ORIGINAL RESEARCH

To determine the relationship between menopause and bone mineral density

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ABSTRACT

Aim: To determine the relationship between menopause and bone mineral density. **Material and methods:**The study included a total of 200 postmenopausal women who were separated into two groups: Group A, consisting of 100 subjects who had menopause before the age of 50 (including age 50), and Group B, consisting of 100 subjects who experienced menopause beyond the age of 50. The research only included postmenopausal women, as determined by the modified Reproductive Aging Workshop (STRAW) staging approach. **Results:**The mean age of menopause onset was 48.88 ± 2.63 for Group A and 54.74 ± 2.87 for Group B. The distribution test revealed a data distribution that is not normal. Nevertheless, we observed no statistically significant disparity in the same variables between the two groups. In group A, the total mass (measured in kilograms) showed a high and significant link with BMI, whereas it had a moderate and significant correlation with height, percentage of body fat, and the A/G ratio. there was a weak but statistically significant correlation between total body mass and BMI. There is no variable that shows a correlation with bone mineral density (BMD).In Group A, the variable total mass exerted a substantial impact on the A/G ratio (18%), percentage of body fat (53%), and particularly on BMI (79%). The body mass index (BMI) had a significant impact on the percentage of body fat (58%), whereas the adiposity-to-gynoid (A/G) ratio showed a correlation of 18%. The T-score of the hip is solely affected by the percentage of body fat (5%).Group B had a significant impact of mass on age at menopause (10%) and BMI (88%). **Conclusion:** No significant correlation was found between the investigated factors and bone mineral density (BMD) in the menopausal group aged 50 years and above. Therefore, we may infer that while the groups had comparable outcomes, the group experiencing menopause before the age of 50 exhibited the most significant correlations between the factors and their impact on bone mineral density (BMD), particularly in the hip region.

Keywords: BMD,Menopausal

INTRODUCTION

The World Health Organization (WHO) defines natural menopause as the absence of menstruation for a minimum of 12 consecutive months, not caused by physiological or pathological factors. According to statistical data, the average age at which natural menopause occurs is 51 years in developed countries, whereas it is 48 years in underdeveloped and non-industrialized countries [1]. Given the increased average life expectancy of 70 years, it is expected that a majority of women would experience more than one third of their lifetime after going through menopause. Besides, the number of menopausal women is growing because the aging population is expanding quickly. Thus, the health: of menopausal women becomes a primary issue globally [2]. Menopause is a normal biological process that occurs when the ovaries stop functioning and the cells undergo apoptosis, which is a kind of programmed cell death. Ovarian function diminishes as one grows older. Menopause is characterized by a decline in the synthesis of estradiol and an increase in levels of follicle-stimulating hormone (FSH). Women undergoing the menopausal transition may encounter several troublesome symptoms, including hot flashes, night sweats, vaginal atrophy and dryness, dyspareunia, sleep disruption, and mood fluctuations [3]. The process of bone tissue remodeling mostly takes place during the first two decades of life, with peak bone mineral density (BMD) being achieved at

around 30 years of age. Generally, a higher density implies a higher concentration of bone loss in the coming years, which may lead to the development of osteopenia or osteoporosis, at least from a physiological perspective [4,5].

Osteoporosis affects around 30% of women who have gone through menopause and 50 to 80% of males who have characteristics that lead to the development of osteoporosis. Primary osteoporosis refers to the classification of osteoporosis in postmenopausal women and men without any underlying illness. Secondary osteoporosis refers to the occurrence of osteoporosis in the context of a disease, usage of drugs, or particular settings [6,7].Fractures are the primary outcome of osteoporosis. Fractures caused by osteoporosis are becoming more frequent in people of all ages. However, women are twice as likely as men to have fractures, particularly after menopause. This makes postmenopausal osteoporosis one of the most prevalent and significant forms of primary osteoporosis [8]. The objective of this research was to evaluate the impact of menopause on bone mineral density (BMD), taking into account the timing of its occurrence.

