Original Article

Comparison of the extent of exercise effects on bone mineral density of boys of Ilam city

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Received: 6 Oct 2010
Revised: 8 Dec 2010
Accepted: 20 Dec 2010

Abstract

Background: *The extent of Bone Minerals Density (BMD) gained during childhood is good index for BMD in adulthood. Recent studies imply that exercise increases BMD; however, there are rare studies about the best ages in which exercise gives the highest effect on children's BMD. This study was carried out with the aim of comparing the extent of exercise effect on various ages on BMD of boys of Ilam City.*

Methods: *A total of 60 boys of Ilam City was selected randomly and were divided in two groups (the experimental and the control). Next, each group was subdivided into three age groups 6-8 yrs, 8-10 yrs and 10-12 yrs. Then their height, weight, body mass index (BMI) and BMD in femur neck and lumbar vertebrae (L_2-L_4)) were measured using Dual energy X-ray Absorptiometry machine (DXA machine). Subsequently, the experimental group performed special exercises for 12 weeks, three sessions per week and 60 minutes per session. After three months, the BMD of both groups was remeasured.*

Results: *Our findings indicated that exercise increases the BMD of children (in femur neck and lumbar spine area) in any age and such increase is more obvious in 8-10 years old boys than the other groups. The difference in BMD of lumbar spine before and after exercise in children 8-10 years is significant (BMD of before exercise = 601 mg/cm^2, BMD of after exercise = 613 mg/cm^2), (t= - 3.502, p= 0.007).*

Conclusion: *Exercise and physical activity during childhood, particularly in 8-10 years old kids result in BMD increase. Therefore, it is proposed that exercise and physical activity in children (particularly in 8-10 years old) is very effective to decrease osteoporosis outbreak during adulthood.*

Key words: *Bone Mineral Density, Exercise, Osteoporosis, Childhood.*

Casp J Intern Med 2010; 1(4):148-153.

The strength and intensity of bones are depended on bone mineral density (BMD), certainly. Bone metabolism is a process in which new bone cells are formed and the old ones are removed, continuously. During childhood and adolescence, the formation rate of new bones is higher than old bones' destruction (1). Osteoporosis is one of the most prevalent bone disorders by which bone density is decreased. Bone fracture risk due to osteoporosis is very high among the aged people (2). Bone densitometry is used for measuring BMD which shows decreasing BMD. Bone densitometry makes osteoporosis diagnosis possible and also helps to detect bone fracture risk. Various approaches have been proposed for determining osteoporosis extent (3, 4). Many studies have shown that some sports and physical activities as special exercises (e.g. walking, jogging, mountain climbing, football, tennis, volleyball, basketball) designed to incur individual's weight enable to increase BMD considerably rather sports which can not incur body weight (e.g. swimming, water polo, cycling and etc.), similarly they may prevent the ongoing decline of bone density during adulthood (5). Also, recent studies showed children with more physical activities enjoy higher bone density. On Other word, more bone density storage during childhood result in vigorous bones formation in older ages.

Indeed, it can be claimed that BMD achieved during childhood and adolescence is a good determinant of BMD during adulthood (6). Therefore, if bone density reaches to an ideal level during childhood, it will prevent osteoporosis occurrence in adulthood (7). It is clear that the obtained bone density during growth period is a determinant factor of fracture potential in the future (8, 9). This question obviously necessitates research in the field of the role of exercise in bone mineral density along its other effective factors.

Tabatabaiee et al. had examined normative values of bone density of Iranian juveniles (10-20 yrs); there was a positive correlation between bone density value and height, weight, and puberty. Likewise, there was a correlation between calcium intake and femur neck density, but it was not found in lumbar vertebrae (10).

Rahimian Mashhadi compared bone density of predominant and subsidiary hands of women athletes who belong to Iranian national teams. Findings showed the BMD rate difference of both radii of tennis players is higher than the other athletes and ordinary people meaningfully. Also the BMD rates of both hands of women members of some certain Iranian national teams are lower than the world standard rate significantly (11). Nazarian (2008) compared the BMD of professional football players and the amateur footballers. Results showed that BMD of femur neck and lumbar vertebrae of professional football players were 1332 and 1311.5 mg/cm^2, respectively. For the amateurs, these values were significant (12).

