Physiological & Psychological effects of Yoga

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What is Yoga

• Yoga is the Sanskrit word for union
• Yoga is an old discipline from India. It is both spiritual and physical.
• Yoga uses breathing techniques, exercise and meditation. It helps to improve health and happiness.
• Techniques of controlling the body and the mind
• Group of physical, mental, and spiritual practices or disciplines which originated in ancient India.
What is Yoga...

- Speculated to date back to pre-Vedic Indian traditions
- Developed around the sixth and fifth centuries BCE
- The Yoga Sutras of *Patanjali* date from the first half of the 1st millennium
- Gained prominence in the West in the 20th century.
- On 11 December 2014, the United Nations General Assembly approved a resolution establishing 21 June as "International Day of Yoga"
Yoga Practice

• Yoga practice can be divided into three subcategories of practice
  • Posture-holding exercise (Asana)
  • Breathing (Pranayama, Kriya)
  • Meditation (Dhyana)

• Emerging as an important health behavior-lifestyle modifying module to achieve holistic health

• Many studies have tried to determine the effectiveness of yoga as a complementary intervention for cancer
Significant physiologic changes after Yoga

• Reduction in the resting heart rate, systolic & diastolic BP and MAPt
• Increase in FVC, FEV\textsubscript{1} and PEFR
• Reduction in BMI.
• Reduction in FBS, serum total cholesterol, serum triglycerides, serum low-density lipoprotein levels, and significant increase in HDL
• Model of the psycho-neuroimmunologic processes are affected
• Activation of the hypothalamic-pituitary-adrenal axis and inflammation
• Decreases in self-reported anxiety and depression as well as increases in mindfulness
• Raises Plasma levels of Brain Derived Neurotrophic Factors
• Increases level of the cortisol awakening response.
Psychologically beneficial effects

• Parasympathetic activity overrides the sympathetic activity
• Decreases in anger, depression and fatigue
• Beneficial effects on tension, anxiety and vigor.
• Mental health and cognitive benefits
• Significant decrease in Adrenocorticotropic hormone and cortisol values related to the participants' stress levels
• Self-reported emotional experience (Stress & Coping) is improved
• Significant improvement in reaction time
Sleep, Brain and humoral functions

• Brain Wave Coherence study showed significant increase in both Delta and Alpha wave coherence leading to improvement of coherent and integrated brain functioning
• Increased orderliness of brain functioning, leading to good academics
• Reduced the depression and improved quality of sleep in elderly.
• Reduced glutathione, vitamin C, and vitamin E; the ratio of reduced to oxidized glutathione; and total antioxidant status were increased significantly following yogic practice.
• Dopamine, Oxytocine, Endorphine & Serotonin levels increased
Yoga can be beneficial

• Stress & Anxiety
• Inflammation
• Cardiac & Respiratory function
• Depression & Quality of Life
• Sleep & Brain function
• Chronic pain
• Flexibility & Balance
• Chronic & acute Pain
Thanks for your attention

I bring Vijaya/Dussera greetings form India and my colleagues from my Institute
The Impact of Yoga and Pranayama Breathing on Serum Markers

An Evidence Based Intervention

Dr. Dheeraj Mohania, Scientist-I, Dr. R. P. Centre, All India Institute of Medical Sciences (AIIMS)
Ansari Nagar, New Delh-110052, India
INTRODUCTION – YOGA

- Yoga is one of the best scientifically proven lifestyle modality and an ancient Vedic science thought to have originated in India in 5000 BC which has well-established multiple health benefits (Fishman and Saltonstall, 2008).

- Yoga’s ultimate goal - quieting one’s mind to achieve the union of mind, body and spirit which includes practice of specific posture (asana) and regulated breathing (Pranayama).

- Regardless of its spiritual origins, yoga has become a popular route to physical and mental well-being and has been adapted for use in complementary and alternative medicine in North America and Europe (De Michaelis, 2005).

- In Western societies, yoga is gaining increased popularity as a therapeutic method. About 20 million adult Americans reported that yoga had been recommended to them by a physician or therapist (Clarke et al., 2015).

