



PERFORMING ARTS

SPECIAL INTEREST GROUP



ORTHOPAEDIC SECTION
AMERICAN PHYSICAL THERAPY ASSOCIATION



American Physical Therapy Association
The Science of Healing. The Art of Caring.

PASIG MONTHLY CITATION BLAST: No.70

April 2012

Dear Performing Arts SIG members:

A warm welcome to new members, and great thanks to many of you who have volunteered to help our group grow in new directions. We value the thoughts and participation of all our members, therefore, if you would like to participate or have ideas to share, please email me. I look forward to hearing from you!

For our April 2012 Citation BLAST, Laura Reising, MS, SPT, has compiled abstracts on the topic, "Female Athlete Triad." The format is an annotated bibliography of articles generally from the last decade. The PASIG Research Committee initiated this monthly Citation BLAST on performing arts-related topics in June 2005 in the hopes of encouraging our members to stay current in the literature and, perhaps, consider conducting research themselves. Each month we send a new list of performing arts (PA) citations to members of the PASIG to further the pursuit of PA-related scholarship. (Information about EndNote referencing software can be found at <http://www.endnote.com>, including a 30-day free trial).

Best regards,

Annette

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PERFORMING ARTS CONTINUING EDUCATION AND CONFERENCES

Orthopaedic Section Independent Study Course. *20.3 Physical Therapy for the Performing Artist.*

Monographs are available for:

- Figure Skating (J. Flug, J. Schneider, E. Greenberg),
- Artistic Gymnastics (A. Hunter-Giordano, Pongetti-Angeletti, S. Voelker, TJ Manal), and
- Instrumentalist Musicians (J. Dommerholt, B. Collier).

Contact: Orthopaedic Section at: www.orthopt.org

Orthopaedic Section Independent Study Course. *Dance Medicine: Strategies for the Prevention and Care of Injuries to Dancers.*

This is a 6-monograph course and includes many PASIG members as authors.

- Epidemiology of Dance Injuries: Biopsychosocial Considerations in the Management of Dancer Health (MJ Liederbach),
- Nutrition, Hydration, Metabolism, and Thinness (B Glace),
- The Dancer's Hip: Anatomic, Biomechanical, and Rehabilitation Considerations (G. Grossman),
- Common Knee Injuries in Dance (MJ Liederbach),
- Foot and Ankle Injuries in the Dancer: Examination and Treatment Strategies (M. Molnar, R. Bernstein, M. Hartog, L. Henry, M. Rodriguez, J. Smith, A. Zujko),
- Developing Expert Physical Therapy Practice in Dance Medicine (J. Gamboa, S. Bronner, TJ Manal).

Contact: Orthopaedic Section at: www.orthopt.org

Harkness Center for Dance Injuries, Hospital for Joint Diseases. Principles of Dance Medicine: Clinical management of the dancer patient. New York, NY, July 12 – 15, 2012.

<http://hjd.med.nyu.edu/harkness/education/healthcare-professionals/upcoming-educational-courses>

Performing Arts Medical Association (PAMA). 30th Annual Symposium: Medical Problems of Performing Artists, Snowmass, CO, July 26 – 29, 2012. Contact:

<http://www.artsmed.org>

International Association for Dance Medicine and Science: 22nd Annual Meeting, Singapore. October 25 – 28, 2012. Contact: <http://www.iadms.org>

Female Athlete Triad

In 1992, the association of amenorrhea, disordered eating and osteoporosis was recognized as the Female Athlete Triad (FT). Since then, researchers have been striving to compile strong scientific evidence regarding the physiological and pathophysiological mechanisms of this syndrome; in addition to, clinical outcomes regarding symptomology, quality of life and treatment. Athletics emphasizing low body weight for optimal performance for aesthetic purposes—i.e., dance, gymnastics and figure skating—are associated with an increased prevalence of the female athlete triad (FT). When energy expenditure supersedes energy intake, the resultant low energy availability may lead to amenorrhea and reduced bone mineral density (BMD) in these performing artists. It is imperative for the physical therapist to screen dancers of all levels for any component of the triad and to initiate a multidisciplinary treatment team when indicated. The following papers dating back to 2002 outlines the symptomology, pathophysiology, treatment and potential lifelong health consequences of this syndrome.

