Peer Reviewed Journal Articles Pertaining to Yoga and the Following Topics

Health

Altman, K. & Elaine, R. (2001). A brief therapy model to reduce stress by practicing breathing exercises, mindful meditation, and yoga stretching. *Dissertation Abstracts International: Section B: The Sciences and Engineering,* 62(1-B), 530.

Abstract: [Dissertation Abstract] The purpose of this research study is to measure whether the Complementary and Alternative Medicine (CAM) techniques of breathing exercises, mindful meditation, and yoga stretching affect the stress indicators of heart rate, blood pressure, and respiration rate during a 4-week stress reduction program. The brief therapy model is tested both from quantitative and qualitative perspectives to determine its effectiveness in reducing stress. The theoretical basis of this research is the seminal work of the Benson and Kabat-Zinn 8-week programs founded at Harvard Medical School and the University of Massachusetts Medical Center, respectively. The data for this research were collected from outpatients at the Foshay Cancer Center of the Jupiter Medical Center in Florida and the program benefits were accessed from physical, mental, emotional, and spiritual perspectives. From the beginning of the first program session to the end of the fourth program session, significant reductions in the average heart rates, systolic blood pressures, and respiration rates of the research participants were recorded. The findings suggest that the brief therapy model can be effective in reducing stress using breathing exercises, mindful meditation, and a major component of yoga stretching.

Bastille, J.V. & Gill-Body, K.M. (2004). A yoga-based exercise program for people with chronic post stroke hemiparesis. *Physical Therapy*, 84(1), 33-48.

Abstract: Background and Purpose. This was a preliminary investigation of the effects of a yoga-based exercise program on people with chronic (greater than 9 months) poststroke hemiparesis. Many people who have had a stroke report an impaired health status because of a reduced level of activity. Proponents of yoga contend that it offers a gentle alternative exercise program that can be easily adapted for people who have had a stroke. Subjects and Methods. Four subjects with chronic poststroke hemiparesis participated in this single-case study. The primary outcome measures were the Berg Balance Scale (BBS) and the Timed Movement Battery (TMB). A secondary outcome measure was the Stroke Impact Scale (SIS). The baseline testing phase varied for each subject and ranged from 4 to 7 weeks. The 8-week intervention phase consisted of 1.5-hour yoga sessions, 2 times per week, in the subject's home. The primary outcome data were collected each week, and the secondary outcome data were collected before the baseline testing phase and before and after the intervention phase. Results. Subjects 1, 2, and 4 had improved

TMB scores, and subjects 3 and 4 had improved BBS scores. Discussion and Conclusion. The results suggest that yoga may be beneficial to people who have had a stroke. Further investigation is warranted to further examine the effects of yoga in this population.

Authors Conclusions: All subjects in this single-subject experimental design study demonstrated some positive effect in the primary and secondary outcome variables. Not all of the subjects had similar responses to the yoga intervention, and there were several differences among the subjects that may have contributed to the variance in results. Two subjects demonstrated what the author believed to be clinically significant improvements in balance, however the data suggests that the Berg Balance Scale may not be sensitive to detect changes that may occur in some people with high level balance deficits. Three out of the four subjects improved in the Timed Movement Battery test at self selected speeds. The subject who demonstrated the most improvements in balance and mobility was the most adherent to the yoga program on a daily basis. Overall, the results suggest that yoga may be beneficial for people with chronic poststroke hemiparesis, but further investigation is warranted.

Birkel, D.A. & Edgren, L. (2000). Hatha yoga: improved vital capacity of college students. *Alternative Therapies in Health and Medicine.* 6(6), 55-63.

Abstract: [Journal Article] **CONTEXT:** The vital capacity of the lungs is a critical component of good health. Vital capacity is an important concern for those with asthma, heart conditions, and lung ailments; those who smoke; and those who have no known lung problems. **OBJECTIVE:** To determine the effects of yoga postures and breathing exercises on vital capacity. **DESIGN:** Using the Spiropet spirometer, researchers measured vital capacity. Vital capacity determinants were taken near the beginning and end of two 17-week semesters. No control group was used. **SETTING:** Midwestern university yoga classes taken for college credit. **PARTICIPANTS:** A total of 287 college students, 89 men and 198 women. **INTERVENTION:** Subjects were taught yoga poses, breathing techniques, and relaxation in two 50-minute class meetings for 15 weeks. **MAIN OUTCOME MEASURES:** Vital capacity over time for smokers, asthmatics, and those with no known lung disease. **RESULTS:** The study showed a statistically significant (P less than .001) improvement in vital capacity across all categories over time. **CONCLUSIONS:** It is not known whether these findings were the result of yoga poses, breathing techniques, relaxation, or other aspects of exercise in the subjects' life. The subjects' adherence to attending class was 99.96%. The large number of 287 subjects is considered to be a valid number for a study of this type. These findings are consistent with other research studies reporting the positive effect of yoga on the vital capacity of the lungs.

Bonadies, V. (2004). A yoga therapy program for AIDS-related pain and anxiety:

Implications for therapeutic recreation. *Therapeutic Recreation Journal,* 38(2), 148-166.

Abstract: An evaluation study was conducted to determine the effectiveness of an 8-week therapeutic recreation intervention in reducing pain and anxiety. The therapeutic recreation intervention utilized yoga. Participants included persons with Human Immunodeficiency Virus (HIV) infection and Acquired Immune Deficiency Syndrome (AIDS) who were experiencing co-occurring difficulties with pain and anxiety. Pre- and post-session self-report pain and anxiety ratings were collected, as well as PRN pain medication usage. Findings, while hampered by limited sample size, suggest that yoga is effective in decreasing self-perceptions of pain and anxiety in this population and reducing their usage of PRN pain medication. Limitations of the study and recommendations for future research and practice are discussed.

Chuntharapat, S., Petpichetchian, W. & Hatthakit, U. (2008). Yoga during pregnancy: effects on maternal comfort, labor pain and birth outcomes. *Complementary Therapies in Clinical Practice,* 14(2), 105-15.

Abstract: This study examined the effects of a yoga program during pregnancy, on maternal comfort, labor pain, and birth outcomes. A randomized trial was conducted using 74-primigravid Thai women who were equally divided into two groups (experimental and control). The yoga program involved six, 1-h sessions at prescribed weeks of gestation. A variety of instruments were used to assess maternal comfort, labor pain and birth outcomes. The experimental group was found to have higher levels of maternal comfort during labor and 2h post-labor, and experienced less subject evaluated labor pain than the control group. In each group, pain increased and maternal comfort decreased as labor progressed. No differences were found, between the groups, regarding pethidine usage, labor augmentation or newborn Apgar scores at 1 and 5 min. The experimental group was found to have a shorter duration of the first stage of labor, as well as the total time of labor.

Cohen, B. E., Kanaya, Alka, M., Macer, J., Shen, H., Chang, A. & Grady, D. (2007). Feasibility and acceptability of restorative yoga for treatment of hot flushes: A pilot trial. *Maturitas,* 56(2), 198-204.

Abstract: [Journal; Peer Reviewed Journal] Objective: To determine the feasibility and acceptability of a restorative yoga intervention for the treatment of hot flushes in postmenopausal women. Methods: A pilot trial in 14 postmenopausal women experiencing >=4 moderate to severe hot flushes per day or >=30 moderate to severe hot flushes per week. The intervention consisted of eight restorative yoga poses taught in a 3-h introductory session and 8 weekly 90-min sessions. Feasibility was measured by

recruitment rates, subject retention and adherence. Acceptability was assessed by subject interview and questionnaires. Efficacy measures included change in frequency and severity of hot flushes as recorded on a 7-day diary. Results: Recruitment was accomplished as planned. The majority of study subjects (93%) completed the trial. Of those who completed the trial, 92% attended seven or more of the eight yoga sessions. The majority of the subjects were satisfied with the study and 75% continued to practice yoga 3 months after the study. Mean number of hot flushes per week decreased by 30.8% (95% CI 15.6-45.9%) and mean hot flush score decreased 34.2% (95% CI 16.0-52.5%) from baseline to week 8. No adverse events were observed. Conclusions: This pilot trial demonstrates that it is feasible to teach restorative yoga to middle-aged women without prior yoga experience. The high rates of subject retention and satisfaction suggest that yoga is an acceptable intervention in this population. Our results indicate that a larger, randomized controlled trial to explore the efficacy of restorative yoga for treatment of menopausal symptoms would be safe and feasible.

Da Silva, G.D., Lorenzi-Filho, G. & Lage, L.V. (2007). Effects of yoga and the addition of Tui Na in patients with fibromyalgia. *Journal of Alternative Complementary Medicine,* 13(10), 1107-13.