MATERIAL AND METHODS

This research was conducted with the approval of the institutional ethics board. The study included a total of 200 postmenopausal women who were separated into two groups: Group A, consisting of 100 subjects who had menopause before the age of 50 (including age 50), and Group B, consisting of 100 subjects who experienced menopause beyond the age of 50. The research only included postmenopausal women, as determined by the modified Reproductive Aging Workshop (STRAW) staging approach. Patients who shown a lack of willingness to engage were omitted from the research.

METHODOLOGY

The personal and anthropometric data were directly extracted from the laboratory's database. The examination of body composition was conducted using Dual Energy X-Ray Absorptiometry (DXA). The equipment's internal database supplied the parameters for assessing overall body composition and bone density. The Android/gynoid (A/G) interaction was also established.

STATISTICAL ANALYSIS

Data tabulation was conducted using Microsoft Excel version 2015, while data analysis was carried out using SPSS software version 24.0. The sample's normality and homogeneity were assessed using the Kolmogorov-Smirnov test, which confirmed the normal distribution of the data. Therefore, in order to compare groups, the Wilcoxon test was used for two related samples. The Spearman's correlation test was used to assess the correlation between the variables in both groups, as well as within each individual group. A linear regression analysis was conducted to examine the impact of each variable on the key features of the groups. The risk estimate between groups was analyzed using odds ratios and confidence intervals. A significance level of <0.05 was used for all analyses to determine statistical significance.

RESULTS

The research used a database to pick a cohort of 200 postmenopausal women, ranging in age from 45 to 85 years. The sample was categorized into two groups depending on the age at which menopause occurred: Group A (50 years or under) or Group B (51 to 60 years) (Table 1).The bone mineral density (BMD) was comparable across the two groups, exhibiting osteopenia patterns in the spine and normal BMD in the hip. Both groups had osteopenia in the neck region. The mean age of menopause onset was 48.88 ± 2.63 for Group A and 54.74 ± 2.87 for Group B. The distribution test revealed a data distribution that is not normal. Nevertheless, we observed no statistically significant disparity in the same variables between the two groups. Furthermore, the connection between factors in both groups was confirmed (Table 2).In group A, the total mass (measured in kilograms) showed a high and significant link with BMI, whereas it had a moderate and significant correlation with height, percentage of body fat, and the A/G ratio. The T-score for hip in respect to BMD showed a significant connection with fat percentage. In the group of women over 50 years old who are experiencing menopause, there was a substantial and statistically significant association between total body mass and the age at which menopause began. Additionally, there was a weak but statistically significant correlation between total body mass and BMI. There is no variable that shows a correlation with bone mineral density (BMD).After confirming the association between factors within the same group, we conducted a regression analysis to determine the impact of each variable on the primary attributes of the groups (Table 3). In Group A, the variable total mass exerted a substantial impact on the A/G ratio (18%), percentage of body fat (53%), and particularly on BMI (79%). The body mass index (BMI) had a significant impact on the percentage of body fat (58%), whereas the adiposity-to-gynoid (A/G) ratio showed a correlation of 18%. The T-score of the hip is solely affected by the percentage of body fat (5%).Group B had a significant impact of mass on age at menopause (10%) and BMI (88%). The odds ratio (OR) for having reduced bone mineral density (BMD) in group A was 0.79, suggesting a decreased risk.

Table1: Basic parameter of the participants

	(Group A) Menopause 50 or less	(Group B) Menopause after 50 years
Parameter	Mean±SD	Mean±SD
Age(years)	66.34±6.87	66.99±5,34
Totalmass(Kg)	71.48±5.47	70.77±5.29
Height(cm)	158.55±5.79	156.26±4.48
Bodymassindex(Kg/m^2)	28.552.24	28.99±3.37
Ageatmenopause (years)	48.88±2.63	54.74±2.87
%fat	41.22±3.94	40.09±3.09
A/Grelation	0.98± 0.11	0.95± 0.12
LumbarspineBMD	0.88± 0.13	0.88± 0.14
LumbarspineT-score	-1.6±1.2	-1.7±1.5
HipBMD	0.87± 0.13	0.87± 0.12
HipT-score	-0.7±1.0	-0.7±0.9
NeckT-score	-1.2±1.3	-1.2±1.1
Yearssincemenopause(years)	15.56±3.68	14.46±3.65