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Ackerman K, Nazem T, Chapko D, Russell M, Mendes N, Taylor AP, Boussein ML, Misra M (2011). Bone microarchitecture is impaired in adolescent amenorrheic athletes compared with eumenorrheic athletes and nonathletic controls. J Clin Endocrinol Metab **96**(10): 3123-33.

CONTEXT: Bone mineral density (BMD) is lower in young amenorrheic athletes (AA) compared to eumenorrheic athletes (EA) and nonathletic controls and may contribute to fracture risk during a critical time of bone accrual. Abnormal bone microarchitecture is an independent determinant of fracture risk and has not been assessed in young athletes and nonathletes. OBJECTIVE: We hypothesized that bone microarchitecture is impaired in AA compared to EA and nonathletes despite weight-bearing exercise. DESIGN AND SETTING: We conducted this cross-sectional study at the Clinical Research Center of Massachusetts General Hospital. SUBJECTS AND OUTCOME MEASURES: We assessed BMD and bone microarchitecture in 50 subjects [16 AA, 18 EA, and 16 nonathletes (15-21 yr old)] using dual-energy x-ray absorptiometry and high-resolution peripheral quantitative computed tomography. RESULTS: Groups did not differ for chronological age, bone age, body mass index, or vitamin D levels. Lumbar BMD Z-scores were lower in AA vs. EA and nonathletes; hip and femoral neck BMD Z-scores were highest in EA. At the weight-bearing tibia, athletes had greater total area, trabecular area, and cortical perimeter than nonathletes, whereas cortical area and thickness trended lower in AA. Trabecular number was lower and trabecular separation higher in AA vs. EA and nonathletes. At the non-weight-bearing radius, trabecular density was lower in AA vs. EA and nonathletes. Later menarchal age was an

important determinant if impaired microarchitecture. After controlling for covariates, subject grouping accounted for 18-24% of the variability in tibial trabecular number and separation. CONCLUSION: In addition to low BMD, AA have impaired bone microarchitecture compared with EA and nonathletes. These are the first data to show abnormal bone microarchitecture in AA.

Doyle-Lucas AF, Davy BM (2011). Development and evaluation of an educational intervention program for pre-professional adolescent ballet dancers: nutrition for optimal performance. J Dance Med & Sci **15**(2): 65-75.

The purpose of this investigation was to develop, implement, and evaluate a theoretically based nutritional education intervention through a DVD lecture series (three 30-minute classes) in summer intensive programs for pre-professional, adolescent ballet dancers. Objectives of this intervention program were to increase knowledge of basic sports nutrition principles and the Female Athlete Triad and promote self-efficacy for adopting healthier dietary habits. Dancers ranging from 13 to 18 years old who were attending summer intensive programs affiliated with professional ballet companies were recruited. Group One (n =231) participated in the nutrition education program, while Group Two the control participants (n = 90) did not. Assessments of the participants' dietary status consisted of a demographic questionnaire, a Sports Nutrition Knowledge and Behavior Questionnaire, and a Food Frequency Questionnaire. The intervention group was assessed at baseline, immediately post-program, and at six weeks post-program. The control group was assessed at baseline and at six weeks post-baseline. The intervention program was effective at increasing nutrition knowledge, perceived susceptibility to the Female Athlete Triad, and self-efficacy constructs. Improvements in dietary intake were also observed among intervention group participants. To improve overall health and performance nutrition education should be incorporated into the training regimens of adolescent dancers. This potentially replicable DVD-based program may be an effective, low-cost mechanism for doing that.

Doyle-Lucas AF, Akers JD, Davy BM (2010). Energy efficiency, menstrual irregularity, and bone mineral density in elite professional female ballet dancers. J Dance Med & Sci **14**(4): 146-154.

