

FACTORS THAT AFFECT BONE MASS DENSITY (BMD)

ABSTRACT

Background and Objective: Bone Mass Density (BMD) refers to the strength of bones, which peaks between the ages of 25 and 35 years. Achieving optimal peak bone mass and maintaining it is crucial to prevent osteoporosis later in life. This study investigates the influence of Age, Gender, and physical activity on BMD, aiming to understand their contributions to bone health. **Method:** This descriptive study analyzed the relationship between bone density and influencing factors. Normality tests were conducted on Age, Gender, and physical activity. Correlation analysis was performed to assess the strength of these relationships. **Results:** The study found that Age is the most influential factor affecting BMD, with a strong negative correlation ($r = -0.942$). As age increases, BMD tends to decrease, indicating that aging significantly impacts bone strength. Gender and physical activity also played a role but were less significant than age. **Discussion:** The results confirm that bone strength peaks in early adulthood and declines with age. Although physical activity, especially weight-bearing exercises, can mitigate this decline, age remains the primary factor influencing BMD. **Conclusion:** Age is the primary factor affecting BMD, with a significant negative correlation. Maintaining physical activity is essential for preserving bone health and preventing osteoporosis. Further research should explore interventions to improve bone density with aging.

Keywords: Bone Mass Density (BMD), Age, Physical activity, Osteoporosis prevention, Bone health

1. INTRODUCTION

In young adults aged 25-35 years, there is a peak phase of bone development, indicated by the metric known as Bone Mass Density (BMD). Bone mass density (BMD) evaluates the strength of the skeletal system (1) BMD is influenced by achieving peak bone mass, after which bone density decreases with age (2) Attaining and maintaining appropriate peak bone mass can reduce the likelihood of developing osteoporosis in the future. (3)

Women show lower bone mass density compared to men and experience faster bone mass loss (4) Approximately 41.6 percent of young women aged 25 to 34 exhibit poor Bone Mass Density (BMD). It is essential to build and maintain adequate bone mass from an early age to prevent osteoporosis in women. (5)

Osteoporosis is a disorder defined by porous bones, characterized by reduced bone mass density and compromised bone tissue quality, resulting in increased fragility, which may lead to

pathological fractures, kyphosis, diminished stature, and back discomfort. In 1990, the WHO reported a global incidence of 1.7 million osteoporosis-related fractures, projecting a growth to 6.3 million by 2050, with 716 occurring in developing countries(6)(7)

The global incidence of fractures attributable to osteoporosis is notably elevated in Asia, with Indonesia exhibiting the second-highest prevalence of osteoporosis following China. Data from Indonesia's Ministry of Health (2015) indicates that osteoporosis is more prevalent in women. Bone mass density diminishes from young adulthood and steadily declines in postmenopausal women and men over the age of 50.(8) With advancing age, cellular alterations impact mineral concentrations in the body, hence affecting bone density.(9)

This study examines the impact of Age, Gender, and physical activity on Bone Mass Density (BMD), with the aim of understanding how these factors contribute to overall bone health.

2. RESEARCH METHODOLOGY

The research method used in this study is descriptive research. (10)This method involves collecting data to answer specific questions or test hypotheses regarding the current status of the research subjects. Additionally, a normality test was conducted to assess the distribution of two variables: Age, Gender, and physical activity, which are factors influencing bone density. The descriptive approach allows for the examination of these factors' influence on Bone Mass Density (BMD), providing an understanding of how they contribute to bone health(11).. The results are shown in the table below.

Table 1 . Descriptive Statistics and Normality Test for Bone Density and Age

Variable	Mean ± SD	Median (min – max)	p
Bone Density	0,93 ± 0,44	0,94 (-0,22 – 2,00)	<0,001
Age	53,49 ± 20,57	53 (18 – 89)	<0,001

The Kolmogorov-Smirnov test for bone density and age produced a p-value of < 0.05, indicating that the data were not normally distributed. A Spearman's Rank Correlation test was utilized to examine the relationship between the variables.

Table 2. Correlation Test Between Age and Bone Density

Variabel	p	r
Bone Density	<0,001*	-0,942
Age		

Note : * Significant (p < 0,05)

The association test between age and bone density, utilizing Spearman's Rank Correlation, yielded a p-value of <math><0.001</math> (

