

Frequency of osteopenia and associated risk factors among young female students

Rabail Rani Soomro, Syed Imran Ahmed, Muhammad Khan

Abstract

Objective: To find out the frequency of osteopenia and associated risk factors among young female students.

Methods: This observational, cross-sectional study was conducted at the Dow University of Health Sciences, Karachi, from August 2011 to January 2012, and comprised young female students. Convenient sampling method was used. Age, residence, sun exposure, menstrual status, level of physical activity, exercise, vitamin D, calcium intake were variables of interest. Dual-energy X-ray absorptiometry scan was used to measure bone mineral density on the lumbar spine, hip, femur and distal forearm. SPSS 16 was used for data analysis.

Results: A total of 100(76.9%) students were included in this study. The age range was 20-30 years. Overall,70(70%)participants were osteopenic, while 30(30%) were normal. Age<25 years, living with less exposure to sun, less physical activity and diet low in calcium and vitamin D were common risk factors.

Conclusion: The frequency of osteopenia was significantly high among young female students.

Keywords: Frequency, Bone mineral density, Osteopenia, Dual-energy X-ray absorptiometry. (JPMA 67: 365; 2017)

Introduction

Osteopenia is a term well defined as low bone density or decreased bone density. If not prevented earlier, it can worsen to severe osteoporosis and a risk for fractures.¹ The burden of osteopenia at a younger age is considerably high in Pakistan. A study conducted in Khyber Pakhtunkhwa (KPK) province of Pakistan found osteopenia among 47.7% females and osteoporosis among 24.7%.² Additionally, supportive findings were seen in a study conducted in Karachi where 64% of women aged below 30 years and 55% of women aged below 45 years were osteopenic.³ Furthermore, another local study showed that 77.77% females aged 30-45 years were having osteopenia.⁴ Hence, osteopenia is a major concern among young female population, especially from Asia. Its early detection is indeed desirable among our college and university-going students. Therefore, it is significant to set up cost-effective preventive approaches, specifically at young age, to overcome the later consequences of osteoporosis. The diet enriched in adequate levels of calcium and vitamin D, cessation of smoking, living under adequate sun exposure and being physically active may delay the magnitude of osteoporosis in later life.^{5,6} Walking has been found a necessary and cost-effective strategy to improve bone density at any age.⁷ However, a few studies lay more emphasis on weight-bearing exercises to have maximum effects on bone mineral density, especially when done at

younger age, though it is a known fact that peak bone mass is attained around the age of 30 years.³

The high prevalence of osteopenia and osteoporosis in Pakistan is not a novel and uncommon public health problem. An estimated data presented at 4th National Seminar on Osteoporosis revealed that out of 171.8 million subjects throughout Pakistan there would be 40.18 million (including 20.73 million women and 19.45 million men) with osteopenia and 9.91 million (including 7.19 million women and 2.71 million men) with osteoporosis. This burden is expected to rise up to 11.30 million in 2020 and 12.91 million in 2050.⁸ Thus, the enormity of this health problem in Pakistan is of a major concern affecting young female population with osteopenia which can later on be victim of osteoporosis and its adversities. However, Pakistan as a developing country remains ill-adapted to handle the burden of this disease due to lack of awareness of this disease, poor literacy rate and its costly rehabilitation. In the country, lack of physical activity and sedentary lifestyle of younger generation may be major contributory factors to early loss of bone mass density. Medical and allied health students being overburdened with studies do not concentrate on healthy diet and physical activity to improve their bone status. After knowing the severity of problem and becoming aware of high prevalence of osteopenia in community, allied health female students were mainly focused to see the problem at younger age. Seeking the data in younger females will provide attentiveness to arrange awareness programmes to our universities/colleges regarding risk factors of

.....
Dow University of Health Sciences (DUHS), Karachi.

Correspondence: Rabail Rani Soomro. Email: rabail.physio@gmail.com

osteopenia. The current study was planned to find out the frequency of osteopenia among young female students.

Subjects and Methods

This cross-sectional, observational study was conducted at the Department of Physiotherapy, Institute of Physical Medicine and Rehabilitation (IPM&R), Dow University of Health Sciences (DUHS), Karachi, from August 2011 to January 2012, and comprised young female students. Approval was obtained from the institutional review board. Allied health students of physiotherapy, prosthetics and orthotics and occupational therapy department were selected for screening. Permission was taken from the principals concerned and they were requested to provide list of students aged 20-30 years of the ongoing semester.

