



PASIG PERFORMING ARTS
SPECIAL INTEREST GROUP



PASIG MONTHLY CITATION BLAST: No.97

September 2014

Dear Performing Arts SIG members:

Don't forget to update your membership profile on the Orthopaedic Section Website. This ensures that you will have access to all the most current information! https://www.orthopt.org/login.php?forward_url=/surveys/membership_directory.php

PASIG ON SOCIAL MEDIA: Learn about the most recent developments in the Orthopaedic Section and the PASIG --**check out the APTA Orthopaedic Section Facebook Page**—be sure to “like” it and look for future PASIG information posted there: <https://www.facebook.com/pages/APTA-Orthopaedic-Section/121020534595362>

We also have a **Twitter** account! Visit <https://twitter.com/PT4Performers> for updates.

Looking for an opportunity to share case reports, clinical pearls, or original research? Have you recently encountered an interesting patient case in the performing arts? Please consider submitting to the **PASIG section of the Orthopaedic Practice Magazine**. If you have further questions about submitting a case report, please contact Annette Karim at neoluvsonlyme@aol.com.

CSM 2015 is around the corner! (Indianapolis, Indiana, February 4-7, 2015) The PASIG educational programming will be given by Clare Frank DPT, MS, OCS, FAAOMPT on Dynamic Neuromuscular Stabilization in Spinal Rehabilitation & Performance. It will be an exciting and informative class, with very applicable methods of evaluating and treating the performing artist. We hope you will all also attend the **PASIG Business Meeting at CSM 2015**—more details to follow!

Attention PT students! For those of you who will be presenting a Performing Arts-content poster or platform for APTA CSM 2015: We offer a student scholarship through the PASIG for accepted presentations. If you would like information about this student scholarship, please e-mail Amy Humphrey, PT, DPT, OCS, MTC at amymarieis@comcast.net

We are still in need of a PASIG nominating committee member!! If you are interested in serving on the PASIG nominating committee, or in any other way, please contact Rosie Canizares at rcc4@duke.edu.

OTHER RESEARCH OPPORTUNITIES

1. We still need writers for the 2014 Citation blasts!!! (Particularly for the months after September 2014). These are put together on a monthly basis. Please contact me for more information, at brookerwinder@gmail.com. Go to the website to look at topics that have been covered, add new content or update old citation topics: http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes

2. If you are seeking research participants, or are seeking a researcher to work with your potential participants, contact both Brooke Winder, Research Chair: Brookerwinder@gmail.com and Amanda Blackmon, Membership Chair: mandy@onetherapy.com

3. We are working on creating a brief dance screen as a resource for the PASIG website. The new contact for dance screening is Sarah Wenger: Sbw28@drexel.edu

This month's citation blast highlights recent research on bone density issues in dancers. Thank you to Kathleen Bower, PT, DPT, MTC for your contribution on this important topic!

Best regards,

Brooke

Brooke Winder, PT, DPT, OCS

Chair, PASIG Research Committee

Director of Physical Therapy, The Cypress Center, Pacific Palisades, CA

Home: brookeRwinder@gmail.com Work: brooke@thecypresscenter.com

PASIG Research Committee members:

Shaw Bronner PT, PhD, OCS, sbronner@liu.edu

Jeff Stenback PT, OCS, jsptocs2@hotmail.com

Sheyi Ojofeitimi PT, DPT, OCS, sojofeit@gmail.com

Susan D. Fain PT, DMA, sfain@ptcentral.org

Laura Reising, MS, PT, DPT, lbreising@gmail.com (EndNote Organizer)

PERFORMING ARTS CONTINUING EDUCATION, CONFERENCES, AND RESOURCES

Musician Health Series, Janice Ying, PT, DPT, OCS
Glendale Adventist Therapy and Wellness Center, Los Angeles area (Eagle Rock), CA
<http://www.musicianshealthcorner.com/>
Healthy Musician Series - Overuse

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-American Physical Therapy Association,
Performing Arts SIG

http://www.orthopt.org/content/special_interest_groups/performing_arts

Performing Arts Citations and Endnotes

http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes

ADAM Center

<http://www.adamcenter.net/>

Publications:

<http://www.adamcenter.net/#!vstc0=publications>

Conference abstracts:

<http://www.adamcenter.net/#!vstc0=conferences>

Dance USA

<http://www.danceusa.org/>

Research resources:

<http://www.danceusa.org/researchresources>

Professional Dancer Annual Post-Hire Health Screen:

