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ORTHOPAEDIC SECTION
AMERICAN PHYSICAL THERAPY ASSOCIATION

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PASIG MONTHLY CITATION BLAST: No.40 **May 2009**

Dear PASIG members:

Spring is in full boom here in the East. Planning for the CSM PASIG programming is well underway. **Save the date**: our next Combined Sections Meeting will be held in San Diego, CA, February 17 –20, 2009.

CSM abstract submission is open as of March 18th and the deadline will be here sooner than you think (midnight, June 3rd). I hope many of you will consider submitting an abstract from your performing arts research. Abstract topics can include pilot and full scientific research studies, case studies, clinical topics, or special interest reports. Go to http://www.apta.org/csm for more information and to connect to Scholar One Abstract Central for electronic submission.

Also, please don't forget, the PASIG sponsors an annual student research scholarship. This award is to recognize students, who have had an abstract accepted to CSM, for their contribution to performing arts medicine and research. We encourage you to mentor your students in PA-related research and have them apply! If the PASIG Research Committee can assist students, please contact us. For more information on the research award please check our webpage (www.orthopt.org/sig_pa.php). Students with additional questions can contact PASIG Treasurer Amy Humphrey (ahumphrey@bodydynamicsinc.com).

For this May Citation BLAST, I've selected a topic that is a common issue in PA: *Hypermobility*. The format is an annotated bibliography of articles on the selected topic from 1998 – 2008. Anyone interested in contributing a special topic citation blast, please volunteer. The BLASTS and updated libraries are posted on the PASIG webpage for our members to access and download. (Information about EndNote referencing software can be found at http://www.endnote.com, including a 30-day free trial).

As always, your comments and suggestions are welcome. Please drop me an e-mail anytime.

Regards,
Shaw

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Hypermobility

Joint hypermobility is defined as an excessive range of joint movement with differences due to gender, ethnicity, and age. There is conflicting information about the relationship of hypermobility to musculoskeletal pain. Some researchers report an association between hypermobility and joint injury and non-hypermobility to muscle strains. Also of note, nonpathological musculoskeletal tightness was associated with a decreased steady-state VO2 for treadmill walking and jogging; proprioception and knee extensor strength is diminished in hypermobile individuals. The prevalence in the general population appears to range from 10 – 16%. Joint hypermobility may serve as a positive selection factor for dance, instrumentalists, gymnastics, acrobatics, contortionism, and yoga. However, it also represents a risk factor for injury in the performing arts.

We include the Beighton test as part of our annual pre-participation screening for dancers. Those with 4/9 or higher receive counseling on joint protection.

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Aktas I, Ofluoglu D, et al. (2008). The relationship between benign joint hypermobility syndrome and carpal tunnel syndrome. Clin Rheumatol.

Benign joint hypermobility syndrome (BJHS) is defined as the presence of musculoskeletal symptoms in persons with generalized joint laxity in the absence of systemic rheumatologic disease. There is an association between soft tissue rheumatism, entrapment neuropathies, and BJHS. The purpose of the study was to identify the relationship between BJHS and carpal tunnel syndrome (CTS). Ninety patients were included in the prospective controlled study. All selected participants were referred to our electrophysiological laboratory with clinical diagnosis of CTS. Subsequently, subjects were divided into two groups as group I and II. Group I included patients with CTS and group II had patients without CTS based on electrophysiological findings. All subjects were assessed for existing BJHS by using the Brighton 1998 criteria. Fifty-five patients were recruited into group I (CTS) and 35 subjects were in group II. The mean age in group I and II was 49.5 +/- 10.8 and 40 +/- 9.9 years, respectively. The subjects in group II were younger than those in group I ($p < 0.05$). The mean Beighton score was 2.04 +/- 2.7 and 1 +/- 1.68 in groups I and II, respectively. In patients with CTS, BJHS rate was markedly higher than those in patients without CTS with respect to Brighton 1998 criteria ($p < 0.0001$). There was a positive correlation between CTS and BJHS ($r = 0.59$, $p = 0.0001$). Consequently, we suggested that BJHS could be a predisposing factor for CTS or vice versa.

Birrell FN, Adebajo AO, et al. (1994). High prevalence of joint laxity in West Africans. Br J Rheumatol **33**(1): 56-9.

Previous surveys have suggested marked ethnic and geographical variation in the occurrence of joint hypermobility. We investigated the prevalence of joint hypermobility and the influences of age, sex, body mass and occupation in a rural Yoruba population in Nigeria. The study sample consisted of 204 individuals aged 6-66 yr from the townships of Igbo-ora and Eruwa in south western Nigeria. Sixty-eight had reported joint pain as part of a population survey of arthritic disorders and each was age and sex matched with one household and one neighbour control. Joint hypermobility was assessed, at four peripheral sites bilaterally and forward flexion of the trunk, by a single observer using the Beighton score. Each subject had weight and height recorded, answered a brief questionnaire about occupation and joint symptoms and was examined for peripheral joint disease. Only 11 (5%) of the subjects were negative at all five sites whereas 111 (54%) were hypermobile at three or more sites including 23 (11%) positive at all five. Using a score of 4/9 or greater as a cutoff, 88 (43%) were positive, including 35% of males and 57% of females. There was a linear decline with age in females but a more rapid decline only to age 35 yr in males. There was no relation to body mass or occupation. We conclude that joint hypermobility amongst this population is substantially greater than that recorded for other groups but is not associated with joint pain.

Boyle KL, Witt P, et al. (2003). Intrarater and Interrater Reliability of the Beighton and Horan Joint Mobility Index. J Athl Train **38**(4): 281-285.

OBJECTIVE: Clinicians may benefit from using a joint mobility index to screen for individuals on the high end of the spectrum of joint laxity (ie, those with generalized joint laxity), which may be associated with musculoskeletal complaints. Reliability of the Beighton and Horan Joint Mobility Index (BHJMI) has not been reported in the literature. Our purpose was to determine intrarater and interrater reliability of (1) composite BHJMI scores (the overall score from 0 to 9), and (2) categorized scores, the BHJMI scores in 3 categories (0 to 2, 3 to 4, and 5 to 9) DESIGN AND SETTING: This was an intrarater and interrater reliability study. Data were collected in an academic physical therapy department and in a high school. SUBJECTS: Forty-two (intrarater) and 36 (interrater) female volunteers, aged 15 to 45 years. MEASUREMENTS: Subjects were screened using the BHJMI. Percentage agreement and the Spearman rho were used to analyze BHJMI composite and category scores. RESULTS: The percentage agreement and the Spearman rho for intrarater and interrater reliability of BHJMI composite scores were 69% and.86 and 51% and.87, respectively. The percentage agreement and the Spearman rho for intrarater and interrater reliability of the category scores were 81% and.81 and 89% and.75, respectively. CONCLUSIONS: Reliability of the BHJMI was good to excellent in screening for generalized joint laxity in females aged 15 to 45 years.

