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Plyometrics and lifestyle effects on bone mineral density among premenopausal women: demographic and physiological analysis

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ABSTRACT

Bones have a numerous significant functions in the body such as supporting and protecting various organs of the body. Osteoporosis is a disease of bone characterized by low bone mass and micro-architectural deterioration of bone tissue, that leads to enhanced bone fragility and increased likelihood of fractures. Osteoporosis may be caused due to lower than the normal peak bone mass. Low bone mass results in faster rate of bone porosity and predisposes to osteoporotic fractures. Plyometrics is one of the most effective types of exercises for stimulating bone growth. The aim of the study was first to evaluate the effectiveness of plyometrics benefits on physiological parameters of osteoporosis among premenopausal women. Second to find out the association between the physiological parameters of osteoporosis among premenopausal women with selected demographic variables. The research approach was a Quantitative approach. Design adapted for the study was a true Experimental design with one control group and one experimental group. Data collected from 40 self help group women who were the members of kanchi sangamam from a selected area at Chennai. Sample were collected by using simple random technique. Based on the inclusion criteria and availability of premenopausal women, they were allocated into the control group (n=20) and experimental group (n=20). Plyometrics was given to the experimental group for 12 weeks. The control group did not receive an intervention. It was analyzed by descriptive and inferential statistics. The study determined there is significant changes in physiological parameters of osteoporosis among the experimental group(p<0.001) as compared to the control group.

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INTRODUCTION

Women are a gift of god. Nature had form series of conversion from her birth up to death, which comprises menarche, pregnancy, labour, motherhood, pre-menopause, menopause and post-menopausal stages (Swamy *et al.*, 2017).

Bone metabolism is a dynamic and continuous process to maintain a balance between the resorption of old and injured bone initiated by Osteoclasts and the formation of new bone under the control of Osteoblasts.

Early adulthood, formation exceeds resorption because bone density increases and then plateaus until the age of 30 to 40 years. Henceforth, resorption exceeds formation and bone density decreases through the rest of life, which in turn may lead to osteoporosis, (Indumati *et al.*, 2007).

Osteoporosis can lead to important clinical outcomes, adversely affecting the quality of life of people and is a frequent cause of pain, spinal deformity, inadequate or severe functional loss and increased fracture risk. (Marchese *et al.*, 2012).

In women, it has been postulated that menopause is followed by an sudden decrease in bone mass and density within a year. Osteoporosis, depicted as low bone mass leading to increased fracture risk, is a major health problem that affects approximately 10 million Americans. The aging U.S. population is predicted to contribute to as much as a 50% increase in prevalence by 2025.

Osteoporotic fracture–related pain and disability affect function and quality of life. (Kling *et al.*, 2014). Osteoporosis is a major international health problem, accentuated by increasing longevity.

Osteoporosis is estimated to affect 200 million women worldwide-approximately one-tenth of women aged 60, one-fifth of women aged 70, two-fifths of women aged 80 and two-thirds of women aged 90. 1 out of 8 males and 1 out of 3 females in India suffers from osteoporosis, India one of the largest affected countries in the world. (Nikoseet, 2015).

Quantitative ultrasound (QUS) is a rapid and inexpensive method of measuring bone density. QUS uses high frequency sound waves to measure bone density.

It is cheap, radiation free and quick method of measuring bone density and is a good screening procedure (Najam and Huda, 2012), Plyometric training exercises are designed to develop explosive jumping power and increase speed and power in general.

Plyometric training entails a great impact loading as the before mentioned ground reaction forces, it represents one of the potentially most valued training modality for improving bone mass. The purpose of plyometric studies was to improve bone mass over time periods of 9 weeks. (Gregov and šalaj, 2014).

Regularly performing plyometrics is a major lifestyle measure for osteoporosis prevention. The International Osteoporosis Foundation gives recommendation of exercise schedules, one of which is "45 to 60 minutes of weight-bearing aerobic exercise three days per week (i.e., brisk walking)".

It's clear that higher levels of exercises may be associated with additional benefits for bone health, Particularly in young adult women. Saraví and Sayegh (2013).