Graph

Notes		
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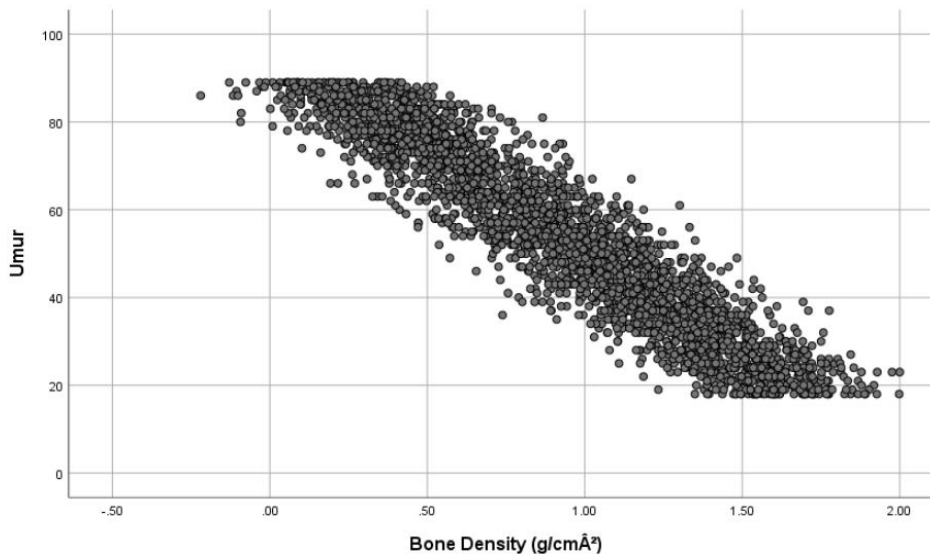


Figure 1. Descriptive Statistics and Normality Test for Bone Density and Age

Table 3. Corellation Between Physical Activity and Bone Density

Variabel	p	r
Physical Activity	0,850	0,003
Age		

The Spearman's Rank Correlation test yielded a p-value of 0.850 ($p > 0.05$), signifying the absence of a meaningful link between physical activity and bone density.

Table 4. Difference in Bone Density Based on Gender

Gender	Median (min – max)	p
Male	0,92 (-0,13 – 2,00)	0,171
Female	0,95 (-0,22 – 2,00)	

The test for variations in bone density by gender yielded a p-value of 0.171 ($p > 0.05$). This indicates that there is no substantial disparity in bone density between males and females.

3. RESULTS

The analysis of the factors influencing bone density based on the data obtained is as follows:

A. Relationship Between Age and Bone Mass Density

The association test between age and bone density, utilizing Spearman's Rank Correlation, yielded a p-value of <0.001 ($p < 0.05$) and an r-value of -0.942 (0.8 – <1.0). This indicates a significant inverse relationship with a very strong correlation, meaning that as age increases, bone density decreases.

B. Relationship Between Gender and Bone Mass Density

The test for gender differences in bone density returned a p-value of 0.171 ($p > 0.05$). This suggests that there is no significant difference in bone density between males and females.

C. Relationship Between Physical Activity and Bone Mass Density

Spearman's Rank Correlation was used to examine the relationship between physical activity and bone density, and the p-value was 0.850 ($p > 0.05$). This shows there is no significant relationship between physical activity and bone density.

4. DISCUSSION

The study found that age is the most important factor influencing bone mass density. The Spearman's Rank connection test resulted in a p-value of <0.001 ($p < 0.05$) and r-value of -0.942 (0.8 - <1.0), indicating a strong negative connection. The gender-based test returned a p-value of 0.171 ($p > 0.05$), indicating no statistically significant difference. The Spearman's Rank Correlation test used to investigate the relationship between physical activity and bone density produced a p-value of 0.850 ($p > 0.05$), indicating the absence of a significant relationship. Numerous studies show that osteopenia is common in women under the age of 25, with a prevalence of 37.1% (9). In elderly women, the prevalence of osteoporosis is found to be higher, at 80% (10). In 2011, bone density screening was conducted in 5 major cities in Indonesia, and it was found that 35% were normal, 36% showed symptoms of osteopenia, and 29% had osteoporosis (11). Osteoporosis is the disease that most affects the decrease in bone mass density.

Several pharmacological drugs have been developed to manage and increase bone mass density, including: Bisphosphonates, which work by inhibiting osteoclast activity, the cells responsible for bone resorption; Hormonal therapy, including Selective Oestrogen Receptor Modulators (SERM), functions by simulating the effects of endogenous estrogen, thereby enhancing bone mass density; Denosumab, a monoclonal antibody, influences osteoclast maturation and diminishes fracture risk(12); and the combination of Calcium and Vitamin D serves as fundamental therapy for osteoporosis prevention and treatment, with Vitamin D facilitating optimal calcium absorption.(13)

5. CONCLUSION

Age is the primary factor of bone mass density. The Spearman's Rank Correlation test yielded a p-value of <0.001 ($p < 0.05$) and an r-value of -0.942 ($0.8 - <1.0$). This aligns with the observation that bone mass density often diminishes with advancing age.

RECOMMENDATION

As age increases, it is recommended that individuals maintain their physical fitness, regularly check their bone mass density status, and do so as early as possible and on a regular basis.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The authors hereby state that no generative AI tools such as large language models (ChatGPT, COPILOT, etc.) or text-to-image generators were utilized in the creation or editing of this work.

DATA AVAILABILITY

All relevant data are included in the paper and its supporting information files. This study will assist researchers in identifying critical areas for Factors That Affect Bone Mass Density (Bmd)

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