Corben T, Lewis JS, et al. (2008). Contribution of lumbar spine and hip movement during the palms to floor test in individuals with diagnosed hypermobility syndrome. Physiother Theory Pract **24**(1): 1-12.

The ability to place the hands to the floor forms part of the assessment of joint hypermobility. The test may be symptom free, or in the case of joint hypermobility syndrome, may be associated with pain in the spine, hip, and knee. The aim of this study was to identify the relative amount of movement at the lumbar spine and hip during this test in people with asymptomatic and symptomatic hypermobility compared with a control group. Thirty-six female subjects (10 asymptomatic hypermobility, 13 symptomatic hypermobility, and 13 control) ranging between 18 and 60 years of age participated in the investigation. Measurements were made by using digital photography and inclinometers. Measurement

reliability was established prior to the investigation. There was a significant difference ($p<0.05$) between hip flexion range in the two hypermobility groups compared to the control group; there was no significant difference in lumbar spine movement between the three groups. The findings suggest that people with asymptomatic or symptomatic hypermobility perform the hand to floor test with the same relative contribution from the lumbar spine and hip joints. Both groups perform the hands to floor test and with a greater relative hip flexion range than a control group.

de Inocencio Arocena J, Benito Ortizde OCI (2004). Joint hypermobility: prevalence and relationship with musculoskeletal pain. An Pediatr (Barc) **61**(2): 162-6.

OBJECTIVES: (1) To determine the prevalence of joint hypermobility in children aged 4-14 years old without organic disease of the locomotor system; (2) to compare the prevalence of hypermobility in children with and without arthralgia and (3) to analyze the influence of certain variables on the development of arthralgia. PATIENTS AND METHODS: We performed an observational study in a sample of children aged 4-14 years old living in Area 4 of the Community of Madrid (Spain). Joint hypermobility was evaluated using a goniometer. Hypermobility was defined using Beighton's criteria. RESULTS: A total of 222 subjects were analyzed: 176 in the primary care setting and 46 in the emergency department of a referral hospital. Of the 222 children, 43 reported arthralgia. The prevalence of hypermobility (> or = 4 criteria) was 55 % (123/222), reaching 71 % (49/69) in children aged less than 8 years. No significant differences were found in the prevalence of hypermobility in children with and without arthralgia (65 % and 53 % respectively). Of the variables analyzed (age, sex, country of origin, primary care/emergency department setting) only differences in the absolute number of Beighton criteria present in children with and without arthralgia (4.34 +/- 2.47 and 3.48 +/- 2.35, p = 0.03) were detected, which disappeared when at least four criteria (definition of hypermobility) were required. CONCLUSIONS: Fifty-five percent of the population studied and 71 % of those younger than 8 years old met the criteria for joint hypermobility. In the sample analyzed, the presence of joint hypermobility did not seem to favor the development of arthralgias.

Decoster LC, Bernier JN, et al. (1999). Generalized Joint Hypermobility and Its Relationship to Injury Patterns Among NCAA Lacrosse Players. J Athl Train **34**(2): 99-105.

OBJECTIVE: To prospectively observe and compare injury patterns between hypermobile and nonhypermobile NCAA athletes. DESIGN AND SETTING: Athletes were screened for generalized joint hypermobility before the 1995 lacrosse season. Injuries were recorded through the end of the postseason and compared in hypermobile and nonhypermobile athletes. SUBJECTS: A total of 310 male and female volunteers from 17 lacrosse teams participated in the study. MEASUREMENTS: Hypermobility was evaluated with the technique of Carter and Wilkinson (as modified by Beighton and colleagues), which uses 9 joint measurements to assess global joint mobility. For an athlete to be considered hypermobile, 5/9 of these measurements must have been positive. Next, certified athletic trainers prospectively recorded injuries and hours of practice and game participation on a standard form. After the season, all data forms were returned to us for analysis. Significance was set at P = .05, and x(2) and independent t tests were used to compare injuries between groups. RESULTS: Twenty of 147 men (13.6%) and 54 of 163 women (33.1%) were hypermobile, yielding an overall hypermobility prevalence of 23.8%. One hundred athletes sustained 134 injuries. There were no significant differences in overall injury rate among hypermobile (2.29/1000 hours) compared with nonhypermobile (3.54/1000 hours) athletes. Nonhypermobile athletes suffered contact injuries at a higher rate (1.38/1000 hours) than hypermobile athletes (0.52/1000 hours). Hypermobile athletes showed an increased rate of ankle injuries, and nonhypermobile athletes showed a trend toward an increased rate of

strains. Multiple approaches to analysis of the data revealed no other significant findings. CONCLUSIONS: There was no difference in overall injury rates between hypermobile and nonhypermobile athletes in this sample. This finding is somewhat surprising in light of significant evidence that hypermobility appears to be a factor in joint complaints among nonathletes. Additional research is needed to clearly determine whether a relationship exists between hypermobility and injury rates among athletes.

Decoster LC, Vailas JC, et al. (1997). Prevalence and features of joint hypermobility among adolescent athletes. Arch Pediatr Adolesc Med **151**(10): 989-92.

OBJECTIVE: To determine the prevalence of joint hypermobility in a group of adolescent, interscholastic athletes. DESIGN: Cross-sectional; descriptive or observational. SETTING: Free preparticipation physical examinations for sports. SUBJECTS: Two hundred and sixty-four athletes (150 male, 114 female; average age, 15.5 years) comprised the entire set of athletes who came to our clinic for free physical examinations. INTERVENTION AND MAIN OUTCOME MEASURES: We screened 264 athletes using the widely accepted Carter-Wilkinson-Beighton method, which examines range of motion at the knees, trunk, fingers, thumbs, and elbows bilaterally and employs a 0 to 9 scoring scheme (5 = hypermobile). We also used an "injury allowance," whereby if an athlete screened positive for only one side of a bilateral test but had a history of injury to the corresponding side, he or she was given an injury allowance point. RESULTS: Thirty-two scored 5 or higher, with another 2 screening positive for hypermobility by the injury allowance, for a total of 34 hypermobile athletes (12.9%). There was a highly significant difference between sexes ($P < .001$), with 25 female (22%) and 9 male subjects (6%) testing positive. CONCLUSIONS: The overall prevalence of hypermobility and the significant sex difference found in this group of adolescent athletes were similar to nonathletes populations of comparable age. Research on nonathletes has been relied on by many to recommend that hypermobile persons avoid strenuous physical activity; however, research on athletes is less than conclusive. Given that a significant segment of young athletes, especially females, may be hypermobile, prospective studies are warranted to investigate this question before we can justify depriving hypermobile youths of the many known benefits of regular or strenuous exercise.

el-Shahaly HA, el-Sherif AK (1991). Is the benign joint hypermobility syndrome benign? Clin Rheumatol **10**(3): 302-7.

