Research Article

Bone Mineral Density Difference Among Reproductive Women Versus Post-Menopausal Women of Lahore, Pakistan

Rida Jamil Sabit, Muhammad Jamil Sabit*, M. Asad Siddiq, Umer Maqsood

Pain and Physical Therapy CME Academy, Pakistan

*Corresponding author: Muhammad Jamil Sabit, Pain and Physical Therapy CME Academy, Pakistan. Email: painspecialistpk@yahoo.com

Abstract

Background: In Pakistan approximately 9.9million people are suffering from osteoporosis out of which 7.2 million are women. Low bone mineral density is the major risk factor for osteoporosis. Low BMD was seen mostly among the post-menopausal women.

Objective: The purpose of our study was to evaluate the difference in BMD level in reproductive and postmenopausal women in District Lahore.

Material & Method: A cross -sectional survey was done on 196women, 98 reproductive and 98 postmenopausal. Convenient sampling was done using the Bone Density Scan Questionnaire and DEXA scans were done to evaluate their BMD using t-scores on females visiting outpatient department of pain Centre Mayo hospital Lahore, AL-NOOR and Punjab medical centers. The data was analyzed using SPSS. The mean and standard deviations of t-score at lumbar and hip were evaluated in reproductive and post-menopausal women to check the difference in their BMD. According to WHO, the value of T- score -1.0 SD or more as normal, T-score between -1.0 and -2.5 SD indicates osteopenia and T- score of -2.5 SD or below indicates osteoporosis.

Result: The mean age of reproductive women was 41.00±9.69 (50%) and postmenopausal women 62.30±6.37 (50%).The aim of the study was to evaluate the BMD difference among these two groups of women. The t-score at Lumbar Spine shows that the P value (0.01) shows there is significant difference between the reproductive and postmenopausal women BMDs. The t-score at Hip shows that the P value is (0.08) which shows there is no significant difference in reproductive and postmenopausal women BMD.

Conclusion: This study concludes that there is significant difference of BMD between reproductive and menopausal females as the P-value is 0.05. Average T-score of lumbar in post- menopausal and reproductive women is 0.01 which shows the difference, average T-score for hip in reproductive and postmenopausal is 0.08 which shows there is no significant difference.

Keywords: Bone Mineral Density; BMD; Osteoporosis; Post-menopausal; Reproductive Age

Introduction

Osteoporosis, being a systemic disease that involves a decrease in bone mass density leads to fracture susceptibility [1]. Osteoporosis is affecting 200million of population worldwide [2]. According to WHO criteria the reproductive age of women is (15-49) years) while average age of menopause is 51years, but it can vary widely [3].

The risk factors for osteoporosis are preventable and non-preventable. The non-preventable factors are age, gender, BMI and menopause. The preventable factors are limited exposure to sun, low protein intake, low levels of calcium and vitamin D in blood over a prolonged period of time, inactivity, excessive alcohol and caffeine, decrease estrogen, or any underline disease, for example SLE, RA [4]. There is increased fracture susceptibility with low BMD. Increased risk of fracture of about 1.5-3.0fold with decreased BMD

(Bone Mineral Density) at hip and lumbar spine [5].

Study conducted in the United States shows that over 8.5million women had low estrogen levels which caused fall in BMD and bone mass [6]. In a study, it has been found that in European Union over 22million women are affected by osteoporosis [7]. According to United Nations, in China, Hong Kong, Mongolia, North Korea, Japan and Macau, osteoporosis is becoming a growing problem. In China by 2050 the population of aged more than 60 years will reach to 400million. While in West Asia the incidence of hip fractures after 65 years of age has increased [8]. In Pakistan approximately 9.9million people are suffering from osteoporosis out of which 7.2 million are women, the expected rate to 11.3 million by 2020 will be increased [9]. Reproductive status is considered to be the hallmark of BMD differences but in fact there are many other factors which could be responsible for decreased BMD in reproductive and post-menopausal women [10].

