ORIGINAL ARTICLE

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ASSOCIATION OF MENSTRUAL FUNCTION WITH BONE MINERAL DENSITY AMONGST PUNJABI UNIVERSITY FEMALE ATHLETES

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ABSTRACT

Background: Menstruation being an inevitable part of a girl's life and more so, an important indicator of normal physical, physiological and functional well-being. Female athlete who engages in high-intensity exercise is at risk as a consequence of the hormonal change, which results in menstrual dysfunction, subsequently; the athlete is at risk for compromised skeletal integrity. The objective of the study is to find the prevalence of menstrual dysfunction among female athletes of Punjabi University, Patiala, to assess the bone mineral density in female athletes and to examine the relationship of Bone Mineral Density with Menstrual dysfunction in female athletes.

Methods: The present study evaluated the menstrual status and its association with Bone Mineral Density in 76 adolescent female athletes. Convenient random sampling was adopted to recruit athletes by inclusion and exclusion criteria.

Result: The percentile analysis of menstrual dysfunction is found to be 59.3% Out of 59.3% population with menstrual dysfunction, 55.5 % have oligomenorrhea, 28.9% have amenorrhea, and 15.5% have polymenorrhea. In this study population, the mean age of menarche is 13.81. Out of 76 female athletes, 35 have normal BMD ranges whereas 41 are having lower BMD ranges. The association of bone mineral density was found to be non-significant with both stress fracture ($X2 = 4.38$, $p= 0.3570$), and epimenorrhea ($X2 = 4.49$, $p = 0.3437$). The analysis of Pearson's correlation coefficient (r) suggested a negative association between menstrual function with Bone Mineral Density (-0.06292 at 0.05 levels). The result found to be statistically non-significant; therefore, any change in menstrual function is not associated with Bone mineral density.

Conclusion: Common menstrual dysfunctions reported were: oligomenorrhea, polymenorrhea, amenorrhea, and amenorrhea. However, pre-menstrual syndrome (PMS) and dysmenorrhea were specifically found to be very high in prevalence i.e. 94.7% and 92.1% respectively. This dysfunction may be related to the intensity of training and body's physiological response to it.

Keywords: Menstrual function, Bone mineral density (BMD), stress fracture, epimenorrhea, pre-menstrual syndrome (PMS) and dysmenorrhea.

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INTRODUCTION

During the past few decades, escalating numbers of women of all ages have been engaging in sports, at both recreational and competitive levels. A steadily rising level of competition and more demanding physical preparation accompanies this. Engagements in various activities and exercise training are encouraging experience for females providing improved physical fitness enhanced moral and better physical and mental strength for most individuals [1]. Disappointingly, occasional unavailability of competent coaches as well as the high enthusiasm of parents and athletes, often cause sports activities to drift away from their fundamental function. Thus, adverse effects of highly intense training are reflected in athlete's health [2]. The female reproductive system is extremely hypersensitive to physiological stress, and reproductive abnormalities including delayed menarche, exercise-induced amenorrhea, and oligomenorrhea occur in 6–79% of women engaged in athletic activity [3].

Regardless of which menstrual dysfunction an athlete suffers from, even slight menstrual irregularity can cause serious health consequences, specifically decreased bone mineral density, subsequently lead to increased risk of stress fractures and premature osteoporosis. Any amount of bone erosion is detrimental to a female athlete. This decline in bone mineral density may not be mutable and amplify the risk for stress fractures [4].

Branco (1996) and Fruth (1995) concluded that menstrual disorders had been shown to have an adverse effect on bone mineralization [5,6]. As many as 51% of endurance trainer [4], 44% of ballet dancers [2] and 12% of swimmers and cyclists seven have reported menstrual disturbances during a period of training. The aim of the study was to investigate the prevalence of menstrual dysfunction among female athletes of Punjabi University and to examine the relationship of menstrual dysfunction with bone mineral density.

METHODOLOGY

A cross-sectional study was conducted in Punjabi University, Patiala. The present study assessed menstrual status and its association with Bone Mineral Density in 76 adolescent female athletes of age group 13-29 years. Convenient random sampling was adopted to recruit female athletes by general information and on a method of inclusion and exclusion criteria.

Athletes	Absolute number (N)	Percentage (%)
Short distance runners	10	13.15
Long distance runners	25	32.9
Shot put	5	6.5
Hammer throw	10	7.9
Javelin throw	6	13.15
Cross country	8	10.6
Marathon runners	12	15.7
Total	76	

Table 1: Shows number of athletes participated in the study

Documentation of data relating demographic profile, menstrual status, nutritional and training profile was done to recognize and evaluate predominating menstrual irregularities. The study has covered all the menstrual dysfunction such as amenorrhea, oligomenorrhea, polymenorrhea, epimenorrhea, dysmenorrhea, hyper or hypomenorrhea and pre-menstrual syndrome. The study was conducted during the month of September 2015 to March 2016.