Over a period of two years, joint hypermobility was identified in 95 female and 19 male patients who attended rheumatology and rehabilitation units in Ismailia city. Pauciarticular pains referring to large and medium-sized joints was their most frequent complaint. Clinical diagnosis of carpal and/or tarsal tunnel syndromes was made in 45.6% of patients, and various forms of soft tissue rheumatism were evident in 73% of them. On radiologic evaluation of the involved joints, 60.5% of the examined patients showed significant degenerative lesions. The most prominent finding in the study, however, was the aggregation of varieties of articular and extra-articular abnormalities in the same patient. Extra-articular features included high frequencies of occurrence of varicose veins, piles and uterine prolapse among other abnormalities. Thus, results of the study lend support to the view that joint hypermobility predisposes to several articular and nonarticular lesions raise serious questions about the reputable benignity of the syndrome.

Fatoye F, Palmer S, et al. (2009). Proprioception and muscle torque deficits in children with hypermobility syndrome. Rheumatology (Oxford) **48**(2): 152-7.

OBJECTIVES: Sensorimotor deficits such as impaired joint proprioception and muscle weakness have been found in association with hypermobility syndrome (HMS) in adults. HMS is more common in children than adults, yet such deficits have not been adequately

investigated in paediatric populations. It is therefore uncertain as to what sensorimotor deficits are present in children with HMS. This study investigated knee joint proprioception and muscle torque in healthy children and those with HMS. METHODS: Thirty-seven healthy children (mean age +/- s.d. = 11.5 +/- 2.6 yrs) and 29 children with HMS (mean age +/- s.d. = 11.9 +/- 1.8 yrs) participated in this study. Knee joint kinaesthesia (JK) and joint position sense (JPS) were measured, with the absolute angular error (AAE) calculated as the absolute difference between the target and perceived angles. Knee extensor and flexor muscle torque was assessed and normalized to body mass. Mann-Whitney U-tests were performed to compare JK, JPS and muscle torque between the two groups. RESULTS: Children with HMS had significantly poorer JK and JPS compared with the controls (both P < 0.001). Knee extensor and flexor muscle torque was also significantly reduced (both P < 0.001) in children with HMS compared with their healthy counterparts. CONCLUSIONS: The findings of this study demonstrated that knee joint proprioception was impaired in children with HMS. They also had weaker knee extensor and flexor muscles than healthy controls. Clinicians should be aware of these identified deficits in children with HMS, and a programme of proprioceptive training and muscle strengthening may be indicated.

Ferrari J, Parslow C, et al. (2005). Joint hypermobility: the use of a new assessment tool to measure lower limb hypermobility. Clin Exp Rheumatol **23**(3): 413-20.

OBJECTIVES: The aim of the study was to compare the use of a new assessment tool for diagnosis of hypermobility in the lower limb to the Beighton score for generalised hypermobility. METHODS: Three groups of children were compared (n = 225) and included a "normal" population of 116 school children, a "possible hypermobile" group of 88 children attending afoot and gait clinic and a "known hypermobile" group of 21 children referred from a paediatrician or rheumatologist. The Beighton score was used to measure generalised hypermobility. The Lower Limb Assessment Score was used to measure hypermobility in the lower limbs. RESULTS: The Lower Limb Assessment Score was able to distinguish between the three groups of children better than the Beighton score. At a threshold of 5/9 indicating hypermobility, the Beighton score identified hypermobility in 34% of school children; the lower limb score identified hypermobility in 21% of school children after a threshold was identified. There was disagreement between the scores in school children where 26.7% of children appeared to have a positive Beighton score that was not accompanied by a positive lower limb score. In the "known hypermobile" group the Beighton score was positive in only 10% of children when the lower limb score was negative for hypermobility. CONCLUSION: In this group of school children, the Beighton score appeared to over-diagnose hypermobility at the threshold of 5/9. Specific thresholds for diagnosis need to be set dependant on the age and ethnic group of the population being studied. The Lower Limb Assessment Score may be a useful score for health professionals specifically interested in lower limb hypermobility.

Gannon LM, Bird HA (1999). The quantification of joint laxity in dancers and gymnasts. J Sports Sci **17**(9): 743-50.

The aim of this study was to determine the range of movement in gymnastic and dance populations. Sixty-five participants (41 females, 24 males; mean age 21.4 years) were assessed. The sample included dancers and gymnasts ranging from novice and club standard to international and professional status. Non-specialized physical education students acted as controls. Range of movement was measured at the shoulders, hips, lumbar spine and ankles using a Loebl hydrogoniometer, and inherent joint laxity was assessed using Beighton and coworkers' adaptation of the Carter and Wilkinson 9-point scale. The right and left sides of the body were assessed and measures of active and passive motion were recorded. A graded increase in laxity was observed from controls,

through novice gymnasts, to dancers and finally international gymnasts. The greater laxity of females than males was also confirmed. Dancers and gymnasts had a greater passive range of movement in all joints, which was partly inherited and partly acquired. There was a large difference between their active and passive ranges, which appeared to render the joints unstable.

Garlington MD, Ojofeitim Si, et al. (2006). Prevelance of joint hypermobility and correlation and with injury in professional and student modern dancers: A preliminary investigation. J Orthop Sports Phys Ther **36**(1): A24.

Purpose/Hypothesis: Research suggests that joint laxity predisposes individuals to musculoskeletal injury. This study investigated the prevalence of joint hypermobility in professional and student modern dancers and examined hypermobility as a risk factor for injury in this population. Subjects: Ninety professional (age 26.6 +/- 5.27 years; 16.4 years dance training) and university dance majors (age 18.1 +/- 1.1 years; 10.8 years dance training) at a large dance organization were screened for joint hypermobility using the Beighton hypermobility scale. This nine-point scale provides a measure of global joint laxity. Materials/Methods: Dancers with scores ≥ 4 were considered to be hypermobile. Injury clinic data for the students and professionals were collected retrospectively from physical therapy clinic records at the dance organization. Beighton scores and number of injury clinic visits were examined for correlation to see if joint hypermobility was a risk factor for injury in this population. Inter-rater reliability for this scale has been reported to be r = 0.80 – 0.87 and was r = 0.86 for the investigators in this study. Results: Forty-two of 90 dancers (46.7%) had Beighton scores of ≥ 4. There was no significant difference between male and female Beighton scores. There was no correlation between Beighton score and injury clinic visits for professional dancers. However, there was a fair (r = -0.431) negative correlation between Beighton score and injury clinic visits for students. Conclusions: Prevalence of joint hypermobility in this population was higher than that found in similar studies on athletic and military populations (range 7.5% to 24%) due to the unique flexibility requirements of dance. However, prevalence was lower than that found previously in student (44.4%) and professional (90.1%) ballet dancers. Training exclusively in ballet may have an effect on joint hypermobility due to the process of self-selection and the narrower criterion by which ballet dancers are judged. The emphasis at this dance organization on injury prevention and joint protection may have decreased the injury rates found in this analysis, reflecting the negative correlation finding. Comparisons between data from other studies are limited due inconsistency with methods used by various researchers to define injury, definition of hypermobility according to the Beighton score, and administeration of the Beighton test. Since data were only available from students who made appointments for injury clinic, we were unable to monitor all students for injuries, Due to these differences (in access to physical therapy and hours of participation in dance activities) we were also unable to directly compare injury rates for student and professional dancers. The results of this study are preliminary and require further research. Clinical Relevance: The increased flexibility and high injury rates found in dances warrant monitoring for increased risk of injury.

