BONE DENSITY BY PERIPHERAL QUANTITATIVE COMPUTED TOMOGRAPHY AND DUAL-ENERGY X-RAY ABSORPTIOMETRY IN ADOLESCENT GIRLS WITH ANOREXIA NERVOSA

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**Purpose:** Adolescents with anorexia nervosa (AN) commonly exhibit bone loss of the axial skeleton, but effects on the peripheral skeleton are less clear. We examined the relation between malnutrition and bone health in AN, comparing measures obtained by dual-energy X-ray absorptiometry (DXA) and peripheral quantitative computed tomography (pQCT).

**Methods:** Seventy female adolescents (age 15.5 ± 1.9y) with AN and 132 healthy, normal-weighted controls underwent tibial measures by pQCT including trabecular volumetric bone mineral density (vBMD), cortical vBMD and dimensions, and muscle cross-sectional area (CSA). Participants with AN had DXA measures of the hip, spine and total body. DXA and pQCT outcomes were converted to gender- and race-specific Z-scores relative to age. We used independent t-tests to compare pQCT results in AN and controls, and Pearson coefficients to correlate clinical and bone measures.

**Results:** DXA hip and spine BMD Z-scores were significantly below zero in participants with AN. Trabecular vBMD Z-scores were lower (p=0.01) and cortical vBMD Z-scores higher (p<0.001) in AN compared to controls. Trabecular vBMD (but not cortical vBMD) and cortical CSA Z-scores were positively correlated with DXA BMD Z-scores (all p<0.001) for subjects with AN. BMI Z-score and percentage of ideal body weight were positively correlated with Z-scores for trabecular vBMD, cortical CSA, and muscle CSA (p<0.04 for all). Trabecular vBMD Z-scores and muscle CSA were greater in all subjects who exercised compared to non-exercisers. For a given amount of exercise, trabecular vBMD Z-scores, cortical vBMD Z-scores, and muscle CSA Z-scores were higher in subjects with AN than in controls who reported the same amount of exercise. Differences in response to exercise between groups were not seen for cortical BMC, cortical CSA, or section modulus Z-scores. In AN, use of antidepressants was consistently associated with lower pQCT measures. Z-scores for cortical BMC and cortical CSA, and muscle CSA were lower in antidepressant users than in those who did not, by a difference of –0.60, –0.61, and –0.61 units respectively (p<0.03).

**Conclusions:** This investigation is the first study to compare DXA and pQCT outcomes in a cohort of adolescent girls with AN. We observed deficits in BMD by both DXA and pQCT. pQCT assessments correlated well with bone and body composition measures by DXA. pQCT measurements were associated with many of the same clinical parameters and markers of disease severity as have been previously established for DXA and confirmed here. The correlations noted between findings from pQCT and DXA are noteworthy as questions have arisen as to whether these technologies capture the same skeletal properties. Our results suggest that the impact of malnutrition and the accompanying systemic alterations on the peripheral skeleton in AN are similar to that on the axial skeleton. The differences in cortical vBMD and positive associations with exercise merit further study.

**Sources of Support:** NIH R01 AR060829, NICHD K23 HD060066, NIH UL1 RR-025758 (Harvard Clinical
and Translational Science Center), and the Boston Children’s Hospital Department of Medicine and Clinical and Translational Study Unit (CTSU).

20.

**NO SIGNIFICANT SEX DIFFERENCES IN BONE DEFICITS AMONG ADOLESCENTS WITH ANOREXIA NERVOSA**

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**Purpose:** The objective of this study is to compare deficits in bone mineral density (BMD) among male and female adolescents with anorexia nervosa (AN) and to identify other covariates associated with low BMD. Relatively few studies have assessed BMD in males with AN. The limited existing studies in males with AN have found the most significant deficits in BMD at the hip, femoral neck, trochanter, and intertrochanteric regions, all sites of primarily cortical bone, compared to healthy male controls. Although 5-15% of AN patients are male, to our knowledge there are no current studies comparing sex differences in BMD in AN.

**Methods:** Electronic medical records of all subjects 9-20 years of age with a DSM-5 diagnosis of AN with dual-energy x-ray absorptiometry (DXA) scans after initial evaluation by the eating disorders program at Lucile Packard Children’s Hospital, Stanford between March 1997 and February 2011, were retrospectively reviewed. From the DXA scans, the BMD and bone mineral content (BMC) results were converted to sex- and race-specific Z-scores for age using the national Bone Mineral Density in Childhood Study (BMDCS) reference data. Differences in BMD and BMC by sex, percentage median body mass index (%mBMI), and duration of illness were calculated using independent samples t-tests and linear regression analysis.