<http://www.danceusa.org/dancerhealth>

Dancer Wellness Project

<http://www.dancerwellnessproject.com/>

Becoming an affiliate:

<http://www.dancerwellnessproject.com/Information/BecomeAffiliate.aspx>

Harkness Center for Dance Injuries, Hospital for Joint Diseases

<http://hjd.med.nyu.edu/harkness/>

Continuing education:

<http://hjd.med.nyu.edu/harkness/education/healthcare-professionals/continuing-education-courses-cme-and-ceu>

Resource papers:

<http://hjd.med.nyu.edu/harkness/dance-medicine-resources/resource-papers-and-forms>

Links:

<http://hjd.med.nyu.edu/harkness/dance-medicine-resources/links>

Informative list of common dance injuries:

<http://hjd.med.nyu.edu/harkness/patients/common-dance-injuries>

Research publications:

<http://hjd.med.nyu.edu/harkness/research/research-publications>

International Association for Dance Medicine and Science (IADMS)

<http://www.iadms.org/>

Resource papers:

<http://www.iadms.org/displaycommon.cfm?an=1&subarticlenbr=186>

Links:

<http://www.iadms.org/displaycommon.cfm?an=5>

Medicine, arts medicine, and arts education organization links:

<http://www.iadms.org/displaycommon.cfm?an=1&subarticlenbr=5>

Publications:

<http://www.iadms.org/displaycommon.cfm?an=3>

Performing Arts Medicine Association (PAMA)

<http://www.artsmed.org/>

<http://www.artsmed.org/symposium.html>

Interactive bibliography site:

<http://www.artsmed.org/bibliography.html>

Related links:

<http://www.artsmed.org/relatedlinks.html>

Member publications:

<http://artsmed.org/publications.html>

(Educators, researchers, and clinicians, please continue to email your conference and continuing education information to include in future blasts)

Bone Mineral Density in the Dancer

When most people think about ballet dancers, they think of a thin silhouette with straight lines, full turnout and perfectly pointed feet. To maintain that aesthetic many dancers will alter their eating habits in unhealthy ways that can lead to hormone imbalance and bone mineral density problems. When you pair this with

the training and performance regimens as well as the extreme demands that a dancer requires of their bodies, the likelihood of developing a stress fracture is higher than for most athletes. At the beginning of last school year I came back to four high school dancers, in a performing arts program, who were in walking boots due to stress fractures in their feet that occurred during summer dance intensives. This sparked my interest to further investigate the causes of bone mineral density problems and how they can lead to stress fractures. The following abstracts look at many different causes for bone mineral density problems in dancers spanning from the adolescent through retired dancers. I hope that this information can be used in creating a multidisciplinary approach to keeping dancers healthy throughout their training and careers.

Kathleen Bower PT, DPT, MTC
Assistant Director of Dance Medicine
Miami City Ballet
Polestar Pilates Center, Miami FL

Burckhardt P, Wynn E, Krieg MA, Bagutti C, Faouzi M. The effects of nutrition, puberty and dancing on bone density in adolescent ballet dancers. *J Dance Med Sci.* Jun 2011;15(2):51-60.

Introduction: Ballet dancers have on average a low bone mineral content (BMC), with elevated fracture-risk, low body mass index (BMI) for age (body mass index, kg/m²), low energy intake, and delayed puberty. This study aims at a better understanding of the interactions of these factors, especially with regard to nutrition. **Methods:** During a competition for pre-professional dancers we examined 127 female participants (60 Asians, 67 Caucasians). They averaged 16.7 years of age, started dancing at 5.8 years, and danced 22 hours/week. Assessments were made for BMI, BMC (DXA), and bone mineral apparent density (BMAD) at the lumbar spine and femoral neck, pubertal stage (Tanner score), and nutritional status (EAT-40 questionnaire and a qualitative three-day dietary record). **Results:** BMI for age was found to be normal in only 42.5% of the dancers, while 15.7% had a more or less severe degree of thinness (12.6% Grade 2 and 3.1% Grade 3 thinness). Menarche was late (13.9 years, range 11 to 16.8 years). Food intake, evaluated by number of consumed food portions, was below the recommendations for a normally active population in all food groups except animal proteins, where the intake was more than twice the recommended amount. In this population, with low BMI and intense exercise, BMC was low and associated with nutritional factors; dairy products had a positive and non-dairy proteins a negative influence. **Conclusion:** A positive correlation between BMAD and years since menarche confirmed the importance of exposure to estrogens and the negative impact of delayed puberty. Because of this and the probable negative influence of a high intake of non-dairy proteins, such as meat, fish, and eggs, and the positive association with a high dairy intake, ballet schools should promote balanced diets and normal weight and should recognize and help

dancers avoid eating disorders and delayed puberty caused by extensive dancing and inadequate nutrition.