Girls with eating disorders that involve Bulimia Nervosa as well as Anorexia Nervosa are at the increased risk of osteoporosis. In osteoporosis there is an increase in resorption of bone as well as decreased formation of bone. Patients of bulimia nervosa are also at a high risk of osteoporosis [11]. The common risk factor for osteoporosis are menopause, vitamin D deficiency, low body mass index, physical inactivity and gender [12]. Osteoporosis has two types: primary and secondary. In primary osteoporosis (type I and type II), there is a loss of bone mineral with aging due to the decrease in sex hormone. Primary osteoporosis induces secondary osteoporosis. Menopausal women aged 50-65 years, mainly have type 1 osteoporosis due to the estrogen deficiency. In menopause, there is a loss of cancellous and cortical bone tissues. In type II osteoporosis, the characteristic fractures of humerus, pelvis and tibia are common [13].

In postmenopausal women, the chances of osteoporosis related- fractures are high as it is age associated, this includes general factors that relates to aging and deficiency of estrogen hormones that leads to the increase bone resorption [14]. Use of glucocorticoids which leads to the reduce bone ossification, decrease the quality of bone and alter the distribution of micro-architectural integrity [15]. The reason of low BMD among the women of reproductive age is the deficiency of vitamin D which is essential for calcium absorption. The poor socioeconomic status may also lead to low BMD. The daily requirement of calcium during pregnancy is 200mg while 200-400mg is secreted during lactation [16].

According to some studies BMD differences in both reproductive and post-menopausal women has minimized by healthy diet, regular use of supplements [17] and timely awareness can increase the quality of life [18]. In some countries due to lack of awareness and low literacy rate the differences has increased. Even some studies say that these BMD differences can be prevented with timely treatments and education [19]

The Gold standard tool for the screening of BMD is Dual Energy X-ray which is a kind of absorptiometry test, is widely used to diagnose osteoporosis. In Pakistan only 01/10 million DEXA machines are available [16]. The aim of this research was to assess the difference of BMD level in reproductive and postmenopausal women in District Lahore. This is a cross-sectional comparative study in which menopause is one of the major causes of osteopenia/osteoporosis all over the world due to hormonal deficiency. We compared the two groups to find out that how much BMD levels are in reproductive. Menopause is not the only cause of osteopenia/osteoporosis in our society.

Many studies have been done about BMD of post-menopausal women but limited literature is available on BMD in reproductive women. Moreover, no comparative study was found about BMD differences in reproductive and post-menopausal women.

Objective

The purpose of this study is to compare the difference in BMD level and its effect on bone health in reproductive and post-menopausal women in District Lahore.

Rationale

The rationale of the study is to find out whether there is any significant difference in the BMD among reproductive and post-menopausal women in the population of Lahore, Pakistan as in Western societies these variations are minimized with awareness programs about role of exercise, proper diet and supplements. This would be the first step in Pakistan and can be helpful in further studies to assess the other influencing factors.

Operational Definition:

The t- score BMD assessment according to WHO Standards: -

t-score-1.0 SD or more as normal.

t-score between -1.0 and -2.5 SD indicate osteopenia

t-score of -2.5 SD or below indicates osteoporosis [20].

DEXA is the most reliable bone density test that identifies up to (88.2%) cases of osteoporosis (sensitivity 88.2%), and the specificity is (62.5%) [21].

Hypothesis

Null Hypothesis: There is no significant difference between bone mineral density of reproductive and post-menopausal women of Lahore.

Alternate Hypothesis: There is significant difference between bone mineral density of reproductive and post-menopausal women of Lahore.

Literature Review

Nasser M Al-Daghr, et al. 2017 conducted a cased controlled

study on Saudi post-menopausal women aged more than 50 years with controlled group of women without osteoporosis based generalized questionnaire which includes age, age of menarche, menopause age, disease history. They used DEXA based on T score for BMD. According to WHO -1.0SD is normal. -2.5 SD indicates osteoporosis. They studied the role of resistin, leptin IL-1, IL-2, IL-6 in bone metabolism. So anti-cytokine therapy is more effective in preventing osteoporotic fractures [20].