Gleim GW, Stachenfeld NS, et al. (1990). The influence of flexibility on the economy of walking and jogging. J Orthop Res **8**(6): 814-23.

The relationship of 11 measures of trunk and lower limb flexibility to the economy of treadmill walking and jogging as measured by steady-state oxygen consumption (VO2) was studied. Subjects (38 women, 62 men, aged 20-62 years) were tested at six speeds between 53.6 and 187.7 m/min. By combining scores from all flexibility tests, and beginning at speeds of 107.3 m/min, the "tightest" third used significantly less O2/m/kg (9%, p less than 0.05) than the "loosest" third, with "normals" in between. Two tests, trunk rotation and

lower limb turnout, gave the best separation for walking/jogging economy, with the "tightest" third differing significantly from the "loosest" (8-12%) at all speeds tested (ANOVA with Scheffe). We conclude that nonpathological musculoskeletal tightness was associated with a decreased steady-state VO2 for treadmill walking and jogging.

Grahame R. (2007). Joint hypermobility is a liability for the performing artist. Proceedings, International Symposium on Performance Science 2007, Porto, Portugal, European Association of Conservatoires.

Joint hypermobility is defined as a range of joint movement that is considered excessive, taking into consideration the age, gender, and ethnic background of the individual, being greater in women and in those of Asian origin compared with other ethnic groups. All newborn babies can be considered to be hypermobile, but the range of movement diminishes progressively during childhood and then more gradually during adult life. Elderly hypermobile people retain many facets of their hypermobility throughout life. Originally perceived to be a feature of rare inherited diseases such as Marfan and Ehlers-Danlos syndromes, it was only in the in the 1960s that hypermobility syndrome was seen to exist apart from these diseases and as an entity in its own right. In the early 1970s it was first linked to ballet dancers. Joint mobility, though susceptible to training, is largely determined by genetic influences. Joint hypermobility is defined as an excessive range of joint movement taking into consideration age, gender, and ethnic background. It underpins and facilitates the performance of a range of activities including dance, music, gymnastics, acrobatics, contortionism, and yoga. There is evidence that hypermobility acts as a positive selection factor for entry into ballet school in both boys and girls and proves an asset for instrumentalists over their non-hypermobile peers. There is now evidence that it represents a risk factor for injury in performing artists in general.

Grahame R. (2000). Pain, distress and joint hyperlaxity. Joint Bone Spine **67**(3): 157-63.

Pain dominates the lives of many patients with hyperlaxity syndromes, most commonly the Benign Joint Hypermobility Syndrome (BJHS/EDS). As a result they may experience psychosocial problems, which in many cases severely affects their healthy functioning. Above all is the overriding chronic pain in joints, muscles and ligaments, which arises from an inherent predisposition to the effects of everyday trauma, but other factors such as associated osteoarthritis or fibromyalgia are also important. There may also be neurophysiological factors at play producing nociceptive enhancement. Pain and distress of visceral origin can result from laxity of connective tissue within or providing support for the abdominal, thoracic or pelvic viscera leading to hernia, uterine and/or rectal prolapse, mitral valve prolapse or spontaneous pneumothorax. In children joint hyperlaxity is an important (and often unrecognised) source of rheumatic symptoms, which may be ignored or erroneously ascribed to juvenile idiopathic arthritis. The management of pain and distress in the hyperlaxity syndromes requires skill, patience, compassion and understanding. Often the results of conventional anti-rheumatic therapy (including anti-rheumatic drugs and surgery) as applied to other rheumatic diseases are disappointing and innovative approaches are required. Amongst these, for which evidence of efficacy is available, are physiotherapeutic and orthotic stabilisation of hyperlax joints, proprioceptive enhancement and the newer pain management techniques including cognitive behavioural therapy.

Gulbahar S, Sahin E, et al. (2006). Hypermobility syndrome increases the risk for low bone mass. Clin Rheumatol **25**(4): 511-4.

Few studies on the benign joint hypermobility syndrome suggest a tendency toward osteopenia, but there are conflicting results. We assessed bone mineral density in pre-menopausal women with hypermobility. Twenty-five consecutive Caucasian women

diagnosed with benign hypermobility syndrome by Beighton score and 23 age- and sex-matched controls were included in the study. Age, menarch age, number of pregnancies, duration of lactation, physical activity and calcium intake were questioned according to European Vertebral Osteoporosis Study Group (EVOS) form. All subjects were pre-menopausal and none of them were on treatment with any drugs effecting bone metabolism or had any other systemic disease. No statistically significant difference was found for body mass index, menarch age, number of pregnancies, duration of lactation, calcium intake, calcium score and physical activity score between the two groups. Total femoral and trochanteric bone mineral density and t and z scores were significantly lower in hypermobile patients compared to the control group. Ward's triangle and femoral neck z scores were also found to be significantly low in hypermobile patients ($p<0.05$). Significant negative correlations were found between the Beighton scores and trochanteric BMD, t and z scores ($r=-0.29$, $r=-0.30$, and $r=-0.32$) in hypermobility patients. Low bone mass was more frequently found among subjects with hypermobility ($p=0.03$). Hypermobility was found to increase the risk for low bone mass by 1.8 times (95% confidence interval 1.01-3.38). Our study suggests that pre-menopausal women with joint hypermobility have lower bone mineral density when compared to the controls and hypermobility increases the risk for low bone mass.

Jonsson H, Valtysdottir ST, et al. (1996). Hypermobility associated with osteoarthritis of the thumb base: a clinical and radiological subset of hand osteoarthritis. Ann Rheum Dis **55**(8): 540-3.

OBJECTIVES: To study the impact of articular hypermobility on the clinical and radiological features of hand osteoarthritis (OA) and to investigate whether hand osteoarthritis associated with hypermobility should be considered a separate subset of hand OA. METHODS: Fifty consecutive female patients with clinical hand OA and thumb base symptoms were examined for hypermobility according to the Beighton criteria. RESULTS: Thirty one of the 50 patients had hypermobility features (Beighton score > or = 2) and 17 patients fulfilled four or more Beighton criteria. Corresponding figures for 94 control patients were 30 ($p < 0.05$) and nine ($p < 0.001$) respectively. Patients with hypermobility features were characterised clinically and radiologically by fewer and less severely involved interphalangeal joints. Radiologically, two fairly distinct subsets could be identified: Severe interphalangeal OA in which the prevalence of hypermobility was similar to controls, and patients with predominant involvement of the first carpometacarpal joint (CMC 1), most of whom had evidence of hypermobility. CONCLUSION: A causal relation exists between articular hypermobility and development of thumb base OA, and hypermobility associated hand OA constitutes a definite clinical and radiological subset of hand OA. In the clinical setting, the easily applied hypermobility criterion of passive dorsiflexion of the fifth finger > or = 90 degrees is useful in identifying most patients with hand OA and hypermobility.