Osteoporosis being a public health problem, basically, regular plyometrics started early in life ensures adequate bone strength and reduces the risk of falling. Nurses play a vital role in preventing this disease thus curtailing its societal ravages. Nurses are purported to value and have an enthusiasm for health promotion.

Statement of the Problem

Plyometrics and lifestyle effects on bone mineral density among premenopausal women demographic and physiological analysis

Objectives

To evaluate the effectiveness of plyometrics on physiological parameters of osteoporosis among premenopausal women

To find out the association between physiological parameters of osteoporosis among premenopausal women with selected demographic variables

MATERIALS AND METHODS

Study design

The research approach was a Quantitative approach. Design adapted for the study was a true Experimental design with one control group and one experimental group.

Setting and Sampling

The study was conducted among self-help group women from two areas vandalur two zones. The data collection period was from 11/04/2019 to 11/07/2019. 40 self-help group women who meet the inclusion criteria were selected as the sample.

Samples were selected using a simple random sampling technique. From the 9 areas of kanchi women's sangamam private association, randomly selected 2 urban areas.

In the first phase, 180 premenopausal women were assessed for eligibility by checking the weight, height, Bone mineral density. The subjects were screened for BMD using an ultrasound based on BMD machine.

The machine was portable, reliable, and cost effective and was carried to the and suitable for initial screening180 premenopausal women who did not meet any one of the eligibility criteria were excluded.83 Women met the inclusion criteria. Among them, 40 women were selected by using lottery method.

Table 1: The demographic characteristics of the participants are described in terms of frequency and percentage

Demographic Variables	Experimental Group		Control Group	
	No.	%	No.	%
Age				
30 - 35 years	10	50.0	6	30.0
35 - 40 years	10	50.0	14	70.0
Marital status				
Married	17	85.0	17	85.0
Unmarried	0	0	0	0
Widow	3	15.0	3	15.0
Divorce	0	0	0	0
Educational qualification				
Illiterate	3	15.0	2	10.0
Primary education	15	75.0	16	80.0
High school and above	2	10.0	2	10.0
Religion				
Hindu	14	70.0	16	80.0
Christian	4	20.0	3	15.0
Muslim	2	10.0	1	5.0
No. of children				
No children	0	0	0	0
1 to 2 children	15	75.5	18	90.0
3 to 5 children	5	25.5	2	20.0
Type of family				
Nuclear family	15	75.0	19	95.0
Joint family	5	25.0	1	5.0
Socio economic status				
Low	12	60.0	17	85.0
Middle	8	40.0	3	15.0
High	0	0	0	0
Family history of osteoporosis				
Yes	2	10.0	1	5.0
No	18	90.0	19	95.0
Age of attainment of menarche				
<10 years	3	15.0	3	15.0
10 - 13 years	12	60.0	16	80.0
>13 years	5	25.0	1	5.0
Menstrual regularity				
Regular	16	80.0	17	85.0
Irregular	4	20.0	3	15.0
Dietary habits				
Vegetarian	4	20.0	2	10.0
Non-vegetarian	16	80.0	18	90.0
Source of information				
Mass media	2	10.0	2	10.0
Friends	0	0	0	0
Health personnel	0	0	0	0
None	18	90.0	18	90.0

Table 2: Frequency and percentage distribution of level of BMI among premenopausal women in the experimental and control group.

Group	BMI	Pretest		Post Test n = 40 (20+20)	
		No.	%	No.	%
Experimental Group	Underweight (<18.5)	0	0	0	0
	Normal (18.5 – 22.9)	0	0	1	5.0
	Overweight (23.0-24.9)	1	5.0	2	10.0
	Obese (25 – 29.9)	19	95.0	18	90.0
Control Group	Underweight (<18.5)	0	0	0	0
	Normal (18.5 – 22.9)	0	0	0	0
	Overweight (23.0-24.9)	0	0	0	0
	Obese (25 – 29.9)	20	100.0	20	100.0

Table 3: Frequency and percentage distribution of plyometrics among premenopausal women in the experimental and control group.