S.J. Kwon, et al. 2017. In this study the researchers explained the association of sodium intake with low BMC and BND. Cross-sectional study was done using "Korea National Health and Nutrition Examination Survey" on premenopausal and postmenopausal women. The study showed that sodium had negative results on lumbar spine whereas sodium could be a potential factor for causing osteoporosis in postmenopausal women [21,22].

E. P. Paschalis, et al. 2017 explained the three years of Vitamin D and Calcium supplementation has lowered BMD and lowers down the glycosaminoglycan content women of postmenopausal age, hence decreasing the risk factor for osteoporosis [23].

Sangita Paneri, et al. 2017 discussed the impact of BMI and low estrogen level in women. The case controlled study was done on obese postmenopausal women with control group of reproductive age subjects. The results showed that bone related problems are common in obese postmenopausal subjects with elevated BMI and lower estrogen level [24].

Karin kanta. 2017 In this study the comprehensive tool for middle aged women is physical activity. In this cross-sectional study the author divided the subjects into two groups; first the exercise was done for 16 years under the supervision. Second, the multicomponent exercise training for balance, fall prevention, endurance and strength were carried in group. The 16years exercise was unrealistic approach for all but the multicomponent training promoted a healthy life style [25].

Jyoti Thulkar, et al. 2016 conducted a systemic review and meta-analysis based on the risk factors for osteoporosis on Asian postmenopausal women by using osteoporosis self- assessment tool for Asia (OSTA) based on two parameters age and weight. The non-availability of DEXA scan made difficult for them to give drug treatment. they concluded that calcium and vitamin D along with exercise could help to prevent osteoporosis in postmenopausal women [4].

Nighat Yaseen Sofi, et al. 2016 discussed the dietary intake of calcium in reproductive women. The study was done on Delhi women of age 20-49years. The study explained that lower socioeconomic class women are more prone to osteoporotic fractures as the calcium intake is almost half to that in upper class [26].

Heidari, et al. 2015 determined the factors affecting BMD in relation with Demographic, biochemical and clinical data. The cross-sectional case control study was done in elderly women and their BMD was measured. Study concluded with association between osteoporosis and level of education, physical activity and obesity [22].

Oliveira, et al. 2015 the study explained the interaction between socioeconomic status with bone fragility and age. The study was done through Portuguese hospital discharge database. The result was that the incidence of hip fracture increase in elderly as the SES increased and for young individuals the hip fracture increase with decrease SES [27].

Karine Briot, et al. 2015 in this study the researcher discussed the Glucocorticoid-induced osteoporosis in young people. An 18-month randomized trial was done on the patients with corticosteroids therapy which increased the fracture susceptibility and bone mineral loss by two-fold in rheumatic disorders. They measured the risk of fracture by BMD. They reported that fractures caused after GC therapy could not be neglected as it the major cause of secondary osteoporosis [28].

M.A. Paggiosi, et al. 2015determined the impact of GC therapy on trabecular bone score. The case controlled study was conducted in older women with GC therapy and a control group of healthy women. They proposed that after DEXA scan the TBS gave the additional information about glucocorticoid induced bone fragility [29].

Material and Methods

A comparative cross-sectional study conducted in Lahore, Pakistan in 2017, completed in duration 3 months. Raosoft online sample calculator was used, Sample of 196 was taken from a population of 967500 osteoporotic women.

Following formula was used for sample size estimation:

In this formula, "n" represents the sample size and "E" for errors:

X　　　=　　　Z (C/100)2 r (100-r)

N　　　=　　　N x/((N-1)E2 + x)

E　　　=　　　Sqrt [(N - n) x/n (N-1)]

Where: **N** is the population size

E= Margin error (5%)

r= is the fraction response

Z(c/100) is the critical value for confidence level c (90%)

using convenient sampling techniques out of 196, 98 females were reproductive and 98 females were postmenopausal subjects were enrolled from different hospitals i.e. Mayo hospital, Al-Noor medical center and Punjab Medical center, Lahore. Data were collected after taking informed consent. An inclusion criterion was women in reproductive age group and postmenopausal

women after age 51. An exclusion criterion was women who were pregnant, Recent gastrointestinal contrast studies, Bilateral hip replacements or bilateral hip pins or screws would prevent the hip sites from being scanned and Metallic rods or spinal fusion devices in the lumbar spine prevent scanning. Bone density scan questionnaire was used before DEXA scan. Questions were close ended. The data was analyzed using SPSS 20 version Mean ± standard Deviation and t-score of BMD was calculated. Independent T-test was applied to find the comparison of t-score of lumbar and hip in reproductive and postmenopausal women.