Sports that emphasize low body weight for optimal performance, such as ballet, are associated with an increased prevalence of the female athlete triad (FT). Previous research in this area that involves dancers has been limited; the majority of studies have been performed on adolescents training in classical ballet, and not professional adult dancers. The purpose of this study is to compare the physical and behavioral characteristics of female elite ballet dancers to sedentary, recreationally active non-dancing controls, with regard to characteristics of the FT and energetic efficiency. Women aged 18 to 35 years were recruited as participants. The dancers (N = 15) and non-dancing controls (N = 15) were pair-matched via age (dancers: 24.3 ± 1.3 years; controls: 23.7 ± 0.9 years), body mass index (dancers: 18.9 ± 0.2 ; controls: 19.4 ± 0.2 kg/m²), and fat-free mass (dancers: 44.3 ± 0.8 ; controls: 44.1 ± 0.9 kg). Assessments included habitual dietary intake

using 4-day food records, self-reported physical activity, psychometric measures of eating behaviors, health and menstrual history, body composition and bone density (dual energy x-ray absorptiometry), and resting metabolic rate (RMR) assessed by indirect calorimetry. Characteristics of the FT, specifically menstrual irregularities (6 of 15 dancers reported irregular or no menses; 1 of 15 controls reported irregular menses) and low energy availability, were more prevalent in dancers than in pair-matched controls. Despite having a similar fat-free mass (FFM), dancers had a significantly lower absolute RMR (dancers: 1367 ± 27 ; controls: 1454 ± 34 kcal/d; $p < 0.05$) and significantly lower RMR relative to FFM (dancers: 30.9 ± 0.6 ; controls: 33.1 ± 0.8 kcal/kg fat-free mass/d; $p < 0.05$). Energy intake between dancers (1577 ± 89 kcal/d) and pair-matched controls (2075 ± 163 kcal/d) also differed significantly ($p < 0.01$). Six of the 15 dancers met the criteria for the FT (including low bone mineral density, menstrual irregularities, and eating pathology accompanied by low energy availability) and, therefore, represent a population of individuals afflicted with this disorder. These findings provide insight as to the metabolic impact of chronic energy restriction, and suggest that alterations in RMR (i.e., energetic efficiency) may be an indicator of low energy availability. Future larger-scale studies are warranted to address this possibility. Interventions aimed at increasing energy availability in elite female ballet dancers may be needed to promote optimal health status.

Friesen KJ, Rozenek R, Clippinger K, Gunter K, Russo AC, Sklar SE (2011). Bone mineral density and body composition of collegiate modern dancers. J Dance Med & Sci 15(1): 31-36.

This study investigates body composition (BC), bone mineral density (BMD), eating behaviors, and menstrual dysfunction in collegiate modern dancers. Thirty-one female collegiate modern dance majors (D), 18 to 25 years of age, and 30 age-matched controls (C) participated in the study. BC and BMD were measured using dual energy x-ray absorptiometry (DXA). Upper and lower body strength was assessed by chest and leg press one-repetition maximum tests. Participants completed three-day food records, and the diet was analyzed using nutritional software. Menstrual dysfunction (MD) and history of eating disorder (ED) data were collected via questionnaires. BC and BMD variables were analyzed using MANCOVA and frequency of ED and MD by Chi-Square analysis. BMD was greater in D than C at the spine (1.302 ± 0.135 g/cm² vs. 1.245 ± 0.098 g/cm²), and both the right hip (1.163 ± 0.111 g/cm² vs. 1.099 ± 0.106 g/cm²) and left hip (1.160 ± 0.114 g/cm² vs. 1.101 ± 0.104 g/cm²; $p < 0.05$). Total body fat percentage was lower in D than C ($25.9 \pm 4.2\%$ vs. $32.0 \pm 5.9\%$; $p < 0.05$), and percent of fat distributed in the android region was also lower in D than C ($28.0 \pm 6.2\%$ vs. $37.6 \pm 8.6\%$; $p < 0.05$). With regard to diet composition, only percent fat intake was lower in D than C ($27.54 \pm 6.8\%$ vs. $31.5 \pm 7.4\%$, $p < 0.05$). A greater incidence of ED was reported by D than C (12.9% vs. 0%; $p < 0.05$), as well as a greater incidence of secondary amenorrhea (41.9% vs. 13.3%; $p < 0.05$). No differences were found for incidence of primary amenorrhea, oligomenorrhea, or use of birth control. Strength values were higher in D than C for both chest press (30.1 ± 0.9 kg vs. 28.4 ± 1.0 kg; $p < 0.05$) and leg press (170.7 ± 4.2 kg vs. 163.1 ± 3.9 kg; $p < 0.05$). It is concluded that the dancers in our study had a healthy body weight, yet

reported a higher incidence of eating disorders and menstrual dysfunction, than non-dancers. These dancers' higher BMD may be attributable to the mechanical loading and increased strength associated with practicing modern dance. Further, modern dancers had lower centrally located body fat, which decreases the risk for cardiovascular and metabolic diseases.