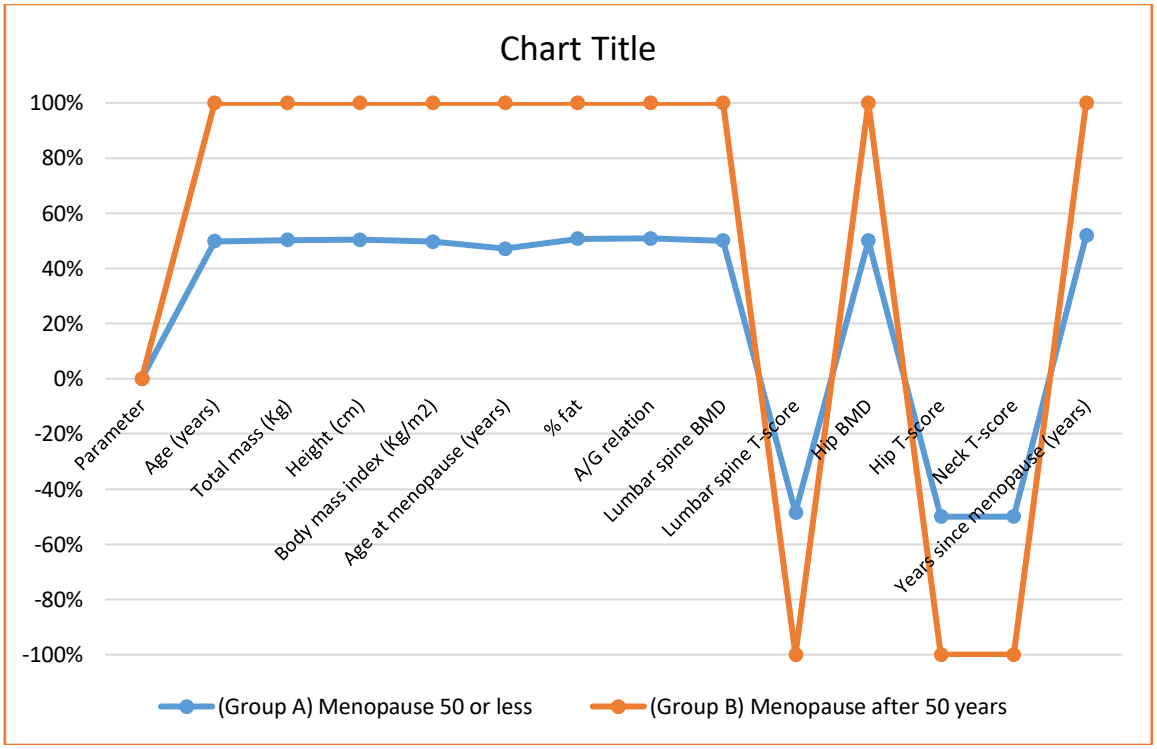

Figure1. Basic parameter of the participants

Table 2: Correlation analysis between variables in both groups.

Variable	Variable	Spearman	*P* value
Totalmass(GroupA)	Height(GroupBA)	0.33	0.004
	BMI(GroupBA)	0.91	0.0001
	%fat(GroupBA)	0.74	0.0001
	A/Grelation(GroupBA)	0.57	0.0001
BMI (GroupA)	%fat(GroupBA)	0.71	0.0001
	A/Grelation(GroupBA)	0.58	0.0001
HipT-score(GroupA)	%fat(GroupBA)	0.31	0.04
Totalmass(GroupB)	Ageatmenopause(GroupAA)	0.46	0.02
	BMI(GroupAA)	0.38	0.03
	BMI(GroupAA)	0.22	0.51
	Ageatmenopause(GroupAA)	-0.03	0.77