Abstract: **OBJECTIVES:** This study aimed to verify whether techniques of yoga with and without the addition of Tui Na might improve pain and the negative impact of fibromyalgia (FMS) on patients' daily life. **DESIGN:** Forty (40) FMS women were randomized into two groups, Relaxing Yoga (RY) and Relaxing Yoga plus Touch (RYT), for eight weekly sessions of stretching, breathing, and relaxing yogic techniques. RYT patients were further submitted to manipulative techniques of Tui Na. **OUTCOME MEASURE:** Outcome measures comprised the Fibromyalgia Impact Questionnaire (FIQ), pain threshold at the 18 FMS tender points, and a verbal graduation of pain assessed before treatment and on the followup. The visual analog scale (VAS) for pain was assessed before and after each session and on the follow-up. **RESULTS:** Seventeen (17) RYT and 16 RY patients completed the study. Both RY and RYT groups showed improvement in the FIQ and VAS scores, which decreased on all sessions. The RYT group showed lower VAS and verbal scores for pain on the eighth session, but this difference was not maintained on the follow-up. Conversely, RY VAS and verbal scores were significantly lower just on the follow-up. **CONCLUSIONS:** These study results showed that yogic techniques are valid therapeutic methods for FMS. Touch addition yielded greater improvement during the treatment. Over time, however, RY patients reported less pain than RYT. These results suggest that a passive therapy may possibly decrease control over FMS symptoms.
Authors Conclusions: The authors conclude that the results from this study point to a possibility that touch intervention may be, in the short term, a very helpful resource. On the other hand, for long-term effects, it may be better to teach persons with fibromyalgia to fully participate in therapeutic programs, changing their self-defeating beliefs, and for this purpose, it is possible that an intervention with yogic techniques alone may be a

better option. The authors strongly recommended that more studies should be done, comparing yoga and/or massage with controls or other active groups, so that more precise conclusions may be achieved.

Harrelson, G.L. & Swann, E. (2003). Yoga, Part II: Breathing, Poses, and Props. *Athletic Therapy Today*, 8(6), 32-33.

Abstract: [Journal: Short Survey] Although little is known scientifically about the overall health benefits of yoga, one area that appears to be promising is its impact on the musculoskeletal system. Regular yoga practice improves muscle flexibility, strength, and endurance and balance. We believe that yoga's advantage over more traditional stretching programs is that the poses stretch and strengthen the muscles in functional relationships, the potential payoff being injury prevention and perhaps improved mental focus. Although yoga can be performed with a video, we believe that initially it is best to work with a qualified instructor, who can help modify poses to meet individual needs, ensure correct pose alignment, and teach correct breathing technique.

McCaffrey, R., Ruknui, P., Hatthakit, U. & Kasetsomboon, P. (2005). The effects of yoga on hypertensive persons in Thailand. *Holistic Nurse Pract*, 19(4), 173-180.

Abstract

To determine the effectiveness of a yoga program on blood pressure and stress, a group of hypertensive patients in Thailand were studied, with the experimental group showing significantly decreased mean stress scores and blood pressure, heart rate, and body mass index levels compared with the control group. Further studies are suggested to determine the effects of yoga on hypertension in Thailand.

Clinical characteristics of study participants: All of the participants in this study had the diagnosis of hypertension (BP>140/90mmHg). None of the participants were currently taking antihypertensive medications at the onset of the study. More than half of the subjects had only recently been diagnosed with hypertension and claimed to exercise irregularly.**Authors Conclusions:** Practicing asana and pranayama yoga for 8 weeks reduces stress, blood pressure, heart rate, and body mass index among persons in Thailand with mild to moderate hypertension. Combining antihypertensive medication with the use of yoga or other nonpharmacologic therapies may help reduce drug use and control blood pressure. Further studies should focus on severe hypertensive individuals or other populations with stress-related health problems.

Oken, B.S., Zajdel, D., Kishiyama, S., Flegal, K., Dehen, C., Haas, M., Kraemer, D.F., Lawrence, J. & Leyva, J. (2006). Randomized, controlled, six-month trial of yoga in healthy seniors: effects on cognition and quality of life. *Altern Therapy Health*

Med 12(1), 40-47.

Abstract
CONTEXT: There are potential benefits of mind-body techniques on cognitive function because the techniques involve an active attentional or mindfulness component, but this has not been fully explored. **OBJECTIVE:** To determine the effect of yoga on cognitive function, fatigue, mood, and quality of life in seniors. **DESIGN:** Randomized, controlled trial comparing yoga, exercise, and wait-list control groups. **PARTICIPANTS:** One hundred thirty-five generally healthy men and women aged 65-85 years.
INTERVENTION: Participants were randomized to 6 months of Hatha yoga class, walking exercise class, or wait-list control. Subjects assigned to classes also were asked to practice at home. **MAIN OUTCOME MEASURES:** Outcome assessments performed at baseline and after the 6-month period included a battery of cognitive measures focused on attention and alertness, the primary outcome measures being performance on the Stroop Test and a quantitative electroencephalogram (EEG) measure of alertness; SF-36 health-related quality of life; Profile of Mood States; Multi-Dimensional Fatigue Inventory; and physical measures related to the interventions. **RESULTS:** One hundred thirty-five subjects were recruited and randomized. Seventeen subjects did not finish the 6-month intervention. There were no effects from either of the active interventions on any of the cognitive and alertness outcome measures. The yoga intervention produced improvements in physical measures (eg, timed 1-legged standing, forward flexibility) as well as a number of quality-of-life measures related to sense of well-being and energy and fatigue compared to controls. **CONCLUSIONS:** There were no relative improvements of cognitive function among healthy seniors in the yoga or exercise group compared to the wait-list control group. Those in the yoga group showed significant improvement in quality-of-life and physical measures compared to exercise and wait-list control groups.

Oken, B.S., Kishiyama, S., Zajdel, D., Bourdette, D., Carlsen, J., Haas, M., Hugos, C., Kraemer, D.F., Lawrence, J. & Mass, M. (2004). Randomized controlled trial of yoga and exercise in multiple sclerosis. *Neurology*, 62(11), 2058-64.

Abstract: Objective: To determine the effect of yoga and of aerobic exercise on cognitive function, fatigue, mood, and quality of life in multiple sclerosis (MS).
Methods: Subjects with clinically definite MS and Expanded Disability Status Score less than or equal to 6.0 were randomly assigned to one of three groups lasting 6 months: weekly Iyengar yoga class along with home practice, weekly exercise class using a stationary bicycle along with home exercise, or a waiting-list control group. Outcome assessments performed at baseline and at the end of the 6-month period included a battery of cognitive measures focused on attention, physiologic measures of alertness, Profile of Mood States, State-Trait Anxiety Inventory, Multi-Dimensional Fatigue Inventory (MFI), and Short Form (SF)-36 health-related quality of life.
Results: Sixty-nine subjects were recruited and randomized. Twelve subjects did not finish the 6-month intervention. There were no adverse events related to the intervention.

There were no effects from either of the active interventions on either of the primary outcome measures of attention or alertness. Both active interventions produced improvement in secondary measures of fatigue compared to the control group: Energy and Fatigue (Vitality) on the SF-36 and general fatigue on the MFI. There were no clear changes in mood related to yoga or exercise.
Conclusion: Subjects with MS participating in either a 6-month yoga class or exercise class showed significant improvement in measures of fatigue compared to a waiting-list control group. There was no relative improvement of cognitive function in either of the intervention groups.

Oretzky, Shira (2007). The effects of yoga on elevated depressive and somatic symptoms in young adults. *Dissertation Abstracts International: Section B: The Sciences and Engineering,* 67(9-B), 5458.

Abstract: [Dissertation Abstract] Depression is among the most common psychological diagnoses facing college students and young adults today. Treatment options that target depressive symptoms in young adults are a pressing concern to prevent pervasive long-term patterns of major depression. Alternative treatments, such as yoga, have steadily increased in popularity in the West for a variety of physical and mental health disorders, producing both mood and physical health benefits. However, methodologically sound scientific research on yoga and depression is limited. The purpose of this study was to examine the effects of a 5-week Vinyasa yoga intervention on depressive and somatic symptoms in young adults with elevated depressive symptoms. Fifty-nine participants between the ages of 18-29, who met criteria for at least mild depressive symptoms at baseline, were included. Participants were randomly assigned to a twice weekly, 5-week Vinyasa yoga group or a wait-list control group. Analyses of manipulation checks, program adherence, and attrition data confirmed that the study accomplished what was proposed. Attrition in this study was low (2 yoga, 3 control), with a total 53 of 58 participants completing the study. Final data were analyzed for 53 participants (29 yoga, 24 control). Assessments conducted at baseline and after the 5-week intervention revealed significant decreases in both self-reported and observer-rated depressive symptoms, somatic symptoms, sleep quality and anxious symptoms, for the yoga group, as compared to controls. Short-term measures of positive and negative affect assessed before and after session 1, 5, and 10, demonstrated consistently, significant decreases in yoga participant's ratings of negative affect within each session, however not across time. Yoga participants did not demonstrate significant within-session increases in positive affect, however they did demonstrate a trend in the predicted direction over time. Finally, 83% of yoga participants were below criteria for mild depressive symptoms at posttest, as compared to 38% of controls. Results provide preliminary evidence for the efficacy of Vinyasa yoga in the treatment and management of depressive symptoms in young adults.

Raghavendra, R.M., Nagarathna, R., Nagendra, H.R., Gopinath, K.S., Srinath, B.S., Ravi, B.D., Patil, S., Ramesh, B.S. & Nalini, R. (2007). Effects of an integrated yoga programme on chemotherapy-induced nausea and emesis in breast cancer patients. *European Journal of Cancer Care*, 16(6), 462-74.

