | |
| High | 04 | 1.7 | 02 | 1.2 | | |
| *Female* | | | | | | |
| Low | 342 | 89.1 | 206 | 92.8 | 4.560 | 0.102 |
| Moderate | 42 | 10.9 | 15 | 6.8 | | |
| High | - | - | 01 | 0.5 | | |
| *Exposure to Sunlight (hr/day)* | | | | | | |
| *Male* | | | | | | |
| 3o'-<1hr | 07 | 3.1 | 19 | 11.5 | 12.371* | 0.006 |
| 1-2 hrs | 92 | 40.2 | 52 | 31.5 | | |
| 2-3 hrs | 107 | 46.7 | 77 | 46.7 | | |
| >3hrs | 23 | 10.0 | 17 | 10.3 | | |
| *Female* | | | | | | |
| 3o'-<1hr | 14 | 3.6 | 04 | 1.8 | 5.138 | 0.162 |
| 1-2 hrs | 136 | 35.4 | 76 | 34.2 | | |
| 2-3 hrs | 204 | 53.1 | 114 | 51.4 | | |
| >3hrs | 30 | 7.8 | 28 | 12.6 | | |
| *Food Habits* | | | | | | |
| *Male* | | | | | | |
| Vegetarian | 151 | 65.9 | 125 | 75.8 | 4.407* | 0.036 |
| Non-vegetarian | 78 | 34.1 | 40 | 24.2 | | |
| *Female* | | | | | | |
| Vegetarian | 346 | 90.1 | 201 | 90.5 | 0.030 | 0.861 |
| Non-vegetarian | 38 | 9.9 | 21 | 9.5 | | |

*Significant at $p<0.05$

(60.6%) and females (51.4%) were found to be normal for their bone health compared to urban males (54.6%) and urban females (47.1%) (Table 5). Prevalence of osteoporosis was investigated to be higher in urban individuals with 7.4 percent of males and 8.1 percent of females compared to 1.6 percent and 3.6 percent, respectively in rural males and females. Bone health was in a better flux in rural individuals both males and females and significantly ($\chi^2$ =6.549; p =0.038) so in rural males.

## DISCUSSION

Most of the studied subjects both urban as well as rural either had a low or moderate level of physical activity and contrary to the expectation more of urban males were significantly active compared to rural males, while females of both the groups were in dismal state so far as their level of physical activity was concerned. Even though the level of activity ranged from low to moderate, in the studied population physical activity could be positively correlated (r =0.157; p =0.01) with T-score and Z-score (r =0.249; p =0.01) (Table 6). Likewise, Braun et al. (2015) highlighted the importance of engaging in sufficient moderate-to-vigorous physical activity during adolescence and reducing sedentary behaviour in older adults to improve bone health. Mandapaka and Nellore (2016) too emphasised the importance of exercise in maintaining good health and excellent bone health. A major risk factor of osteoporosis and low bone mass was physical inactivity (Kirchengast 2015). Lifestyle pattern especially quantitative variations in physical activity affects bone mass (Reuter et al. 2012). Regular physical activity was associated with normal level of BMD (Tandon et al. 2003) whereas increasingly intense athletic activity was reported to enhance BMD (Arasheben et al. 2011), weight bearing exercises were determined to be critical in increasing BMD (Ermin et al. 2012) and sportspersons who are involved in high impact