Table 3: Linear regression between variables in the same groups

Variable(A Group)	Variable	r^2	*P* value
Total mass	Height	0.09	0.005
	BMI	0.88	0.00
	A/G relation	0.71	0.00
	%fat	0.62	0.00
BMI	%fat	0.68	0.00
	A/G relation	0.21	0.00
Hip T-score	%fat	0.05	0.04
Variable (B Group)	**Variable**	r^2	*P* value
Total mass	BMI	0.91	0.01
	Age at menopause	0.09	0.01
BMI, Body mass index;A/G:android/gynoid			

DISCUSSION

Ageing is a complex and multifaceted process that is associated with several diseases that impact numerous organs, including the skeletal system. The decline in bone density associated with aging and the subsequent development of osteoporosis make the elderly more susceptible to fractures and the occurrence of illnesses. This phenomenon is attributed to a multitude of genetic, hormonal, and physiological causes. Approximately 50-80% of the decline in an individual's bone mineral density may be attributed to variables such as hormonal imbalance, aging, environmental influences, lifestyle choices, and genetic predispositions. The decline in bone mineral density (BMD) in women occurs in two distinct phases. Postmenopausal osteoporosis begins after menopause, characterized by a fast, estrogen-driven decline in bone density, lasting around 5-10 years. During this timeframe, about half of the overall bone mineral density (BMD) in the thoracic and lumbar spine is depleted, resulting in frequent occurrences of vertebral body compression fractures. Subsequent to this timeframe, there is a gradual and consistent decline in bone density due to aging. This leads to a reduction in the number of bone trabeculae and the loss of bone tissue in the outer layer, making the femoral bone neck more prone to fractures. The yearly decrease in bone mass is around 0.5% in premenopausal women, 2-2.5% in those experiencing menopause, and around 1.5% in postmenopausal women [6].

Osteoporosis is a disorder that significantly increases the likelihood of fractures. Fractures of the hip, spine, and forearms caused by osteoporosis are linked to significant morbidity, resulting in restricted mobility, deformities, reduced self-sufficiency, and diminished quality of life. The bone loss resulting from a lack of estrogen during menopause is caused by several factors and is a complicated process involving various biochemical changes that collaborate to regulate bone turnover [9]. In this research, the participants were categorized into two groups based on their age, namely before and beyond 50 years. The mean age of menopause onset was 48.88 ± 2.63 years for Group A and 54.74 ± 2.87 years for Group B. Research conducted on postmenopausal women discovered a correlation between the duration since menopause, reduced lean and fat mass, and decreased bone mass [10]. Our investigation revealed that both BMI and fat percentage (% fat) exhibited comparable values across groups A and B.

Regarding the body components, our analysis found that in group A, total mass showed a moderate relationship with other factors. However, it had a strong and significant association with BMI. In addition, total mass had a moderate and significant correlation with variables such as height, percentage of fat, and A/G ratio. Group B exhibited a moderate and statistically significant link between total mass and age of menopause, as well as a weak but statistically significant correlation between total mass and BMI. However, additional studies have indicated that the significant increase in fat mass and decrease in lean mass are specifically associated with the menopausal transition. Furthermore, the changes in body composition, including the increase in fat mass and decrease in lean mass, do not appear to differ significantly between premenopausal and menopausal women. As a result, weight gain during the early stages of the menopausal transition may go unnoticed [11].

Our regression analysis revealed that in group A, total mass exhibited a substantial impact on BMI, % fat, and A/G connection. However, only % fat shown a statistically significant effect on hip T-score, with a significance level of 5%. For the B group, the age of menopause had a significant impact on total mass (10%) and BMI (88%), although it did not affect bone density.