Abstract: This study examined the effect of an integrated yoga programme on chemotherapy-related nausea and emesis in early operable breast cancer outpatients. Sixty-two subjects were randomly allocated to receive yoga (n = 28) or supportive therapy intervention (n = 34) during the course of their chemotherapy. Both groups had similar socio-demographic and medical characteristics. Intervention consisted of both supervised and home practice of yoga sessions lasting for 60 min daily, while the control group received supportive therapy and coping preparation during their hospital visits over a complete course of chemotherapy. The primary outcome measure was the Morrow Assessment of Nausea and Emesis (MANE) assessed after the fourth cycle of chemotherapy. Secondary outcomes included measures for anxiety, depression, quality of life, distressful symptoms and treatment-related toxicity assessed before and during the course of chemotherapy. Following yoga, there was a significant decrease in post-chemotherapy-induced nausea frequency (P = 0.01) and nausea intensity (P = 0.01), and intensity of anticipatory nausea (P = 0.01) and anticipatory vomiting (P = 0.05) as compared with the control group. There was a significant positive correlation between MANE scores and anxiety, depression and distressful symptoms. In conclusion, the results suggest a possible use for stress reduction interventions such as yoga in complementing conventional antiemetics to manage chemotherapy-related nausea and emesis.

Tran M.D., Holly R.G., Lashbrook J. & Amsterdam E.A. (2001). Effects of hatha yoga practice on the health-related aspects of physical fitness. *Preventive Cardiology*, 4(4), 165-170.

Abstract: [Journal: Article]Ten healthy, untrained volunteers (nine females and one male), ranging in age from 18-27 years, were studied to determine the effects of hatha yoga practice on the health-related aspects of physical fitness, including muscular strength and endurance, flexibility, cardiorespiratory fitness, body composition, and pulmonary function. Subjects were required to attend a minimum of two yoga classes per week for a total of 8 weeks. Each yoga session consisted of 10 minutes of pranayamas (breath-control exercises), 15 minutes of dynamic warm-up exercises, 50 minutes of asanas (yoga postures), and 10 minutes of supine relaxation in savasana (corpse pose). The subjects were evaluated before and after the 8-week training program. Isokinetic muscular strength for elbow extension, elbow flexion, and knee extension increased by 31%, 19%, and 28% ($p<0.05$), respectively whereas isometric muscular endurance for knee flexion increased 57% ($p<0.01$). Ankle flexibility, shoulder elevation, trunk extension, and trunk flexion increased by 13% ($p<0.01$), 155% ($p<0.001$), 188% ($p<0.001$), and 14% ($p<0.05$), respectively. Absolute and relative maximal oxygen uptake

increased by 7% and 6%, respectively ($p<0.01$). These findings indicate that regular hatha yoga practice can elicit improvements in the health-related aspects of physical fitness. copyright CHF, Inc.

Yang K. (2007). A review of yoga programs for four leading risk factors of chronic diseases. *Evidence-Based Complementary & Alternative Medicine,* 4(4), 487-91.

Abstract: [Journal Article] Yoga, a form of physical activity, is rapidly gaining in popularity and has many health benefits. Yet healthcare providers have been slow to recognize yoga for its ability to improve health conditions, and few interventions have been developed that take full advantage of its benefits. The purpose of this article is to review published studies using yoga programs and to determine the effect of yoga interventions on common risk factors of chronic diseases (overweight, hypertension, high glucose level and high cholesterol). A systematic search yielded 32 articles published between 1980 and April 2007. The studies found that yoga interventions are generally effective in reducing body weight, blood pressure, glucose level and high cholesterol, but only a few studies examined long-term adherence. Additionally, not enough studies included diverse populations at high risk for diabetes and its related common health problems.

Yurtkuran, M., Alp, A., Yurtkuran, M. & Dilek, K. (2007). A modified yoga-based exercise program in hemodialysis patients: a randomized controlled study. *Complementary Therapies in Medicine,* 15(3), 164-71.

Abstract: **AIM:** To evaluate the effects of a yoga-based exercise program on pain, fatigue, sleep disturbance, and biochemical markers in hemodialysis patients. **MATERIALS AND METHODS:** In 2004 a randomized controlled trial was carried out in the outpatient hemodialysis unit of the Nephrology Department, Uludag University Faculty of Medicine. Clinically stable hemodialysis patients (n=37) were included and followed in two groups: the modified yoga-based exercise group (n=19) and the control group (n=18). Yoga-based exercises were done in groups for 30 min/day twice a week for 3 months. All of the patients in the yoga and control groups were given an active range of motion exercises to do for 10 min at home. The main outcome measures were pain intensity (measured by the visual analogue scale, VAS), fatigue (VAS), sleep disturbance (VAS), and grip strength (mmHg); biochemical variables-- urea, creatinine, calcium, alkaline phosphatase, phosphorus, cholesterol, HDL-cholesterol, triglyceride, erythrocyte, hematocrit--were evaluated. **RESULTS:** After a 12-week intervention, significant improvements were seen in the variables: pain -37%, fatigue -55%, sleep disturbance -25%, grip strength +15%, urea -29%, creatinine -14%, alkaline phosphatase -15%, cholesterol -15%, erythrocyte +11%, and hematocrit count +13%; no side-effects were seen. Improvement of the variables in the yoga-based exercise program was found to be

superior to that in the control group for all the variables except calcium, phosphorus, HDL-cholesterol and triglyceride levels. **CONCLUSION:** A simplified yoga-based rehabilitation program is a complementary, safe and effective clinical treatment modality in patients with end-stage renal disease.

U/E

Dash M. & Telles S. (2001). Improvement in hand grip strength in normal volunteers and rheumatoid arthritis patients following yoga training. *Indian Journal of Physiology and Pharmacology*, 45(3), 355-360.

Abstract: [Journal: Article] The present study aimed at assessing the effects of a set of yoga practices on normal adults (n=37), children (n=86), and patients with rheumatoid arthritis (n=20). An equal number of normal adults, children, and patients with rheumatoid arthritis who did not practice yoga were studied under each category, forming respective control groups. Yoga and control group subjects were assessed at baseline and after varying intervals, as follows, adults after 30 days, children after 10 days and patients after 15 days, based on the duration of the yoga program, which they attended, which was already fixed. Hand grip strength of both hands, measured with a grip dynamometer, increased in normal adults and children, and in rheumatoid arthritis patients, following yoga, but not in the corresponding control groups, showing no re-test effect. Adult female volunteers and patients showed a greater percentage improvement than corresponding adult males. This gender-based difference was not observed in children. Hence yoga practice improves hand grip strength in normal persons and in patients with rhematoid arthritis, though the magnitude of improvement varies with factors such as gender and age.

Ferris, A., Wang, M., Magpantay, L., Whiting, W., Greendale, G. & Salem, G. (2008). Upper extremity functional performance in older adults with hyperkyphosis: The effects of a 6 month yoga intervention. *Medicine & Science in Sports & Exercise*, 40(5), Supplement 1:S376.

Abstract:
INTRODUCTION: Physical function is compromised by hyperkyphosis in older adults[1]. Yoga increases lower-extremity physical function in persons with OA[2]; however, it is unclear if Yoga can improve upper-extremity (UE) function in persons with hyperkyphosis.
RESULTS: Participants improved their TBT performance by 26.4%. Vertical reach did not improve across conditions.
CONCLUSION: Improvements in the TBT suggest Yoga may improve UE functional performance in persons with hyperkyphosis without concurrent changes in vertical reach.

Expanded randomized controlled trials are required to determine the underlying mechanisms associated with these findings.

Garfinkel M.S., Singhal A., Katz W.A., Allan D.A., Reshetar R. & Schumacher H.R. (1998). Yoga-based intervention for carpal tunnel syndrome: a randomized trial. Journal of the American Medical Association, 280(18), 1601-3.

Abstract: [Clinical Trial. Journal Article. Randomized Controlled Trial. Research Support, Non-U.S. Gov't] **CONTEXT:** Carpal tunnel syndrome is a common complication of repetitive activities and causes significant morbidity. **OBJECTIVE:** To determine the effectiveness of a yoga-based regimen for relieving symptoms of carpal tunnel syndrome. **DESIGN:** Randomized, single-blind, controlled trial. **SETTING:** A geriatric center and an industrial site in 1994-1995. **PATIENTS:** Forty-two employed or retired individuals with carpal tunnel syndrome (median age, 52 years; range, 24-77 years). **INTERVENTION:** Subjects assigned to the yoga group received a yoga-based intervention consisting of 11 yoga postures designed for strengthening, stretching, and balancing each joint in the upper body along with relaxation given twice weekly for 8 weeks. Patients in the control group were offered a wrist splint to supplement their current treatment. **MAIN OUTCOME MEASURES:** Changes from baseline to 8 weeks in grip strength, pain intensity, sleep disturbance, Phalen sign, and Tinel sign, and in median nerve motor and sensory conduction time. **RESULTS:** Subjects in the yoga groups had significant improvement in grip strength (increased from 162 to 187 mm Hg; P = .009) and pain reduction (decreased from 5.0 to 2.9 mm; P = .02), but changes in grip strength and pain were not significant for control subjects. The yoga group had significantly more improvement in Phalen sign (12 improved vs 2 in control group; P = .008), but no significant differences were found in sleep disturbance, Tinel sign, and median nerve motor and sensory conduction time. **CONCLUSION:** In this preliminary study, a yoga-based regimen was more effective than wrist splinting or no treatment in relieving some symptoms and signs of carpal tunnel syndrome.

Greendale, G.A., McDivit, A., Carpenter, A., Seeger, L. & Huang, M. (2002). Yoga for women with hyperkyphosis: results of a pilot study. *American Journal of Public Health*, 92(10), 1611-14.