**Results:** A total of 25 males and 347 females with AN met eligibility criteria. There were no significant sex differences in duration of illness or in whole body BMC, lumbar spine BMD, total hip BMD, and femoral neck BMD using independent samples t-tests. Males (81.3 ± 4.8) had higher %mBMI than females (78.5 ± 7.2) but the difference did not reach statistical significance (p=0.052). There were no significant sex differences in bone deficits at the lumbar spine, total hip, femoral neck, or whole body when controlling for %mBMI and duration of illness. Lower %mBMI was significantly associated with bone deficits in whole body BMC (β=0.05, p<0.001), lumbar spine BMD (β=0.04, p<0.001), total hip BMD (β=0.05, p<0.001), and femoral neck BMD (β=0.05, p<0.001) when controlling for sex and duration of illness. Longer duration of illness was also associated with greater deficits in whole body BMC (β= -0.01, p=0.01) and at the lumbar spine (β= -0.01, p=0.02) but not at the hip or femoral neck.

**Conclusions:** Degree of malnutrition rather than sex predicts bone deficits in adolescents with AN. Longer duration of illness was associated with greater deficits in whole body BMC and lumbar spine BMD. This is the first and largest study to evaluate sex differences in BMD among adolescents with AN, and the first study to evaluate bone density using DSM-5 criteria for AN.

**Sources of Support:** None
WHAT, WHEN, AND WHERE: MEASURES OF ADOLESCENT SNACKING BEHAVIORS ARE ASSOCIATED WITH DIETARY INTAKE AND WEIGHT STATUS
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Purpose: While several studies have found that frequent snacking is associated with higher total energy intake, most research shows no evidence of a relationship between snacking behavior and weight status or that young people who consume more snacks are less likely to be overweight or obese. This study examined associations between adolescent snacking behaviors, dietary intake, and weight status with attention to potentially confounding factors that may help to explain the mixed findings of previous research.

Methods: The sample included 2,793 adolescents enrolled in EAT 2010 (Eating and Activity in Teens) during the 2009-2010 academic year. Adolescent participants (53.2% girls, mean age=14.4 years) were recruited through 20 public secondary schools in the Minneapolis/St. Paul metropolitan area, which serve socioeconomically and ethnically/racially diverse communities. Trained research staff administered surveys, including a food frequency questionnaire, and measured adolescents’ height and weight at school. Measures of snacking behavior included number of snacks per week, servings/day of common energy-dense snack foods (e.g., potato chips, candy bars), weekly frequency snacks are prepared away from home, and frequency of snacking while watching television. Linear regression was used to determine if snacking behaviors were associated with daily servings of fruits/vegetables and sugar-sweetened beverages, weekly frequency of eating something purchased from a fast-food restaurant, and BMI z-score. Separate models were run for each outcome variable adjusted for ethnicity/race, gender, age, and parental education. Additional models were examined to address potential confounding factors such as frequency of meal skipping, under-reporting energy intake, intentions to lose weight, hours/week of television viewing, and hours/week of moderate-to-vigorous physical activity.

Results: On average, adolescents reported consuming 3.8 snacks/day on weekdays, 4.9 snacks/day on vacation/weekend days, 2.2 daily servings of energy-dense snack foods, and purchased snacks prepared away from home on 3.2 days/week. Frequency of snacking while watching television was reported as follows: 5.9% never, 24.8% rarely, 43.9% sometimes, 17.0% usually, and 8.4% always. The snacking behavior variables were consistently associated with lower fruit/vegetable intake, higher intake of sugar-sweetened beverages, and more frequent consumption of food purchased from a fast-food restaurant across all models (P<0.01). For example, based on a model including intentions to lose weight and hours per week of television viewing, adolescents who indicated they always had a snack while watching television consumed 0.63 fewer daily servings/1000 calories of fruits/vegetables and 0.15 additional daily servings/1000 calories of sugar-sweetened beverages. Models examining relationships of snacking behaviors with BMI z-score also consistently showed inverse associations regardless of adjustment for potentially confounding factors.

Conclusions: Providers of health programs and services for adolescents should provide encouragement
and recommendations for making healthy food and beverage choices between meals. Additionally, providers should evaluate media use behaviors and discourage eating while watching television. Further research is needed to understand how changes in snacking behaviors may be related to dietary intake and weight status over time.

Sources of Support: This study was supported by Grant Number R01HL084064 from the National Heart, Lung, and Blood Institute and by Grant Number R03HD079504 from the National Institute of Child Health and Human Development.

22.