**Table 2: Number, mean, SD and f-value of nutritional intake in urban/rural college-going males and females**

| Variables | Frequency distribution | | | | | | f-value | p-value |
|---|---|---|---|---|---|---|---|---|
| | Urban | | | Rural | | | | |
| | N | Mean | SD | N | Mean | SD | | |
| *Energy (kcal)* | | | | | | | | |
| Male | 229 | 2212.186 | 564.608 | 165 | 2072.087 | 589.996 | 5.686* | 0.018 |
| Female | 384 | 1902.367 | 475.425 | 222 | 1834.821 | 432.969 | 3.029 | 0.082 |
| Total | 613 | 2018.107 | 531.709 | 387 | 1935.981 | 518.680 | 5.767* | 0.017 |
| *Carbohydrate (gm)* | | | | | | | | |
| Male | 229 | 384.071 | 125.644 | 165 | 351.091 | 111.218 | 7.266* | 0.007 |
| Female | 384 | 349.339 | 107.375 | 222 | 330.423 | 101.004 | 4.558* | 0.033 |
| Total | 613 | 362.314 | 115.669 | 387 | 339.235 | 105.835 | 10.079* | 0.002 |
| *Protein (gm)* | | | | | | | | |
| Male | 229 | 108.129 | 41.986 | 165 | 108.289 | 79.454 | 0.001 | 0.979 |
| Female | 384 | 89.537 | 47.669 | 222 | 85.199 | 25.678 | 1.574 | 0.210 |
| Total | 613 | 96.482 | 46.474 | 387 | 95.044 | 56.484 | 0.192 | 0.661 |
| *Fat (gm)* | | | | | | | | |
| Male | 229 | 32.535 | 16.809 | 165 | 32.470 | 16.433 | 0.001 | 0.969 |
| Female | 384 | 23.467 | 35.267 | 222 | 22.285 | 13.610 | 0.230 | 0.632 |
| Total | 613 | 26.855 | 30.048 | 387 | 26.627 | 15.692 | 0.019 | 0.891 |
| *Calcium (mg)* | | | | | | | | |
| Male | 229 | 1073.288 | 523.021 | 165 | 1108.898 | 594.716 | 0.396 | 0.530 |
| Female | 384 | 761.162 | 402.363 | 222 | 829.520 | 629.538 | 2.654 | 0.104 |
| Total | 613 | 877.763 | 475.462 | 387 | 948.635 | 629.538 | 4.082* | 0.044 |
| *Phosphorus (mg)* | | | | | | | | |
| Male | 229 | 1898.054 | 520.791 | 165 | 1811.647 | 565.078 | 2.458 | 0.18 |
| Female | 384 | 1510.426 | 373.328 | 222 | 1524.760 | 382.776 | 0.204 | 0.652 |
| Total | 613 | 1655.233 | 472.743 | 387 | 1647.076 | 489.628 | 0.069 | 0.793 |
| *Ca: P ratio* | | | | | | | | |
| Male | 229 | 0.567 | 0.251 | 165 | 0.650 | 0.736 | 2.489 | 0.115 |
| Female | 384 | 0.518 | 0.345 | 222 | 0.550 | 0.418 | 1.018 | 0.313 |
| Total | 613 | 0.536 | 0.314 | 387 | 0.592 | 0.577 | 3.941* | 0.047 |

*Significant at $p<0.05$

**Table 3: Number, mean, SD and f-value of anthropometric variables in urban/rural college-going males and females**

| Variables | Frequency distribution | | | | | | f-value | p-value |
|---|---|---|---|---|---|---|---|---|
| | Urban | | | Rural | | | | |
| | N | Mean | SD | N | Mean | SD | | |
| *Height (cm)* | | | | | | | | |
| Male | 229 | 168.785 | 7.287 | 165 | 169.84 | 7.576 | 1.943 | 0.164 |
| Female | 384 | 155.422 | 5.691 | 222 | 158.089 | 6.64 | 27.306 | 0.000* |
| Total | 613 | 160.413 | 9.05 | 387 | 163.099 | 9.137 | 20.733 | 0.000* |
| *Weight (kg)* | | | | | | | | |
| Male | 229 | 62.952 | 11.102 | 165 | 62.316 | 11.678 | 0.301 | 0.584 |
| Female | 384 | 50.312 | 9.535 | 222 | 51.985 | 10.221 | 4.103 | 0.043* |
| Total | 613 | 55.034 | 11.844 | 387 | 56.39 | 11.997 | 3.077 | 0.08 |
| *BMI* | | | | | | | | |
| Male | 229 | 22.073 | 3.474 | 165 | 21.583 | 3.7 | 1.807 | 0.18 |
| Female | 384 | 20.818 | 3.769 | 222 | 20.779 | 3.752 | 0.015 | 0.902 |
| Total | 613 | 21.287 | 3.709 | 387 | 21.122 | 3.746 | 0.467 | 0.495 |

*Significant at $p<0.05$

**Table 4: Number, mean, SD and f-value of T-score and Z-score in urban/rural college-going males and females**

| *Variables* | *Frequency distribution* | | | | | | *f-value* | *p-value* |
|---|---|---|---|---|---|---|---|---|
| | *Urban* | | | *Rural* | | | | |
| | *N* | *Mean* | *SD* | *N* | *Mean* | *SD* | | |
| *T-score* | | | | | | | | |
| Male | 229 | -0.004 | 0.891 | 165 | 0.012 | 0.872 | 0.340 | 0.854 |
| Female | 384 | -0.306 | 0.85 | 222 | -0.455 | 0.95 | 3.966* | 0.047 |
| Total | 613 | -0.193 | 0.877 | 387 | -0.256 | 0.945 | 1.135 | 0.287 |
| *Z-score* | | | | | | | | |
| Male | 80 | 0.01 | 0.807 | 82 | -0.111 | 0.965 | 0.761 | 0.384 |
| Female | 142 | -0.421 | 0.804 | 152 | -0.623 | 0.912 | 4.031* | 0.046 |
| Total | 222 | -0.265 | 0.83 | 234 | -0.444 | 0.961 | 4.473* | 0.035 |