Hincapié CA, Cassidy JD (2010). Disordered eating, menstrual disturbances, and low bone mineral density in dancers: a systematic review. Arch Phys Med Rehabil **91**: 1777-89.

OBJECTIVE: To assemble and synthesize the best evidence on the epidemiology, diagnosis, prognosis, treatment, and prevention of disordered eating, menstrual disturbances, and low bone mineral density in dancers. **DATA SOURCES:** Medline, CINAHL, PsycINFO, Embase, and other electronic databases were searched from 1966 to 2010 using key words such as “dance,” “dancer,” “dancing,” “eating disorders,” “menstruation disturbances,” and “bone density.” In addition, the reference lists of relevant studies were examined, specialized journals were hand-searched, and the websites of major dance associations were scanned for relevant information. **DATA EXTRACTION:** Data from accepted studies were abstracted into evidence tables relating to prevalence and associated factors; incidence and risk factors; diagnosis; and prevention of disordered eating, menstrual disturbances, and/or low bone mineral density in dancers. **STUDY SELECTION:** Citations were screened for relevance using a priori criteria, and relevant studies were critically reviewed for scientific merit by the best evidence synthesis method. After 2748 abstracts were screened, 124 articles were reviewed, and 23 (18.5%) of these were accepted as scientifically admissible (representing 19 unique studies). **CONCLUSIONS:** The dance medicine literature is heterogeneous. The best available evidence suggests that disordered eating, menstrual disturbances, and low bone mineral density are important health issues for dancers at all skill levels. Future research would benefit from clear and relevant research questions being addressed with appropriate study designs and better reporting of studies in line with current scientific standards.

Hoch AZ, Papanek P, Szabo A, Widlansky ME, Schimke JE, Gutterman DD (2011). Association between the female athlete triad and endothelial dysfunction in dancers. Clin J Sport Med **21**(2): 119-25.

OBJECTIVE: To determine the prevalence of the 3 components of the female athlete triad [disordered eating, menstrual dysfunction, low bone mineral density (BMD)] and their relationships with brachial artery flow-mediated dilation in professional dancers. **DESIGN:** Prospective cohort study. **SETTING:** Academic institution in the Midwest. **PARTICIPANTS:** Twenty-two professional ballet dancers volunteered for this study. **INTERVENTIONS:** The prevalence of the female athlete triad and its relationship to endothelial dysfunction. **MAIN OUTCOME MEASURES:** Subjects completed questionnaires to assess disordered eating and menstrual status/history. They also completed a 3-day food record and wore an accelerometer for 3 days to determine energy availability. Serum baseline thyrotropin, prolactin, and hormonal concentrations were obtained. Bone mineral density and body composition were measured with a GE Lunar Prodigy dual-

energy X-ray absorptiometry. Endothelial function was determined as flow-mediated vasodilation measured by high-frequency ultrasound in the brachial artery. An increase in brachial diameter <5% to hyperemic flow stimulus was defined a priori as endothelial dysfunction. RESULTS: Seventeen dancers (77%) had evidence of low/negative energy availability. Thirty-two percent had disordered eating (EDE-Q score). Thirty-six percent had menstrual dysfunction and 14% were currently using hormone contraception. Twenty-three percent had evidence of low bone density (Z-score < -1.0). Sixty-four percent had abnormal brachial artery flow-mediated dilation (<5%). Flow-mediated dilation values were significantly correlated with serum estrogen and whole-body and lumbar BMD. All the 3 components of the triad plus endothelial dysfunction were present in 14% of the subjects. CONCLUSIONS: Endothelial dysfunction was correlated with reduced BMD, menstrual dysfunction, and low serum estrogen. These findings may have profound implications for cardiovascular and bone health in professional women dancers.