- Worldwide, it is estimated that yoga is regularly practiced by about 30 million people (Dangerfield, 2009). However, this number might still underestimate the actual prevalence of yoga practice.
The word *Pranayama* is comprised of two components: ‘prana’ and ‘ayama’. *Prana* means ‘vital energy’ or ‘life force’. *Ayama* is defined as ‘extension’ or ‘expansion’.

Thus, the word ‘Pranayama’ means ‘extension or expansion of the dimension of ‘prana’. (Saraswati, 2008)

In the *Pranayama* practices, there are four important aspects of breathing such as

1. *Puraka* (inhalation)
2. *Recaka* (exhalation)
3. *Antah Kumbhaka* (internal breath retention)
4. *Bahih Kumbhaka* (external breath retention)

An advanced stage of Pranayama which occurs during high states of meditation is called as *kevala kumbhaka* (spontaneous breath retention).
AN EVIDENCE-BASED INTERVENTION
YOGA AND PRANAMAYA
OBJECTIVE: To investigate the effect of yoga on oxidative stress in elderly with grade-I Hypertension

METHODS: An open parallel-arm randomized controlled study.

Study Protocol: Screening of elderly individuals attending geriatric clinic above 60 yrs. for grade I hypertension (SBP- 140-159mmHg /DBP-90-99mmHg) as per ESH and ESC.

YOGA GROUP: Yoga six days in a week for one hour daily in the morning from 06:00 to 07:00 hours for three months. Opening prayer (1 min); Sukshma Vyayama or loosening practices (5 min); Breathing practices like Hands in and out breathing, Ankle stretch breathing, Straight leg raising breathing, Lumbar stretch breathing (5 min); Asanas or maintaining postures such as Padhastasana, Ardhachakrasana, Shashankasana, Ardha Ustrasana, Bhujangasana, Ardha Salabasana and Trikonasana (15 min); Pranayama or breathing exercises such as Anuloma Viloma Pranayama and Brahmari Pranayama (5 min); Cyclic meditation, a yoga based guided relaxation technique; Devotional session (5min); and Closing prayer (1 min).

CONTROL GROUP: The protocol for control group includes flexibility or stretching practices for 15-20 min followed by walking for 35-40 min and rest for 5 min for six days in a week, for one hour in the morning between 06:00 to 7.00 hours for three months under the supervision of an authorised instructor.

RESULTS: Yoga practice for three months has significantly reduced serum MDA level (p<0.001), and enhanced antioxidants level such as SOD activity (p=0.007), serum GSH (p=0.002) and vitamin C (p=0.002). In the control group, we observed a significant increase in serum MDA level (p=0.015) and reduction in serum vitamin C level (p=0.015).

Yoga is an effective means to reduce oxidative stress and to improve antioxidants in elderly hypertensive individuals.
Yoga is as Effective as Standard Pulmonary Rehabilitation in Improving Dyspnea, Inflammatory Markers, and Quality of Life in Patients With Chronic Obstructive pulmonary disease (COPD) [Guleria et al., 2015]

**PURPOSE:** To investigate to see whether yoga was as effective as standard pulmonary rehabilitation on inflammatory markers, dyspnea and quality of life in patients with COPD.

**METHODS:** 60 patients with COPD were randomly divided into 2 groups. One group (group 1) taught yoga exercises including asanas, pranayama, meditation and relaxation technique. The second group (group 2) underwent pulmonary rehabilitation. Both groups underwent one hour of training twice a week for the first 4 weeks. For the remaining 8 weeks the supervised session was fortnightly and the remaining sessions were at home. Baseline evaluation for both group included lung functions, dyspnea assessment (Borg scale, VAS, six minute walk test), quality of life (QOL) and serum inflammatory markers (CRP and IL-6). Repeat assessment of all these parameters was done at the end of 12 weeks in both groups.