Ducher G, Kukuljan S, Hill B, et al. Vitamin D status and musculoskeletal health in adolescent male ballet dancers a pilot study. *J Dance Med Sci.* Sep 2011;15(3):99-107.

Objective: Adequate vitamin D levels during growth are critical to ensuring optimal bone development. Vitamin D synthesis requires sun exposure; thus, athletes engaged in indoor activities such as ballet dancing may be at relatively high risk of vitamin D insufficiency. The objective of this study was to investigate the prevalence of low vitamin D levels in young male ballet dancers and its impact on musculoskeletal health.

Methods: Eighteen male ballet dancers, aged 10 to 19 years and training for at least 6 hours per week, were recruited from the Australian Ballet School, Melbourne, Australia. Serum 25(OH)D and intact PTH were measured in winter (July) from a non-fasting blood sample. Pubertal stage was determined using self-assessed Tanner criteria. Body composition and areal bone mineral density (aBMD) at the whole body and lumbar spine were measured using dual-energy x-ray absorptiometry (DXA). Injury history and physical activity levels were assessed by questionnaire. Blood samples were obtained from 16 participants.

Results: Serum 25(OH)D levels ranged from 20.8 to 94.3 nmol/L, with a group mean of 50.5 nmol/L. Two participants (12.5%) showed vitamin D deficiency [serum 25(OH)D level < 25 nmol/L], seven dancers (44%) had vitamin D insufficiency (25 to 50 nmol/L), and the remaining seven dancers (44%) had normal levels (> 50 nmol/L). No relationship was found between vitamin D status, PTH levels, body composition, and aBMD. The most commonly reported injuries were muscle tears and back pain. The average number of injuries reported by each dancer was 1.9 ± 0.4 (range: 0 to 5). **Conclusion:** There was no difference in the frequency of reported injuries between subjects with vitamin D deficiency or insufficiency (2.1 ± 0.6 injuries) and those with normal vitamin D levels (1.4 ± 0.6 injuries). This pilot study showed that more than half of highly-trained young male ballet dancers presented with low levels of vitamin D in winter. Further investigations in larger samples of adolescent athletes are needed to determine if this could negatively impact bone growth and place them at higher risk for musculoskeletal injuries.

Kaufman BA, Warren MP, Dominguez JE, Wang J, Heymsfield SB, Pierson RN. Bone density and amenorrhea in ballet dancers are related to a decreased resting metabolic rate and lower leptin levels. *J Clin Endocrinol Metab.* Jun 2002;87(6):2777-2783.

Purpose: Osteopenia, which is correlated with amenorrhea and poor nutritional habits, has been well documented in elite ballet dancers. Estrogen replacement therapy and recovery from amenorrhea have not been associated with normalization of bone density. Thus, the osteopenia may be related to changes brought about by chronic dieting or other factors, such as a hypometabolic state induced by poor nutrition. The purpose of this study was to investigate the relationship of chronic dieting and resting metabolic rate (RMR) to amenorrhea and bone density. **Methods:** RMR, bone density, eating disorder assessments,

leptin levels, and complete menstrual and medical histories were determined in 21 elite ballet dancers and in 27 nondancers (age, 20-30 yr). **Results:** No significant correlations were found between high EAT26 scores, a measure of disordered eating, and RMR, bone densities, body weight, body fat, or fat-free mass. However, when RMR was adjusted for fat-free mass (FFM), a significant positive correlation was found between RMR/FFM and bone density in both the arms ($P < 0.001$) and spine ($P < 0.05$) in ballet dancers, but not in the normal controls. The dancers also demonstrated significantly higher EAT scores (22.9 ± 10.3 vs. 4.1 ± 2.4 ; $P < 0.001$) and lower RMR/FFM ratios (30.0 ± 2.2 vs. 32.05 ± 2.8 ; $P < 0.01$). The only variable to predict lower RMR/FFM in the entire sample was ever having had amenorrhea; this group had significantly higher EAT scores (18.0 ± 13.5 vs. 10.3 ± 10.2 ; $P < 0.05$), lower leptin levels (4.03 ± 0.625 vs. 7.10 ± 4.052 ; $P < 0.05$), and lower bone mineral density in the spine (0.984 ± 0.11 vs. 1.10 ± 0.13 ; $P < 0.05$) and arm (0.773 ± 0.99 vs. 0.818 ± 0.01 ; $P < 0.05$). **Conclusion:** We hypothesize that the correlation between low RMR and lower leptin levels and bone density may be more strongly related to nutritional habits in ballet dancers, causing significant depression of RMR, particularly for those with a history of amenorrhea.