NOVEL MEASURES OF CARDIAC FUNCTION IN CHILDREN DIAGNOSED WITH EATING DISORDERS: A TWO-DIMENSIONAL SPECKLE TRACKING ECHOCARDIOGRAPHY STUDY
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Purpose: Cardiovascular complications contribute to the high morbidity and mortality rate among children with eating disorders. Previous studies have shown that the cardiovascular effects of eating disorders manifest with electrocardiogram abnormalities (bradycardia, prolonged QTc) and morphologic changes (decreased LV mass); but little is known about cardiac function. Conventional echocardiography may not detect subtle alterations in myocardial function. Two-dimensional speckle tracking echocardiographic (2DSTE) derived strain is a novel method to quantify left ventricular (LV) function in children and has been shown to have a greater sensitivity for measuring myocardial performance than conventional echocardiography. The aim of this study was to assess global and regional LV function in children newly diagnosed with eating disorders with 2DSTE derived strain.

Methods: We conducted a retrospective pilot study in twenty children (14 ± 2 years, 17 (85%) female) newly diagnosed with eating disorders (DSM-V criteria: anorexia nervosa, n=18; and bulimia nervosa, n=2). Traditional functional and morphological echocardiographic measures (ejection fraction, shortening fraction, and LV mass) were assessed at the time of diagnosis (mean HR, 54 ± 14 beats/minute and mean systolic blood pressure, 94 ± 10 mmHg). LV global longitudinal strain was obtained as an average of 18 regions from the three apical echocardiographic views. Results were compared to normative pediatric strain data. The cohort was stratified by their DSM-V criteria and behavioral patterns, such as patients who restrict, purge, and/or exercise. Age, race, gender, % change from ideal body weight, electrolyte profiles, and vital signs (heart rate, blood pressure) were accounted for in regression analysis.

Results: Traditional echocardiographic measures and LV global longitudinal strain were similar between patients newly diagnosed with an eating disorder and healthy children. These same cardiac measures were also unchanged in eating disorder patients when we stratified the cohort by % change from ideal body weight or patient behavior. Interestingly, at the regional level, basal longitudinal strain was decreased in all eating disorder patients compared to normal children, although this trend was not statistically significant. Moreover, we observed a decrease in the magnitude of basal longitudinal strain.
in patients who purge compared to other eating disorder patients (-16.3 ± 2.1 vs. -19.3 ± 1.5, p<0.05), which persisted when heart rate, blood pressure, gender, electrolyte profiles and age were accounted for in the analysis.

**Conclusions:** In this pilot study, traditional measures of cardiac function and global longitudinal strain were unchanged in patients with eating disorders at the time of diagnosis. However, basal longitudinal strain, as a measure of regional ventricular function, was decreased in all eating disorder patients, and was statistically lower among patients with purging behavior. Utilizing 2DSTE derived strain to assess for regional wall motion abnormalities may be helpful in identifying patients who are at increased risk for developing more significant cardiac dysfunction. The clinical significance of decreased basal longitudinal strain in children with EDs should be further explored in more expansive studies.

**Sources of Support:** None

23.

**TITLE:** EXPERIENCE OF ABUSE, HOUSEHOLD DYSFUNCTION, AND EARLY USE OF ALCOHOL AND MARIJUANA AMONG MINNESOTA YOUTH: THE MODERATING ROLE OF INTERNAL ASSETS

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**Purpose:** Early adolescence (ages 12 to 14 years) is a critical risk period for initiation of substance use. Adverse childhood events (ACEs), including experience of abuse and household dysfunction, are prominent risk factors for early initiation of marijuana and alcohol use. A key component of youth developmental assets and guidepost for development of self-regulation later in the life course, internal assets are important protective factors against substance use among adolescents. The purpose of this study is to investigate if and to what extent internal assets modify associations between adverse childhood events and early initiation of alcohol and marijuana use, respectively. Specifically, we tested hypotheses that associations between experiencing abuse, household dysfunction, or both and early initiation of marijuana and alcohol use were stronger for teens with lower internal assets than for teens who reported higher internal assets.

**Methods:** We used data from 9th and 11th graders who completed the 2013 Minnesota Student Survey (N=79,339). Multivariable logistic regression was used to investigate whether experiencing abuse (verbal, physical or sexual), household dysfunction (living with someone who abuses alcohol or illegal drugs or witnessing physical violence among adults) or both of these types of adverse events were independently associated with early use of alcohol and marijuana (before 14 years), adjusting for race, grades, gender, access to free lunch, parent-teen communication, family structure, and region of residence. Additionally, we investigated whether internal assets (constructed as a mean of responses to 14 items, range=1-4) moderated these associations.