**Yoga is a cost-effective form of rehabilitation and is as effective as a standard PMR. Yoga programs can be adopted as integral part of long term management of COPD.**

<table>
<thead>
<tr>
<th></th>
<th>12 week (Median)</th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>6MWT (m; GP-I)</td>
<td>0.70 (0.10-10.0)</td>
<td>0.80 (0.3-6.6)</td>
<td>32.74 (0.50-206.00)</td>
<td>36.28 (6.88-198.03)</td>
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<tr>
<td>Borg Scale (GP-I)</td>
<td>1.50 (0.5-7.0)</td>
<td>1.00 (0.0-4.0)</td>
<td>70.36±8.81</td>
<td>67.24±17.55</td>
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<tr>
<td>Borg Scale (GP-II)</td>
<td>3.00 (0.0-7.0)</td>
<td>0.50 (0.0-7.0)</td>
<td>70.36±8.81</td>
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<tr>
<td>VAS (mm; GP-I)</td>
<td>55.17±8.55</td>
<td>70.36±8.81</td>
<td>49.67±17.6</td>
<td></td>
<td></td>
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</table>

**CONCLUSIONS:** Yoga and PMR exercises done in a structured manner result in similar improvement in pulmonary functions, 6 minute walk distance, Borg scale, severity of dyspnea, quality of life and levels of C-reactive protein after 12 weeks of training.
OBJECTIVE: To investigate the effect of 12 weeks yogic intervention on blood sugar and lipid in elder women with type 2 diabetes mellitus.

METHODS: 21 elderly T2DM women were divided into two groups: Yogic (YIG; n=10/age 64.70± 4.04/BMI= 24.26 ± 3.40) and controls (CG; n=10/age 64.40 ± 4.79 /BMI= 24.28 ± 2.36).

STUDY PROTOCOL: YIG underwent yoga practice (Asanas, Kriyas, Pranayamas) for 12 weeks (3 sessions/week), while the CG continued their usual routine activities. Standing height, body weight, BMI, blood sugar, and lipid profile were measured before commencement and after 6 and 12 weeks of yogic intervention in both groups.

RESULTS: There was a significant ($P < 0.01$) decrease in fasting plasma glucose, postprandial blood sugar, total cholesterol, triglycerides, low-density lipoprotein, and very low density lipoprotein, with a significant ($P < 0.01$) increase in high-density lipoprotein level from its initial value in YIG, while showing insignificant result in CG.

Yogic intervention may have the beneficial effects on blood sugar and lipid profile in elderly women with T2DM.
Effect of exercise therapy on lipid profile and oxidative stress indicators in patients with type 2 diabetes (Gordon et al., 2008)

**Objective:** This study investigated the impact of Hatha yoga and conventional physical training (PT) exercise regimens on biochemical, oxidative stress indicators and oxidant status in patients with type 2 diabetes.

**Methods:** This prospective randomized study consisted of 77 type 2 diabetic patients in the Hatha yoga exercise group that were matched with a similar number of type 2 diabetic patients in the conventional PT exercise and control groups. Biochemical parameters such as fasting blood glucose (FBG), serum total cholesterol (TC), triglycerides, low-density lipoprotein (LDL), very low-density lipoproteins (VLDL) and high-density lipoprotein (HDL) determined at baseline and at two consecutive three monthly intervals. The oxidative stress indicators (malondialdehyde – MDA, protein oxidation – POX, phospholipase A2 – PLA2 activity) and oxidative status [superoxide dismutase (SOD) and catalase activities] measured.

**Results:** The concentrations of FBG in the Hatha yoga and conventional PT exercise groups after six months decreased by 29.48% and 27.43% respectively (P < 0.0001) and there was a significant reduction in serum TC in both groups (P < 0.0001). The concentrations of VLDL in the managed groups after six months differed significantly from baseline values (P = 0.036). Lipid peroxidation as indicated by MDA significantly decreased by 19.9% and 18.1% in the Hatha yoga and conventional PT exercise groups respectively (P < 0.0001); whilst the activity of SOD significantly increased by 24.08% and 20.18% respectively (P = 0.031). There was no significant difference in the baseline and 6 months activities of PLA2 and catalase after six months although the latter increased by 13.68% and 13.19% in the Hatha yoga and conventional PT exercise groups respectively (P = 0.144).