A study examining the link between age at menopause and bone mass and muscular strength in women aged 50 to 80 years revealed that the early menopausal group had lower levels of both bone mass and muscle strength compared to the later menopausal group [12]. Tan et al. [10] conducted research on bone mineral density (BMD) during the perimenopause. The authors discovered that there is a progressive decrease in BMD of around 2-3% each year over a period of 10 years. This decrease in BMD continues to decline throughout the senile phase [13].

A study was conducted with 897 women who were categorized into four groups (premenopausal, early

perimenopausal, late perimenopausal, and postmenopausal) based on hormone levels and reports of bleeding. The study revealed a notable disparity in femoral neck bone mineral density (BMD) between the late perimenopausal group and the premenopausal group. The densitometric disparity between the pre- and perimenopausal groups amounted to 5%. Nevertheless, when analyzing the bone mineral density (BMD) measurements of individuals in the late perimenopausal group, around 24% of them had osteopenia, indicating that alterations in BMD are already evident at this phase [14]. During our analysis, we observed that both groups had a low bone mineral density (BMD) in the femoral neck region.

Garnero et al. [15] reported that bone mineral density (BMD) may decrease by up to 10% during the menopausal transition, indicating an increase in the rate of bone loss. Around 25% of women who have gone through menopause may be categorized as experiencing osteoporosis [15]. Hence, if the average age at which menopause occurs is 51 years, an early onset of menopause would result in a proportional acceleration of bone aging. Therefore, the early onset of bone aging would result in women reaching the senile stage with a skeleton that is already weakened.

Our research revealed that those who had menopause at or before the age of 50 had a more significant impact on body composition and bone mineral density (BMD) in the hip, compared to those who experienced menopause after the age of 50. Research examining the impact of the time elapsed after menopause on bone mineral density (BMD) found that the rate of bone loss increased by about two-fold every 5 years. The most significant loss occurred between the ages of 45 and 49, with a decrease of 3.3%, and reached a total loss of 50.3% by the age of 85 [16]. Conversely, Fugiel et al. [12] discovered that women who had menopause at an earlier age exhibited a greater decrease in bone density, muscular strength, and functionality in their lower and upper limbs [12].

Separate research investigating the impact of menopause on bone mineral density (BMD) revealed that 30% of women aged 50 and above who were assessed had osteoporosis. This condition is accountable for around 8% to 9% of annual bone fractures [17]. Similarly, another research found that the most significant decrease in bone mineral density (BMD) occurs during the first year after menopause, amounting to around 5%. However, there may still be ongoing losses of 1 to 1.5% in the following years [18]. at research, we observed little alterations in bone mineral density (BMD) in women at the pre- or early perimenopausal stage. Nevertheless, they determined that the deterioration of bone density increased throughout the latter stages of perimenopause and persisted during postmenopause [19].

The NHANES 2005-2008, as referenced by Gourlay et al. [20], reports that osteoporosis affects around 6.8% of women aged 50 to 59 in the femoral neck or lumbar spine, and the prevalence increases to 34.9% in women aged 80 years. The authors referenced a meta-analysis that included 29,082 women. The study found that at the age of 65, the likelihood of hip fractures rose by 2.88 (95% CI 2.31-3.59) for every standard deviation [20].

A study conducted by Svejme et al. [21] revealed that women who experience menopause before the age of 47 are not only at a greater risk of developing osteoporosis, but also have an increased likelihood of experiencing fragility fractures and a higher death rate [21]. Viswanathan et al. [22] found that osteoporotic hip fractures have significant consequences, including prolonged bed rest and limits. These fractures account for around 5% of mortality, and within this group, about 21-30% of individuals die within one year after the fracture [22].

CONCLUSION

The group of women who had menopause before the age of 50 exhibited the strongest correlations between the variables and demonstrated a significant impact of the percentage of body fat on bone mineral density (BMD). No significant correlation was found between the investigated factors and bone mineral density (BMD) in the menopausal group aged 50 years and above. Therefore, we may infer that while the groups had comparable outcomes, the group experiencing menopause before the age of 50 exhibited the most significant correlations between the factors and their impact on bone mineral density (BMD), particularly in the hip region.

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