Questionnaire/ screening proforma was filled by all participants which contained questions regarding their age, height, weight, physical activity, menstrual status, dietary factors, including intake of calcium and vitamin D, and amount of sun exposure.

Participants who agreed to have bone mineral density (BMD, g/cm²) scan on the lumbar spine (L1-L4), left hip, and left neck of femur and left distal radius with dual-energy X-ray absorptiometry (DEXA) were included. The scan is widely used and is considered as validated, most reliable and gold standard method. The scanning and analyses were done by the same operator. DEXA (GE LUNAR PRODIGY, ENCORE 2010 software version 13.31.016) was used to measure BMD. Because all the participants could not be tested in one day, they were

divided into 5 equal groups. Group list and schedule for BMD test were displayed on the notice board and handed over to the principals of the departments concerned. Principals were requested to give off for one day because the students were taken to the Ojha Campus of DUHS for BMD test. The scan was done free of cost at the radiology department of Dow Hospital, Ojha. According to the World Health Organisation's (WHO) classification, T-score of DEXA represents a person with osteopenia and osteoporosis.⁹

According to the WHO study group,⁹ BMD is normal in a young adult when reference mean BMD is within -1 standard deviation (SD); osteopenia when it is below the young adult mean BMD more than -1 SD but less than -2.5 SD; osteoporosis when it is below the young adult mean BMD -2.5 SD or more; and there is severe osteoporosis when it is below the young adult mean BMD -2.5 SD or more in addition to one or more fragility fractures.

Data was entered and analysed using SPSS 16. Frequencies with percentages were calculated for categorical variables. Fisher's exact test was conducted to see the association of outcome with different risk factors with alpha value of 0.05 and 80% power. P<0.05 was considered significant.

Results

Of the 130 students, 100(76.9%) volunteered to have the scan done and they comprised the study sample. The participants' age ranged 20-30 years. Moreover, 90(90%) students were aged < 25 years. Besides, 70(70%) participants were osteopenic while (30%) had normal bone mineral density.

Table: Comparison of various risk factors among normal and osteopaenic individuals.

Characteristics	Variable affecting bone mineral density	Bone Mineral Density		P-value
		Normal N (%)	Osteopaenia N (%)	
Residence	House	30 (100)	5 (7.1)	<0.01*
	Flat	0 (0)	65 (92.9)	
Sunlight Exposure	Yes	30 (100)	5 (7.1)	<0.01*
	No	0 (0)	65 (92.9)	
Menstrual status	Regular	24 (80)	44 (62.9)	0.232
	Irregular	3 (10)	15 (21.4)	
	Missed	3 (10)	11 (15.7)	
Marital status	Single	30 (100)	68 (97.1)	0.488
	Married	0 (0)	2 (2.9)	
High physical activity or sports girl	Yes	3 (10)	18 (25.7)	0.062
	No	27 (90.0)	52 (74.3)	
Exercise 3 or more times per week	Yes	3 (10)	18 (25.7)	0.06
	No	27 (90)	52 (74.3)	
Calcium intake daily	Yes	9 (30.0)	12 (17.1)	0.12
	No	21 (70.0)	58 (82.9)	

*P<0.05 was considered significant using Fisher's exact test.

By habitation of residence, 5(7.1%) of house residents and 65(92.9%) of apartment residents were osteopenic ($p < 0.01$). However, 30(100%) of house residents were normal but none of the apartment resident was normal. Of the, students who get enough sunlight exposure, 30(100%) were normal and 5(7.1%) were osteopenic. Of the students who were not getting proper sunlight exposure, none of them were normal and 65(92.9%) were osteopenic ($p < 0.01$). By menstrual history, we divided female students into three categories, i.e. regular, irregular and missed. The study findings showed that 44(62.9%), 15(21.4%) and 11(15.7%) were osteopenic having regular, irregular and missed periods. Our study was based on university students who were almost single except for two females who were married and both were osteopenic. However, among single females 30(100%) were normal and 68(97.1%) were osteopenic. Moreover, of the students who were highly physically active and exercised more than 3 times per week, 3(10%) were normal and 18(25.7%) were osteopenic. Of the students with no physical activity, 27(90%) were normal and 52(74.3%) were osteopenic. Furthermore, 12(17.1%) of student who were taking calcium supplements and 58(82.9%) of those who were not taking calcium supplements were osteopenic (Table).