The study demonstrate the efficacy of Hatha yoga exercise on fasting blood glucose, lipid profile, oxidative stress markers and antioxidant status in patients with type 2 diabetes and suggest that Hatha yoga exercise and conventional PT exercise may have therapeutic preventative and protective effects on diabetes mellitus by decreasing oxidative stress and improving antioxidant status.

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**Table 3:** Comparison of HDL, LDL and VLDL among conventional PT exercise, Hatha yoga exercise and control type 2 diabetic patients over a 6-month period

<table>
<thead>
<tr>
<th>Variable/Group</th>
<th>Baseline</th>
<th>3 Months</th>
<th>6 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDL (mmol/L)</td>
<td>0.93 ± 0.04</td>
<td>0.94 ± 0.04</td>
<td>0.94 ± 0.04</td>
</tr>
<tr>
<td>Conventional PT</td>
<td>0.95 ± 0.04</td>
<td>0.97 ± 0.04</td>
<td>0.97 ± 0.04</td>
</tr>
<tr>
<td>Hatha yoga</td>
<td>0.93 ± 0.03</td>
<td>0.93 ± 0.03</td>
<td>0.91 ± 0.04</td>
</tr>
<tr>
<td>Control</td>
<td>0.93 ± 0.03</td>
<td>0.93 ± 0.03</td>
<td>0.91 ± 0.04</td>
</tr>
<tr>
<td>LDL (mmol/L)</td>
<td>3.02 ± 0.12</td>
<td>3.00 ± 0.12</td>
<td>3.00 ± 0.12</td>
</tr>
<tr>
<td>Conventional PT</td>
<td>3.00 ± 0.12</td>
<td>3.00 ± 0.12</td>
<td>3.00 ± 0.12</td>
</tr>
<tr>
<td>Hatha yoga</td>
<td>3.00 ± 0.12</td>
<td>3.00 ± 0.12</td>
<td>3.00 ± 0.12</td>
</tr>
<tr>
<td>Control</td>
<td>3.00 ± 0.12</td>
<td>3.00 ± 0.12</td>
<td>3.00 ± 0.12</td>
</tr>
</tbody>
</table>
| VLDL (mmol/L)  | 0.83 ± 0.05 | 0.78 ± 0.05 | 0.77 ± 0.05a
| Conventional PT| 0.80 ± 0.05 | 0.77 ± 0.05 | 0.77 ± 0.05a
| Hatha yoga     | 0.80 ± 0.05 | 0.77 ± 0.05 | 0.77 ± 0.05a
| Control        | 0.84 ± 0.06 | 0.84 ± 0.06 | 0.84 ± 0.06 |

Values represent Mean ± S.E. *p < 0.05; a: statistically significant difference from baseline.

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**Table 4:** Comparison of MDA, PLA2 and POX concentrations among conventional PT exercise, Hatha yoga exercise and control type 2 diabetic patients over a 6-month period

<table>
<thead>
<tr>
<th>Variable/Group</th>
<th>Baseline</th>
<th>3 Months</th>
<th>6 Months</th>
</tr>
</thead>
</table>
| MDA (nmol/L)   | 2.32 ± 0.12 | 2.23 ± 0.12 | 1.90 ± 0.10b
| Conventional PT| 2.36 ± 0.20 | 2.21 ± 0.15 | 1.89 ± 0.16b
| Hatha yoga     | 2.35 ± 0.12 | 2.36 ± 0.12 | 2.37 ± 0.13 |
| Control        | 2.19 ± 0.12 | 2.16 ± 0.12 | 2.15 ± 0.12 |
| PLA2 (U/L)     | 1.97 ± 0.08 | 2.19 ± 0.08 | 2.29 ± 0.09 |
| Conventional PT| 2.10 ± 0.08 | 2.12 ± 0.07 | 2.25 ± 0.07 |
| Hatha yoga     | 2.06 ± 0.09 | 2.16 ± 0.09 | 2.15 ± 0.09 |
| Control        | 2.25 ± 0.12 | 2.21 ± 0.14 | 2.34 ± 0.13 |
| POX (nmol/mg)  | 2.19 ± 0.13 | 2.20 ± 0.14 | 2.34 ± 0.13 |
| Hatha yoga     | 2.21 ± 0.13 | 2.23 ± 0.15 | 2.25 ± 0.16 |
| Control        | 2.21 ± 0.13 | 2.23 ± 0.15 | 2.25 ± 0.16 |

Values represent Mean ± S.E. *p < 0.0001; bp < 0.05; a: significantly different from baseline.