Koutedakis Y, Jamurtas A (2004). The dancer as a performing athlete: physiological considerations. Sports Med **34**(10): 651-661.

The physical demands placed on dancers from current choreography and performance schedules make their physiology and fitness just as important as skill development. However, even at the height of their professional careers, dancers' aerobic power, muscular strength, muscular balance, bone and joint integrity are the 'Achilles heels' of the dance-only selection and training system. This partly reflects the unfounded view, shared by sections of the dance world, that any exercise training that is not directly related to dance would diminish dancers' aesthetic appearances. Given that performing dance itself elicits only limited stimuli for positive fitness adaptations, it is not surprising that professional dancers often demonstrate values similar to those obtained from healthy sedentary individuals of comparable age in key fitness-related parameters. In contrast, recent data on male and female dancers revealed that supplementary exercise training can lead to improvements of such fitness parameters and reduce incidents of dance injuries, without interfering with key artistic and aesthetic requirements. It seems, however, that strict selection and training regimens have succeeded in transforming dance to an activity practiced by individuals who have selectively developed different flexibility characteristics compared with athletes. Bodyweight targets are normally met by low energy intakes, with female dance students and professional ballerinas reported to consume below 70% and 80% of the recommended daily allowance of energy intake, respectively, while the female athlete 'triad' of disordered eating, amenorrhea and osteoporosis is now well recognized and is seen just as commonly in dancers. An awareness of these factors will assist dancers and their teachers to improve training techniques, to employ effective injury prevention strategies and to determine better physical conditioning. However, any change in the traditional training regimes must be approached cautiously to ensure that the aesthetic content of the dance is not affected by new training techniques. Since physiological aspects of performing dance have been viewed primarily in the context of ballet, further scientific research on all forms of dance is required.

Nattiv A, Loucks AB, Manore MM, Sanborn CF, Sundgot-Borgen J, Warren MP (2007). American College of Sports Medicine Position Stand. The female athlete triad. Med Sci Sports Exerc **39**:1867-1882. <http://dx.doi.org/10.1249/mss.0b013e318149f111>

The female athlete triad (Triad) refers to the interrelationships among energy availability, menstrual function, and bone mineral density, which may have clinical manifestations including eating disorders, functional hypothalamic amenorrhea, and osteoporosis. With proper nutrition, these same relationships promote robust health. Athletes are distributed along a spectrum between health and disease, and those at the pathological end may not exhibit all these clinical conditions simultaneously. Energy availability is defined as dietary energy intake minus exercise energy expenditure. Low energy availability appears to be the factor that impairs reproductive and skeletal health in the Triad, and it may be inadvertent, intentional, or psychopathological. Most effects appear to occur below an energy availability of $30 \text{ kcal} \cdot \text{kg}^{-1}$ of fat-free mass per day. Restrictive eating behaviors practiced by girls and women in sports or physical activities that emphasize leanness are of special concern. For prevention and early intervention, education of athletes, parents, coaches, trainers, judges, and administrators is a priority. Athletes should be assessed for the Triad at the pre-participation physical and/or annual health screening exam, and whenever an athlete presents with any of the Triad's clinical conditions. Sport administrators should also consider rule changes to discourage unhealthy weight loss practices. A multidisciplinary treatment team should include a physician or other health-care professional, a registered dietitian, and, for athletes with eating disorders, a mental health practitioner. Additional valuable team members may include a certified athletic trainer, an exercise physiologist, and the athlete's coach, parents and other family members. The first aim of treatment for any Triad component is to increase energy availability by increasing energy intake and/or reducing exercise energy expenditure. Nutrition counseling and monitoring are sufficient interventions for many athletes, but eating disorders warrant psychotherapy. Athletes with eating disorders should be required to meet established criteria to continue exercising, and their training and competition may need to be modified. No pharmacological agent adequately restores bone loss or corrects metabolic abnormalities that impair health and performance in athletes with functional hypothalamic amenorrhea.

Papanek PE (2003). The female athlete triad: an emerging role for Physical Therapy. J Orthop Sports Phys Ther **33**(10): 594-614.