Abstract: We conducted a single-arm, nonmasked intervention trial to assess the effects on anthropometric and physical function of yoga among women with hyperkyphosis. At baseline, the mean age of the 21 participants was 75 yrs. Mean height and mean weight was156.9 cm and 61.5 kg, respectively. Nine women (43%) had no thoracic or lumbar vertebral fracture, 7 (33%) had at least 1 thoracic fracture (median=2), and 5 (24%) had both thoracic and lumbar fractures (all of the women with lumbar fractures had at least 1 thoracic fracture). Nineteen women (90%) completed the study; losses were due to unrelated medical problems. Among those who completed the study, session attendance averaged 80%, and the daily diary completion rate was 100%. There were no adverse events. Measured height increased and distance from tragus to wall diminished;

no changes in kyphometer angle were apparent. Improvements were evident in the case of timed chair stands (faster), the penny test (faster), and functional reach (longer). (22 refs.)
Authors Conclusions: This pilot study suggests that the use of yoga among women with hyperkyphosis is safe and acceptable and may produce better posture. The mechanism by which postural improvements occurred among the participants may have included increased strength and flexibility and heightened attention to alignment. The contemplative state encouraged by yoga's mind-body approach may also lead to enhanced well being, a benefit noted by the majority of participants.

Verma KK, Varstala V, Kytokorpi L, Telama R (1990). The effects of a three-week hatha yoga programme on the reduction of anxiety level and neck and shoulder pain. *Liikunnan ja Kansanterveyden Julkaisuja*, 67, 229.

L/E

DiBenedetto, M., Innes, K.E., Taylor, A.G., Rodeheaver, P.F., Boxer, J.A., Wright, H.J. & Kerrigan, D.C. (2005). Effect of a gentle Iyengar yoga program on gait in the elderly: an exploratory study. *Arch Phys Med Rehabil*, 86(9), 1830-1837.

Abstract:
Inclusion Criteria: Healthy, non-obese adults age 62 years and older and naive to yoga.
Exclusion Criteria: Asymmetric gait pattern, use of an assistive device for walking, evidence of neuromuscular illness, major orthopedic diagnosis in lower back, pelvis, or lower extremities, severe rheumatoid arthritis or osteoarthritis that would cause discomfort during the yoga exercises, acute medical illness, and symptomatic heart or lung disease.
Authors Conclusions: In this preliminary study of healthy elders, significant improvements in hip extension, stride length, and pelvic tilt were observed following a gentle 8-week Iyengar yoga program tailored for older adults. If confirmed in larger, controlled studies, these findings suggest that tailored yoga programs may offer an attractive, cost-effective intervention for improving gait function in elderly populations.

Hip

Casey, B. & Terbizan, D. (2006). Improving lower body flexibility, comparing the use of yoga and a static stretching program. *Medicine & Science in Sports & Exercise*, 38(5), Supplement: S279.

RESULTS: Although subjects in the stretching groups increased their flexibility after 7 weeks of training compared to the control group (p=0.0003), no significant difference was noted between improvements in the yoga and static stretching group relative to the sit

and reach assessment. For hip goniometry, subjects in the yoga improved significantly more than the static stretching and control group (p=0.0176) at posttesting. No significant difference was seen in pre to post Well-Being inventory (p=0.2581).CONCLUSIONS: The use of a yoga program can significantly improve lower extremity flexibility. As both flexibility-trained groups increased their flexibility, it may also be concluded that a yoga program may be just as effective in improving lower extremity flexibility as a static stretching program. Additional research in this area could determine whether the use of yoga in older groups or athletic populations is as effective as a method of flexibility improvement as traditional programs.

Knee

Kolasinski, S.L., Garfinkel M.G., Tsai, A.G., Matz, W., Van Dyke, A. & Schumacher, H.R. (2005). Iyengar yoga for treating symptoms of osteoarthritis of the knees: A pilot study. *Journal of Alternative Complement Medicine*, 11(4), 689-693.

Study Population: Adults (18-64 years), Older persons (65 years or older)
Inclusion Criteria: Subjects were older than 50 years of age with symptomatic osteoarthritis in at least one knee for at least 6 months before entry into the study and were not participating in an exercise program. They had at least two of the following: stiffness greater than 30 minutes; crepitus; bony tenderness; bony enlargement; or absence of palpable warmth. Presence of knee osteoarthritis was diagnosed using the Clinical Criteria for the Classification of Idiopathic Osteoarthritis of the Knee (developed by the American College of Rheumatology).
Authors Conclusions: The author states that "this study suggests that yoga provides a safe and feasible exercise option for previously yoga-naive, obese patients over 50 years of age and offers potential reductions in pain and disability caused by knee osteoarthritis."

Spine/Core

Cohen, M.J., Heinrich, R.L., Naliboff, B.D., Collins, G.A. & Bonebakker, A.D. (1983). Group outpatient physical and behavioral therapy for chronic low back pain. *Journal of Clinical Psychology*, 39(3), 326-33.

Abstract: [Clinical Trial. Controlled Clinical Trial. Journal Article] Conducted a treatment-outcome study to investigate the effectiveness of behavioral (BT) or physical therapy (PT) for treating chronic low back pain (CLBP). Thirteen patients received BT; 12 patients received PT. All patients had at least a 6-month history of seeking treatment of CLBP. Prior to treatment patients were assessed in four principal areas of functioning: (1) physical abilities; (2) current physical functioning; (3) psychological and psychosocial functioning; and (4) pain intensity and pain perception. Treatments were conducted in a

group (5-8 patients) outpatient setting. Both BT and PT met for 10 weekly 2-hour sessions. BT was designed to address the environmental, social, and emotional influences of the pain experience, depression, and decreased activity from CLBP. PT was based upon traditional rehabilitation theory and was designed to improve low back function. The posttreatment results showed general improvement for patients in both groups, but few treatment-specific differences in outcome measures.

The previous article pertains to the following article to link the rolls of Yoga, behavioral therapy and PT.

Granath, J., Ingvarsson, S., Von Thiele, U., Lundberg, U. (2006). Stress management: A randomized study of cognitive behavioural therapy and yoga. *Cognitive Behaviour Therapy*, 35(1), 3-10.

Abstract: [Journal Article. Randomized Controlled Trial. Research Support, Non-U.S. Gov't] In this study, a stress management program based on cognitive behavioural therapy principles was compared with a Kundaliniyoga program. A study sample of 26 women and 7 men from a large Swedish company were divided randomly into 2 groups for each of the different forms of intervention; a total of 4 groups. The groups were instructed by trained group leaders and 10 sessions were held with each of groups, over a period of 4 months. Psychological (self-rated stress and stress behaviour, anger, exhaustion, quality of life) and physiological (blood pressure, heart rate, urinary catecholamines, salivary cortisol) measurements obtained before and after treatment showed significant improvements on most of the variables in both groups as well as medium-to-high effect sizes. However, no significant difference was found between the 2 programs. The results indicate that both cognitive behaviour therapy and yoga are promising stress management techniques.

The previous 2 articles together suggest yoga can address the physical and emotional aspects of PT.

Graves, N., Krepcho, M. & Mayo, H.G. (2004). Does yoga speed healing for patients with low back pain? *Journal of Family Practice*, 53(8), 661-662.

CLINICAL COMMENTARY: Information suggests yoga-and all exercise-effective for low back pain. Good evidence supports the concept that activity is more effective than bed rest for acute low back pain. Recent studies in the rehabilitation and physical therapy literature have emphasized core stability exercises for acute and chronic back pain. As balance, strength, and flexibility improve, the episodes and intensity of acute low back pain diminish. It stands to reason that activities such as hatha yoga that improve muscular strength, flexibility, and balance would similarly improve function and decrease low back pain. The available information would lead me to recommend yoga for my

patients with low back pain. Yoga may well be effective, and no reports in the literature show harm.

Groessl, E.J., Weingart, K.R., Aschbacher, K., Pada, L. & Baxi S. (2008). Yoga for veterans with chronic low-back pain. [Journal Article] *Journal of Alternative & Complementary Medicine,* 14(9), 1123-9.

OBJECTIVES: Chronic back pain affects a large proportion of both the general population and of military veterans. Although numerous therapies exist for treating chronic back pain, they can be costly and tend to have limited effectiveness. Thus, demonstrating the efficacy and cost-effectiveness of additional treatment alternatives is important. The purpose of our study was to examine the benefits of a yoga intervention for Veterans Administration (VA) patients. SUBJECTS/**INTERVENTION:** VA patients with chronic back pain were referred by their primary care providers to a yoga program as part of clinical care. Before starting yoga, a VA physician trained in yoga evaluated each patient to ensure that they could participate safely. **DESIGN:** The research study consisted of completing a short battery of questionnaires at baseline and again 10 weeks later. **OUTCOME MEASURES:** Questionnaires included measures of pain, depression, energy/fatigue, health-related quality of life, and program satisfaction. Paired t-tests were used to compare baseline scores to those at the 10-week follow-up for the single group, pre-post design. Correlations were used to examine whether yoga attendance and home practice were associated with better outcomes. **RESULTS:** Baseline and follow-up data were available for 33 participants. Participants were VA patients with a mean age of 55 years. They were 21% female, 70% white, 52% married, 68% college graduates, and 44% were retired. Significant improvements were found for pain, depression, energy/fatigue, and the Short Form-12 Mental Health Scale. The number of yoga sessions attended and the frequency of home practice were associated with improved outcomes. Participants appeared highly satisfied with the yoga instructor and moderately satisfied with the ease of participation and health benefits of the yoga program. **CONCLUSIONS:** Preliminary data suggest that a yoga intervention for VA patients with chronic back pain may improve the health of veterans. However, the limitations of a pre-post study design make conclusions tentative. A larger randomized, controlled trial of the yoga program is planned.