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**Table 5:** Comparison of the activities of superoxide dismutase (SOD) and catalase among conventional PT exercise, Hatha yoga exercise and control type 2 diabetic patients over a 6-month period

<table>
<thead>
<tr>
<th>Variable/Group</th>
<th>Baseline</th>
<th>3 Months</th>
<th>6 Months</th>
</tr>
</thead>
</table>
| SOD (U/mL)     | 11.25 ± 0.86 | 11.66 ± 0.82 | 13.52 ± 0.94b
| Conventional PT| 11.17 ± 1.18 | 11.64 ± 1.15 | 13.86 ± 1.11b
| Hatha yoga     | 11.01 ± 1.05 | 11.03 ± 0.98 | 10.42 ± 0.93 |
| Control        | 10.82 ± 0.80 | 10.85 ± 0.77 | 10.00 ± 0.80 |
| Catalase (U/mL) | 80.28 ± 5.57 | 85.44 ± 5.54 | 90.07 ± 5.13 |
| Conventional PT| 80.36 ± 7.02 | 85.53 ± 7.77 | 91.25 ± 5.21 |
| Hatha yoga     | 82.10 ± 5.89 | 81.44 ± 4.67 | 82.11 ± 5.34 |
| Control        | 82.10 ± 5.89 | 81.44 ± 4.67 | 82.11 ± 5.34 |

Values represent Mean ± S.E. *p < 0.05; a: significantly different from baseline.
Effect of rhythmic breathing (Sudarshan Kriya and Pranayam) on immune functions and tobacco addiction (Kochupillai et al., 2005)

Background: Stress, a psychophysiological process, acts through the immune-neuroendocrine axis and affects cellular processes of body and immune functions, leading to disease states including cancer. Stress is also linked to the habit of tobacco consumption and substance abuse, which in turn also leads to diseases. Sudarshan Kriya (SK) and Pranayam (P), rhythmic breathing processes, are known to reduce stress and improve immune functions.

AIM: To investigate the rhythmic breathing (Sudarshan Kriya and Pranayama) on immune functions and tobacco addiction

The inexpensive and easy to learn and practice breathing processes (SK and P) in this study demonstrated an increase in NK cells and a reduction in tobacco consumption. When confirmed in large and randomized studies, this result could mean that the regular practice Sudarshan Kriya and Pranayama might reduce the incidence and progression of cancer.
Role of sudarshan kriya and pranayam on lipid profile and blood cell parameters during exam stress: A randomized controlled trial (Subramanian et al., 2012)

**AIM:** To investigate the effect of sudarshan kriya (SK and P) program on lipid profile and blood cell parameters during exam stress.

**METHODS:** Blood samples of 43 engineering students were collected at four intervals namely baseline (BL), exam stress (ES), three and six weeks practice of SK and P during exam stress. Lipid profile (TC, TGL, VLDL) and hematological parameters (neutrophil, lymphocytes, platelet count, packed cell volume (PCV), mean cell volume (MCV) were measured at all four intervals.

**Study design:** The study included forty-three students and was randomized into two major groups. Group I (n=21): Control group/ Group II (n=22): Study group: The two groups were further subdivided as follows:
- Group Ia : Baseline (no exam) [BL]
- Group Ib : Exam stress [ES]
- Group Ic : Three weeks + exam stress
- Group Id : Six weeks + exam stress
- Group IIa : Baseline (no exam) [BL]
- Group IIb : Exam stress [ES]
- Group IIc : SK and P practice (three weeks)+exam stress
- Group IId : SK and P practice (six weeks)+exam stress

**RESULTS:** Exam stress elevated TC, TGL and VLDL levels. Hematological parameters affected by ES included neutrophil, lymphocytes, platelet count, PCV and MCV. Three and six weeks practice of SK and P reduced the elevated lipid profile, hematological parameters and improved lymphocyte levels.