Juul-Kristensen B, Rogind H, et al. (2007). Inter-examiner reproducibility of tests and criteria for generalized joint hypermobility and benign joint hypermobility syndrome. Rheumatology (Oxford) **46**(12): 1835-41.

OBJECTIVE: To test the reproducibility of tests and criteria for generalized joint hypermobility (GJH) and benign joint hypermobility syndrome (BJHS). METHODS: A standardized protocol for clinical reproducibility studies was followed using a three-phase study (with a training, an overall agreement and a test phase). An overall agreement of at least 0.80 was required to proceed to the test phase. Phases 1, 2 and 3 used 14 patients (with varying degrees of hypermobility), 20 patients (50% cases) and 40 patients (50% cases), respectively. The inclusion criterion for cases was hypermobility (patients with Ehlers-Danlos Syndrome or BJHS) and for controls, non-hypermobility (patients with

shoulder and/or back pain); patients were selected from patients' files (phases 1 and 2) or included consecutively from our outpatient clinic (phase 3). RESULTS: The overall agreement in phase 2 was 0.95 for GJH and 0.90 for BJHS. Reproducibility for diagnosing GJH and BJHS in phase 3 showed kappa values of 0.74 and 0.84, respectively. Kappa in the Beighton tests for diagnosing GJH (currently or historically) was generally above 0.80, except for the fifth fingers and elbows (> or = 0.60). In the Brighton tests for diagnosing BJHS, kappa was above 0.73, except for the skin signs (0.63). Lowest kappa was found in the Rotes-Querol tests, where it was > or = 0.57, except for the right shoulder (0.31). CONCLUSION: We found a good-to-excellent reproducibility of tests and criteria for GJH and BJHS. Future research on the validity of the tests and criteria for joint hypermobility is urgently needed.

McCormack M, Briggs J, et al. (2004). Joint laxity and the benign joint hypermobility syndrome in student and professional ballet dancers. J Rheumatol. **31**(1): 173-8.

OBJECTIVE: To ascertain the prevalence of hypermobility and the benign joint hypermobility syndrome (BJHS) in male and female student and professional ballet dancers, and explore whether BJHS has any effect on a dance career. METHODS: Students from the Royal Ballet School and professional dancers from the Royal Ballet Company, London, were compared with a control group of teenagers and adults from a local secondary school and The Royal Opera House, respectively. The data, examined by variance analysis, included anthropometric variables, the Beighton score, and clinical features constituting BJHS. Odds ratios for hypermobility and BJHS in dancers were calculated, and the prevalence and distribution of BJHS was examined. RESULTS: Hypermobility and BJHS were common in male and female dancers compared with controls. An OR of 11.0 (95% CI 3.3-31.8) was found for hypermobility in dancers for both the ballet school and the professional company. The prevalence of BJHS was found to decline both from student to professional and within the ballet company from corps de ballet to Principal. Odds ratios for BJHS in student dancers were significant, OR = 3.9 (95% CI 1.3-11.3), but not so in professional dancers: OR = 1.7 (95% CI 0.6-4.7). Arthralgia was common in dancers and was reported more often in males than females. In females, pain was reported most by dancers with other features of BJHS, in particular stretchy skin. CONCLUSION: Hypermobility and BJHS are common in both male and female student and professional ballet dancers. The fall in prevalence, and the greater reporting of arthralgia with other features of BJHS in young female dancers, suggests that BJHS may have an important negative influence, and this may have implications for training. The same pattern was not observed in males, suggesting that their pain-reporting and injury are related to factors other than BJHS.

Mebes C, Amstutz A, et al. (2008). Isometric rate of force development, maximum voluntary contraction, and balance in women with and without joint hypermobility. Arthritis Rheum **59**(11): 1665-9.

OBJECTIVE: To determine differences between hypermobile subjects and controls in terms of maximum strength, rate of force development, and balance. METHODS: We recruited 13 subjects with hypermobility and 18 controls. Rate of force development and maximal voluntary contraction (MVC) during single leg knee extension of the right knee were measured isometrically for each subject. Balance was tested twice on a force plate with 15-second single-leg stands on the right leg. Rate of force development (N/second) and MVC (N) were extracted from the force-time curve as maximal rate of force development (= limit Deltaforce/Deltatime) and the absolute maximal value, respectively. RESULTS: The hypermobile subjects showed a significantly higher value for rate of force development (15.2% higher; P = 0.038, P = 0.453, epsilon = 0.693) and rate of force development related to body weight (16.4% higher; P = 0.018, P = 0.601, epsilon = 0.834) than the controls. The

groups did not differ significantly in MVC (P = 0.767, P = 0.136, epsilon = 0.065), and MVC related to body weight varied randomly between the groups (P = 0.921, P = 0.050, epsilon = 0.000). In balance testing, the mediolateral sway of the hypermobile subjects showed significantly higher values (11.6% higher; P = 0.034, P = 0.050, epsilon = 0.000) than that of controls, but there was no significant difference (4.9% difference; P = 0.953, P = 0.050, epsilon = 0.000) in anteroposterior sway between the 2 groups. CONCLUSION: Hypermobile women without acute symptoms or limitations in activities of daily life have a higher rate of force development in the knee extensors and a higher mediolateral sway than controls with normal joint mobility.

Mikkelsson, M., J. J. Salminen, et al. (1996). Joint hypermobility is not a contributing factor to musculoskeletal pain in pre-adolescents. J Rheumatol **23**(11): 1963-7.

OBJECTIVE: To study the prevalence of joint hypermobility and the association of hypermobility with musculoskeletal pain in pre-adolescents. METHODS: Finnish school children in the 3rd and 5th grade, n = 1637, mean ages 9.8 and 11.8 years, were studied by Beighton criteria for joint hypermobility, with total score > or = 6 as a cutoff point for hypermobility, pretested questionnaire for musculoskeletal pain, and classification to different pain groups on the basis of painful body area and frequency of pain. RESULTS: The mean Beighton scores were 2.7 and 2.4 for the 3rd and 5th grade children, respectively. Total score was > or = 6 in 7.8% of the children. No association of hypermobility with musculoskeletal pain was found. Of the hypermobile children, 29.9% (95% CI 22.3 to 38.8), and of the nonhypermobile children, 32.3% (95% CI 29.9 to 34.7) had musculoskeletal pain at least once a week. Children with hypermobility did not have more pain due to injuries. Disability caused by musculoskeletal pain did not correlate with Beighton total score. CONCLUSION: Both joint hypermobility and musculoskeletal pain are common in pre-adolescents. Hypermobility appears not to be a contributing factor to musculoskeletal pain in pre-adolescents.