Also, Bone Mineral Density was measured using qualitative ultrasound densitometry, and ranking population into the normal, osteopenic and osteoporotic category. Latterly, an association of menstrual function with Bone Mineral Density was evaluated using statistical tools.

Selection Criteria: The criteria for inclusion of athletes in this study was age i.e. post-menarcheal to 28 years, non-pregnant, athlete population and practiced regularly for two years. The criteria for exclusion of athletes in this study was age i.e. pre-menarcheal and more than 29, H/o neurological, gynecological and psychological disease, history of recent abortion and Females taking oral contraceptives.

Analysis: The data so collected were compiled in MS Excel and analyzed into tabular and graphical form. Chi-square test was used to assess the statistical association between the study variables. Pearson Correlation Coefficient was used to find out the relationship between Bone Mineral Density and Menstrual Function.

RESULTS

Total 76 female athletes were interviewed and examined. The demographic characteristics of study population are Mean$\pm$ standard deviation for age, weight, height, and BMI are 21.93$\pm$ 1.71, 55.53$\pm$ 9.30, 163.6$\pm$ 7.04 and 20.7$\pm$ 3.26 respectively.

The prevalence of menstrual dysfunction in the study population is found to be 59.3%. Out of 59.3% population with menstrual dysfunction, 55.5 % have oligomenorrhea, 28.9% have amenorrhea, and 15.5% have polymenorrhea.

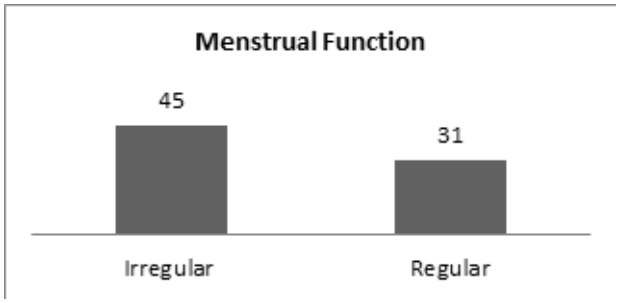

Figure 1: Show the prevalence of Menstrual Dysfunction amongst female athletes

In this study population, the mean age of menarche i.e. 13.81. 60.5 % of the study population was having menarche age group of 13-15 years whereas only 17.1% had late menarche.

The prevalence of premenstrual syndrome and dysmenorrhea among female athletes was found to be 94.7% and 92.1% respectively. 36.8% of the total study population have epimennorhea, 47.3 % of total study population has

longer duration menstruation period & 55.2% of total study population reports heavy menstrual flow.

The present study found that out of 76 female athletes, 35 have normal BMD ranges whereas 41 are having lower BMD ranges.

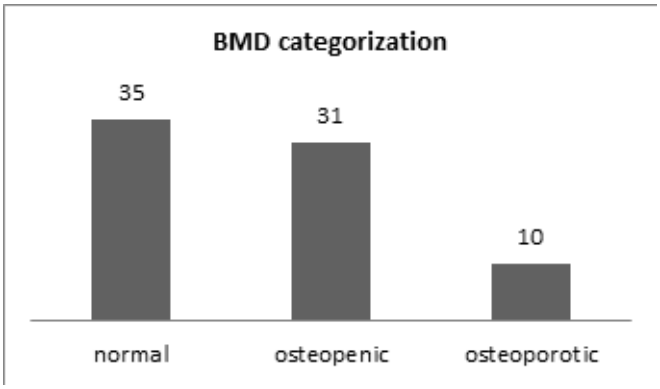

Figure2: Depicting the ranges of BMD among female athletes

Another outcome shown in this present study was a history of stress fracture. The majority of the athletes never had stress fracture i.e. 58 out of 76, whereas 18 had a history of stress fracture as shown in figure. III.