**SK and P practice has the potential to overcome ES by improving lipid profile and hematological parameters.**
Alterations in Salivary Proteome following Single Twenty-Minute Session of Yogic Breathing
(Balasubramanian et al., 2015)

Background and Aim: Yogic breathing (YB) has been suggested to reduce stress and blood pressure and increase cognitive processes. However, alterations after YB at the molecular level are not well established.

Yogic Breathing intervention. Yogic breathing exercise contains two phases, namely Chanting Om and Thirumoolar Pranayama, each for 10 minutes. Saliva samples collected starting from 0 min and every five minutes as shown.

Results: DMBT1 was elevated in 7 of YB group by 10-fold and 11-fold at 10 and 15 minutes, respectively, whereas it was undetectable in the time-matched AC group ($P < 0.05$). There was a significant interaction between groups and time assessed by two-way ANOVA ($P < 0.001$). IGLC2 also showed a significant increase in YB group as measured by Western Blotting.

These data are the first to demonstrate the feasibility of stimulating and detecting salivary protein biomarkers in response to an acute Yoga exercise.

### Table: Protein Identification

<table>
<thead>
<tr>
<th>Protein Identification</th>
<th>Uniprot #</th>
<th>MW</th>
<th>log_{10} PC</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ig lambda-2 chain C regions</td>
<td>P0CG05</td>
<td>11 kDa</td>
<td>1.1</td>
<td>0.009</td>
</tr>
<tr>
<td>Mucin-7</td>
<td>Q9TA7X</td>
<td>39 kDa</td>
<td>0.8</td>
<td>0.002</td>
</tr>
<tr>
<td>Alpha-2-macroglobulin-like protein 1</td>
<td>A8K2U0</td>
<td>161 kDa</td>
<td>-1.4</td>
<td>0.006</td>
</tr>
<tr>
<td>Deleted in malignant brain tumors 1 protein</td>
<td>Q9UGM3</td>
<td>261 kDa</td>
<td>1.1</td>
<td>0.010</td>
</tr>
<tr>
<td>Immunoglobulin J chain</td>
<td>P01991</td>
<td>18 kDa</td>
<td>1.8</td>
<td>0.010</td>
</tr>
<tr>
<td>Ig alpha-1 chain C region</td>
<td>P01876</td>
<td>38 kDa</td>
<td>1.5</td>
<td>0.012</td>
</tr>
<tr>
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<td>P01871</td>
<td>49 kDa</td>
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<tr>
<td>Ig heavy chain V-III region BRO</td>
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<td>13 kDa</td>
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<tr>
<td>Cystatin-S</td>
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<tr>
<td>Keratin, type I cytoskeletal 10</td>
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<tr>
<td>Pro lactin-inducible protein</td>
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<td>Ig alpha-2 chain C region</td>
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<td>37 kDa</td>
<td>1.3</td>
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<tr>
<td>Keratin, type II cytoskeletal 5</td>
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<td>62 kDa</td>
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<tr>
<td>Glyceraldehyde-3-phosphate dehydrogenase</td>
<td>P04406</td>
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<tr>
<td>Kallikrein-1</td>
<td>P06870</td>
<td>29 kDa</td>
<td>2.9</td>
<td>0.026</td>
</tr>
<tr>
<td>UPP1762 protein C6orf58</td>
<td>Q0P552</td>
<td>38 kDa</td>
<td>1.5</td>
<td>0.028</td>
</tr>
</tbody>
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Increased salivary DMBT1 abundance in Yogic breathing participants
Undetectable salivary DMBT1 level in Attention Control participants
Yogic breathing when compared to attention control reduces the levels of pro-inflammatory biomarkers in saliva: a pilot randomized controlled trial (Twal et al., 2016)

AIM: As Yoga practice stimulates salivary secretion, and saliva is considered a source of biomarkers, changes in salivary cytokines before and after Yogic breathing exercise as specified in an ancient Tamil script, Thirumanthiram, were examined using a Cytokine Multiplex to compare to Attention Control (AC) group.