Group	Level of plyometrics	Pretest		Post Test n = 40 (20+20)	
		No.	%	No.	%
Experimental Group	Inactive	18	90.0	0	0
	Moderately Inactive	2	10.0	2	10.0
	Moderately Active	0	0	5	25.0
	Active	0	0	13	65.0
Control Group	Inactive	18	90.0	18	90.0
	Moderately Inactive	2	10.0	2	10.0
	Moderately Active	0	0	0	0
	Active	0	0	0	0

Table 4: Frequency and percentage distribution of level of bone mineral density among premenopausal women in the experimental and control group.

Group	Level of Bone Mineral Density	Pretest		Post Test n = 40 (20+20)	
		No.	%	No.	%
Experimental Group	Normal	0	0	19	95.0
	Osteopenia	20	100.0	1	5.0
	Osteoporosis	0	0	0	0
Control Group	Normal	0	0	0	0
	Osteopenia	20	100.0	20	100.0
	Osteoporosis	0	0	0	0

Table 5: Association of pretest and post test level of plyometrics among premenopausal women in the experimental group.

Demographic Variables		Pretest Kruskal Wallis H-Test & p-value	n = 20 Post Test Kruskal Wallis H-Test & p-value
Age		x^2=2.105	x^2=1.236
30 - 35 years	10	d.f=1, p = 0.147, N.S	d.f=1, p = 0.266, N.S
35 - 40 years	10		
Marital status		x^2=0.372	x^2=1.002
Married	17	d.f=1, p = 0.542, N.S	d.f=1, p = 0.317, N.S
Unmarried	0		
Widow	3		
Divorce	0		
Educational qualification		x^2=18.947	x^2=3.067
Illiterate	3	d.f=2, p = 0.0001, S***	d.f=2, p = 0.216, N.S
Primary education	15		
High school and above	2		
Religion		x^2=3.474	x^2=5.064
Hindu	14	d.f=2, p = 0.176, N.S	d.f=2, p = 0.080, N.S
Christian	4		
Muslim	2		
No. of children		x^2=0.702	x^2=1.120
No children	15	d.f=1, p = 0.402, N.S	d.f=1, p = 0.292, N.S
1 to 2 children	5		
3 to 5 children	0		
Type of family		x^2=0.849	x^2=0.019
Nuclear family	15	d.f=1, p = 0.357, N.S	d.f=1, p = 0.891, N.S
Joint family	5		
Socio economic status		x^2=1.404	x^2=3.475
Low	12	d.f=1, p = 0.236, N.S	d.f=1, p = 0.062, N.S
Middle	8		
High	0		
Family history of osteoporosis		x^2=3.289	x^2=2.120
Yes	2	d.f=1, p = 0.070, N.S	d.f=1, p = 0.145, N.S
No	18		
Age of attainment of menarche		x^2=0.762	x^2=3.909
<10 years	3	d.f=2, p = 0.683, N.S	d.f=2, p = 0.142, N.S
10 - 13 years	12		
>13 years	5		
Menopausal regularity		x^2=0.526	x^2=0.483
Regular	16	d.f=1, p = 0.468, N.S	d.f=1, p = 0.487, N.S
Irregular	4		
Dietary habits		x^2=1.390	x^2=0.798
Vegetarian	4	d.f=1, p = 0.238, N.S	d.f=1, p = 0.372, N.S
Non-vegetarian	16		
Source of information		x^2=18.947	x^2=2.120
Mass media	2	d.f=1, p = 0.0001, S***	d.f=1, p = 0.145, N.S
Friends	0		
Health personnel	0		
None	18		

***p<0.001, S –Significant, N.S – Not Significant

Inclusion Criteria for the study were premenopausal Women belongs to the age group of 30 to 40 years and Premenopausal women between the age of 30 -40 years residing in selected urban areas during the study. Who were willing to participate in this study. Who are bone mineral density measurement T- scores ranging from -1 to - 2.5, as per Quantitative Ultra Sound Test.