Sherman, K.J., Cherkin, D.C., Erro, J., Miglioretti, D.L. & Deyo, R.A. (2005). Comparing yoga, exercise, and a self-care book for chronic low back pain: a randomized, controlled trial. *Annals of Inernal Medicine,* 143(12), 849-56.

Abstract: BACK**GROUND:** Chronic low back pain is a common problem that has only modestly effective treatment options. **OBJECTIVE:** To determine whether yoga is more effective than conventional therapeutic exercise or a self-care book for patients with chronic low back pain. **DESIGN:** Randomized, controlled trial. **SETTING:** A nonprofit,

integrated health care system. **PATIENTS:** 101 adults with chronic low back pain. **INTERVENTION:** 12-week sessions of yoga or conventional therapeutic exercise classes or a self-care book. **MEASUREMENTS:** Primary outcomes were back-related functional status (modified 24-point Roland Disability Scale) and "bothersomeness" of pain (11-point numerical scale). The primary time point was 12 weeks. Clinically significant change was considered to be 2.5 points on the functional status scale and 1.5 points on the bothersomeness scale. Secondary outcomes were days of restricted activity, general health status, and medication use. **RESULTS:** After adjustment for baseline values, back-related function in the yoga group was superior to the book and exercise groups at 12 weeks (yoga vs. book: mean difference, -3.4 [95% CI, -5.1 to - 1.6] [P < 0.001]; yoga vs. exercise: mean difference, -1.8 [CI, -3.5 to - 0.1] [P = 0.034]). No significant differences in symptom bothersomeness were found between any 2 groups at 12 weeks; at 26 weeks, the yoga group was superior to the book group with respect to this measure (mean difference, -2.2 [CI, -3.2 to - 1.2]; P < 0.001). At 26 weeks, back-related function in the yoga group was superior to the book group (mean difference, -3.6 [CI, -5.4 to - 1.8]; P < 0.001). **LIMITATIONS:** Participants in this study were followed for only 26 weeks after randomization. Only 1 instructor delivered each intervention. **CONCLUSIONS:** Yoga was more effective than a self-care book for improving function and reducing chronic low back pain, and the benefits persisted for at least several months.
Authors Conclusions: In addition to the Roland disability scale and symptom bothersomeness score, other outcomes reported were medication use, which was similar among groups at baseline, and decreased most sharply in the yoga group. Only 21% of participants in the yoga group reported medication used during the week before the 26-week interview compared with 50% in the exercise group and 59% in the book group. Performance on the physical and mental health components of the Short Form-36 Health Survey and responses to questions regarding restricted activity were not significantly different between groups over time. This study suggest that viniyoga is a safe and effective treatment for chronic back pain and provides physicians with a rationale for recommending it (and possibly other therapeutically oriented styles of yoga as well) to their patients. Physicians should encourage their patients to choose instructors who have experience working with individuals who have back pain and who can help them manage the symptom flare-ups that may occur as a result of physical activity. Future research evaluation yoga for chronic back pain should investigate its mechanisms of action and whether similar results are seen in more diverse populations and in patients with more severe back pain.
At the end of the 12 weeks of intervention, the scores in the yoga group dropped from an average of 8 to approximately 4 on the Roland Disability Scale (a 23-question survey) and bothersomeness rated on an 11-point scale (0-10), and this drop was significantly better than either self-care (3.4-point difference) or exercise (1.8-point difference). Scores on the bothersomeness scale improved to a similar degree in all 3 groups. At 26 weeks, disability scores continued to be better in the yoga group and the bothersomeness scores were significantly better in the yoga-treated patients, with an average 2.2-point greater drop with yoga than with self-care (P<.001).

Tekur, P., Singphow, C., Nagendra, H.R. & Raghuram, N. (2008). Effect of short-term intensive yoga program on pain, functional disability and spinal flexibility in chronic low back pain: a randomized control study. *Journal of Alternative & Complementary Medicine*, 14(6), 637-44.

Abstract: **OBJECTIVE:** The aim of this study was to compare the effect of a short-term intensive residential yoga program with physical exercise (control) on pain and spinal flexibility in subjects with chronic low-back pain (CLBP). **DESIGN:** This was a wait-list, randomized controlled study. **SETTING:** The study was conducted at a residential integrative health center in Bangalore, South India. **SUBJECTS:** Eighty (80) subjects (females, n = 37) with CLBP, who consented were randomly assigned to receive yoga or physical exercise if they satisfied the selection criteria. Intervention: The intervention consisted of a 1-week intensive residential yoga program comprised of asanas (physical postures) designed for back pain, pranayamas (breathing practices), meditation, and didactic and interactive sessions on philosophical concepts of yoga. The control group practiced physical exercises under a trained physiatrist and also had didactic and interactive sessions on lifestyle change. Both of the groups were matched for time on intervention and attention. **OUTCOME MEASURES:** Pain-related outcomes were assessed by the Oswestry Disability Index (ODI) and by spinal flexibility, which was assessed using goniometer at pre and post intervention. Data were analyzed using repeated measures analysis of variance (RMANOVA). **RESULTS:** Data conformed to a Gaussian distribution. There was a significant reduction in ODI scores in the yoga group compared to the control group ($p = 0.01$; effect size 1.264). Spinal flexibility measures improved significantly in both groups but the yoga group had greater improvement as compared to controls on spinal flexion ($p = 0.008$; effect size 0.146), spinal extension ($p = 0.002$; effect size 0.251), right lateral flexion ($p = 0.059$; effect size 0.006); and left lateral flexion ($p = 0.006$; effect size 0.171). **CONCLUSIONS:** Seven (7) days of a residential intensive yoga-based lifestyle program reduced pain-related disability and improved spinal flexibility in patients with CLBP better than a physical exercise regimen.

Williams, K.A., Petronis, J., Smith, D., Goodrich, D., Wu, J., Ravi, N., Doyle, E.J., Gregory, R., Munoz Kolar, M., Gross, R. & Steinberg, L. (2005). Effect of Iyengar yoga therapy for chronic low back pain. *Pain*, 115(1-2), 107-17.

Abstract: [Clinical Trial. Journal Article. Randomized Controlled Trial. Research Support, Non-U.S. Gov't] Low back pain is a significant public health problem and one of the most commonly reported reasons for the use of Complementary Alternative Medicine. A randomized control trial was conducted in subjects with non-specific chronic low back pain comparing Iyengar yoga therapy to an educational control group. Both programs were 16 weeks long. Subjects were primarily self-referred and screened by primary care physicians for study of inclusion/exclusion criteria. The primary outcome for the study was functional disability. Secondary outcomes including present pain intensity, pain

medication usage, pain-related attitudes and behaviors, and spinal range of motion were measured before and after the interventions. Subjects had low back pain for 11.2+/-1.54 years and 48% used pain medication. Overall, subjects presented with less pain and lower functional disability than subjects in other published intervention studies for chronic low back pain. Of the 60 subjects enrolled, 42 (70%) completed the study. Multivariate analyses of outcomes in the categories of medical, functional, psychological and behavioral factors indicated that significant differences between groups existed in functional and medical outcomes but not for the psychological or behavioral outcomes. Univariate analyses of medical and functional outcomes revealed significant reductions in pain intensity (64%), functional disability (77%) and pain medication usage (88%) in the yoga group at the post and 3-month follow-up assessments. These preliminary data indicate that the majority of self-referred persons with mild chronic low back pain will comply to and report improvement on medical and functional pain-related outcomes from Iyengar yoga.

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Sports/Running

Boyle C.A., Sayers S.P., Jensen B.E., Headley S.A., & Manos T.M. (2004). The effects of yoga training and a single bout of yoga on delayed onset muscle soreness in the lower extremity. *Journal of Strength & Conditioning Research*, 18(4), 723-9.

Abstract: [Journal Article. Research Support, Non-U.S. Gov't] The purpose of this study was to determine the effects of yoga training and a single bout of yoga on the intensity of delayed onset muscle soreness (DOMS). 24 yoga-trained (YT; n = 12) and non-yoga-trained (CON; n = 12), matched women volunteers were administered a DOMS-inducing bench-stepping exercise. Muscle soreness was assessed at baseline, 24, 48, 72, 96, and 120 hours after bench-stepping using a Visual Analog Scale (VAS). Groups were also compared on body awareness (BA), flexibility using the sit-and-reach test (SR), and perceived exertion (RPE). Statistical significance was accepted at p </= 0.05. A 2 x 2 mixed factorial ANOVA with repeated measures at 24 and 48 hours revealed a significant ($p < 0.05$) group main effect with VAS scores greater for CON than YT. Paired t-tests revealed that in YT, VAS scores were higher before yoga class than after yoga class at 24 hours (21.4 [+/- 6.9] mm vs. 11.1 [+/- 4.1] mm; $p = 0.02$). The SR was greater in YT than in CON (65.0 [+/- 7.9] cm vs. 33.3 [+/- 7.0] cm; $p < 0.01$); however, no differences were found between yoga and control in BA (94.0 [+/- 4.4] units vs. 83.8 [+/- 3.7] units; $p = 0.21$) or in RPE at 5-minute intervals (2.9 [+/- 0.3], 5.3 [+/- 0.8], 5.8 [+/- 0.9], and 5.2 [+/- 0.8] vs. 2.5 [+/- 0.3], 4.0 [+/- 0.5], 4.2 [+/- 0.3], and 4.9 [+/- 0.4]. Yoga training and a single bout of yoga appear to attenuate peak muscle soreness in women following a bout of eccentric exercise. These findings have significant implications for coaches, athletes, and the exercising public who may want to implement yoga training as a preseason regimen or supplemental activity to lessen the symptoms associated with muscle soreness.