**Results:** Approximately 19% and 13% of participants were early initiators of marijuana and alcohol use, respectively. Approximately 12% of the overall sample reported experiencing any abuse, 8% reported experiencing any household dysfunction and 10% experienced both abuse and dysfunction. In adjusted models, experiencing abuse, household dysfunction, and both, were independently associated with
higher odds of early initiation of marijuana and alcohol use, respectively. Internal assets significantly moderated the association between experiencing both abuse and household dysfunction and early initiation of marijuana use (p<.001), such that a stronger association was apparent for participants with lower internal assets scores compared to those with higher internal assets. Specifically, at the 5th percentile of the internal assets distribution, the odds of early initiation of marijuana use were two times higher for those who experienced both abuse and dysfunction (vs. neither) (AOR 2.2; CI: 1.9-2.5). However at the 90th percentile, the same odds ratio was significantly lower (AOR 1.4; CI: 1.1-1.8). Internals assets weakly moderated the association between experience of both abuse and household dysfunction and early initiation of alcohol use (p=0.08).

Conclusions: Protecting teens from experiencing adverse events is a priority to prevent adverse health behaviors including initiation of substance use. At the same time, resources need to be directed toward clinicians, schools and communities to help build internal assets in vulnerable youth to help buffer them against negative/stressful experiences and protect against early initiation of marijuana use.

Sources of Support: DC : National Research Service Award (NRSA) in Primary Medical Care, grant no. T32HP22239 (PI: Borowsky), Health Resources and Services Administration, Department of Health and Human Services.

24.

SIMULTANEOUS EXPOSURE TO ALCOHOL USE AND ALCOHOL INTERACTIVE MEDICATIONS AMONG ADOLESCENTS WITH A CHRONIC MEDICAL CONDITION AND ASSOCIATIONS WITH KNOWLEDGE: FINDINGS FROM A MULTI-CLINIC STUDY WITH IMPLICATIONS FOR CLINICAL PREVENTIVE SERVICES
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Purpose: 20% of US youth have a chronic medical condition. For these medically vulnerable youth alcohol use may pose significant risk for harm related to simultaneous exposure to alcohol interactive (AI) medications. A familiar concern among older adults, simultaneous exposure to alcohol and AI medications may be under-appreciated and under-addressed among adolescents despite this group’s peak risks for alcohol use and binge drinking and increasing rates of pediatric onset chronic disease. We sought to estimate the prevalence of simultaneous exposure to alcohol use and AI medications among a medically heterogeneous sample of chronically ill adolescents, testing also mediating effects on this relationship of knowledge about the potential for alcohol use to interact with medications.

Methods: Electronic structured survey data were collected from consented youth in care at one of five hospital clinics for either a respiratory condition or food allergy, Type 1 diabetes, juvenile idiopathic arthritis, inflammatory bowel disease (IBD) or attention deficit hyperactivity disorder (ADHD). Eligible youth were ages 9 to 18 years of age, had their condition for ≥ 1 year, read and spoke English, and could manipulate a tablet computer configured with a privacy preserving polarizing screen. We estimated prevalence and demographic correlates of past year alcohol use and binge drinking using age/gender cutoffs. Associations between drinking and use of alcohol interactive prescription medications were examined using multilevel multivariable regression in models that controlled for demographics, mental
health and clinic. AI analyses focused on high school youth. Analyses were undertaken in SAS 9.3.

**Results:** Of 522 youth (participation rate 77%), average age was 16 years, 81% were in high school, 48.5% were female, 75% were White, and 70.6% had at least one college educated parent. Among high school youth (n=423), 84% (n=357) were taking AI prescription medications. Of these, 35% reported past year alcohol use of which 32% reported binge drinking. Simultaneous exposure to past year alcohol use and AI medications was correlated with age (p<.0001). The adjusted odds of past year alcohol were 0.59 (95% confidence intervals 0.53, 0.67) (p<.0001) among high school youth taking AI prescription medications compared to those not taking them. The protective association between AI medication use and past year drinking was reduced when participant knowledge about AI issues was included in the model (adjusted OR 0.72; 95% confidence interval 0.50, 1.04, p<.05), suggesting that knowledge may partially mediate this relationship.

**Conclusions:** Alcohol use is prevalent among a large, medically heterogeneous sample of high school youth with chronic medical conditions taking alcohol interactive medications. Use of AI medications was protective of drinking in cross-sectional analyses. Knowledge about the potential for negative interactions between alcohol and medications appeared to mediate this relationship, suggesting the importance of targeted educational interventions that center on avoiding risk and minimizing interactions. The high prevalence of drinking among this sample and gravity of potential health risks associated with simultaneous exposure to AI medications for adolescents who drink support efforts to mount widespread screening and prevention programs targeting medically vulnerable youth in healthcare settings.

**Sources of Support:** Funded by R01AA021913