Discussion

In our study, the frequency of osteopenia was high among those who were aged below 25 years. Of all participants, 70(%) were osteopenic which highlighted that osteopenia was the foremost prevalent metabolic disorder among younger female students in Pakistan. The findings of the current study findings conformed to previous information showing burden of osteopenia. A study conducted in Karachi showed BMD to be decreased in 64% of women < 30 years.³ In the same study, most participants suffering from osteopenia were aged between 20 and 30 years. Similarly, in current study female population age ranged from 20-30 years. In contrast to our study, a study conducted in Tehran found less prevalence of osteopenia at 17.4% in females of age-group 20-29 years and 8.3% in 30-39 years of females.¹⁰ However, undeniably, the risk of osteoporosis is 1.56 times greater among Asian women as compared to Caucasian women as stated by the National Osteoporosis Risk Assessment Study (NORA).¹¹ Thus, similar studies have been done in India, Iran and Japan to highlight Asian young females to be targeted by osteoporosis earlier in their life due to associated risk factors among Asian population.^{4,12,13} Our study found strong relationship among style of living and sun exposure with reduction in BMD. The students who were living in apartments and not getting enough sun exposure were found to have reduced BMD compared to students living in houses and having enough sun exposure ($p < 0.005$). Our study results are

similar to previous studies which confirm the popular belief among Pakistani women that they don't get proper sun exposure due to most females living in apartments and wearing Islamic-style clothing.

Furthermore, high parity was found associated with osteopenia and early osteoporosis, but our study was limited to young allied health students so we did not get any finding because all students were single, except two who were recently married. However, menstrual status — whether regular, irregular or missed — did not impact any significant change in BMD among students in our study. Furthermore our study showed higher ratio of osteopenia (74.3%) among women who were not physically active and did not exercise. Another study supported these findings that very low percentage of Pakistani women (6.9%) did exercise and overall 72% of Pakistani women led sedentary lifestyle.¹⁴ Studies have shown that doing exercise at the years of peak bone acquisition in college or university leads to lasting benefits on bone mineral density.¹⁵ So female students, particularly in the fields of medical and allied health, should be encouraged at young age to be engaged in physical activity and do weight-bearing exercise regularly to enhance BMD. Contrary to this, our study also showed that students (10%) who were physically active and did exercise had osteopenia which we assume was because of taking enough dairy products and vitamin D enriched diet.

The Institute of Medicine, United States, recommends daily allowance of calcium intake for females at 1,000-1,300mg with exceptional to increasing demand in pregnancy and lactation.¹⁶ A high percentage of Pakistani population has deficiency of calcium and vitamin D.¹⁷ Likewise, our study showed that students who were taking calcium supplements were less osteopenic (17.1%) compared to students who were not taking calcium supplements (82.9%). A study conducted in Saudi Arabia has shown the prevalence of vitamin D3 deficiency in medical students at 96%.¹⁸ Although we did not test vitamin D3 level in our study, we assume somehow the same status in allied health students. Our study targeted students who were young, active and had potential to follow proper diet and exercise. But still, this study highlighted the highest ratio of osteopenia. However, studies done in different sets of population showed similar results. A study conducted in Poland showed no statistically significant difference among BMD values of farmers in rural areas compared to nurses, teachers and retired workers in urban areas.¹⁹ Moreover, studies also showed high prevalence of osteopenia among non-working women comparable to working women and students.¹⁹

These findings show that risk factors do play some role,

but are secondary to genetic predisposition in reduction of bone mineral density.

A study by Nisar et al. reported unhealthy lifestyle and dietary habits in students of a private medical university in Karachi.²⁰ Similarly, our study findings strongly endorsed the importance of style of living, sun exposure, physical activity and calcium-enriched diet among young females to enhance their BMD level at earliest so that later on adverse effects of osteoporosis can be prevented. Many studies done in Pakistan show our young female population to be victims of early osteoporosis. Therefore, the preventive measures should be taken on a large scale. Counselling for diet and regular physical activity training, especially weight-bearing exercise, should be encouraged among all schools, colleges and medical universities.

One of the strengths of the current study was the use of DEXA scan which is considered the gold standard method to assess osteopenia and osteoporosis. However, the study had its limitations as well. For example, the sample size was small and the study's findings cannot be generalised. Further screening of osteopenia on large population including young students should be done including family/genetic history which was not part of our study. Furthermore, male students should also be investigated in future studies.