Khan KM, Warren MP, Stiehl A, McKay HA, Wark JD. Bone Mineral Density in Active and Retired Ballet Dancers. *J Dance Med Sci.* 1999;3(1):15-23.

Many members of both the balletic, and non-balletic worlds believe that ballet dancers are at risk for low bone mineral density (BMD), and therefore, osteoporotic fracture. However, the athletic nature of ballet dancing, particularly the jumping component, provides a substantial osteogenic stimulus. Further, ballet is often commenced at a young age, when physical activity may allow a child to optimize peak bone mass. Thus, we reviewed the literature seeking answers to four key questions: 1. Do dancers exhibit lifestyle risk factors that may cause them to have diminished BMD? 2. What is the effect of prolonged amenorrhea on BMD? 3. Do dancers, as a group, have greater or lesser bone mineral than their non-balletic counterparts? 4. Do the hours spent in childhood ballet classes influence adult BMD? We concluded that factors such as primary amenorrhea, low body weight, low energy intake, low calcium intake, and eating disorders can all lead to low BMD in dancers. However, in studies of retired dancers the effect of these risk factors on hip and lumbar spine BMD appears to be somewhat modulated, which may reflect that high impact activity during a key prepubertal age has a beneficial effect. The practical implication of these findings is that ballet, in moderation, and not associated with abnormal eating behavior or prolonged menstrual disturbance, can be seen as a positive lifestyle choice that may serve to decrease the risk of osteoporosis in later life.

Kuennen MR. Risk Factors for Bone Mineral Degradation in Young Female Dancers. *J Dance Med Sci.* 2007;11(4):124-128.

Research articles on bone mineral characteristics are not scarce in the literature. Authors have quantified many different risk factors that influence these characteristics. Perhaps the most significant contributor to bone mineral

characteristics, bone mineral density (BMD), and other bone mineral parameters is lifetime estrogen status. Age at onset of menarche influences bone mineral content (BMC) and BMD, with later menarcheal onset producing bone mineral decrements. Both lifetime estrogen status and age at menarche are significantly influenced by caloric intake and leptin levels. Poor dietary habits have been shown to produce reduced bone mineral parameters. Supplementation with calcium and magnesium, and the use of albuterol for asthma have been shown to significantly increase bone mineral properties. Heritability also greatly influences bone mineral parameters, as does ethnicity. BMD by ethnicity has been shown as highest in American Indians and African Americans, moderate in Caucasians and Hispanics, with the lowest levels being reported in Asians. Increases in Body Mass Index (BMI), lean, and fat mass have been shown to increase BMC and BMD. It has been widely shown that acquisition of BMC and BMD due to physical activity interventions occurs to a greater degree in premenarcheal versus postmenarcheal adolescent females. This increase in bone mineral parameters has been shown to be as high as 30% in adult competitive athletes who have trained since childhood. Specifically, the greatest increases in bone are produced through high intensity, high strain, high ground reaction force, varied type, and multiple bout, short duration activities.

Munoz MT, de la Piedra C, Barrios V, Garrido G, Argente J. Changes in bone density and bone markers in rhythmic gymnasts and ballet dancers: implications for puberty and leptin levels. *Eur J Endocrinol*. Oct 2004;151(4):491-496.

Objective: Our aim was to compare physical activity and biochemical markers with bone mineral acquisition in rhythmic gymnasts and ballet dancers. **Methods:** Weight, height, body mass index, nutritional intake, bone age and menstrual histories were analyzed in nine rhythmic gymnasts, twelve ballet dancers and fourteen controls. Bone mineral density (BMD) was assessed by X-ray absorptiometry at the lumbar spine, hip and radius. Bone alkaline phosphatase (bAP) and amino-terminal propeptide of procollagen I (PNIP) in serum and urinary alpha-isomer of the carboxy-terminal telopeptide of collagen I (alpha-CTX) were measured. **Results:** Bone age was delayed 2 years and mean age at menarche was 15+/-0.9 years in rhythmic gymnasts and 13.7+/-1 years in ballet dancers, compared with 12.5+/-1 years in controls. Trochanteric and femoral neck BMD was significantly higher in rhythmic gymnasts compared with ballet dancers and controls. Right forearm (non-loaded zone) BMD was significantly decreased in rhythmic gymnasts and ballet dancers compared with controls. All subjects had normal bAP and PNIP levels, but the alpha-CTX/creatinine (Cr) ratio was increased in rhythmic gymnasts ($P < 0.001$) with an inverse correlation between right forearm BMD and the alpha-CTX/Cr ratio ($r = -0.74$, $P < 0.001$). Serum leptin levels were decreased in rhythmic gymnasts and ballet dancers. Rhythmic gymnasts had a positive correlation between right forearm BMD and leptin levels ($r = 0.85$, $P < 0.001$). **Conclusion:** Decreased bone mass in rhythmic gymnasts could be partially explained by an increase in bone resorption. Serum leptin levels could be implicated in the pubertal delay and be a good marker of bone mass in these subjects.