Exclusion Criteria for the study

Women were having cognitive impairment, chronic illness affected with mental health problems who are not willing to participate the plyometrics demonstration. Women who are under Hormonal Replacement Therapy Women who are previously diagnosed as osteoporosis. In post menopausal period

Ethical consideration

The Institutional Ethical Committee approved this study of Saveetha Medical college Hospital (006/04/2019/Institutional Ethical Committee/ Saveetha Medical College Hospital). Setting permission was obtained from kanchi women's sangamam private self help group association. To ensure anonymity, no name was written in the demographic datasheet. At the beginning of the study, participant information sheet was provided, and informed consent was taken from the study participants.

Instruments

The demographic characteristics of 40 premenopausal women in terms of consists of age, marital status, education, religion, no of children, type of family, socioeconomic status, family history of osteoporosis, age of attainment of menarche, mensural regularity, dietary habits, source of information regarding osteoporosis.

The physiological parameters were weight a bathroom scale was used to take the weight. The subjects were weighed barefoot and with minimal clothing on a standard portable bathroom scale. The scale was set to zero before each measurement. Height a perpendicular wall against a flat floor was identified as the field and was marked using fiber tape to an accuracy of 0.1 cm.

The subjects were asked to stand bare feet on the floor against the wall. The feet of the subjects were parallel and with heels, buttocks, shoulders and back of the head touching the wall. The head was held comfortably erect and marked for measuring height with a flat scale touching the top of the head horizontally and its vertical edge flat against the wall.

Measurement of index body mass index was calculated by dividing weight (in kilograms) by the square of the height (in meters) the classification of obtained BMI values (WHO, 2004).

The demonstration of plyometrics was demonstrated by the researcher. The investigator underwent training for six months plyometrics training and certified. The plyometrics that include Hip(strengthening), knee (strengthening), shoulder (resistance) spine(resistance) At the end of the demonstration the same plyometrics will redemo by premenopausal women and pamphlet are issued to the premenopausal women, The pamphlet had pictorial representations. Each wing was divided into two groups, in total 2 groups were formulated. Two groups were selected for demonstration. Each group consists of 10 subjects. The pamphlets are validated for its content, language, clarity, accuracy and feasibility from the experts before its utilization. Reinforcement on every weakened by the researcher. The subjects are instructed to go regular walking 30 minutes per day for 5 days a week. Physical activity will be assessed by using a General Practice Physical Activity Questionnaire (GPPAQ) in both experimental and control group.

Dietplan:24-hour nutritional recall was done. Calcium rich diet plan were given to the participants as per the directions of a dietician. The daily diary was maintained to monitor the intake of prescribed diet

Data collection

Data collection was done from April 2019 to July 2019 after obtaining permission from the kanchi-women's sangamam private association. Women who meet the inclusion criteria were randomly assigned into two groups, one control group and one experimental. Group. The pre-test was done. After the assessment plyometrics was given to the Experimental group. The control group did not receive any response. The post-test was done after 12 weeks of intervention among two groups.

Data analysis

Data was entered in a master data sheet, categorical variables were summarized using frequency and percentage. Quantitative variables are summarized using mean, standard deviation, median. To assess the effectiveness of plyometrics benefits on physiological parameters of osteoporosis, study the association of plyometrics with selected socio demographic variables test and kruskal Wallis test were performed. is $p < 0.001$, considered as statistically significant. Complete data analysis was performed using software (SPSS version20).

RESULTS AND DISCUSSION

Demographic characteristics of the participants

Table 1 shows the description of premenopausal women according to their demographic variables in the experimental and control group. In experimental group, with half of women were between the Age 30 to 35 years and 35 to 40 years.17 of them was married and 3 of them widow. In Educational qualification 3 of them were illiterate, $\frac{3}{4}$ women were primary education and only 2of them high school education. 14 of them in Hindu religion, 4 of them Christian, 2 of them muslim.

In no of children $\frac{3}{4}$ of them were 1 to 2 children and 5 of them only have 3 to 5 children. In type of family $\frac{3}{4}$ nuclear family and 5 of them were joint family.12 of them were low socioeconomic status and 8 of them were middle class.18 of them were no family history of osteoporosis and 2 of them have family history of osteoporosis.

