

# ANALYSIS AND RESEARCH ON THE KEY FACTORS OF SPORTS IN MAINTAINING HUMAN HEALTH

ANÁLISE E PESQUISA SOBRE OS FATORES-CHAVE DO ESPORTE NA MANUTENÇÃO DA SAÚDE HUMANA

ANÁLISIS E INVESTIGACIÓN SOBRE LOS FACTORES CLAVE DEL DEPORTE PARA MANTENER LA SALUD HUMANA



ORIGINAL ARTICLE  
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## ABSTRACT

**Introduction:** The research on the promotion of physical fitness of the human body by exercise has also attracted widespread attention in sports and rehabilitation medicine. **Object:** This article uses ultrasound to study the bone density health of the human body, thereby establishing the relationship between sports and bone density health. We hope to use the research results of this article to improve people's awareness of sports health. **Method:** We used ultrasound to test the bone mineral density of two groups of students (exercise group and non-exercise group) to explore the relationship between different sports items and the students' bone mineral density. **Results:** There is a significant difference in bone density between the two groups of students. There is no gender difference in bone density. **Conclusion:** Students need to strengthen physical exercise in the growth and development stage to improve bone density. **Level of evidence II; Therapeutic studies - investigation of treatment results.**

**Keywords:** Sports; Bone Density; Bone Health; Middle Aged; Aged.

## RESUMO

**Introdução:** A pesquisa sobre a promoção da aptidão física do corpo humano por meio do exercício também tem atraído atenção generalizada na medicina esportiva e de reabilitação. **Objeto:** este artigo usa o ultrassom para estudar a saúde da densidade óssea do corpo humano, estabelecendo assim a relação entre esportes e saúde da densidade óssea. Esperamos usar os resultados da pesquisa deste artigo para aumentar a conscientização das pessoas sobre a saúde no esporte. **Método:** Usamos ultrassom para testar a densidade mineral óssea de dois grupos de alunos (grupo de exercícios e grupo de não exercícios) para explorar a relação entre diferentes itens esportivos e a densidade mineral óssea dos alunos. **Resultados:** Existe uma diferença significativa na densidade óssea entre os dois grupos de alunos. Não há diferença de gênero na densidade óssea. **Conclusão:** Os alunos precisam fortalecer os exercícios físicos na fase de crescimento e desenvolvimento para melhorar a densidade óssea. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Esportes; Densidade Óssea; Saúde Óssea; Pessoa de Meia-Idade; Idoso.

## RESUMEN

**Introducción:** La investigación sobre la promoción de la aptitud física del cuerpo humano mediante el ejercicio también ha atraído una amplia atención en la medicina deportiva y de rehabilitación. **Objeto:** Este artículo utiliza la ecografía para estudiar la salud de la densidad ósea del cuerpo humano, estableciendo así la relación entre el deporte y la salud de la densidad ósea. Esperamos utilizar los resultados de la investigación de este artículo para mejorar la conciencia de las personas sobre la salud deportiva. **Método:** Utilizamos ultrasonido para probar la densidad mineral ósea de dos grupos de estudiantes (grupo de ejercicio y grupo sin ejercicio) para explorar la relación entre diferentes artículos deportivos y la densidad mineral ósea de los estudiantes. **Resultados:** Existe una diferencia significativa en la densidad ósea entre los dos grupos de estudiantes. No hay diferencia de género en la densidad ósea. **Conclusión:** Los estudiantes necesitan fortalecer el ejercicio físico en la etapa de crecimiento y desarrollo para mejorar la densidad ósea. **Nivel de evidencia II; Estudios terapéuticos: investigación de los resultados del tratamiento.**

**Descriptorios:** Deportes; Densidad Óssea; La Salud Óssea; Personas de Mediana Edad; Anciano.



## INTRODUCTION

The physical health of college students is related to their development and the present and future of Chinese modernization, and bone health is an essential guarantee for physical health.<sup>1</sup> Therefore, the study of sports in promoting the bone health of college students has also attracted widespread attention in fields such as sports and rehabilitation medicine. Bone density is an essential indicator of bone quality, reflecting the degree of osteoporosis and an essential basis for predicting fracture risk.<sup>2</sup>

This study uses an ultrasound bone density meter to measure the bone mineral density of college students. Based on reflecting the essential condition of college students' bone mineral density, this study explores the influence of gender, physical exercise and different sports on the calcaneal bone density of college students, with a view to the research results.

## METHOD

### General information

In this study, 78 social sports majors (regular exercise group) and 50 other non-sports majors (non-regular exercise group) were the research objects. Through the questionnaire survey, congenital bone diseases, diabetes, hyperthyroidism and other chronic diseases that affect bone metabolism were excluded.

### Technical route

We adopted a two-factor (gender and exercise group) inter-group controlled experimental design. The dependent variables are the T value, Z value and bone mass index (BQI) that reflect bone density.