We recommend investigating larger population of students including both males and females so that this problem should be addressed on a larger scale and solved through collaboration of all authorities concerned.

Conclusion

Osteopenia was highly prevalent among young female population. Preventive measures should be advocated at school/university level to avoid osteoporosis and its consequences later in life.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: The Dow University of Health Sciences provided funding for this study.

References

1. Karaguzel G, Holick MF. Diagnosis and treatment of osteopenia. *Rev Endo Meta Dis.* 2010; 11:237-51.
2. Arif M, Inam M. Frequency of osteopenia and osteoporosis in different parts of North West Frontier Province. *J Postgrad Med Ins.* 2006; 20:196-02
3. Jaleel R, Nasrullah FD, Khan A. Osteopenia in the younger females. *J of Surgery Pakistan Int.* 2010; 15:29-33.
4. Masood Z, Shahzad S, Saqib A, Ashraf K. Osteopenia and osteoporosis; frequency among females. *Professional Med J.* 2014; 21:477-83.
5. Suleiman S, Nelson M, Li F, Buxton-Thomas M, Moniz C. Effect of calcium intake and physical activity level on bone mass and turnover in healthy, white, postmenopausal women. *Am J Clin Nutr.* 1997; 66:937-43.
6. Lisker R, Lopez MA, Jasqui S, Ponce DC, Leon Resales S, Correa Rotter R, et al. Association of Vitamin D receptor polymorphisms with osteoporosis in Mexican Postmenopausal Women. *Hum Bio.* 2003; 75:399-03.
7. Karlsson MK, Nordqvist A, Karlsson C. Physical activity increases bone mass during growth. *Food Nutr Res.* 2008; 52:01-10.
8. Raza SA. Endocrinology in Pakistan: Transcending in care of endocrinological disorders. *Indian J Endocrinol Metab.* 2011; 15:43-5.
9. Anon WHO publication - Kanis JA, on behalf of the World Health Organization Scientific Group. Assessment of osteoporosis at the primary health care level. WHO Collaborating Centre for Metabolic Bone Diseases, University of Sheffield 2007.
10. Larijani B, Hossein-Nezhad A, Mojtahedi A, Pajouhi M, Bastanhagh MH, Soltani A et al. Normative data of bone mineral density in healthy population of Tehran, Iran: A cross sectional study. *BMC Musculoskelet Disord.* 2005; 6:38.
11. Siris ES, Miller PD, Barrett-Connor E, Faulkner KG, Wehren LE, Abbott TA, et al. Identification and fracture outcomes of undiagnosed low bone mineral density in post-menopausal women results from the National Osteoporosis Risk Assessment. *JAMA.* 2001; 286:2815-22.
12. Babu AS, Iqbal FM, Noone MS, Joseph AN, Samuel P. osteoporosis and osteopenia in India: A few more observations. *Indian J Med Sci.* 2009; 63:76-7.
13. Limpaphayom KK, Taechakraichana N, Jaisamrarn U, Bunyavejchevin S, Chaikittisilpa S, Poshyachinda M, et al. Prevalence of osteopenia and osteoporosis in Thai women. *Menopause.* 2001; 8:65-9.
14. Iqbal SP, Dodani S, Qureshi R. Risk factors and behaviors for coronary artery disease (CAD) among ambulatory Pakistanis. *J Pak Med Assoc.* 2004; 54:261-6.
15. Russo CR. The effects of exercise on bone. Basic concepts and implications for the prevention of fractures. *Clin Cases Miner Bone Metab.* 2009; 6:223-8.
16. National Institutes of Health. Dietary Supplement Fact Sheet: Calcium. (Online) 2011. cited (2016 Jun 11 Available from: URL:
17. Masood Z, Mahmood Q, Ashraf KT. Vitamin D deficiency- an emerging public health problem in Pakistan. *JUMDC.* 2010; 1:04-9.
18. Al Elq AH. The status of vitamin D in medical students in the preclerkship years of a Saudi medical school. *J Family Community Med.* 2012; 19:100-4.
19. Filip RS, Zagórski J. Bone mineral density and osteoporosis in rural and urban women. Epidemiological study of the Lublin region (Eastern Poland). *Ann Agric Environ Med.* 2001; 8:221-6.
20. Nisar N, Qadri MH, Fatima K, Perveen S. Dietary and life style among the students of a private medical university in Karachi. *J Pak Med Assoc.* 2008; 58:687-90.