Results

	Frequency (n=196)	Percentage
Yes	22	11.2
No	174	88.8

Table 1: Frequency distribution of previous bone scans.

Total 196 subjects were enrolled, 22 had done their previous bone scan and 174 had not.

		Frequency (n=196)	Percentage
Menopause	**Yes**	98	50.00%
	No	98	50.00%

Table 2: Frequency distribution of menopause.

We have compared the frequency distribution of menopausal women, the results showed that 98 reproductive women and 98 post-menopausal women.

	Menopause		Total	P value
	Yes	No		
Normal	30	48	78	0.01
Osteopenia	41	36	77	
Osteoporosis	27	14	41	

Table 3: T-score of Lumbar.

Total population 0f 196 sample is selected 30 females are at menopause and their dexa is normal, 48 females are reproductive and their dexa is normal. 41 postmenopausal females are osteopenia and 36 reproductive females are osteopenic, 27 postmenopausal females are osteoporotic, 14 reproductive females are osteoporotic. Total p. value (0.01) shows there is significant difference in osteoporosis and osteopenia in reproductive and postmenopausal females.

	Menopause		Total	P value
	Yes	No		
Normal	45	51	96	
Osteopenia	33	38	71	0.08
Osteoporosis	20	9	29	

Table 4: T-score of Hip.

The total population, 196 samples were taken, 45 postmenopausal and 51 reproductive females are normal, 33 postmenopausal and 38 reproductive are osteopenia, 20 postmenopausal and 9 reproductive are osteoporotic. P value is (0.08) which shows there are no significant difference in osteoporosis and osteopenia in reproductive and postmenopausal females.

		Reproductive (n= 98)	Postmenopausal (n=98)	P value
		Mean ± SD	Mean ± SD	
T- score	**L1**	-0.58±1.31	-1.21±1.24	0.001
	L2	-0.66±1.29	-1.25±1.39	0.003
	L3	-0.82±1.24	-1.34±1.44	0.007
	L4	-1.16±01.29	-1.51±1.65	0.093

Table 5: Independent T-test for L1-L4 T score.

An independent sample t-test showed that reproductive women (n=98, L1 t-score Mean ± SD=-0.58±1.31, L2 t-score Mean ± SD=-0.66±1.29, L3 t-score Mean ± SD= -0.82±1.24 L4 t-score Mean ± SD=-1.16±01.29) and Post-menopausal women (n=98, L1 t-score Mean ± SD=-1.21±1.24, L2 t-score Mean ± SD=-1.25±1.39,L3 t-score Mean ± SD=-1.34±1.44 and L4 t-score Mean ± SD=-1.51±1.65). P-value for L1 t-score=0.001, P-value for L2 t-score=0.003, P-value for L3 t-score =0.007 and P-value for L4 t-score=0.093.

		Reproductive (n=98)	Post-menopausal (n=98)	P value
		Mean ± SD	Mean ± SD	
T- score	**Neck of femur**	-1.51±1.22	-2.19±1.57	0.002
	Trochanter	-0.66±1.72	-0.97±1.42	0.172
	Inter trochanter	-0.45±1.25	-1.02±1.31	0.002

Table 6: Independent T test for T- score of neck of femur, Trochanter and Intertrochanter.

