



Grant Information Summary:

History Predicts Stress Fracture in Active Female Adolescents

Practical Significance Statement

Stress fractures are markers of inheritable skeletal problems that may place adolescent girls at an increased long-term risk for osteoporosis.

Study Background

Stress fractures are particularly concerning in active female adolescents and because they may signify insufficiency of the bones to withstand repetitive loading. Although a 'fracture threshold' is not yet defined for children and adolescents, approximately 80-90% of in vitro skeletal strength in adults is determined by bone mineral density (BMD). A woman's peak bone mass (PBM) is achieved by the early 20s and is one of the strongest predictors of her long-term risk of osteoporosis. Understanding the factors that

predispose individuals to stress fractures in this population could indirectly elucidate the risk factors associated with low BMD.

Objective

Increased physical activity and menstrual irregularity (MI) have been associated with increased risk for stress fracture among adult women active in athletics. The purpose of this study was to determine if they are also risk factors among adolescents.

Design And Setting

A matched case-control study was conducted at the sports medicine clinics of an urban tertiary care pediatric medical center.

Subjects

Patients who had participated in at least 3 hours per week of physical activity were eligible for enrollment. Patients with chronic illnesses or use of medications known to affect BMD were excluded. Each case diagnosed with her first stress fracture was matched prospectively with 2 controls.

Measurements

The primary outcome, stress fracture in any extremity or the spine, was confirmed radiographically. Family history and menstrual history were obtained by semi-structured interview, with MI defined as primary or secondary amenorrhea or oligomenorrhea. Physical activity was quantified using a validated self-administered questionnaire.

Results

There was no significant difference in the mean hours per week of total physical activity between girls in this sample with stress fracture (8.2 hrs/week) and those without (7.4 hrs/week, $P=0.51$). The prevalence of MI was similar among cases and controls (21.4% vs. 14.3%, $P=0.24$). In multivariate models, the only significant predictor of stress fracture was a positive family history of osteoporosis or osteopenia (odds ratio = 2.96, 95% confidence interval [CI]: 1.36, 6.45).

Conclusions

Among highly active female adolescents, only a family history of a low bone density was independently associated with stress fracture. The magnitude of this association suggests that further investigations of inheritable skeletal factors are warranted in this population.

Principal Investigator:



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Keith J. Loud received his A.B. degree in Biochemical Sciences from Harvard College, and his M.D. degree from McGill University. Upon completing medical school, Dr. Loud completed his residency at Dartmouth-Hitchcock Medical Center in the Department of Pediatrics, and his fellowship in the Divisions of Adolescent Medicine and Sports Medicine at Children's Hospital in Boston. Dr. Loud also completed his MS degree in Clinical Sciences from Harvard Medical School during this time. Currently, Dr. Loud serves as the Medical Director of Adolescent Health Services at Children's Hospital of Akron Ohio. Additionally, Dr. Loud is an Assistant Professor of Pediatrics at Northeast Ohio Universities' College of Medicine. Dr. Loud is Board Certified by the American Board of Pediatrics in Sports Medicine and Adolescent Health and a member of numerous Pediatric and Sports Medicine societies.

Publication & Presentation List

Loud KJ, Micheli LJ, Bristol SK, Austin SB, Gordon CM. Family History Predicts Stress Fracture in Active Female Adolescents. *Pediatrics* 2007; *in press*.

Loud KJ, Gordon CM, Bristol SK, Austin SB, Micheli LJ. Predictors of Stress Fracture in Active Female Adolescents. Presented at National Athletic Trainers' Association Annual Meeting, Atlanta, Georgia, 15 June 2006.

Loud KJ, Micheli LJ, Bristol SK, Austin SB, Gordon CM. Bone Mineral Density in Active Female Adolescents with Stress Fracture. Presented at American Society for Bone and Mineral Research Annual Meeting, Nashville, Tennessee, October 2005.

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