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Bone Structure and Strength in Competitive Gymnasts

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Abstract

Introduction: Participation in high impact sports during growth has shown to increase bone quality[1]. Gymnastics is one the of the highest impact sports involving impacts of up to 10 times body weight[2]. Gymnasts have previously displayed increased bone mass and strength; however, it is not yet understood how bone structure is affected by gymnastics participation. The purpose of this study was to investigate the roll of gymnastics participation on bone structure and bone strength.

Methods: The study recruited 17 highly competitive female gymnasts and 15 recreationally active controls (16 to 30 years). Areal bone mineral density (aBMD) and body composition of the hip, spine, and whole body were determined by dual energy x-ray absorptiometry (DXA, Discovery A, Hologic). Bone structure properties were determined for the non-dominant tibia and radius using high resolution peripheral quantitative computed tomography (HR-pQCT, Scanco Medical, Brutisellen, Switzerland). Finite element analysis (FEA) was used to determine an in vivo estimation of bone strength. All data are presented as means $\pm$standard deviation. Differences between groups were identified with analysis of covariance, adjusting for differences in body size.

Results: Gymnasts had a higher whole body aBMD of 1.070 ± 0.122 g/cm^2 compared to controls, 0.944 ± 0.123 g/cm^2 ($p<0.01$). Gymnasts also had a larger cross-sectional area of their radius, 305 ± 39 mm^2 versus 247 ± 40 mm^2 ($p<0.01$), and tibia, 683 ± 65 mm^2 versus 626 ± 66 mm^2, than controls. Therefore, FEA revealed gymnasts had stronger bones reflected by a higher failure load, 2830 ± 500 N versus 1915 ± 503 N ($p<0.01$) in the radius, and 7300 ± 845 N versus 5810 ± 852 N ($p<0.01$) in the tibia, compared with controls.

Conclusion: Gymnasts exhibited enhanced bone structure and strength when compared to inactive controls. The high loading associated with the sport is likely to induce these desired bone properties.

References

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