An independent sample t-test showed that reproductive women (n=98, neck of femur t-score Mean ± SD=-1.51±1.22, Trochanter t-score Mean ± SD=-0.66±1.72, Inter-trochanter t-score Mean ± SD=-0.45±1.25) and Post-menopausal women (n=98, neck of femur t-score Mean ± SD=-2.19±1.57, Trochanter t-score Mean ± SD=-0.97±1.42, Inter-trochanter t-score Mean ± SD=-1.02±1.31)P-value for neck of femur t-score=0.002, P-Value for Trochanter t-score=0.172, P-value for Inter-trochanter t-score=0.172.

	Reproductive (n=98)	Postmenopausal (n=98)	P value
	Mean ± SD	Mean ± SD	
t-score	-1.06±1.19	-1.55±1.35	0

Table 7: Independent t-test for the comparison of t-scores of lumbar in Reproductive and Post-Menopausal Women.

An independent sample of t-test showed that the two groups i.e. reproductive women (n=98, t-score Mean ± SD= -1.06±1.19) and Post-menopausal women (n=98, t-score Mean ± SD=-1.55±1.35) the P-value for t-score=0.007

	Reproductive (n=98)	Post-Menopausal (n=98)	P value
	Mean ± SD	**Mean ± SD**	
t-score	-0.67±1.19	-1.16±1.29	0

Table 8: Independent t-test for the comparison of t-scores of hips in Reproductive and Post-Menopausal Women.

An independent sample of t-test showed that the two groups i.e. reproductive women (n=98, t-score Mean ± SD= -0.67±1.19) and Post-menopausal women (n=98, t-score Mean ± SD= -1.16±1.29) the P-value for t-score=0.00.

Discussion

In my study half of population was reproductive and half postmenopausal. According to my study, the P-value of average t-score for both reproductive and post-menopausal is < 0.05 which shows there is significant difference in their t-score. P-value of average T score of lumbar in post- menopausal and reproductive women is 0.01 which shows the difference, P-value of average t score for hip in reproductive and postmenopausal is 0.08 which shows there is no significant difference. According to study, there are more chances of osteoporosis and osteopenia in lumbar region as compared to the hip region. Females who have less BMD are more prone to development of osteoporosis either reproductive or post-menopausal. BMD differences in both reproductive and post-menopausal women have minimized by healthy diet, regular use of supplements and timely awareness can increase the quality of life.

Reproductive status is considered to be the hallmark of BMD differences but in fact there are many other factors which could be responsible for decreased BMD in reproductive and post-menopausal women. It is biologically and scientifically proven that low bone mass density occurs in post-menopausal women due to decline in estrogen but it can be prevented with exercise Walking as an exercise program can improve the femoral BMD in postmenopausal women. A combined exercise program (resistance + aerobic + impact) is recommended for an enhancement of spine BMD, however, the problematic finding in our study is the same

result in reproductive women which is biologically questionable since estrogen is sufficient enough to prevent bone resorption. So, it is not only the hormonal factors which cause low BMD in such women. Lack of awareness about the benefits of calcium and overall negligence towards health are all a part of one big phenomenon of low BMD in normal reproductive women. A study was done in Pakistan 2016 to check the bone mineral density status of reproductive age and according to the results, more than half of women had low BMD or more development of chances of osteoporosis this is due to low calcium intake. And according to a survey daily intake of calcium in the diet is almost 400-600 mg/day which is half of the required amount this are also major contributing factors to decrease BMD. (Rakshanda Toheed, et al. 2016). A Study was performed in Karachi on osteoporosis in menopausal women, and according to the study 52.5 % post- menopausal women had osteoporosis this is due to the decrease in BMD after menopause, lack of physical activity due to low intake of calcium, which is the leading cause of development of osteoporosis. (Shazia Khokharet., 2016). The Research was performed in India on preventable risk factors in post -menopausal females according to this study development of osteoporosis in Asia is almost 41%, major causes were a low intake of calcium and vitamin D. Exercise is the major preventable factors to reduce osteoporosis in postmenopausal females, resistance exercises and aquatic exercises are much better (Jyoti Thulkar, et al. 2016). Another study was performed in Karachi to assess the knowledge about osteoporosis in women in child bearing age, results of the study show Women's had very limited knowledge regarding osteoporosis in child bearing age, they were unaware about the risk factors. Due to the lack of knowledge of osteoporosis the early signs of osteoporosis neglected by the females. Most of the females were unaware about the fact that osteoporosis is in consortium with menopause. (Aimen Akhtar, et al. 2016).