Oral A, Tarakci D, Disci R. Calcaneal quantitative ultrasound measurements in young male and female professional dancers. *J Strength Cond Res.* Aug 2006;20(3):572-578.

Purpose: The aim of this study was to assess the bone status of dancers using calcaneal quantitative ultrasound (QUS). **Methods:** Twenty-four male and 26 female dancers (aged 19-36 years) and 100 age- and sex-matched nonathletic controls were included in this study. QUS parameters (broadband ultrasound attenuation [BUA], speed of sound [SOS], quantitative ultrasound index [QUI], and estimated heel bone mineral density [eBMD]) were obtained for both heels in all subjects using a gel-coupled QUS device. **Outcomes:** Two-way analysis of variance, including the factors of dancing status and gender, revealed significant differences in all QUS parameters between the dancers and the controls ($p < 0.001$ for all), without a significant interaction with gender status. For each heel (right versus left), the mean QUI, BUA, SOS, and eBMD values of the male and female dancers were 22.0% vs. 20.9% and 16.6% vs. 16.0%; 21.6% vs. 24.1% and 13.2% vs. 14.3%; 2.3% vs. 2.0% and 1.7% vs. 1.7%; and 25.0% vs. 23.9% and 19.0% vs. 18.6% higher than those of the male and female controls, respectively. Analysis of covariance still revealed significant differences between the dancers and the controls after controlling for the influence of body mass index ($p < 0.001$). **Conclusion:** Furthermore, the finding that significant bilateral differences in BUA did exist in the controls but not in the dancers demonstrated site-specific effects of exercise on bone, indicating that it is the dance that improved bone properties. Calcaneal QUS, with a strong discriminative ability between those involved in professional dance and normally active individuals, emerges as an attractive technology for exploring the benefits of exercise on bone, which might be a challenge for those in the conditioning field, who need to identify those who need intervention in terms of bone status and promote participation in high-impact physical activity, such as dance, to enhance bone quality.

To WW, Wong MW, Lam IY. Bone mineral density differences between adolescent dancers and non-exercising adolescent females. *J Pediatr Adolesc Gynecol.* Oct 2005;18(5):337-342.

Objective: To compare the bone mineral density (BMD) of the axial and appendicular skeleton between regularly exercising collegiate dancers and age matched non-exercising young females between the age of 17 and 19 to assess the impact of weight-bearing exercises and menstrual status on BMD. **Interventions:** All subjects had a full hormonal profile, bio-impedance estimation of body fat, and dual energy X-ray absorptiometry and quantitative peripheral CT scans (pQCT) to determine bone density. **Results:** The incidence of oligo/amenorrhoea in the dancers was 20%. The lumbar spine BMD (1.006 g/cm² vs. 0.938, $P = 0.048$) and hip BMD (neck of femur 0.978 g/cm² vs. 0.838, $P < 0.001$; Ward's triangle 0.816 g/cm² vs. 0.720, $P = 0.003$; trochanter 0.777 g/cm² vs. 0.682; $P < 0.001$) were significantly higher in the eumenorrhoeic dancers as compared to controls. The radial BMD as measured by pQCT did not differ between the two groups, but the core trabecular tibial BMD was also higher

in the dancers (321 mg/cm³ vs. 286, $P = 0.006$). When only oligo/amenorrhoeic dancers ($n = 7$) were compared with the controls, the same differences in BMD values were no longer observed. **Conclusion:** Young women undergoing regular intensive weight-bearing exercises as in the collegiate dancers here studied have higher BMD in the axial and appendicular skeleton as compared to non-exercising females of the same age if they remain eumenorrhoeic during their training. This advantage was apparently lost when they developed oligo/amenorrhoea.



Remember, PASIG membership is free to all orthopaedic section members.

https://www.orthopt.org/sig_pa_join.php