In age of attainment menarche <10 years only 12 of them attain menarche in the age 10-13yrs,5 of them were >13 years attain the menarche. $\frac{3}{4}$ have regular mensuration, only 4 of them have irregular menstruations. Dietary habits $\frac{3}{4}$ were non vegetarian and only 4 of them were vegetarian. Source of information about osteoporosis only 2 of them were knew about mass media and 18 of them were not known about information about osteoporosis.

In control group, with 6 women were between the Age 30 to 35 years and 14 women 35 to 40 years. 17 of them were married and 3 of them widow. In Educational qualification 2 of them were illiterate, $\frac{3}{4}$ women were primary education and only 2of them high school education. $\frac{3}{4}$ of them in Hindu religion, 3 of them Christian, 1 of them muslim.

In no of children $\frac{3}{4}$ of them were 1 to 2 children and 2 of them only have 1 to 2 children. In type of family $\frac{3}{4}$ nuclear family and 1 of them were joint family.17 of them were low socioeconomic status and 3 of them were middle class.19 of them were no family history of osteoporosis and 1 of them have family history of osteoporosis.

In age of attainment menarche <10 years only 3 of them attain menarche, In the age 10-13yrs 16 of them were >13years only 1 attain the menarche. $\frac{3}{4}$ have regular mensuration, only 3 of them have irregular menstruations. Dietary habits $\frac{3}{4}$ were non vegetarian and only 2 of them were vegetarian.

Source of information about osteoporosis only 1 of them were Knew about mass media and19 of them were not known about information about osteoporosis

Physiological parameters

Table 2 Depicted data regarding body weight of the subjects were measured and body mass index was calculated (BMI, kg/m2). For BMI, the WHO criteria were applied and the percentage of experimental group in pretest overweight 1(5.0%), obese 19(95.0), under weight and normal weight there is no subject and the post test overweight 2(10.0%), obese 18(90.0), under weight and normal weight there is no subject. Control group in pretest and post test, obese 20(100.0), under weight, normal weight and overweight there is no subject.

Table 3 Deals about the plyometrics of the premenopausal women. In pre test experimental group inactive 18(90.0%), moderately inactive 2(10.0%), moderately active and active no subjects in group.

In post test experimental group active 13(65.0%), moderately active 5(25.0%), moderately inactive 2(10.0) and inactive no subjects in group. In pretest and post test control group inactive 18(90.0%), moderately inactive 2(10.0%), moderately active and active no subjects in group. It implies that the BMD is improved and had effect on plyometrics.

Table 4 shows that effectiveness of improving bone health in experimental group there was significant difference between the pretest & posttest level of bone mineral density among pre menopausal women in the experimental and control group.

Association between socio-demographic variables in physiological parameters of osteoporosis

In the present study reveals the association of demographic variables among premenopausal women. Table 5 krustal Wallis test was performed to find out the association between the demographic variables and plyometrics. It reveals that there is significant association activity regarding prevention of osteoporosis. The average of physiological parameters in the plyometrics group during pre-test and post-test as compared to the experimental group (p<0.001).

The primary aims of this randomized controlled trial are to examine the immediate and long-term effects of a 12-weeks supervised group exercise programme on habitual walking speed in older women with osteoporosis (Stanghelle *et al.*, 2018).

The exercise is essential in the treatment and prevention of osteoporosis. But we are also of the idea that methods for evaluating the Quality of Life in osteoporotic and osteopenic patients (Marchese *et al.*, 2012).

The exercises appear extremely site-specific, able to increase muscle mass and BMD only in the stimulated body regions. Multicomponent exercises con-

sist of a combination of different methods (aerobics, strengthening, progressive resistance, balancing, and dancing) aimed at increasing or preserving bone mass (Benedetti *et al.*, 2018).

Exercise have additive effects by increasing bone mineral density, the increase in muscular strength and functional capacity that occurs in response to exercise also reduces the incidence of osteoporotic fractures by reducing the risk of falling. (Metcalfe *et al.*, 2001).

The present study examined the effectiveness plyometrics accord that the experimental group boosts up their bone mineral density. There is a significant difference in the physiological parameters of osteoporosis among premenopausal women.