Over the last thirty years, participation by girls and women in organized athletics has increased dramatically. This presents unique challenges in the area of sports medicine, orthopaedics, and pediatrics. While the benefits of participation in sports and exercise vastly outweigh the risks of permanent injury, an evolving concern is the number of stress fractures in active women. The female athlete triad ("triad") describes the coexistence of 3 distinct medical conditions that may occur in athletic girls and women. Originally, the triad included eating disorders, amenorrhea, and osteoporosis. Presently, it includes eating disorders/disordered eating behavior, amenorrhea/oligomenorrhea, and decreased bone mineral density (osteoporosis

and osteopenia). Briefly, when coupled with inadequate nutrition, the high caloric expenditure of exercise training results in a sustained negative caloric balance or low energy availability, which is exquisitely sensed by the hypothalamus, initiating a complex neuroendocrine adaptive cascade. This cascade is associated with changes in the hypothalamic-pituitary-ovarian axis, such that estrogen levels are decreased, resulting in reproductive dysfunction that may include amenorrhea, oligomenorrhea, or anovulation. Low estrogen in otherwise young healthy women, like menopause, is associated with decreased bone mineral density and increased risk of fractures. The triad is not an inevitable consequence of participation in sports or physical activity at any level; however, exercise may contribute to the disruption of caloric balance. The triad is a complex disorder that requires intervention by a multidisciplinary team. Physical therapists bring a unique expertise to the team. The present review summarizes each component of the triad, component linkage, and the role of physical therapy in prevention, assessment, and intervention.

Ravaldi C, Vannacci A, Bolognesi E, Mancini S, Faravelli C, Ricca V (2006). Gender role, eating disorder symptoms, and body image concern in ballet dancers. J Psychosom Res **61**: 529–535.

OBJECTIVE: Our objective was to evaluate the relationships between gender role, eating behavior, and body image in nonprofessional female ballet dancers. **METHODS:** One hundred ten female ballet dancers and 59 controls were administered the Bem Sex Role Inventory, the Eating Disorder Examination (EDE), the Body Uneasiness Test (BUT), and the Beck Depression Inventory. **RESULTS:** Ballet dancers scored higher than controls in most of the items evaluating body image and eating behaviors; a high number of ballet dancers with undifferentiated gender role were also observed. In the dancers group, male-typified subjects showed higher median scores of EDE and BUT scales, while in the control group, the highest median scores of EDE and BUT scales were found in undifferentiated subjects. **CONCLUSION:** Ballet schools' cultural pressure towards an ideal of leanness could interfere with the process of gender role acquisition. Ballet dancers appear to be over concerned with performance; this could reinforce the internalization of several constructs that are generally considered as typically male.

Thein-Nissenbaum JM, Rauh MJ, Carr KE, Loud KJ, McGuine TA (2011). Associations Between Disordered Eating, Menstrual Dysfunction, and Musculoskeletal Injury Among High School Athletes. J Orthop Sports Phys Ther **41**(2): 60-69. *Epub 22 October 2010.* doi:10.2519/jospt.2011.3312

STUDY DESIGN: Retrospective cohort study. **OBJECTIVES:** To determine the prevalence of, and association between, disordered eating (DE), menstrual dysfunction (MD), and musculoskeletal injury (MI) among high school female athletes. **BACKGROUND:** Female athlete triad (Triad) syndrome is the interrelatedness of DE, MD, and low bone mass. Few studies have examined 2 or more Triad components simultaneously, or their relationship to injury, among female high school athletes. **METHODS:** The subject sample consisted of 311 female high school athletes competing on 33 interscholastic high school teams

during the 2006- 2007 school year. Athletes completed the Eating Disorder Examination Questionnaire (EDE-Q) and Healthy Wisconsin High School Female Athletes Survey (HWHSFAS). Athletes were classified by sport type as aesthetic (AES), endurance (END), or team/anaerobic (T/A). RESULTS: Of those surveyed, 35.4% reported DE, 18.8% reported MD, and 65.6% reported sustaining a sports-related musculoskeletal injury during the current sports season. Athletes reporting DE were twice as likely to be injured compared to those reporting normal eating behaviors (odds ratio [OR], 2.3; 95% confidence interval [CI]: 1.4, 4.0). Multivariate logistic regression analyses revealed that athletes who reported a history of DE (OR, 2.1; 95% CI: 1.1, 3.9) or prior injury (OR, 5.1; 95% CI: 2.9, 8.9) were more likely to be injured during the sports season. CONCLUSION: A high prevalence of DE and MD exists among high school female athletes. Additionally, athletes with DE were over 2 times more likely to sustain a sports-related injury during a sports season. Screening and intervention programs designed to identify and decrease the prevalence of DE should be implemented with high school females.