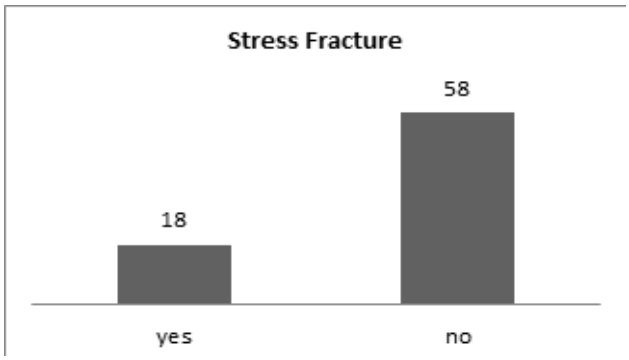

Figure 3: shows the prevalence of stress fracture in the study population

The Chi-Square for Bone Mineral Density and Menstrual function was 1.71 and p-value is < 0.05, indicating that there exists a statistically non-significant relationship between bone mineral density and menstrual function.

Interestingly, out of whole study population, 23.7% had stress fracture.17.1% Females of normal category had stress fracture whereas 82.9% didn't have a stress fracture. Only 22.6% females of osteopenia category had a stress fracture, 77.4% didn't have a stress fracture. The chi-square for BMD and stress fracture was 4.38 and p value<0.10, indicating that there exists statistically non-significant relationship.

BMD		Stress fracture			X^2	df	P value
		Yes	No	Total			
Normal	Count	6	29	35	4.38	4	0.3570
	% within graph	17.1%	82.9%	100.0%			
Osteopenic	Count	7	24	31			
	% within graph	22.6%	77.4%	100.0%			
Osteoporotic	Count	5	5	10			
	% within graph	50%	50%	100.0%			
Total	Count	18	58	76			
	% within graph	23.7%	76.3%	100.0%			

Table 2: Represents Association of Bone Mineral Density with stress fracture

Additionally, Association of Bone Mineral Density with Epimenorrhea was checked. BMD ranges under normal category 82.9% don't have Epimenorrhea whereas only 17.1% have Epimenorrhea. Under level osteopenic, 75% doesn't have Epimenorrhea whereas only 25. % Have Epimenorrhea. 50%-50% females under osteoporotic category have Epimenorrhea & don't have Epimenorrhea. The Chi-Square for the association between Bone Mineral Density & Epimenorrhea was 4.49, and p-value was 0.3437, which indicates there exists a statistically non-significant relationship.

BMD		Epimenorrhea		Total	X^2	df	P value
		Yes	No				
Normal	Count	6	29	35	4.49	4	<0.05
	% within graph	17.1%	82.9%	100.0%			
Osteopenic	Count	8	23	31			
	% within graph	25.8%	74.2%	100.0%			
Osteoporotic	Count	5	5	10			
	% within graph	50.0%	50.0%	100.0%			
Total	Count	19	57	76			
	% within graph	25.0%	75.0%	100.0%			

Table 3: Represents the Association of Bone Mineral Density with Epimenorrhea

The Pearson's correlation coefficient (r) for menstrual function and Bone Mineral Density was -0.06292 at 0.05 levels. The result found to be statistically non-significant; therefore, any change in menstrual function is not associated with Bone mineral density.

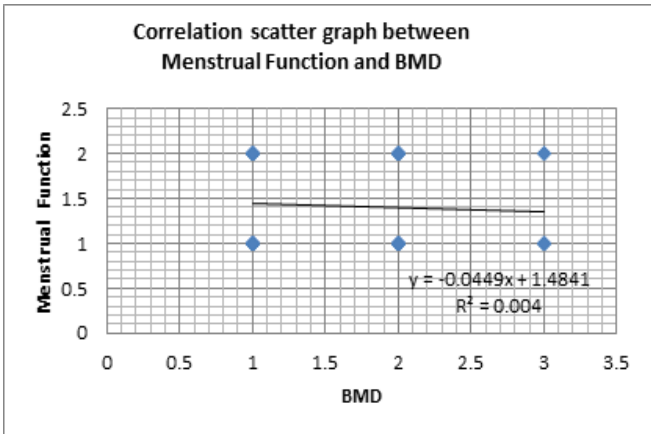

Figure 4: Depicting correlation between menstrual function and BMD

DISCUSSION

The findings of the present study have been discussed under following subtitles.

(I) Prevalence of menstrual dysfunction
(II) Evaluation of BMD and stress fracture
(III) Association of menstrual dysfunction and bone mineral density

(I) Prevalence of menstrual dysfunction

The prevalence of menstrual dysfunction in the study population is found to be 59.3 %. Out of 59.3% population with menstrual dysfunction, 55.5 % have oligomenorrhea, 28.9% have amenorrhea, and 15.5% have polymenorrhea, this variability in results are similar to the findings of the

previous study done by Sanborn et al(1982)[7] and Warren& Perlroth, 2001[8] in which variability in reproductive abnormalities ranging from late menarche, primary and secondary amenorrhea and oligomenorrhea come about in 6–79% of women involved in sports & other physical training.