Donohue, B., Miller, A., Beisecker , M., Houser, D., Valdez, R., Tiller, S. & Taymar, T. (2006). Effects of brief yoga exercises and motivational preparatory interventions in distance runners: results of a controlled trial. *British journal of sports medicine*. 40(1), 60-3.

OBJECTIVE: To examine the efficacy of two preparatory interventions on one mile run performance in 90 high school long distance runners. **METHOD:** After participants had completed a one mile baseline run, they were randomly assigned to participate in either one of two interventions (brief yoga exercises, motivational shouting exercises) or a no intervention control condition. Experimental conditions were implemented one week after the baseline run about 20 minutes before a second one mile trial. **RESULTS:** Participants assigned to the motivational intervention improved their running performance significantly more than those assigned to the other two conditions. Although the magnitude of the effect was small, participants assigned to yoga exercises showed significant improvements in running performance relative to control condition participants. Consumer satisfaction ratings indicated that participants who were assigned to the motivational and yoga exercise groups liked their interventions more than those assigned to the control group. **CONCLUSION:** Motivational and yoga interventions designed to improve long distance running performance were equally acceptable to the participants, but the former had a greater effect.

Balance

Hart, C. & Tracy, B.(2008). Yoga as steadiness training: effects on motor variability in young adults. *Journal of Strength & Conditioning Research,* 22(5), 1659-1669.

Hart, CEF and Tracy, BL. Yoga as steadiness training: effects on motor variability in young adults. J Strength Cond Res 22(5): 1659-1669, 2008-Exercise training programs can increase strength and improve submaximal force control, but the effects of yoga as an alternative form of steadiness training are not well described. The purpose was to explore the effect of a popular type of yoga (Bikram) on strength, steadiness, and balance. Young adults performed yoga training (n = 10, 29 +/- 6 years, 24 yoga sessions in 8 weeks) or served as controls (n = 11, 26 +/- 7 years). Yoga sessions consisted of 1.5 hours of supervised, standardized postures. Measures before and after training included maximum voluntary contraction (MVC) force of the elbow flexors (EF) and knee extensors (KE), steadiness of isometric EF and KE contractions, steadiness of concentric (CON) and eccentric (ECC) KE contractions, and timed balance. The standard deviation (SD) and coefficient of variation (CV, SD/mean force) of isometric force and the SD of acceleration during CON and ECC contractions were measured. After yoga training,

MVC force increased 14% for KE (479 +/- 175 to 544 +/- 187 N, $p < 0.05$) and was unchanged for the EF muscles (219 +/- 85 to 230 +/- 72 N, $p > 0.05$). The CV of force was unchanged for EF (1.68 to 1.73%, $p > 0.05$) but was reduced in the KE muscles similarly for yoga and control groups (2.04 to 1.55%, $p < 0.05$). The variability of CON and ECC contractions was unchanged. For the yoga group, improvement in KE steadiness was correlated with pretraining steadiness ($r = -0.62$ to -0.84, $p < 0.05$); subjects with the greatest KE force fluctuations before training experienced the greatest reductions with training. Percent change in balance time for individual yoga subjects averaged +228% (19.5 +/- 14 to 34.3 +/- 18 seconds, $p < 0.05$), with no change in controls. For young adults, a short-term yoga program of this type can improve balance substantially, produce modest improvements in leg strength, and improve leg muscle control for less-steady subjects.

Lee, L. (2006).Enhancing balance, lower extremity function, and gait in people with parkinson's disease through yoga exercise. *American Journal of Physical Medicine & Rehabilitation,* 85(3), 284.

Abstract: Movement disorders as wells as injurious falls and fear of falling hasten functional decline and immobility in older adults with Parkinson's disease (PD). Nonetheless, exercise programs have not been accepted as a standard part of a treatment regimen for people with PD. For instance, a recent New England Journal of Medicine review article on management of PD devoted only part of one sentence to exercise. To improve function and lessen disability in this population, the optimal type of exercise and its benefits must be better delineated. This study examined the effect of Yoga exercises on mobility and lower extremity function. It was hypothesized that Yoga exercises would improve gait efficiency, lower extremity function, balance, and fear of falling in older adults with PD. 17 subjects (10 male, 7 female, age 72 ± 10 yr) with mild to moderate PD completed a 10-wk Iyengar Yoga program consisting of 2 one-hour classes per week and daily 30-min home exercises. Subjects were tested before and after completion of the Yoga program and assessed using Student's paired t tests. Self-selected comfortable walking speed, indicative of gait efficiency, improved from 1.0 ± 0.2 m/sec to 1.2 ± 0.2 m/sec for the group ($P < 0.002$). Short Physical Performance Battery, a measure of lower extremity function, increased from 8.2 ± 1.8 points to 9.7+/-2.3 points ($P = 0.006$). Scores of the Berg Balance Scale improved from 50 ± 5–53 ± 3 points ($P = 0.006$). Lastly, fear of falling, as measured by the Falls Efficacy Scale, increased from 68 ± 18 points to 77 ± 19 points ($P = 0.02$). The data suggest that Yoga exercises may be an effective option for older adults with PD who wish to enhance balance, gait efficiency, and lower extremity function.

Pain

Evans, S., Subramanian, S. & Sternlieb, B. (2008). Yoga as treatment for chronic pain

conditions: A literature review. *International Journal on Disability and Human Development,* 7(1), 25-32.

Abstract: Yoga is a popular modality of complementary and alternative medicine (CAM), and yet a relatively small body of literature examines the efficacy of yoga in addressing health problems. This review details the existing studies on yoga for chronic health conditions associated with pain in individuals across the lifespan. Overall, there is compelling preliminary evidence about the beneficial aspects of yoga in addressing a variety of pain conditions including osteoarthritis, back pain, headaches, and irritable bowel syndrome. Problematic to the literature as a body is the lack of detail offered by most researchers about the branch of yoga chosen, the specific postures employed, and the qualifications of yoga teachers in these studies. Also of issue is the typically small sample size as well as an absence of theoretical models to inform interventions and assessments. These shortcomings have conceivably impeded greater wide-scale replication and dissemination of yoga programs for health conditions. For people with chronic pain conditions, yoga offers a relatively low-cost and easily accessible CAM intervention and would likely be of public health benefit if studied more rigorously in the future. Copyright copyright Freund Publishing House Limited.

Kakigi, R., Nakata, H., Inui, K., Hiroe, N., Nagata, O., Honda, M., Tanaka, S., Sadato, N. & Kawakami, M. (2005). Intracerebral pain processing in a Yoga Master who claims not to feel pain during meditation. *European Journal of Pain,* 9(5), 581-9.

Abstract: We recorded magnetoencephalography (MEG) and functional magnetic resonance imaging (fMRI) following noxious laser stimulation in a Yoga Master who claims not to feel pain when meditating. As for background MEG activity, the power of alpha frequency bands peaking at around 10 Hz was much increased during meditation over occipital, parietal and temporal regions, when compared with the non-meditative state, which might mean the subject was very relaxed, though he did not fall asleep, during meditation. Primary pain-related cortical activities recorded from primary (SI) and secondary somatosensory cortices (SII) by MEG were very weak or absent during meditation. As for fMRI recording, there were remarkable changes in levels of activity in the thalamus, SII-insula (mainly the insula) and cingulate cortex between meditation and non-meditation. Activities in all three regions were increased during non-meditation, similar to results in normal subjects. In contrast, activities in all three regions were weaker during meditation, and the level was lower than the baseline in the thalamus. Recent neuroimaging and electrophysiological studies have clarified that the emotional aspect of pain perception mainly involves the insula and cingulate cortex. Though we cannot clearly explain this unusual condition in the Yoga Master, a change of multiple regions relating to pain perception could be responsible, since pain is a complex sensory and emotional experience.

Reid, M., Papaleontiou, M., Ong, A, Breckman, R., Wethington, E. & Pillemer, K. (2008). Self-Management Strategies to Reduce Pain and Improve Function among Older Adults in Community Settings: A Review of the Evidence. *Pain Medicine.* 9(4), 409-424.