CONCLUSIONS

The pilot study was conducted among premenopausal women among 30 to 40 years. The results reveal that three months of plyometrics significantly improved the bone mineral density among premenopausal women.The experimental group showed more effectiveness compared to the control group. In the present study, statistical analysis was carried out by using Mann Whitney Rank Sum Test and Wilcoxon Signed Rank Test. No ramifications were found in the study. . This pilot study was found feasible for the main study. Participants were very co-operative throughout the study. The pilot study concluded that was an improvement in bone mineral density at the end of intervention. The main study data collection was included after discussing with the experts.

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Conflict of interest

The author declares no conflict of interest.

Implications

Nursing practice

Nurses must realize and accept the teaching role, as the members of the society are aware that it is their right to be informed and they need to know more

Screening for low BMD cases can be routinely carried out in the premenopausal women to identify and manage at its earlier stage

Osteoporosis prevention exercises can be demonstrated to the patients and family as part of home care advices

Nursing Education

Emphasis on organization and conduction of screening camps in hospital and community setting could be considered in the nursing curriculum

Student nurses could be encouraged to render health education utilizing the pamphlet

Nursing Administration

Measures to make available of the information pamphlet on osteoporosis for the premenopausal women and their family members could be carried out

Screening camps and teaching programs on osteoporosis could be planned

Collaboration with community health nurses in planning and implementing osteoporosis preventive measures could be practiced

Nursing Research

Dissemination of research findings could be carried out

Osteoporosis registry could be maintained

The data from similar research studies could be collected to submit the report to the government to formulate policies on osteoporosis prevention and management at primary health levels

REFERENCES

Benedetti, M. G., Furlini, G., Zati, A., Mauro, G. L. 2018. The Effectiveness of Physical Exercise on Bone Density in Osteoporotic Patients. *BioMed Research International*, 2018:1–10.

Gregov, C., šalaj, S. 2014. The effects of different training modalities on bone mass: A. *review. Kinesiology*, 46:10–28.

Indumati, V., Patil, V. S., Jailkhani, R. 2007. Hospital based preliminary study on osteoporosis in postmenopausal women. *Indian Journal of Clinical Biochemistry*, 22(2):96–100.

Kling, J. M., Clarke, B. L., Sandhu, N. P. 2014. Osteoporosis Prevention, Screening, and Treatment: A Review. *Journal of Women's Health*, 23(7):563–572.

Marchese, D., D'Andrea, M., Ventura, V., Montalcini, T., Foti, D., Pujia, A., Gulletta, E., Iocco, M. 2012. Effects of a Weight-Bearing Exercise Training on Bone Mineral Density and Neuromuscular Function of Osteopenic Women. *European Journal of Inflammation*, 10(3):427–435.

Metcalfe, L., Lohman, T., Going, S., Houtkooper, L., Ferriera, D., Flint-Wagner, H., Cussler, E. 2001.

Postmenopausal Women and Exercise for Prevention of Osteoporosis: The Bone, Estrogen, Strength Training (BEST) Study. ACSM's. *Health & Fitness Journal*, 5(3).

Najam, R., Huda, N. 2012. Assessment of Osteoporosis in Post Menopausal Women: A Clinical Study. *Nepal Journal of Obstetrics and Gynaecology*, 6(2):11–13.

Nikoseet 2015. Prevalence of osteoporosis in female population. 4.

Saraví, F. D., Sayegh, F. 2013. Bone Mineral Density and Body Composition of Adult Premenopausal Women with Three Levels of Physical Activity. *Journal of Osteoporosis*, 2013:1–7.

Stanghelle, B., Bentzen, H., Giangregorio, L., Pripp, A. H., Bergland, A. 2018. Effect of a resistance and balance exercise programme for women with osteoporosis and vertebral fracture: study protocol for a randomized controlled trial. *BMC Musculoskeletal Disorders*, 19(1):100–100.

Swamy, P. G. N., Ravindra, H. N., Rathod, Y., Rathwa, R., Singh, S., Solanki, K., Vaghela, R. 2017. A Descriptive Study on Knowledge Regarding Prevention of Osteoporosis among Pre-Menopausal Women in Rural Areas of Waghodia Taluka with a View to. *Develop Information Booklet*, 2:17–32.