Mishra MB, Ryan P, et al. (1996). Extra-articular features of benign joint hypermobility syndrome. Br J Rheumatol **35**(9): 861-6.

To define the phenotype of patients with benign joint hypermobility syndrome (BJHS), we studied 58 consecutive patients (mean age 37 yr) presenting to a rheumatology clinic and 30 controls. Patients underwent rheumatological and ophthalmic examination, hypermobility scoring, echocardiography, measurement of bone mineral density (BMD), and skin thickness, elasticity and light transmissibility. The median hypermobility score was 5/9 Beighton and 31/56 Contompasis. Eighteen (31%) patients complained of significant arthralgia. Six (10%) patients and two (7%) controls had mitral valve prolapse (MVP) (chi(2) = 0.27, P = NS). Neither MVP nor aortic diameters showed a correlation with hypermobility score. There was no significant reduction in BMD. There was a significant correlation between hypermobility and light transmissibility of the skin (r = 0.71, P < 0.0001 Contompasis; r = 0.47, P < 0.05 Beighton) and skin stretchiness (r = 0.49, P < 0.05 Contompasis; r = 0.39, P < 0.05 Beighton). On ophthalmic examination, 14 (41%) patients had upper eyelid laxity. Thus, patients with BJHS do not have an increased prevalence of significant cardiac, bone, skin or eye abnormalities, helping differentiate BJHS from other more serious hereditary disorders of connective tissue.

Myer, G. D., K. R. Ford, et al. (2008). "The effects of generalized joint laxity on risk of anterior cruciate ligament injury in young female athletes." Am J Sports Med **36**(6): 1073-80.

BACKGROUND: Women who participate in high-risk sports suffer anterior cruciate ligament injury at a 4- to 6-fold greater rate than men. PURPOSE: To prospectively determine if female athletes with decreased passive knee joint restraint (greater joint laxity) and greater

side-to-side differences in knee laxity would be at increased risk of anterior cruciate ligament injury. STUDY DESIGN: Case control study; Level of evidence, 3. METHODS: From 1558 female soccer and basketball players who were prospectively screened, 19 went on to tear their anterior cruciate ligaments. Four height- and mass-matched control subjects were selected from the uninjured screened athletes for comparison with each of the 19 injured subjects, making a total of 95 subjects (19 injured; 76 uninjured). Generalized joint-laxity tests and anterior-posterior tibiofemoral translation were quantified using the CompuKT knee arthrometer. A multivariable logistic regression model was constructed to determine predictors of anterior cruciate ligament injury status from recorded laxity measures. RESULTS: A multivariable logistic regression model (chi-square = 18.6; P = .002) used the independent variables laxity measures of knee hyperextension (P = .02), wrist and thumb to forearm opposition (P = .80), fifth-finger hyperextension > 90 degrees (P = .71), side-to-side differences in anterior-posterior tibiofemoral translation (P = .002), and prior knee injury (P = .22) to predict anterior cruciate ligament-injury status. The validated C statistic, or validated area under the receiver operating characteristic curve, was 0.72. For every 1.3-mm increase in side-to-side differences in anterior-posterior knee displacement, the odds of anterior cruciate ligament-injured status increased 4-fold (95% confidence interval, 1.68-9.69). A positive measure of knee hyperextension increased the odds of anterior cruciate ligament-injured status 5-fold (95% confidence interval, 1.24-18.44). CONCLUSION: The current results indicate that increased knee-laxity measures may contribute to increased risk of anterior cruciate ligament injury. The methods to quantify knee joint laxity in this report may be used in conjunction with measures of neuromuscular control of the knee joint to identify high-risk female athletes with high accuracy. Once high-risk female athletes are identified, they may be targeted to the appropriate interventions to reduce injury risk.

Nomura E, Inoue M, et al. (2006). Generalized joint laxity and contralateral patellar hypermobility in unilateral recurrent patellar dislocators. Arthroscopy **22**(8): 861-5.

PURPOSE: The purpose of this study was to assess the relation between generalized joint laxity and patellar hypermobility in unilateral recurrent patellar dislocators. TYPE OF STUDY: Case series. METHODS: A total of 82 patients (23 male and 59 female patients) with unilateral recurrent patellar dislocation were studied compared with an age- and sex-matched control group. The modified Carter and Wilkinson criteria for generalized joint laxity and lateral patellar hypermobility test were examined. RESULTS: Generalized joint laxity (score of 4 or 5) was present in 20 patients (24%) with recurrent patellar dislocation in 8 subjects (10%) of the control group. The mean total score was 2.5 (SD, 1.4) in the recurrent patellar dislocators and 1.7 (SD, 1.3) in the control group. The incidence of generalized joint laxity (P = .013) and the mean total score (P = .00004) were statistically significant between the two groups. A hypermobile patella was present in 42 patients (51%) and in 5 subjects (6%) of the control group. There was a large statistically significant difference between the two groups (P < .00001). CONCLUSIONS: Although a hypermobile patella and generalized joint laxity were significant between the recurrent patellar dislocators and the control group, a hypermobile patella was more significant than generalized joint laxity as the predisposing factors of patellar dislocation. LEVEL OF EVIDENCE: Level IV, prognostic case series.

Quatman CE, Ford KR, et al. (2008). The effects of gender and pubertal status on generalized joint laxity in young athletes. J Sci Med Sport **11**(3): 257-63.

Our purpose was to examine the effects of pubertal status on generalized joint laxity in a population of male and female athletes. We hypothesized that females would show higher generalized joint laxity after the onset of puberty while males would not. This cross-sectional cohort study included 275 female and 143 male middle school and high school basketball and soccer athletes. Joint laxity was assessed using the Beighton and Horan Joint Mobility

Index. BHJMI scores were averaged and female and male athletes were compared by pubertal stage. Females demonstrated increased joint laxity scores between pre-pubertal and post-pubertal groups (P=0.042), while males did not. Pre-pubertal male and female athletes were not different in cumulative joint laxity scores (female pre-puberty mean=2.00; male pre-pubertal mean=1.66). However, following the onset of puberty females (pubertal mean=2.96; post-pubertal mean=3.03) demonstrated a greater joint laxity score compared to males (pubertal mean=1.24; post-pubertal mean=1.30). Gender differences in BHJMI score was found at puberty and post-puberty (P<0.001). In contrast to males, females may have greater generalized joint laxity following the onset of puberty. Structural and physiological changes that occur during puberty such as alterations in passive joint restraints, may affect the type, severity and incidence of injuries in the maturing adolescent population.

Remvig L, Jensen DV, et al. (2007). Are diagnostic criteria for general joint hypermobility and benign joint hypermobility syndrome based on reproducible and valid tests? A review of the literature. J Rheumatol **34**(4): 798-803.