*Significant at p<0.05

**Table 5: Number and percentage distribution of urban/rural college-going males and females w.r.t. bone mineral density (BMD)**

| *BMD* | *Frequency distribution* | | | | ÷$^2$*- value* | *p-value* |
|---|---|---|---|---|---|---|
| | *Urban* | | *Rural* | | | |
| | *N* | *%* | *N* | *%* | | |
| *Male* | | | | | | |
| Normal | 125 | 54.6 | 100 | 60.6 | | |
| Osteopenia | 87 | 38 | 62 | 37.6 | 6.549 | 0.038* |
| Osteoporosis | 17 | 7.4 | 3 | 1.8 | | |
| *Female* | | | | | | |
| Normal | 181 | 47.1 | 114 | 51.4 | | |
| Osteopenia | 172 | 44.8 | 100 | 45 | 4.882 | 0.087 |
| Osteoporosis | 31 | 8.1 | 8 | 3.6 | | |

*Significant at p<0.05

**Table 6: Co-relation coefficient 'r' for lifestyle variables and anthropometric parameters w.r.t. T-score and Z-score**

| *BMD* | *Physical activity* | *Exposure to sun* | *Food habits* | *Height (cm)* | *Weight (kg)* | *BMI* |
|---|---|---|---|---|---|---|
| *T-score* | | | | | | |
| Urban | 0.132** | -0.049 | 0.067 | 0.06 | 0.057 | 0.039 |
| Rural | 0.195** | -0.095 | -0.013 | 0.072 | 0.03 | -0.009 |
| Total | 0.157** | -0.069* | 0.037 | 0 .059 | 0.044 | 0.02 |
| *Z-score* | | | | | | |
| Urban | 0.289** | 0.027 | 0.047 | 0.093 | 0.091 | 0.027 |
| Rural | 0.186** | -0.102 | -0.064 | 0.022 | 0.024 | -0.102 |
| Total | 0.249** | -0.053 | -0.011 | -0.044 | 0.051 | -0.053 |

*Significant at p<0.05; **Significant at p<0.01

sports were found to have greater bone mineral density and mean T-score value as compared to athletes involved in moderate impact sports (Multani et al. 2011).

A significant difference in number of hours spent in direct sunlight was noticeable in urban and rural individuals with urban individual spending significantly more time in the sun. Though on an average more than ninety minutes were spent in the sun by eighty percent of participants, a significant negative correlation (Table 7) was observed with T-score and Z-score.

**Table 7: Co-relation coefficient 'r' for nutritional intake w.r.t. T-score and Z-score**

| *BMD* | *Energy (kcal)* | *Carbohydrate (gm)* | *Protein (gm)* | *Fats (gm)* | *Calcium (mg)* | *Phosphorus (mg)* | *Ca: P ratio* |
|---|---|---|---|---|---|---|---|
| *T-score* | | | | | | | |
| Urban | 0.057 | 0 | 0.089* | 0.068 | 0.095* | 0.06 | 0.033 |
| Rural | 0.131** | .143** | 0.006 | 0.086 | -0.043 | 0.107* | -0.073 |
| Total | 0.089** | 0.058 | 0.052 | 0.069* | 0.027 | 0.080* | -0.027 |
| *Z-score* | | | | | | | |
| Urban | 0.112 | 0.066 | 0.104 | 0.086 | 0.160* | 0.09 | 0.117 |
| Rural | 0.193** | 0.206** | -0.002 | 0.057 | -0.05 | 0.125 | -0.134* |
| Total | 0.169** | .156** | 0.052 | 0.074 | 0.032 | 0.122** | -0.049 |

*Significant at $p<0.05$; **Significant at $p<0.01$

In spite of a high exposure to the sun the studied population was not seen to be much benefitted as far their bone health is concerned. This could be attributed to a tendency in younger population either to avoid or remain veiled while they are out in the sun owing to social reasons and a fascination for white skin. In the observed population insufficient sun absorption could lead to an inadequate vitamin D resulting in poor absorption of calcium, thereby mitigating the benefit of higher calcium intake. In concurrence to the present study, it was suggested that despite availability of plenty and adequate sunshine Indian population has the highest prevalence of low bone mass and bone mineral content (Verma et al. 2015) and this could be due to the tradition of covering the skin, especially in women, leading to lesser sun exposure (Roy et al. 2007).