Byjeh compared the bone density and muscular strength of women athletes with amateurs. Results showed that athletes had higher BMD in comparison with amateurs except the taekwondo athletes who had lower BMD in their lumbar vertebrae (13). Salehikia examined the long-term effect of endurance, speed and resistance exercises on BMD of men athletes and compared them with control, body builders and sprinters who had higher BMD in their femur neck and lumbar vertebrae; whereas the BMD of both mentioned parts was lower in track runners significantly (14). Borrer et al. showed that the physical activities act as a preserver and driver for bone formation. Women who start sport activities with various intensities and sufficient calories and calcium amounts empower and enrich their BMD contents and bone transverse growth (15).

Snow et al. analyzed exercise and inactivity effect on BMD of gymnasts. They observed an increase as large as 3.4 percent in BMD of lumbar vertebrae after a 24-month exercise course and after an inactivity course subsequent to competitions a decrease as large as 1.6 percent was found on BMD (16). Foorwood et al. showed the effect of physical activity on BMD of girls (over 18), and its protective effect on women bone density (17). Vincent Rodriguez et al found that BMD of predominant hand and femur neck of handball players is higher than the control (18). Also Vincent Rodriguez et al indicated that playing football, prior to puberty, increases BMD in femur parts of children (19). Moreover, Kannus et al. estimated the effects of mechanic load on predominant and subsidiary member of tennis players and concluded that BMD of predominant hand of tennis players is more than the amateurs (20).

Expensive researches about the effect of sports on BMD are obstacles toward performing such studies especially in children. In this study, we have tried to examine and compared the effect of sports in various ages (6-8 yrs, 8-10 yrs and 10-12 yrs) on bone material density in boys of Ilam City.

Method

This quasi- experimental study aimed at comparing and analyzing pretest and post-test results. The statistical society of this study was all young boys of Ilam city between 6 to12 years old studying in schools of this sub-province. After the initial review and selection of preliminary sample to estimate the required sample size for this study the sample size was a determined (n=60). According to the type of the studied variable (BMI), for selecting the samples, we used cluster two stage sampling method. For the allocation and division of the samples, it should be said that after selecting the sample size (n=60), from the nine elementary schools of Ilam City, three schools were randomly selected. Then in each school, one class as one unit was selected and within this class, 20 students were randomly selected (20 boys on 6-8 yrs, 20 boys on 8-10 yrs and 20 boys on 10-12 yrs). Then, children in any age group were subdivided into experimental and control groups randomly (each age class includes 10 boys). The samples were healthy not affecting BMD. Likewise, they were similar in terms of height, weight and BMI approximately.

Information due to predefined questionnaire showed that they have same affordability and nourishment behaviors little difference in their diet and receiving calories. For consuming calcium and other medicin, all samples showed a negative result. None of them was sensitive in drinking milk. Also, there was not any report about the history of osteoporosis or any disorders affecting bone metabolism in their families. After selecting the sample and following their written informed consent from their parents, BMDs of femur neck and lumbar vertebrae ($L_2 - L_4$) were measured using DXA. After pre-testing all samples (both the control and the experimental groups), the control group was released but the experimental groups were (in all three age groups) embarked to perform exercises for 12 consecutive weeks (three months of summer) three sessions per week (odd days) including 60 minutes. The exercise plan consisted of 15 minutes jogging and warming up, 10 minutes rope skipping, 25 minutes ball playing and finally 10 minutes cooling down (such exercises are categorized as tension sports). After 36 sessions, BMD of both groups were re-measured and the data were analyzed statistically. The whole diagnosis stages of the study were monitored and supported by Ilam University and the children's parents who agreed totally.