OBJECTIVE: In this review we focus on current knowledge of the reliability of tests and diagnostic criteria for generalized joint hypermobility (GJH) and benign joint hypermobility syndrome (BJHS). METHODS: Currently, The British Society of Rheumatology recommends the Beighton scoring system. With this approach, GJH is judged present when 4 or more of 9 tests are positive. Curiously, only one inter/intrarater reproducibility study is available and it uses a cutoff level of 6, rather than the Beighton-recommended 4 positive tests. RESULTS: Using a 6 cut level, intra- and interobserver kappa scores were 0.75 and 0.78, respectively. Beighton scoring recommendations have been correlated with a global joint mobility index as well as with 2 other scoring systems, the Carter and Wilkinson, and the Rotes-Querol. All illustrate high concurrent validity with one another. For the recently proposed Brighton criteria diagnosing BJHS no reproducibility studies exist. In the latter, the recommendations reflect high nosographic sensitivity and specificity while predictive values for positive test scores are poor. CONCLUSION: In general, the reproducibility of the various tests seems to be good, especially when performed by experienced rheumatologists.

Remvig L, Jensen DV, et al. (2007). Epidemiology of general joint hypermobility and basis for the proposed criteria for benign joint hypermobility syndrome: review of the literature. J Rheumatol **34**(4): 804-9.

OBJECTIVE: This literature review of generalized joint hypermobility (GJH) syndromes discusses information regarding sex-, age-, and race-related factors from publications that specifically document validated GJH criteria. METHODS: We present an analysis of criterion-referenced connections that identify similarities among major and minor clinical criteria that identify both GJH and benign joint hypermobility syndrome (BJHS). In our search, we found considerable empirical evidence that supports an increased prevalence of hypermobility among children, women, and certain racial groups. Two commonly used clinical assessment tools, the Carter and Wilkinson criteria (>or= 3 positive tests out of 5) and the Beighton method (>or= 4 positive tests out of 9), are the sources of these data. BJHS is diagnosed through a set of major and minor criteria - a combination of symptoms and objective findings -- that include arthralgia, back pain, spondylosis, spondylolysis/spondylolisthesis, joint dislocation/subluxation, soft tissue rheumatism, marfanoid habitus, abnormal skin, eye signs, varicose veins or hernia or uterine/rectal prolapse. RESULTS: Clinically, there is some evidence that arthralgia, the proposed BJHS major criterion, is a major component of alleged hypermobility-related problems. In contrasting, there is no clear evidence that proposed BJHS minor diagnostic criteria are associated with hypermobility-related problems. An empirical correlation between

hypermobility and osteoarthritis is possible, but so far unproven. There are no randomized controlled studies regarding effects of existing treatments. CONCLUSION: Generalized hypermobility is both sex- and age-related. Racial differences are also identifiable. The existence of BJHS can be accepted using present criteria.

Sahin N, Baskent A, et al. (2008). Evaluation of knee proprioception and effects of proprioception exercise in patients with benign joint hypermobility syndrome." Rheumatol Int.
The first aim is to show if there is a disorder in proprioception in cases with benign joint hypermobility syndrome (BJHS) when compared to healthy subjects. The second aim is to evaluate the effect of proprioception exercise in BJHS cases. To evaluate the proprioceptive sensibility of the knee joint with 40 BJHS and 30 healthy subjects enrolled in the study. Then, cases with BJHS were randomized into two groups; proprioceptive exercises were applied to 15 patients for 8 weeks in clinic and 25 patients were taken as controls. Outcome measures included proprioceptive sensation, AIMS2 and VAS. Proprioception is significantly impaired in cases with BJHS. In BJHS group, significant decreases in VAS levels were detected in cases who did exercise compared with cases who did not, and statistically significant improvements were detected in occupational activity. For this reason proprioception exercises cause decrease in pain and improvement of functional status in BJHS group.

Sahin N, Baskent A, et al. (2008). Isokinetic evaluation of knee extensor/flexor muscle strength in patients with hypermobility syndrome. Rheumatol Int **28**(7): 643-8.
Benign joint hypermobility syndrome (BJHS) is a syndrome with musculoskeletal pain originating from the increased laxity of the joints and the ligaments. The study was to compare the isokinetic strength of knee extensor/flexor muscles of BJHS patients with healthy controls. Forty patients diagnosed as having BJHS with Brighton criteria and 45 years of age, height and weight-matched healthy controls were recruited for the study. Isokinetic testing was performed with isokinetic dynamometry of Biodex System 3Pro and measurements were recorded at knee extension/flexion pattern concentrically at 60, 180, and 240 degrees/s angular velocities. The study group was also evaluated for functional impairment and pain by HAQ and VAS respectively. Knee extensor muscle strength was significantly lower in the patient group compared with the controls. It was hypothesized that the muscle weakness in the study group was related to lengthening of the quadriceps muscle and pain-related inactivity as well as joint instability and proprioception defect.

Scott D, Bird H, et al. (1979). Joint laxity leading to osteoarthrosis. Rheumatol Rehabil **18**(3): 167-9.
Joint laxity was compared in 50 females with symptomatic osteoarthrosis and an age-matched control group without osteoarthrosis. Generalized joint laxity measured by the scoring system of Cater and Wilkinson (1964) modified by Beighton (1973) was significantly higher in the osteoarthritic group (X2 = 10.00, P less than 0.05). In osteoarthritics the pattern of clinical joint involvement varied with the degree of generalized joint laxity.

Seckin U, Tur BS, et al. (2005). The prevalence of joint hypermobility among high school students. Rheumatol Int **25**(4): 260-3.
OBJECTIVE: The aim of this study was to determine the prevalence of joint hypermobility among high school students and to define the characteristics of patients with joint hypermobility. METHODS: The students underwent complete history and physical examination. In order to designate marfanoid habitus, body weight, height, and span/height and upper/lower segment ratios were recorded. The degree of joint hypermobility was scored by the Beighton scoring system. The following features were also examined:

arthralgia, myalgia, low back pain, sciatica, spinal deformities, temporomandibular joint pain and crepitus, effusion, swan neck deformity, arachnodactyly, joint dislocation, joint sprain, Raynaud's phenomenon, stria, varicose veins, abdominal and inguinal hernia, heart disease history, myopia, dropping eyelids, and antimongoloid slant. RESULTS: Eight hundred sixty-one students (433 females and 428 males) with a mean age of 15.4+/-1.1 years (range 13-19) were examined. Joint hypermobility was observed in 101 (11.7%) of the students. According to the Beighton scoring system, the majority of these (61.4%) were observed to score 4. Our results show that phenotype has no relation with joint mobility. Of the total number of students, there were 31 male (7.2%) and 70 female (16.2%) hypermobile subjects. The difference between sexes was highly significant (P=0.00005). Joint sprain was detected in 14 of hypermobile students (13.9%) and 50 of nonhypermobile students (6.6%). Its presence was the only significant parameter between hypermobile and nonhypermobile students (P=0.0094). CONCLUSIONS: Joint hypermobility was found in 11.7% of the students in our study, and the results are in harmony with the previous studies on Western populations. Although hypermobility does not seem to be very problematic in young people, as in our focus group, we believe that it is important for physicians to recognize this problem to ensure correct diagnosis and treatment, since it may lead to mimic rheumatic diseases in the future.