Although intake of most of the nutrients was within the ICMR (1992) recommended limits, the studied young males and females (Table 3) were slightly deficient in their energy intake compared to recommended dietary allowance (RDA) of 2677 kcal/day for 18+ years males and 2061 kcal/day for 18+ years females, protein intake was higher than recommended requirement of 70 g for males and 60 g for females and intake of calcium was noticed to be way higher than the recommended limits of 500 mg. The intake of energy, carbohydrates was found to be significantly higher in urban males and that of carbohydrates in urban females. A significantly higher intake of calcium (f=4.082; p=0.044) was noticeable in rural subjects with a significantly high Ca: P ratio (f=3.941; p=0.047). In the other reported studies, it was highlighted that an adequate amount of dietary calcium obtained from dairy products is important for reaching a normal bone mass and, moreover, dairy products also contain other important components like high biological value proteins and phosphorus as well as other minerals and vitamins that help to increase bone mass (Rizzoli 2014; Weaver 2014). In the present study, T-score depicted (Table 7) a positive correlation with protein and calcium intake in urban males and with energy and carbohydrate and phosphorus intake in rural males. Akin to the carried out study, total energy intake, was positively associated with BMD among both men and women (Trichopoulou et al. 1997) and high calcium intake was associated with higher total BMD values by Yannakoulia et al. (2004), however, it was suggested that cumulative effect of dietary pattern may have negative implications on bone health, explaining the small but significant adverse effect of protein on BMD, independent of the total energy or calcium ingested. Weaver et al. (1999) also recommended that the effect of protein intake on bone mass should be evaluated along with calcium intake, since with the increased intake of dietary protein urinary excretion of calcium also increases, and thereby requirement of dietary calcium increases accordingly. Shams-White et al. (2017) in a meta-analysis concluded that there are no adverse effects of higher protein intake. A systematic review and meta-analysis found that dietary protein levels even above the RDA may be beneficial in reducing bone loss provided there is adequate calcium intake. It found no evidence that acid load due to higher dietary protein intakes, whether of animal or vegetable origin, is damaging to bone health (Rizzoli et al. 2018). Parallel to the present findings, in a study on 255 healthy women aged 20-69 years, daily dietary energy, protein and calcium intake coupled with greater physical activity and higher education levels favoured bone health (Kumar et al. 2010). Although, the level of physical activity and intake of certain nutritional content were higher in urban subjects, the bone health was better for those hailing from rural areas. This could be ascribed to a significant higher intake of calcium by rural subjects.

In the studied population, rural girls were significantly taller (f=27.306; p=0.000) and heavier (f=4.103; p=0.043) in comparison to urban females but no significant difference was noticeable in males. No significant correlation was present between these anthropometric variables and of derived variable, BMI with T/Z- score. Whereas various studies did report, a positive correlation of BMD with weight (Wilkin et al. 2010), high prevalence of osteoporosis in low stature adults (Ibrahim et al. 2011), a correlation of height and physical activity with osteoporotic index (Kim et al. 2013), a positive correlation of BMD with weight, height, BMI, physical activity, diet and calcium phosphorus ratio (Naseem 2013), and furthermore age, BMI, and physical activity were significantly associated with BMD (Martinaityte et al. 2017).

In the studied data no significant difference in mean T/Z-score was established in urban and rural males but T-score (f=3.966; p=0.047) as well Z-score (*f*=4.031; p=0.046) did differ significantly in female subjects from urban and rural background. In overall data, the urban and rural groups displayed a significant (f =4.473; p=0.035) difference in Z-score. On the basis of T-score, osteopenia and osteoporosis indicating impaired bone health was much pronounced in urban areas with 45.4 percent of urban males and 52.9 percent of urban females compared to rural areas with 42.2 percent of males and 48.6 percent of rural females. Similar to the present findings, in a study (Samar et al. 2011) peak bone mineral density in rural young females was significantly higher than urban females but there was no significant difference in between two types of male population, however with advancement in age, prevalence of osteoporosis disease was greater in rural population and it was more prominent in men. In a study in age range of 20-30 years, seventy percent participants were reported to be osteopenic and low physical activity, less exposure to sunlight and diet low in calcium and vitamin D were assessed to be the common risk factors (Soomro et al. 2017). Presence of approximately more than forty percent of respondents in osteopenic and about five percent in osteoporotic state in the existing study is symptomatic of a poor bone health in young generation.

## CONCLUSION

The studied population had optimal exposure to sunlight, low to moderate physical activity level and was within recommended range of nutrient intake except for energy. Bone density was observed to be significantly influenced with increase in physical activity and nutritional intake. T-score and Z-score had significant correlation with physical activity in both urban and rural individuals. T-score was significantly correlated with protein and calcium intake in urban subjects and with energy, carbohydrates and phosphorus in rural subjects. Z-score had positive correlation with calcium intake in urban individuals and with energy and carbohydrate and in rural subjects.

## RECOMMENDATIONS

As indicated by the present study, a high occurrence of osteopenia and osteoporosis is a stark reality prevailing in young population, in urban and rural areas, without their being aware of harsh realities associated with it in the form of debilitating diseases and economic burden later in life. With the increasing life expectancy and sedentary lifestyle its impact would be on the rise in forthcoming generations. Therefore, bone density management programmes should be established within healthcare community centres as well as educational institutes to sensitize youngsters in this regard and provide them guidance for healthy lifestyle changes.

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