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Context: Self-management strategies for pain hold substantial promise as a means of reducing pain and improving function among older adults with chronic pain, but their use in this age group has not been well defined.
Objective: To review the evidence regarding self-management interventions for pain due to musculoskeletal disorders among older adults.
Design: We searched the Medline and Cumulative Index to Nursing and Allied Health Literature databases to identify relevant articles for review and analyzed English-language articles that presented outcome data on pain, function, and/or other relevant endpoints and evaluated programs/strategies that could be feasibly implemented in the community. Abstracted information included study sample characteristics, estimates of treatment effect, and other relevant outcomes when present.
Results: Retained articles (N = 27) included those that evaluated programs sponsored by the Arthritis Foundation and other programs/strategies including yoga, massage therapy, Tai Chi, and music therapy. Positive outcomes were found in 96% of the studies. Proportionate change in pain scores ranged from an increase of 18% to a reduction of 85% (median = 23% reduction), whereas change in disability scores ranged from an increase of 2% to a reduction of 70% (median = 19% reduction). Generalizability issues identified included limited enrollment of ethnic minority elders, as well as non-ethnic elders aged 80 and above.
Conclusions: Our results suggest that a broad range of self-management programs may provide benefits for older adults with chronic pain. Research is needed to establish the efficacy of the programs in diverse age and ethnic groups of older adults and identify strategies that maximize program reach, retention, and methods to ensure continued use of the strategies over time.

Yoga Breathing

Fluge, T., Richter, J., Fabel, .H, Zysno, .E., Weller, E. & Wagner, T.O. (1994). Long term effects of breathing exercises and yoga in patients with bronchial asthma. *Pneumologie (Stuttgart, Germany),* 48(7), 484-90.

Abstract: [Clinical Trial. Comparative Study. English Abstract. Journal Article. Randomized Controlled Trial] To compare the effects of breathing exercises (BE) or Yoga (Y) on the course of bronchial asthma we studied 36 subjects with a mild disease. The patients were randomly divided into 3 groups. 2 of them participated in a 3 weeks

training program of BE or Y while the third group rested without any additional treatment (control group, C). At the end of the training period the patients were asked to practise BE or Y on their own. Drug therapy and lung function parameters before and after a beta 2-agonist metered dose inhaler (albuterol, ALB) were recorded prior to the training program and in 4 weeks intervals for 4 months thereafter. The response to the beta 2-agonist was documented continuously in 28 patients. The mental state of the patients was elucidated by questionnaires.--Prior to the study a significant effect of inhaled ALB on the FEV1 was shown without any significant between group differences. Both, BE and Y, caused a significant amelioration of the mental state but only the BE induced a significant improvement of lung function parameters compared to the individual baseline values. The FEV1 increased significantly by 356.3 +/- 146.2 ml ($p < 0.05$) and the VC by 225.0 +/- 65.5 ml ($p < 0.01$). These long-term changes were not significantly different from the actual response to ALB. BE decreased the RV significantly by 306.3 +/- 111.6 ml ($p < 0.05$), an effect significantly higher compared to the beta 2-agonist ($p < 0.01$). BE in combination with ALB caused an additive effect.

Monnazzi, P., Leri, O., Guizzardi, L., Mattioli, D. & Patacchioli, F.R. (2002). Anti-stress effect of yoga-type breathing: Modification of salivary cortisol, heart rate and blood pressure following a step-climbing exercise. *Stress and Health*, 18(4) 195 -200.

Abstract: [Journal: Article] This paper reports salivary cortisol levels and cardiovascular adjustments monitored after the performance of physical exercise in a subject (healthy man, 58 years old) who had practised and taught yoga techniques for a number of years. The subject performed two different step-climbing trials which were varied according to the different breathing recovery techniques used. Immediately after the step-climbing, the subject was asked either to get his breath back spontaneously (as reference) or by 3 min breathing using the 'Istity Method', based on the prolongation or amplification of the steps of the breath (breathing in-out) with short regular rest intervals. The measurements of the basal heart rate, blood pressure and cortisol concentration in the saliva were made just before starting, and 5, 15 and 30 min after the end of step-climbing. Results suggest that the Istity breathing method can induce rapid modification of the cardiovascular function and attenuation of the cortisol level after exposure to physical stress. It might be of interest to pursue further studies of this effect, perhaps not confined to yoga experts, since the 'Istity Method' can be implemented by anyone after a short and simple training period.

Naveen, K.V., Nagarathna, R., Nagendra, H.R. & Telles, S. (1997). Yoga breathing through a particular nostril increases spatial memory scores without lateralized effects. *Psychological reports*, 81(2), 555-61.

Abstract: [Clinical Trial. Journal Article. Randomized Controlled Trial] Uninostril breathing facilitates the performance on spatial and verbal cognitive tasks, said to be right and left brain functions, respectively. Since hemispheric memory functions are also known to be lateralized, the present study assessed the effects of uninostril breathing on the performance in verbal and spatial memory tests. School children (N = 108 whose ages ranged from 10 to 17 years) were randomly assigned to four groups. Each group practiced a specific yoga breathing technique: (i) right nostril breathing, (ii) left nostril breathing, (iii) alternate nostril breathing, or (iv) breath awareness without manipulation of nostrils. These techniques were practiced for 10 days. Verbal and spatial memory was assessed initially and after 10 days. An age-matched control group of 27 were similarly assessed. All 4 trained groups showed a significant increase in spatial test scores at retest, but the control group showed no change. Average increase in spatial memory scores for the trained groups was 84%. It appears yoga breathing increases spatial rather than verbal scores, without a lateralized effect.

Petrofsky, J.S., Cuneo, M., Dial, R. & Morris, A. (2005). Muscle activity during yoga breathing exercise compared to abdominal crunches. *Journal of Applied Research*, 5(3), 501-7.

Abstract: [Journal: Article] Yoga and yoga-related training have often been touted as providing good muscle stretching and relaxation, as well as being beneficial for overall stress management. During forceful muscle contractions of yoga, substantial muscle activity can be demonstrated. In the present investigation, the muscle activity of the right and left rectus abdominis and of the right and left external oblique muscles was examined to assess the level of muscle activity during one type of yoga maneuver: a breathing exercise performed in the seated position. The results showed that while muscle activity during this yoga breathing exercise was comparable to that seen during the performance of abdominal crunches, the longer duration of the breathing exercises increased the total work on the abdominal muscles up to 5 times greater than the work during crunches. Because of the high muscle activity, this form of exercise would be good for people who cannot easily exercise on the floor such as people with disabilities or obese people.

Raghuraj, P. & Telles, S. (2004). Right uninostril yoga breathing influences ipsilateral components of middle latency auditory evoked potentials. *Neurological Sciences.* 25(5), 274-80.

Abstract: [Journal; Peer Reviewed Journal] A previous report described selective electrical activity of the cerebral hemispheres with uninostril breathing. In the present study, middle latency auditory evoked potentials (MLAEPs) were recorded from symmetrical scalp sites during the practice of uninostril yoga breathing. There were two sessions (40 min each) of right nostril yoga breathing (RNB) and of breath awareness

(BAW), with (i) 'before', (ii) test (either RNB or BAW) and (iii) 'after' periods. The participants were 14 male volunteers aged between 18 and 33 years, and the setting was a yoga centre. MLAEPs were recorded from symmetrical scalp sites (C4 and C3). During RNB, the peak amplitudes of two negative components (viz. Na wave and Nb wave) were significantly increased on the right side. Increased peak amplitudes of Na and Nb waves suggested that RNB increased the number of neurons recruited on the right side, suggesting a possible application of RNB in certain psychiatric disorders with cerebral hemispheric imbalance.

Raghuraj, P. & Telles, S. (2008). Immediate effect of specific nostril manipulating yoga breathing practices on autonomic and respiratory variables. *Applied Psychophysiology and Biofeedback*, 33(2), 65-75.

Abstract: [Journal Article] The effect of right, left, and alternate nostril yoga breathing (i.e. RNYB, LNYB, and ANYB, respectively) were compared with breath awareness (BAW) and normal breathing (CTL). Autonomic and respiratory variables were studied in 21 male volunteers with ages between 18 and 45 years and experience in the yoga breathing practices between 3 and 48 months. Subjects were assessed in five experimental sessions on five separate days. The sessions were in fixed possible sequences and subjects were assigned to a sequence randomly. Each session was for 40 min; 30 min for the breathing practice, preceded and followed by 5 min of quiet sitting. Assessments included heart rate variability, skin conductance, finger plethysmogram amplitude, breath rate, and blood pressure. Following RNYB there was a significant increase in systolic, diastolic and mean pressure. In contrast, the systolic and diastolic pressure decreased after ANYB and the systolic and mean pressure were lower after LNYB. Hence, unilateral nostril yoga breathing practices appear to influence the blood pressure in different ways. These effects suggest possible therapeutic applications.

Telles, S., Raghuraj, P., Maharana, S. & Nagendra, H.R. (2007). Immediate effect of three yoga breathing techniques on performance on a letter-cancellation task. *Perceptual and Motor Skills*, 104(3 Pt 2), 1289-96.

Abstract: [Journal Article. Randomized Controlled Trial] The effects of three yoga breathing practices were evaluated on performance on a letter-cancellation task which is a left-hemisphere dominant task. The three yoga breathing practices (right, left, and alternate nostril breathing) were selected because unilateral forced nostril breathing stimulates the contralateral hemisphere. There were 20 male volunteers whose ages ranged from 20 to 45 years (M age=28.4 yr., SD=5.7). All subjects were assessed before and after four sessions, i.e., right nostril yoga breathing, left nostril yoga breathing, alternate nostril yoga breathing, and breath awareness as a control. The letter-cancellation task scores were significantly improved, i.e., there were fewer errors following right and

alternate nostril yoga breathing (Wilcoxon paired signed-ranks test). The improved performance may be related to the enhancement of contralateral hemisphere function found with selective nostril breathing.