Conclusion

This study concludes that there is significant difference of BMD between reproductive and menopausal females as the P-value is 0.05. The P-value of average T-score for lumbar in post- menopausal and reproductive women is 0.01 which shows the difference, P-value of average T-score for hip in reproductive and postmenopausal is 0.08 which shows there is no significant difference. As osteoporosis is irreversible so we can highlight the awareness of bone heath. Early diagnosis by testing for osteoporosis may limit fractures in post-menopausal women.

Limitations

Once we have arrived at the conclusion of the study, we are more aware of the limitations that can hamper the study outcome. The study was conducted in Mayo Hospital Lahore, Punjab Medical Center and Al-Noor Diagnostic Center which do not necessarily constitute the major population of reproductive and post-

menopausal women, there is not much diversity. Also, the study has a very small sample size which could have been improved for better results. Moreover, the total time the study was completed in was 3 months, which is not sufficient enough to collect satisfactory data.

References

1. Sugimoto T, Sato M, Dehle FC, Brnabic AJM, Weston A, et al. (2016) Lifestyle-Related Metabolic Disorders, Osteoporosis, and Fracture Risk in Asia: A Systematic Review. Value in Health Regional Issues 9: 49-56.

2. Vijayakumar R, Büsselberg D (2016) Osteoporosis: An under-recognized public health problem: Local and global risk factors and its regional and worldwide prevalence. Journal of Local and Global Health Science: 2.

3. Organization WH (1974) World Health Organization. Scientific Group on the Assessment of the Carcinogenicity and Mutagenicity of Chemicals: Report of a WHO Scientific Group. World Health Organization.

4. Thulkar J, Singh S, Sharma S, Thulkar T (2016) Preventable risk factors for osteoporosis in postmenopausal women: Systematic review and meta-analysis. Journal of Mid-life Health 7: 108.

5. Drieling RL (2015) Osteoporosis Medication Use and Fracture Risk in the Women's Health Initiative.

6. Nichols GN (2016) Bone Health Education for Osteoporosis Risk Reduction in Premenopausal Women: A Quality Improvement Project.

7. Modi A, Sen S, Adachi JD, Adami S, Cortet B, et al. (2016) Gastrointestinal symptoms and association with medication use patterns, adherence, treatment satisfaction, quality of life, and resource use in osteoporosis: baseline results of the MUSIC-OS study. Osteoporosis International 27: 1227-1238.

8. Cheung EY, Tan KCB, Cheung CL, Kund AWC (2016) Osteoporosis in East Asia: Current issues in assessment and management. Osteoporosis and Sarcopenia 2: 118-133.

9. Akhtar, A, et al. (2016) Knowledge About Osteoporosis in Women Of Child Bearing Age (15-49 Years) Attending Fauji Foundation Hospital Rawalpindi. Pak Armed Forces Med J 66: 558-563.

10. Gutin B, Kasper MJ (1992) Can vigorous exercise play a role in osteoporosis prevention? A review. Osteoporosis International 2: 55-69.

11. Hay P (2016) Reflections on the 'State of the Evidence' for treatments in anorexia nervosa. Acta Psychiatrica Scandinavica 133: 339-340.

12. Salmas-Physiotherapist, P., et al., Physiotherapy for Osteoporosis.

13. Lorbergs AL, A Holland (2016) Falling Between the Cracks: Attitudes and Perceptions toward Osteoporosis Prevention among Postmenopausal Women. Journal of Osteoporosis and Physical Activity.

14. Sarfaraz S (2016) Osteoporosis Awareness in Female Population of Karachi: A Cross Sectional Survey Based Study.

15. Cosman F, SJ de Beur, MS LeBoff, EM Lewiecki, B Tanner, et al. (2014) Clinician's guide to prevention and treatment of osteoporosis. Osteoporosis international 25: 2359-2381.