## METHOD

### Bone mineral density determination method and the meaning of related indicators

We use the American GE Achilles Insight ultrasonic bone densitometer (the accuracy: bone mass index (BQI) less than 2%, velocity change (SOS) less than 0.2%, broadband ultrasonic attenuation (BUA) less than 1.4%, and the test is tested for the part of the left heel bone, the relative value of bone density, T value, Z value and bone mass index (BQI) were obtained.

### Questionnaire survey and grouping method

Questionnaires including essential information such as height, weight, history of related diseases that affect bone density, and exercise status were distributed to the subjects to screen the research subjects and obtain their basic information.

### Data statistical analysis method

We export the test data in Excel format, and use SPSS 16.0 data statistics software for statistical analysis and processing, and use "mean  $\pm$  standard deviation" ( $M \pm SD$ ) to represent various inspection indicators.<sup>3</sup> We mainly used a two-factor analysis of variance to investigate the influence of gender and exercise factors on bone mineral density-related indicators and used a t-test to analyze the differences between the regular exercise and the irregular exercise groups. We use  $P < 0.05$  as the standard for the difference's significance and  $P < 0.01$  as the standard for the very significant difference.

### Skeleton model based on Wolff's law

(1) Quantitative analysis of the mechanical environment: at each instant, the bone is regarded as the same as the engineering material, and the finite element analysis method can be used to obtain the relevant quantities that characterize the mechanical environment at each point in the bone. (2) Use the bone model equation to describe the changes in bone structure and calculate the changes in the size, density and material

properties of each point in the bone after a long enough time. (3) The first two steps repeatedly iterate until convergence: the end of the bone model so that a new bone structure that adapts to the new mechanical environment is obtained. The iterative formula used in the skeleton model:

$$\rho_j(t + \Delta t) = \rho_j(t) + \Delta t \rho \quad (1)$$

$\rho_j(t + \Delta t)$  is the density value of unit j at the time  $t + \Delta t$ ,  $\rho_j(t)$  is the density value of unit j at time t,  $\Delta t$  is the time step in the iterative process.  $\rho$  is the apparent density change rate.<sup>4</sup> The material model is isotropic, and the elastic modulus of the material parameter is calculated by the following formula

$$E(x, t) = C_\rho(x, t)^r \quad (2)$$

In the formula,  $C$ ,  $r$  is a constant,  $E$  is the modulus of elasticity, and  $\rho$  is the apparent density. Poisson's ratio remains unchanged and is taken as a fixed value. Three-dimensional orthotropic materials have nine independent parameters:  $E_1, E_2, E_3, \nu_{12}, \nu_{13}, \nu_{23}, \nu_{14}, G_{12}, G_{23}, G_{13}$ . There are four two-dimensional orthotropic independent parameters:  $E_1, E_2, \nu_{12}, G_{12}$ . Basic equation:  $\frac{d\rho(x,t)}{dt} = \tau \left( \sum_{i=1}^N f_i(x)(S_i - k) \right)$ .

$$0 < \rho(x) \leq \rho_{cb} \quad (3)$$

Where  $\tau$  is the time constant that controls the rate of reconstruction,  $f_i(x)$  is the spatial influence function,  $S$  is the excitation, the strain energy density per unit mass is taken,  $k$  is the reference excitation, and  $\rho_{cb}$  is the maximum bone density, usually taken as the density of compact bone.<sup>5</sup>

## RESULTS

### The overall situation of college students' bone mineral density

In this study, based on the diagnostic criteria recommended by the World Health Organization (WHO), combined with the actual situation of the bone mineral density of college students, the bone density of T value  $> 1SD$ ,  $-1SD < T \text{ value} < 1SD$ , T value  $< -1SD$  was defined as "Higher" (means higher bone mass and good bone quality), "normal" (means average bone mass) and "low" (means low bone mass and bone loss).<sup>6</sup> The specific conditions of college students' bone mineral density are shown in Table 1.

The proportion of people with higher bone density in the regular exercise group was significantly higher than that in the irregular exercise group, and only a minimal number of people had low bone mass; the irregular exercise group showed a higher proportion of standard and lower bone mass.

### Analysis of variance of bone mineral density-related indicators by gender and exercise group

According to the results of the two-way analysis of variance, the difference in BQI value between groups is very significant ( $P = 0.000 < 0.01$ ), and there is no gender difference; the difference in T value between gender and group is very significant.

**Table 1.** Distribution of Bone Mineral Density Grade Evaluation of College Students.

Gender	Group	n	Bone density evaluation/%		
			Higher	Normal	Low
Male	Regular exercise group	51	56.9	39.2	3.9
	Irregular exercise group	28	28.6	39.3	32.1
Female	Regular exercise group	27	74.1	25.9	0
	Irregular exercise group	22	45.5	45.5	9.1

## Research on gender differences in bone mineral density of college students

It can be seen from Table 2 and Table 3 that there are significant differences between men and women in various indicators of bone mineral density in the regular exercise group; there is no difference in the BQI values of male and female students in the non-regular exercise group, only the T and Z values are different.