Vedanthan, P.K., Kesavalu, L.N., Murth, K.C., Duvall, K., Hall, M.J., Baker, S. & Nagarathna, S. (1998). Clinical study of yoga techniques in university students with asthma: a controlled study. *Allergy and asthma proceedings : the official journal of regional and state allergy societies*, 19(1), 3-9.

Abstract: [Clinical Trial. Journal Article. Randomized Controlled Trial] Adult asthmatics, ranging from 19 to 52 years from an asthma and allergy clinic in a university setting volunteered to participate in the study. The 17 students were randomly divided into yoga (9 subjects) and nonyoga control (8 subjects) groups. The yoga group was taught a set of breathing and relaxation techniques including breath slowing exercises (pranayama), physical postures (yogasanas), and meditation. Yoga techniques were taught at the university health center, three times a week for 16 weeks. All the subjects in both groups maintained daily symptom and medication diaries, collected A.M. and P.M. peak flow readings, and completed weekly questionnaires. Spirometry was performed on each subject every week. Analysis of the data showed that the subjects in the yoga group reported a significant degree of relaxation, positive attitude, and better yoga exercise tolerance. There was also a tendency toward lesser usage of beta adrenergic inhalers. The pulmonary functions did not vary significantly between yoga and control groups. Yoga techniques seem beneficial as an adjunct to the medical management of asthma.

Contraindications of Yoga: Case Reports

Bianchi G.**,** Cavenago C. & Marchese M. (2004). Can the practice of yoga be dangerous? Considerations over a case of epiphyseal separation of the distal tibia in a teenager. *Journal of Orthopaedics and Traumatology*, 5(3), 188-90.

Abstract: We describe a fracture-separation of the epiphyseal plate of the distal tibia (Salter-Harris type III, or juvenile fracture of Tillaux) in a 15-year-old girl. The case is of interest, above all, in that the trauma occurred during the execution of a yoga posture. The literature does not speak of complications or traumatic consequences of this type of activity. Analyzing the biomechanics of the traumatic event, it appears that even a physical exercise characterized by slow and gradual movements can cause severe damage, such as the injury described.

Walker, M., Meekins, G. & Hu, S. (2005). Yoga neuropathy. A snoozer. *Neurologist,* 11(3), 176-8.

Abstract: Sciatic nerve compression very rarely occurs bilaterally. The authors present a woman with profound lower extremity weakness and sensory abnormality after falling asleep in the head-to-knees yoga position (also called "Paschimottanasana"). Clinical and electrodiagnostic findings are discussed in detail and a brief review of the literature is presented.

Support of Group Yoga Classes

Annesi, J.J. (2002). Goal-setting protocol in adherence to exercise by Italian adults. *Perceptual and Motor Skills*, 94(2), 453-8.

Abstract: [Clinical Trial. Journal Article. Randomized Controlled Trial] A goal-setting protocol, based on research in goal setting and performance and personal construct theory, was tested for its effect on adherence to a new exercise program. The Goal-setting group (n = 50) had significantly less dropout (30%) than the control group (n = 50) (74%). The Goal-setting group also had significantly better attendance ($p<.0001$). Suggestions for increasing confidence in findings through further research and practical implications of using the protocol to improve exercise maintenance across settings were discussed.

Yoga has a goal element.

Cox, K.L., Burke, V., Gorely, T.J., Beilin, L.J. & Puddey, I.B. (2003). Controlled comparison of retention and adherence in home- vs center-initiated exercise interventions in women ages 40-65 years: The S.W.E.A.T. Study (Sedentary Women Exercise Adherence Trial). *Preventive Medicine*, 36(1),17-29.

Abstract: [Clinical Trial. Comparative Study. Journal Article. Randomized Controlled Trial] **BACKGROUND:** In an 18-month exercise intervention in previously sedentary older women (40-65 years), we examined whether an initial 6 months of supervised exercise leads to greater long-term retention and adherence to regular physical activity than an unsupervised home-based program and whether these outcomes are influenced by the exercise intensity. **METHODS:** Women (N = 126) were recruited from the community and randomly assigned to either center-based or home-based exercise three times/week. The center-based group attended supervised sessions for 6 months, while

after 10 initial sessions the home-based group exercised at home. After 6 months both groups were home-based for a further 12 months. Within each arm, subjects were further randomized to exercise at either moderate or vigorous intensity. **RESULTS:** The center-based group had higher retention than the home-based (97, 94, 81 versus 87, 76, and 61%) at 6, 12, and 18 months, respectively ($P < 0.05$). At 6 months, adherence was higher in the center-based group (84 versus 63%, $P < 0.001$) and energy expenditure was higher at 6 ($P < 0.05$) and 12 ($P < 0.01$) months. At 18 months, retention was higher with moderate exercise ($P < 0.05$), while adherence was similar with both intensities. **CONCLUSION:** An initial 6 months of center-based exercise enhanced retention in both the short and the long term and promoted short-term adherence and energy expenditure. Long-term, moderate exercise retained more subjects, but had little influence on adherence.

Cyarto, E.V., Brown, W.J. & Marshall, A.L. (2006). Retention, adherence and compliance: important considerations for home- and group-based resistance training programs for older adults. *Journal of science and medicine in sport / Sports Medicine Australia*, 9(5), 402-12.

Abstract: [Journal Article. Randomized Controlled Trial. Research Support, Non-U.S. Gov't] Reports on the efficacy of physical activity intervention trials usually only include discussion of the primary outcomes. However, assessing factors such as participant retention, adherence and compliance can assist in the accurate interpretation of the overall impact of a program in terms of reach and appeal. A quasi-randomised trial was carried out to assess and compare retention and adherence rates, and compliance with, a twice weekly resistance training program provided either individually at home or in a group format. Retirement villages (n=6) were assigned to either 'Have A Try' (HAT, home-based) or 'Come Have A Try' (CHAT, group-based); both programs included nine strength and two balance exercises. The program involved a 20-week Intervention Phase a 24-week Maintenance Phase and a 20-week On-going Maintenance Phase. One hundred and nineteen participants (mean age 80+/-6 years) were recruited (HAT=38, CHAT=81). There was no difference in retention rates at the end of the Intervention Phase, but significantly more HAT than CHAT participants had dropped out of the study ($p<0.01$) after the Maintenance Phase and the On-going Maintenance Phase. During the Intervention Phase, over half the HAT and CHAT participants completed > or =75% of the prescribed activity sessions, but adherence was significantly greater in CHAT than HAT during the Maintenance Phase ($p<0.01$). Participants in CHAT were significantly more compliant than HAT participants ($p<0.05$). Both home- and group-based formats were successful over the short-term, but, in retirement villages, the group program had better adherence and compliance in the longer-term.

Flegal, K.E., Kishiyama, S., Zajdel, D., Haas, M. & Oken, B.S. (2007). Adherence to

yoga and exercise interventions in a 6-month clinical trial. *BMC Complementary and Alternative Medicine.* 7, 37.

Abstract: [Journal Article. Randomized Controlled Trial. Research Support, N.I.H., Extramural] Background: To determine factors that predict adherence to a mind-body intervention in a randomized trial. Design: We analyzed adherence data from a 3-arm trial involving 135 generally healthy seniors 65-85 years of age randomized to a 6-month intervention consisting of: an Iyengar yoga class with home practice, an exercise class with home practice, or a wait-list control group. Outcome measures included cognitive function, mood, fatigue, anxiety, health-related quality of life, and physical measures. Adherence to the intervention was obtained by class attendance and biweekly home practice logs. Results: The drop-out rate was 13%. Among the completers of the two active interventions, average yoga class attendance was 77% and home practice occurred 64% of all days. Average exercise class attendance was 69% and home exercise occurred 54% of all days. There were no clear effects of adherence on the significant study outcomes (quality of life and physical measures). Class attendance was significantly correlated with baseline measures of depression, fatigue, and physical components of health-related quality of life. Significant differences in baseline measures were also found between study completers and drop-outs in the active interventions. Adherence was not related to age, gender, or education level. Conclusion: Healthy seniors have good attendance at classes with a physically active intervention. Home practice takes place over half of the time. Decreased adherence to a potentially beneficial intervention has the potential to decrease the effect of the intervention in a clinical trial because subjects who might sustain the greatest benefit will receive a lower dose of the intervention and subjects with higher adherence rates may be functioning closer to maximum ability before the intervention. Strategies to maximize adherence among subjects at greater risk for low adherence will be important for future trials, especially complementary treatments requiring greater effort than simple pill-taking.

Gettman, L.R., Pollock, M.L. & Ward, A. (1983). Adherence to unsupervised exercise. Physician Spotsmed, 11(10), 56-66.

Abstract: Forty-seven male police officers (mean age 41.0 years) were randomly assigned to three exercise groups: unsupervised, supervised, and control. Training consisted of walking and jogging three days per week for 20 weeks. The attrition rate for the unsupervised group (35%) was lower than for the supervised group (45%). The main reason the subjects gave for dropping out was lack of time. Both groups increased significantly compared to the control group in treadmill performance time, maximum oxygen uptake, and maximum oxygen pulse; and decreased significantly in resting heart rate, heart rate response to a step test, percent body fat, total skinfold fat, and waist girth.

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