Warren MP, Brooks-Gunn J, Fox RP, Holderness CC, Hyle EO, Hamilton WG, Hamilton L (2003). Persistent osteopenia in ballet dancers with amenorrhea and delayed menarche despite hormone therapy: a longitudinal study. Fertil Steril **80**: 398-404.

OBJECTIVE: To investigate the role of estrogen deprivation and replacement in amenorrheic and nonamenorrheic dancers on hormone therapy and calcium. DESIGN: Clinical, placebo-controlled, randomized trial study. Healthy volunteers in an academic research environment. PATIENTS: Fifty-five dancers (mean age: 22.0 +/- 4.6, age at menarche: 14.7 +/- 2.3 years), including 24 amenorrheics. INTERVENTION: Amenorrheics were randomized in a controlled trial to receive placebo or Premarin, 0.625 mg for 25 days monthly, with Provera, 10 mg, for 10 of these 25 days (hormone therapy) for 2 years. These women were compared to normally menstruating controls. The study participants also received 1250 mg of calcium per day. MAIN OUTCOME MEASURES: Bone mineral density (BMD) measured at the foot, wrist, and lumbar spine. Our overall results showed no difference in BMD between the treated or placebo groups, indicating that hormone therapy did not change or normalize BMD when compared to normals. Five patients (all on placebo) who resumed menses during the study showed an increase in BMD without normalization. CONCLUSION: These findings suggest that mechanisms other than hypoestrogenism may be involved with the osteopenia associated with exercise-induced amenorrhea.

Warren MP, Brooks-Gunn J, Fox RP, Holderness CC, Hyle EO, Hamilton WG (2002). Osteopenia in exercise-associated amenorrhea using ballet dancers as a model: a longitudinal study. J Clin Endocrinol Metab **87**: 3162-8.

Few longitudinal studies have investigated the effects of amenorrhea and amenorrhea plus exercise on bone mineral density (BMD) of young women. We carried out a 2-yr comparison of dancers and nondancers, both amenorrheic and normal, that investigated the role of hypothalamic amenorrhea on bone in this context. We studied 111 subjects (mean age, 22.4 +/- 4.6 yr; age of menarche, 14.1 +/- 2.2 yr), including 54 dancers, 22 with hypothalamic amenorrhea, and 57 nondancers, 22 with hypothalamic amenorrhea.

Detailed hormonal and nutritional data were obtained in all groups to determine possible causal relationship to osteoporosis. The amenorrheic groups, dancers and nondancers, both showed reduced BMD in the spine, wrist, and foot, which remained below controls throughout the 2 yr. Only amenorrheic dancers showed significant changes in spine BMD (12.1%; $P < 0.05$) but still remained below controls, and within this subgroup, only those with delayed menarche showed a significant increase. The seven amenorrheic subjects (three dancers and four nondancers) who resumed menses during the study showed an increase in spine and wrist BMD (17%; $P < 0.001$) without achieving normalization. Delayed menarche was the only variable that predicted stress fractures ($P < 0.005$), which we used as a measure of bone functional strength. Analysis of dieting and nutritional patterns showed higher incidence of dieting behavior in this group, as manifested by higher Eating Attitudes Test scores (16.3 +/- 2.00 vs. 11.5 +/- 1.45; $P < 0.05$) and higher fiber intakes (30.7 +/- 3.00 vs. 17.5 +/- 2.01 g/24 h; $P < 0.001$). We concluded that low bone mass occurs in young women with amenorrhea and delayed menarche, both exercisers and nonexercisers. Crucial bone mass accretion may be compromised by their reproductive and nutritional health.

Please remember to update your orthopaedic section profile, thank you!

https://www.orthopt.org/surveys/membership_directory.php