# Bone Mineral Density Health for Female Athletes and Active Females

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## ABSTRACT

According to the National Osteoporosis Foundation (2007) 80% of all new cases of osteoporosis occur among females. Females are at an elevated risk of developing osteopenia and osteoporosis as they age. Protecting and maintaining bone health is imperative to females of any age. Consequently, the primary purpose of this investigation was to examine the effect of body mass index (BMI), the presence of an eating disorder, and exercise intensity on predicting deficiencies in bone mineral density (BMD) of this sample of females. The population comprised of 175 active female volunteers aged 18-24, 71 of which were National Collegiate Amateur Athletic Association (NCAA) Division II athletes. The participants completed a demographic questionnaire, were measured for height and weight, and were submitted to a bone density scan of the non-dominant hand by Metriscan. The regression analysis produced no significant outcomes among the main effects. However, the amount of calcium intake and the number of hours per week of exercise did reveal significant relationships between the previously mentioned variables and bone health. Further investigation into the effects of calcium and the number of hours of exercise per week should be pursued.

## INTRODUCTION

Osteoporosis, cardiovascular disease, and cancer have been categorized as three of the most catastrophic health issues among women. (Ford, Bass, Turner, Mauromoustakos, & Graves, 2004). In fact, 10 million new cases of osteoporosis are reported each year (Surgeon General Report, 2004). Although, exercise can promote bone health, excessive exercise alone or in conjunction with a host of compounding health variables can result in compromised bone mineral density (BMD) and eventually osteoporosis. Women develop their peak bone mass by age 30; with 60% to 70% formed by age 20 (Nattiv & Armsey, 1997; Teitz, 1997; Zeni, Street, Dempsey, & Staton, 2000). After this age, women will loose BMD at a rate of 0.5% per year, the rate can accelerate to 5% per year following menopause, (Leslie & St. Pierre, 1999; Melton et al., 2004; Steinwig, 2002). Female athletes, in particular, can lose 25% of their BMD if their osteopenic condition is ignored throughout their competitive years (Yurth, 1995). Therefore, it is imperative for female athletes and young women to be aware of the potential threats to their BMD health. Past research has indicated that the Female Athlete Triad (eating disorders, amenorrhea, and osteoporosis) predicts BMD issues (Beals, Brey, & Gonyou, 1999; Nattiv & Lynch, 1994). Anderson, Anshel, Binkley, & Parsons (2006) determined that body mass index (BMI) can be utilized as a predictor of BMD deficiencies in National Collegiate Amateur Athletic Association (NCAA) Division I-A athletes. In this investigation the researchers examined three potential predictors of BMD: BMI, whether or not the individual had an eating disorder, and exercise intensity. Therefore, the focus of this project was to examine the effect of BMI, the presence of an eating disorder, and exercise intensity on predicting deficiencies in BMD of female athletes and active females in this investigation.

## METHODS

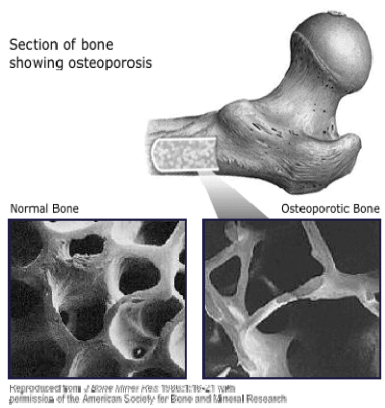
***Participants***
A population of 175 young women ages 18-24 volunteered to participate in this investigation. The sample of volunteers were comprised of 71 females who were NCAA Division II collegiate athletes and 104 females whom were either students at one of two southern universities or teachers in South Georgia. The ethnicity of the sample was somewhat homogeneous with approximately 71% Caucasian ($n$= 124), 20% African-American ($n$=35), 6% Latino ($n$=11), 0.5% Native American ($n$=1), and 2.2% ($n$=4) who identified their race as other.

***Instrumentation and Procedures***
Data were collected from the campuses of two southern universities. Each participant completed a demographic questionnaire, Eating Attitudes Test-26 (EAT-26), Metriscan of the middle three fingers of the non-dominant hand, and underwent measurement of height and weight (to determine BMI).

***Statistical Analysis***
A regression analysis was performed on the data from each sample in order to determine the effect of BMI, whether or not the participant had the presence of an eating disorder (score on the EAT-26), and exercise intensity on female athletes and young women. An additional correlation analysis was performed to determine if there were any significant relationships between BMD and additional health related variables.

## RESULTS

Model one of the regression was not significant. The $R^2$ for this model was .029 (see Table 1), indicating that only 2.9% of the variance in the BMD of the females represented in this sample is explained by the three main effects (exercise intensity, evidence of an eating disorder, and BMI). However, further analysis of the data revealed a significant relationship between another health variable, the amount of calcium supplements an individual consumes, and their corresponding BMD ($p < .05$), as well as a significant negative relationship between the occurrence of a stress fracture and the number of hours in which an individual exercises per week ($p < .01$).

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## DISCUSSION

The primary purpose of this project was to examine the impact of the three main effects on the BMD of the population in this investigation. The findings from the regression analysis were inconclusive, and therefore, did not support this purpose; although, further analysis of the data did provide more insight into two additional contributing factors to the bone health of this sample. For example, there was a significant positive relationship between BMD and calcium supplementation, as well as a significant negative relationship between stress fractures and hours of exercise per week. Calcium has been proven to aid in the preservation of BMD (National Institute of Health, 1994); therefore, this finding supports this notion. Conversely, the American College of Sports Medicine (2007) has stated that bone health can be impacted by deficient energy intake (i.e., < 30 kcal/kg), this outcome was not supported in this investigation, yet the investigators did conclude that the more hours per week the participants exercised, the more likely they were to encounter a stress fracture.

## CONCLUSION

***Limitations***
The most significant limitation was the method which was used to collect data on BMD. The Metriscan produced only a T-Score. Unfortunately, the T-Score results provided somewhat of a categorical variable in the regression analysis for the dependent variable. Additionally, the EAT-26 is a measure for eating disorders and may not accurately identify disordered eaters.

***Recommendations for Future Research***
Perform a similar investigation utilizing dual x-ray absorptiometry (DXA) to determine if the number of hours exercised per week by females could predict bone health.

Table 1

Summary of Regression Analysis for Variables that Predict the Bone Mineral Density in Female Athletes and Active Females

| Variable | *B* | *SEB* | β | |
|---|---|---|---|---|
| Step 1 | | | | |
| Constant | 2.367 | 0.179 | | *** |
| Exercise intensity | 0.037 | 0.047 | .043 | |
| EAT-26 | 0.002 | 0.005 | 0.020 | |
| BMI | -0.015 | 0.005 | -0.156 | |

*Note*: $R^2 = .029$