The weights and heights of the boys were measured without shoes and so with their light garments by Seca balance, made in Germany with 0.5 kg precision and Holtin Stadiometer, made in Britain with 0.1 cm precision, respectively. The body density determinant was measured through dividing body weight to height square (m^2). DXA machine (Norland Compact Model) was used for measuring BMD of samples. DXA is a new and precise tool for analyzing bone density which works through taking pictures from various parts of the body through X-ray. Its ray percent is little and harmless. Keep in mind that BMD has been offered as mg/cm^2 in this study.

SPSS and EXCEL softwares were employed for analyzing the achieved data. Thus, in descriptive statistics mean and standard deviation were used for and in inferential statistics to compare pretests and post-tests. From the comparison test paired sample method, to compare the control and the experimental group in same age class, comparison test independent method was used.

Also, ANOVA was used for comparing the difference among the pretests and post tests of all groups. The diagrams were depicted by EXCEL software. The meaningful level which has been considered in this study is equal to 0.05.

Results

As it can be observed from table 1, there is not any meaningful difference between the mean value of BMD pretest and post test of femur neck of various groups. As it can be observed from table 1, there is a meaningful difference between the mean value of BMD pretest and post test of lumbar vertebrae of the 6-8 yrs and 10-12 yrs of age of the experimental group and 8-10 yrs of age of the control group. According to research results, there is a meaningful difference between the means of the difference of pretest and post test of femur neck BMD of control (-8.133) and experimental (4.9) group (sig= 0.049).

Table 1: Mean and standard deviation of pretest and post test of femur neck and lumbar vertebrae BMD of various groups

Groups	Cases	BMD	Protest Mean±SD	Posttest Mean±SD	Pavlue
Experimental(years)	6-8y	Femur neck	661.8±77.87	658.1±74.89	0.681
		Lumbar vertebrae	531.5±21.43	539.2±22.42	0.037
	9-10y	Femur neck	755.7±74.2	745.5±66.32	0.204
		Lumbar vertebrae	611.4±20.4	611±21.75	0.926
	11-12y	Femur neck	793±67.43	794.4±6.92	0.100
		Lumbar vertebrae	608.1±25.99	613.9±27.05	0.030
Control(years)	6-8y	Femur neck	694.2±96.1	695.4±86.81	0.926
		Lumbar vertebrae	547.4±17.1	553.5±15.29	0.262
	9-10y	Femur neck	746.3±77.44	758.4±75.3	0.109
		Lumbar vertebrae	601.2±24.97	613.6±26.95	0.007
	11-12y	Femur neck	793±67.43	794.4±6.92	0.784
		Lumbar vertebrae	635.6±22.29	642.5±20.31	0.216

According to research results, there is not any meaningful difference between the means of difference pretest and post test results of lumbar vertebrae BMD of control (4.366) and experimental (8.466) groups (sig= 0.217). According to research results, the highest difference between the mean of pretest – post test difference of femur neck BMD of control and experimental groups belonged to 8-10 yrs of age of the experimental group (t= 2.213). This difference is meaningful (sig= 0.040).

According to research results, the highest difference between mean of pretest – post test difference of lumbar vertebrae BMD of control and experimental groups belonged to 8-10 yrs of age of the experimental group (t =2.333). This difference is meaningful (sig= 0.031).

As it can be observed from table 1, there is not any meaningful difference between mean value of BMD pretest and post test of femur neck of various groups.

As seen in table 2, the highest difference between mean of pretest – post test difference of femur neck BMD belonged to 8-10 yrs of age and 6-8 yrs old children. Moreover, it is seen on table 2 the highest difference between the mean of pretest – post test difference of lumbar vertebrae BMD belonged to 8-10 yrs of age and 6-8 yrs old children.