What another outcome showed in this study population was the mean age of menarche i.e. 13.81. 60.5 % of the study population was having menarche age group of 13-15 years. Only 17.1% had late menarche, which is contradicting the results of Dale, 1979 [9] were remarkably late menarche was observed, especially in dancers and long distance runners.

Also, 36.8% of the total study population has epimennorhea, 47.3 % of total study population has more extended duration menstruation period and 55.2% of total study population reports heavy menstrual flow.

Petit & prior (2000) [10] and Michelle (1991) [11] concluded that female athletic performance had been associated with a broad spectrum of menstrual dysfunction, ranging from exercise-induced spotting, heavy bleeding, anovulation, amenorrhea and long menstrual cycle.

(II) Evaluation of BMD and stress fracture

The present study evident 53.9% of the total study population have lower values of BMD which are osteopenic and osteoporotic. Considering Indian context, racial and genetic factors are also significant for variance as much as 50-70 percent in peak bone density, with Asians having depleted peak bone density, while blacks are having the highest bone mineral density [10]. Indians have also been surveyed to have a low Bone mineral density in contrast to Caucasians.

Numerous explanations to this, like short physique, the higher predominance of hypovitaminosis D and conventional Indian vegetarian diets which are undersupplied in vitamin D and protein, may be answerable by Wojse et al (2000) [12]. where he founds lower bone mineral density values accounted in Indians.

Irrespective of higher prevalence of lower BMD among female athletes, this study delineates only 23.7% had a history of stress fracture, this result is controversial with the previous study conducted by Bahner (2007) where the decrease in bone mineral density may not be transformable and multiply the probability for stress fractures.

(III) Association of menstrual dysfunction and bone mineral density.

The present study found 72.2% study population with the history of stress fracture also reported early menarche; the findings were consistent with the previous studies done by Warren et al. (1991) [13], where the age of menarche found to be correlated with the occurrence of the stress fracture. The possible explanation to assure the interconnection between age at menarche and risk for the stress fracture is uncertain and demands further study.

The present study also delineates 59.3 % of total study population accounts menstrual dysfunction and 53 % out of study population have lower BMD than the normal values; still no statistical association between menstrual dysfunction and BMD was found, which is controversial with previously concluded by studies that menstrual irregularities exhibit has an adverse effect on bone mineralization [14,15].

The present evaluation founds that 59.3% of total study population has menstrual dysfunction. Out of 59.3% population with menstrual dysfunction, 58.5 % population have lower BMD values than the normal which is osteopenic and osteoporotic still the result of the present study doesn't show any statistical significance. This possibly could be explained by the fact that female sexual hormones (for e.g. estrogen, progesterone) persuade the bone metabolism because they incite osteoblastic activity [16,17].

An apparent contraindication to studies mentioned above reported, where a significant relationship between menstrual dysfunction and bone mineral density was found, the findings of the present study didn't find any significant relation.

Association of Menstrual function with Bone Mineral Density shows a statistically non-significant relationship in female athletes ($p<0.05$), and represents that any disturbance in menstrual function is not associated with Bone Mineral Density.

STRENGTH, LIMITATIONS AND FUTURE SCOPE OF STUDY

Strength of the study is the included age group of 13-26 years, thus conclusion regarding menstrual status and bone mineral density are unlikely to attribute to bone shedding related with aging and the peri-menopause, Present study has strong elimination conditions made research results pertinent to healthy young female generation & enlisted population was not formerly examined with regard to menstrual history and Bone Mineral Density. Several prospective precincts may have an influence on present study outcome, which is study was done only on limited subjects available i.e. 76 players, Genetic and behavioral factors effect on menstrual status, physical performance was not taken into account, Self-reported menstrual status data was used in alternative to laboratory measures.

Future scope of study: The study can be done on larger sample size in depth hormonal analysis and effect of hyper/hypothyroidism on reproductive health including comprehensive training and nutritional profile.

CONCLUSION

In this study, the prevalence of menstrual dysfunction among female athletes was 59.3%. Common menstrual dysfunctions reported were: oligomenorrhea, polymenorrhea, epimenorrhea, and amenorrhea. However, pre-menstrual syndrome (PMS) and dysmenorrhea were specifically found to be very high in prevalence i.e. 94.7% and 92.1% respectively. This dysfunction may be related to the intensity of training & body's physiological response to it.

In this study, 53.9 % female athletes showed lower bone density values. These lower values indicate osteopenia to be more prevalent than osteoporosis. BMD was found to be statistically non-significant in association with menstrual function.

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