Bone Stress Injury and Relationships between Single and Combined Female Athlete Triad Risk Factors
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Identifying factors associated with bone stress injury (BSI), including stress reaction and stress fracture, may aid in targeting those at risk and formulating prevention guidelines for exercising girls and women. **PURPOSE:** To evaluate the effect of single or combined risk factors associated with the Female Athlete Triad on the incidence of BSI among a multi-center prospective sample of 4 cohorts of physically active girls and women. **METHODS:** At baseline, participants’ (N= 262, mean age 18.2 ± 0.2y) eating attitudes and behaviors, menstrual function, sports participation or exercise activity, injury history, and pathologic weight control behaviors were assessed. Dual-energy x-ray absorptiometry (DXA) measured bone mass of the whole body, total hip, femoral neck, lumbar spine and body composition. Participants were followed prospectively for occurrence of injury; those confirmed by a physician were recorded. **RESULTS:** Twenty-eight (10.7%) participants incurred a BSI. Leanness competitive sport athletes exhibited the highest percent of injuries, compared to non-leanness competitive sport athletes and exercising women (18.7% vs. 8.1% vs. 4.2%, respectively, X²= 10.0, p< 0.01). The single risk factor most predictive of BSI was low BMD, defined as a Z-score ≤ -1.0, (odds ratio [OR] = 3.2, 95% confidence interval [CI]: 1.4, 7.1). Among those with BMD Z-score ≤ -1.0, 20.6% incurred BSI. The strongest 2- and 3-variable combined risk factors were low BMD (≤ -1.0) + BMI <21.0 (OR= 4.6, 95% CI: 2.0, 10.7; 27.5% incurred BSI), and low BMD (≤ -1.0) + BMI <21.0 + Oligo/Amenorrhea (O/A) (OR= 9.6, 95% CI: 2.3, 40.8; 50% incurred BSI). For individuals with BMD ≤ -1.0, BMI <21.0, dietary restraint, leanness sport, and O/A (compared to those with BMD > -1.0), 44% incurred BSI (OR= 9.8, 95% CI: 2.4). **CONCLUSIONS:** While low bone mass emerged as the strongest single predictor of bone stress injury, the percent of exercising women and adolescents with injury more than doubled among those with additional risk factors including BMI <21.0, O/A, high dietary restraint, and participation in leanness sport. These data support the notion that the cumulative risk for BSI increases as the number of Triad-related risk factors accumulate.

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