Table 2: Comparison mean of pretest and post test difference of femur neck and lumbar vertebrae BMD between various age classes (Experimental Groups)

Group		**cases**	**Mean Differences**	**sig**
BMD of femur neck	6-8 yr	8-10 yr	- 10.900	0.386
		10-12 yr	- 0.200	0.987
	8-10 yr	6-8 yr	10.900	0.386
		10-12 yr	10.700	0.395
	10-12 yr	6-8 yr	0.200	0.987
		8- 10 yr	10.700	0.395
BMD of lumbar vertebrae	6-8yr	8-10yr	-6.3	0.349
		10-12yr	-0.8	0.905
	8-10yr	6-8yr	6.3	0.349
		8-10yr	5.5	0.412
	10-12yr	6-8yr	0.8	0.905
		8-10yr	-5.5	0.412

Discussion

In spite of the numerous studies about the effect of exercise and sports on bone mineral density, there are few studies about the comparison of sport effects on children's BMD during various ages. This study aimed at analyzing and comparing the effects of sport on BMD of both the femur neck and lumbar vertebrae of young boys of Ilam City in various ages.

Our results showed that the BMD of femur neck and lumbar vertebrae in 6-8 yr old boys increased subsequently in exercise; however, such increase was not significant. It indicates that sport may increase the BMD of femur neck and lumbar vertebrae in 6-8 yr old children. Our findings showed that the BMD of femur neck and lumbar vertebrae in 8-10 yr old boys increased subsequently in participation of sport plan. However, this increase was not significant. It indicates that sport may increase BMD of femur neck in 8-10 yr old children. Also, it can be inferred that such increase in 8-10 yr old children is more than the other two groups. Results showed that the BMD of lumbar vertebrae of 8-10-year children increased after taking part in the sport plan. This increase was significant (p= 0.007). It indicates that sport may increase the BMD of lumbar vertebrae in 8-10-yrs old children.

We found that BMD of femur neck and lumbar vertebrae in 10-12 yrs old boys increased subsequently in exercise; however, such increase was not significant. It indicates that sport may increase BMD of femur neck and lumbar vertebrae in 10-12 yrs old children.

We did not find any significant difference in the pretest and post test between the BMD of femur neck and lumbar vertebrae in 6-8 yrs old children of control and experimental groups. This finding demonstrates that performing physical activities by the 6-8 yrs old children may increase BMD of femur neck and lumbar vertebrae. However, inactivity will result in the decrease of BMD of femur neck in 6-8 yrs old children. The difference of pretest and post test of femur neck and lumbar vertebrae BMD in 6-8 yrs old children was not significant.

Performing physical activities by 8-10 yrs old children increased BMD of femur neck and lumbar vertebrae and their inactivity decreased BMD of femur neck and lumbar vertebrae, possibly. There was a meaningful difference between pretest and post test results of femur neck and lumbar vertebrae BMD in 8-10 yrs old children (control and experimental groups). Therefore, 8 to 10 years of age is considered critical and vital age for BMD of femur neck and lumbar vertebrae. Thus, performing physical activities in such age range increases BMD of femur neck and lumbar vertebrae and inactivity in such age range has a negative effect on their BMD. This in contrast to Byjeh et al. findings (13). However the results of Nazarian, Vincent Rodriguez and Azunka studies were in the same line with these results (12, 18).

We found that there was not any significant difference between the pretest and post test results of femur neck and lumbar vertebrae BMD in 10-12 yrs old children. This finding shows that performing physical activities of 10-12 yr children may increase their BMD of femur neck and lumbar vertebrae, however, lack of performing exercises of 10-12 yr children will have a negative influence on the BMD of femur neck. There was not any meaningful difference between the pretest and post test results of femur neck and lumbar vertebrae BMD of 10-12 yrs old children (both the experimental and the control groups) statistically.

Generally, concerning the aforementioned results, sport in any age class increases BMD (both in femur neck and in lumbar vertebrae) of children which is higher in 8-10 yrs old children rather than the two other groups. Briefly, sports and physical activities during childhood, particularly in 8-10 years old enhances bone mineral density.

Therefore, in order to have lower complications and disorders due to the decrease of BMD in the society. Official authorities are then requested to pay more attention to sports and physical activities of children, particularly those who are 8-10 years old.

Acknowledgement

Thank you to Ilam University of Iran for their utmost support.

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