

Title: DAILY PHYSICAL ACTIVITY AND BONE HEALTH AMONG HIGH SCHOOL STUDENTS

Author Information: Stephanie M. Otto, Department of Health and Exercise Science, Gustavus Adolphus College, St. Peter, MN 56082; Don Morgan, Department of Health and Human Performance, Middle Tennessee State University, Murfreesboro, TN 37132; Richard S. Farley, Department of Health and Human Performance, Middle Tennessee State University, Murfreesboro, TN 37132; Jwa K. Kim, Department of Psychology, Middle Tennessee State University, Murfreesboro, TN 37132; Dana K. Fuller, Department of Psychology, Middle Tennessee State University, Murfreesboro, TN 37132; Jennifer L. Caputo, Department of Health and Human Performance, Middle Tennessee State University, Murfreesboro, TN 37132.

Introduction: With advancements in healthcare and public education, life expectancy is increasing and the prevalence of age related health conditions such as osteoporosis are rising. It is well known that children and adolescents who engage in healthy behaviors are more likely to carry those behaviors into adulthood. More specifically, children and adolescents who engage in weight bearing physical activity have higher bone density and are less likely to develop osteoporosis later in life (1). Furthermore, technology that measures daily physical activity is improving and individuals are interested in the amount of activity they and their children should participate in to remain healthy. The primary focus of this study was to quantify the association between pedometer-based physical activity and various measures of bone mass in adolescents. A secondary purpose of this investigation was to determine if adolescents who took at least 10,000 steps per day exhibited higher bone mass compared to those who took less than 10,000 steps per day.

Methods:

- Participants - Participants ($N = 46$) included boys and girls averaging 16 (± 0.9) years. The average daily step count of our sample was 7,285 steps ($\pm 2,842$ steps).
- Protocol - Daily step accounts were tallied using NL-2000 pedometers for a 7-day period while maintaining normal activity. Areal bone mineral density (aBMD, g/cm^2) and content (BMC, g) were measured at the hips and lumbar spine with a Hologic dual energy x-ray absorptiometry (DEXA) machine.
- Statistical Analysis – Bivariate correlations were calculated for average daily step count, age, height, weight, BMI, total hip, femoral neck, trochanteric, and lumbar spine aBMD and BMC to determine if significant ($p < .05$) relationships existed. Multivariate analyses of covariance (MANCOVA) were conducted to determine if, when controlling for height, a difference existed in total hip, femoral neck, trochanteric or spine aBMD or BMC between participants who took an average of 10,000 daily steps or more and those who registered less than an average of 10,000 daily steps. Height was used as a control variable in the absence of maturation data. Data were

analyzed for the entire sample and also grouped by sex to document the potential effect of this variable. For these analyses, the alpha level was set at .025 following the Bonferroni method to control the error rate inflation due to multiple tests.

Results: Average daily step counts were significantly correlated to total hip ($r = .36$) ($r = .37$), femoral neck ($r = .31$) ($r = .36$), and trochanteric ($r = .35$) ($r = .29$) aBMD and BMC_a respectively. Total hip, femoral neck, and trochanteric aBMD, and total hip along with femoral neck BMC_a were significantly higher ($p < .025$) among participants who achieved 10,000 steps or more per day compared to those who were not successful in achieving this step activity goal. When data were stratified by sex, total hip and trochanteric aBMD were significantly higher for girls who accumulated 10,000 or more steps per day.

Discussion: These findings indicate a significant positive relationship exists between accumulated step activity and bone mass in adolescent youth. Furthermore, the 10,000 step per day criterion appears to adequately discriminate group differences in bone health in this pediatric population for girls. Differences in hip aBMD found among girls, but not in boys, could be due to the influence of sex and genetics on bone development. This latter finding emphasizes the importance of physical activity in adolescent girls, especially considering that girls tend to become more sedentary as they age compared to boys (2).

1. Heaney R, Abrams S, Dawsom-Hughes B, Looker A, Marcus R, Matkovic V et al. Peak bone mass.

Osteoporosis Int 11: 985-1009, 2000.

2. Slemenda C, Miller J, Hui S, Reister T, Johnston CC. Role of physical activity in the development of skeletal mass in children. *J Bone Min Res* 6: 1227-1233, 1991.