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The Effects of a Caloric Restrictive Diet on Bone Mineral Density and Bone Strength in Male and Female Rats

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The purpose of this study was to determine the existence of sex differences following a 40% caloric restrictive diet and its impact on tibial bone mineral density (BMD) and bone strength between male and female rats. Thirty-two, six-week-old Sprague Dawley rats (16 males and 16 females) were randomly divided into an ad libitum fed control group (MC, n=8 and FC, n=8) and a pair-fed diet group placed on the 40% caloric restriction (MD, n=8 and FD, n=8) for a 6 week period. The caloric restrictive diet was equivalent to the normal fed diet in vitamin and mineral content where the only difference was 40% less calories. After 6 weeks, there were no significant interaction effects, therefore main effects (i.e., sex and diet) were examined. While the tibial BMD was equivalent between males (0.206 ± 0.003 g/cm²) and females (0.207 ± 0.004 g/cm²), bone strength (amount of force required to break the tibia expressed in Newtons, N) was significantly greater for males (112.0 ± 2.4 N) compared to females (74.8 ± 3.1 N). The BMD was significantly lower for caloric restrictive fed groups (0.200 ± 0.003 g/cm²) compared to normal fed animals (0.213 ± 0.003 g/cm²). In like manner, bone strength significantly lower for diet fed animals (86.5 ± 5.6 N) compared to control fed animals (100.3 ± 5.1 N). The results imply that caloric restriction lowers BMD and bone strength irrespective of sex. However, bone strength was greater for males compared to females.

Results

![Figure 1: Bone Mineral Density (BMD) of the tibia for the baseline group sacrificed immediately (B, n=16), regularly fed group allowed to eat ad lib (C, n=16), and the 40% caloric restricted group (D, n=16). *Significant difference between Control vs Diet.](image)

![Figure 2: Bone Mineral Density (BMD) of the tibia comparing males (M=16) and females (F=16).](image)

![Figure 3: Fat (N) of the tibia comparing males (M=16) and females (F=16). *Significant difference between Males vs. Females.](image)

![Figure 4: Femur (N) of the tibia comparing males (M=16) and females (F=16). *Significant difference between Males vs. Females.](image)

The caloric restrictive diets resulted in significantly lower body weights for both males and females. No interaction effects were found so main effects (i.e. diet and sex) were determined where caloric restricted animals had lower BMD (0.200 ± 0.003 g/cm²) compared to normal fed animals (0.213 ± 0.003 g/cm²), similarly, bone strength was found to be significantly lower for diet fed animals (86.5 ± 5.6 N) when compared to control fed animals (100.3 ± 5.1 N). In contrast, the BMD was equivalent between males (0.206 ± 0.003 g/cm²) and females (0.207 ± 0.004 g/cm²), however, males were found to have significantly higher bone strength (112.0 ± 2.4 N) compared to females (74.8 ± 3.1 N). There were no interaction effects between sexes and males on the caloric restriction, therefore, our hypothesis was not supported. Since bone strength was greater in males compared to females, this suggests possible sex differences in bone architecture.

Summary and Conclusions

- The caloric restrictive diets resulted in significantly lower body weights for both males and females.
- No interaction effects were found so main effects (i.e. diet and sex) were determined where caloric restricted animals had lower BMD (0.200 ± 0.003 g/cm²) compared to normal fed animals (0.213 ± 0.003 g/cm²), similarly, bone strength was found to be significantly lower for diet fed animals (86.5 ± 5.6 N) when compared to control fed animals (100.3 ± 5.1 N).
- In contrast, the BMD was equivalent between males (0.206 ± 0.003 g/cm²) and females (0.207 ± 0.004 g/cm²), however, males were found to have significantly higher bone strength (112.0 ± 2.4 N) compared to females (74.8 ± 3.1 N).
- There were no interaction effects between sexes and males on the caloric restriction, therefore, our hypothesis was not supported.
- Since bone strength was greater in males compared to females, this suggests possible sex differences in bone architecture.

Works Cited


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