16. Toheed R, Ayub TB, Munawwar I, Mumtaz S, Waheed G (2016) Bone Mineral Density (BMD) Status and its Determinants in Rural Women of Reproductive Age. Journal of Rawalpindi Medical College (JRMC) 20: 129-131.

17. Moschonis G, Katsaroli I, Lyritis GP, Manios Y (2010) The effects of a 30-month dietary intervention on bone mineral density: The Postmenopausal Health Study. British journal of nutrition 104: 100-107.

18. Baig L, Mansuri FA, Karim SA (2009) Association of menopause with osteopenia and osteoporosis: results from population based study done in Karachi. J Coll Physicians Surg Pak 19: 240-244.

19. Abd-Alhameed I, E Saba, HM Darwish (2010) Prevalence and awareness of osteoporosis among postmenopausal Palestinian women. Archives of Osteoporosis 5: 111-118.

20. Al-Daghri NM, Yakout S, Aljohani N, Al-Saleh Y, Al-Attas OS, et al. (2017) Changes in serum cytokines and vitamin D in Saudi postmenopausal women with osteoporosis. Int J Clin Exp Med 10: 1179-1185.

21. Humadi A, RH Alhadithi, SI Alkudiari (2010) Validity of the DEXA diagnosis of involutional osteoporosis in patients with femoral neck fractures. Indian journal of orthopaedics 44: 73.

22. Kwon SJ, YC Ha, Y Park (2017) High dietary sodium intake is associated with low bone mass in postmenopausal women: Korea National Health and Nutrition Examination Survey, 2008-2011. Osteoporosis International: 1-8.

23. Paschalis EP, Gamsjaeger S, Hassler N, Fahrleitner-Pammer A, Dobnig H, et al. (2017) Vitamin D and calcium supplementation for three years in postmenopausal osteoporosis significantly alters bone mineral and organic matrix quality. Bone 95: 41-46.

24. Paneri S, Panchonia A, Varma M, Sarkar PD, Yadav S (2017) Impact of body mass index and low estrogen level on urinary hydroxyl proline and other bone related parameters in postmenopausal women. International Journal of Reproduction, Contraception, Obstetrics and Gynecology 3: 335-337.

25. Karinkanta S (2017) Exercise: a comprehensive tool for ageing women to take care of their health. Menopause 24: 7-8.

26. Sofi NY, U Kapil, M Jain (2016) Status of dietary intake of calcium in women of reproductive age in Delhi, India. Indian Journal of Community Health 28: 106-107.

27. Oliveira CM, Economou T, Bailey T, Mendonça D, Pina MF (2015) The interactions between municipal socioeconomic status and age on hip fracture risk. Osteoporosis international 26: 489-498.

28. Briot K, C Roux (2015) Glucocorticoid-induced osteoporosis. RMD open 1: e000014.

29. Paggiosi M, N Peel, R Eastell (2015) The impact of glucocorticoid therapy on trabecular bone score in older women. Osteoporosis International 26: 1773-1780.

Appendix

Consent Form

The study you are about to participate is to compare the Bone Mass Density of reproductive and post-menopausal women of Lahore, Pakistan. The study has no potential harm to participants. All data collected from you will be coded in order to protect your identity, and should not be disclosed to anyone. Following the

study there will be no way to connect your name with your data.

You are free to withdraw from the study at any time. You agree to participate, indicating that you have read and understood the nature of the study, and that all your inquiries concerning the activities have been answered to your satisfaction.

Bone Density Scan Questionnaire Date: _____

Patient Name: _____ Age: _____

Previous bone density scan: Yes _____ No _____

Please check one of the following:

Pre-menopausal_____ Post-menopausal_____

Have you been diagnosed with osteopenia/osteoporosis? Yes _____ No _____

Dexa Results

Lumbar: _____

L1_____

L2 _____

L3 _____

L4 _____

L5 _____

Hip: _____

Neck of femur:_____

Trochanter: _____

Inter Trochanter: _____