### The effect of exercise on bone density

It can be seen from Table 4 that the differences in indicators between the boys' regular exercise group and the non-regular exercise group are very significant ( $P < 0.01$ ), and there are also significant differences between the girls' groups ( $P < 0.05$ ); this result suggests this kind of exercise the differences are more pronounced among boys.

### The impact of different sports on bone density

The ball category covers tennis and badminton. Besides, other boys are classified into other sports groups.<sup>7</sup> (Table 5) The results showed that boys' bone mineral density indexes in the ball sports group were better than those in other sports groups ( $P < 0.05$ ).

**Table 2.** Independent sample t-test results of each index of the bone mineral density of boys and girls in the regular exercise group.

Index	gender	n	M±SD	t	P
BQI	Boys	51	121.29±15.21	2.073	0.042
	Schoolgirl	27	113.56±16.56		
T value	Boys	51	1.427±1.26	-2.299	0.024
	Schoolgirl	27	2.200±1.65		
Z value	Boys	51	1.514±1.26	-2.103	0.039
	Schoolgirl	27	2.219±1.64		

**Table 3.** Independent sample t-test results for bone mineral density of boys and girls in the irregular exercise group.

Index	gender	n	M±SD	t	P
BQI	Boys	28	104.36±21.42	0.56	0.578
	Schoolgirl	22	101.32±15.50		
T value	Boys	28	-0.004±1.80	-2.032	0.048
	Schoolgirl	22	0.977±1.55		
Z value	Boys	28	-0.007±1.79	-2.06	0.045
	Schoolgirl	22	0.986±1.55		

**Table 4.** Independent sample t-test results of bone mineral density among boys in different sports groups.

	Index sport group	n	M±SD	t	P
Bone strength	Regular exercise group	51	121.29±15.21	4.082	0.001
	Irregular exercise group	28	104.36±21.42		
T value	Regular exercise group	51	1.427±1.26	3.736	0.001
	Irregular exercise group	28	-0.004±1.79		
Z value	Regular exercise group	51	1.514±1.26	3.978	0.001
	Irregular exercise group	28	-0.007±1.79		

**Table 5.** The t-test of various indexes of bone mineral density among boys of different sports.

Index	Sports	n	M±SD	t	P
Bone strength	Ball group	16	128.12±13.59	2.25	50.029
	Another sports group	35	118.17±15.06		
T value	Ball group	16	1.994±1.12	2.244	0.029
	Another sports group	35	1.169±1.25		
Z value	Ball group	16	2.100±1.16	2.336	0.024
	Another sports group	35	1.246±1.23		

## DISCUSSION

The WHO lists osteoporosis as one of the three major diseases of middle-aged and older people. It is a common health problem faced by human beings and is being paid more and more attention by the medical profession. In the past, traditional concepts believed that osteoporosis was only a middle-aged or senile disease. Still, as people's lifestyle changes, more and more chronic diseases began to develop in the direction of youth.

In terms of gender differences in bone mineral density of college students: This study shows that there are significant differences in indicators between the boys' regular exercise group and the non-regular exercise group ( $P < 0.01$ ), and there are also significant differences between the girls' groups ( $P < 0.05$ ), the difference in BQI and T values of female college students between the two groups was not significant, consistent with some results of this study.

The main reason for the gender difference in bone density is that the bones of men are more potent than women, and the cortical bone is thicker, and the bone content is higher. However, the gender difference in bone density of the human body shows different changes with age: bone mineral content increases with age from infant to adolescence and increase, and there is no noticeable gender difference. After puberty, the increase in bone mineral content is more pronounced in men than in women, while college students are at the end of puberty.<sup>8</sup> Therefore, it is difficult to determine whether the gender difference in bone mineral density of college students in this particular period is significant.

The muscle strength of badminton and tennis players holding the clap hand is greater than that of the contralateral limb. The bone density of the humerus is also higher than that of the contralateral limb. Different sports have different stimulation of bone, which affects the construction and remodeling of bone. Research on the effects of different forms of exercise on the bone mineral density of adolescent women shows that the impact of impact exercise on bone mineral density is significantly higher than that of non-impact exercise. Some scholars have shown that different forms of exercise have different stimulating effects on bone, and therefore the impact on bone density also presents different characteristics. Among them, strength exercises and impact exercises are the most helpful for improving bone density.

## CONCLUSION

This study shows that the bone mineral density of college students in the regular exercise group is better than that of the irregular exercise group. The bone density of the irregular exercise group is lower. In particular, boys should pay enough attention. Regular exercise male and female college students are significantly higher than the non-regular exercise group in the examined bone mineral density index, suggesting that regular participation in sports promotes the increase of human bone density and strengthens bone strength.

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