Sendur OF, Gurer G, et al. (2006). The frequency of hypermobility and its relationship with clinical findings of fibromyalgia patients. Clin Rheumatol.

The etiology and pathogenic mechanisms of fibromyalgia (FM) are unknown. A number of studies have suggested that there was a link between hypermobility and FM. In this study, we aimed to expose the frequency of hypermobility in FM patients and its relation with clinical findings. For this reason, 236 women (118 FM women as study group and 118 healthy women as control group) were enrolled in the study. Joint hypermobility was evaluated in the participants by using Beighton scoring system. The rate of joint hypermobility among FM patients (Beighton score of at least 4 or more) was found to be higher than the control group (46.6 vs 28.8%). This result was also statistically meaningful ($p<0.05$). In addition, the mean Beighton score of FM group was observed to be higher than the control (3.68 vs 2.55, $p<0.001$). Although not reaching statistical difference ($p>0.05$), more severe clinical findings were observed in FM patients with hypermobility when compared with ones without.

Seow CC, Chow PK, et al. (1999). A study of joint mobility in a normal population. Ann Acad Med Singapore **28**(2): 231-6.

Joint hypermobility is a clinical entity that has been little studied in Southeast Asia in contrast to the many studies that have been conducted in the West. A pioneer study was conducted in Singapore involving 306 subjects from the three major races i.e. Chinese, Malays and Indians. Their ages ranged from 15 to 39 years. The objective was to ascertain the joint mobility profile in a study sample representative of the Singapore population and the prevalence of joint hypermobility amongst normal individuals. Joint mobility was assessed using criteria according to Carter and Wilkinson modified by Beighton et al. The distribution of the three major races in the study sample was based on the 1990 census of the Singapore population. The prevalence of joint hypermobility was found to be 17%. The results showed that joint mobility decreases with age and that females had consistently higher degree of joint mobility compared to males throughout the age group. Among the racial groups, Malays had the highest degree of joint mobility followed by Indians and Chinese.

Smith R, Damodaran AK, et al. (2005). Hypermobility and sports injuries in junior netball players. Br J Sports Med **39**(9): 628-31.

OBJECTIVE: To evaluate the incidence of hypermobility in young female netball players and to determine the relation between hypermobility, previous injuries sustained in netball or other sports, and the use of protective equipment. METHODS: Under 16 year old female netball players from a local suburban netball association were assessed for joint hypermobility using the validated Beighton score (0-9, with higher scores indicating increasing hypermobility). Player profiles and details of sporting injuries, both netball and non-netball, and the use of protective equipment were gathered by means of a self completed questionnaire. Parental and child consent was obtained. RESULTS: Two hundred netball players were recruited for the study. Twenty one percent of the subjects with a Beighton hypermobility score of 0-2 had sustained previous netball injuries compared with 37% with Beighton scores of 3-4, and 43% with scores of 5-9. These differences were significant ($p<0.025$). Injuries were most common in the ankle (42%), knee (27%), and fingers (15%). Thirty nine players (19%) wore protective equipment, and within this group 30 (77%) had sustained previous injuries. No association was detected between hypermobile joints and non-netball sporting injuries. CONCLUSIONS: In this study hypermobility was significantly associated with an increased prevalence of injuries in junior netball players. A targeted interventional approach may help to reduce injuries in this susceptible group.

Stewart D, Burden S (2004). Does generalised ligamentous laxity increase seasonal incidence of injuries in male first division club rugby players? Br J Sports Med. **38**(4): 457-60.

OBJECTIVES: To investigate if ligamentous laxity increases seasonal incidence of injury in male first division club rugby players, and to determine if strength protects against injury in hypermobile and tight players. METHODS: Fifty one male first division club rugby players were examined for ligamentous laxity using the Beighton-Horan assessment and graded with an overall laxity score ranging from 0 (tight) to 9 (hyperlax). Each participant was classified into a group determined by their laxity score: tight (0-3), hypermobile (4-6), or excessively hypermobile (7-9). The incidence of joint injuries was recorded prospectively throughout the rugby season and correlated with laxity score. Differences between the groups were analysed. RESULTS: The overall prevalence of generalised joint hypermobility was 24% (12/51). The incidence of injuries was significantly higher in hypermobile (116.7 per 1000 hours) than tight (43.6 per 1000 hours) players ($p = 0.034$). There were no significant differences in peak strength between the hypermobile and tight groups. CONCLUSIONS: The laxity of the players may explain the differences in injury rates between these groups. Peak strength does not protect the hypermobile joint against injury. It appears that hypermobility may cause an increase in the injury rate of male first division club rugby players.

Viswanathan V, Khubchandani RP (2008). Joint hypermobility and growing pains in school children. Clin Exp Rheumatol **26**(5): 962-6.

OBJECTIVES: To study the association between growing pains (GP) and joint hypermobility (HM), children aged 3-9 were examined for the coexistence of HM and GP. METHODS: The study group consisted of 433 children (219 boys, 214 girls; age range 3-9 years) from one public school in Mumbai, India. In the assessment of HM, the Beighton criteria were used. Any child who met > or = 5/9 criteria was considered to have HM. Children were considered to have GP if they fulfilled the Petersons criteria, namely the pains were bilateral, intermittent non-articular pains involving the lower limbs; typically occurring during late afternoons or evenings with a normal physical examination and normal laboratory parameters whenever performed. The assessment of HM and GP were carried out independently. Children with bilateral knee hypermobility were also evaluated for the occurrence of GP. RESULTS: Of the

433 children, 177 (40.8%) were found to have HM and 122 (28.1%) GP; 75 (61.4%) of the 122 with GP had HM and 75 (42.3%) of the 177 with HM had GP. Using chi square statistical analysis, joint hypermobility and GP were found to be highly associated. Knee hypermobility also showed significant statistical association with GP. CONCLUSION: This study suggests that there is a strong association between joint hypermobility and GP in schoolchildren. It is possible that joint hypermobility may play a part in the pathogenesis of GP. More studies are needed to establish the clinical significance of this association.

Zapata AL, Moraes AJ, et al. (2006). Pain and musculoskeletal pain syndromes in adolescents. J Adolesc Health **38**(6): 769-71.

The presence of musculoskeletal pain was evaluated in adolescents. Pain was reported by 40% of respondents, benign joint hypermobility syndrome by 10%, myofascial syndrome by 5%, tendonitis by 2%, and fibromialgia by 1%. Logistical regression analysis indicated that sex and age were predictive of pain.