Methods: 20 volunteers were randomized into two groups stratified by gender (N = 10 per YB and AC groups); The YB group performed two YB exercises, each for ten minutes, for a total of twenty minutes in a single session. The AC group read a text of their choice for 20 min. Saliva was collected immediately after YB training at 0, 5, 10, 15 and 20 min and analyzed by Multiplex ELISA.

Results: The levels of interleukin (IL)-1β, IL-8, and monocyte chemotactic protein−1 (MCP-1) were significantly reduced in YB group when compared to AC group. The level of reduction of IL-8 was significant at all time points tested, whereas IL-1β showed reduction at 15 and 20 min time points (p < 0.05), and MCP-1 level was marginally different at 5–20 min. There were no significant differences between YB and AC groups in the salivary levels of IL-1RA, IL-6, IL-10, IL-17, IP-10, MIP-1b, and TNF-α.

These data are the first to demonstrate the feasibility of detecting salivary cytokines using multiplex assay in response to a Yoga practice.
THANKS FOR YOUR KIND ATTENTION

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The Role of Yoga in the Adjuvant Treatment of Breast Cancer: Results from a Large Randomized Controlled Trial

Quality of life results

**Nita S. Nair**, Nishu Singh Goel, Rohini W Hawaldar, Shabina Siddique, Vani Parmar, Aarti Pandey, Jaya Ghosh, Joyita Deodhar, Anuradha Daptardar, Rajendra A. Badwe

Tata Memorial Centre, Mumbai
Background

• Yoga appears to enhance emotional well-being and mood and may serve to buffer deterioration in both overall and specific domains of QOL

• May provide beneficial changes in circulating levels of nonspecific markers of chronic low-grade inflammation.

• Fatigue is one of the most prevalent QOL concerns, affecting 30% to 70% of breast cancer survivors and Yoga may impact the same

• In breast cancer survivors with sleep disturbance, Yoga significantly improved QOL and this improvement in QOL may be mediated by concurrent improvements in sleep disturbance and fatigue
Review of yoga therapy during cancer treatment

- Findings most consistently support improvement in psychological outcomes (e.g., depression, distress, anxiety).
- Several studies also found that yoga enhanced quality of life, though further investigation is needed to clarify domain-specific efficacy (e.g., physical, social, cancer-specific).
- Evidence increasingly suggests that yoga ameliorates sleep and fatigue.
- Suggested for strengthening yoga research methodology to inform clinical guidelines.
- Cochrane review: Included 24 studies with a total of 2166 participants,
  - Provided moderate-quality evidence showing that yoga improved health-related quality of life
  - Reduced fatigue and reduced sleep disturbances in the short term
  - Yoga did not appear to reduce depression or anxiety

Supportive care in cancer 2017
Yoga Vs Conventional Exercises in BC: A randomized controlled trial (CTRI no: REF/2014/03/006566)

Target enrollment: 850 (1:1)

Primary endpoint: DFS

Stratification:
- Menopausal status
- Clinical Stage
- Treatment

Evaluations:
- EORTC QLQ-C30 & BR-23
- Brief Fatigue Inventory
- VAS (Pain score)
- Spirituality Questionnaire
- PFT

Inv.: Nair, Badwe et al.

Stage I-III
On Rx for BC

Conventional exercises

Conventional exercises + Yoga

Phase I: 1-14 days
Phase II: 15- completion of adjuvant
Phase III: If compliant to phase 2, next 5 years
Objectives

Primary:
- Disease free survival

Secondary:
- Quality of life
- Overall Survival
- Circulating levels of markers of inflammation

This is the first randomized controlled trial of this magnitude (850 women), which in addition to testing the impact of yoga on QOL is also powered to evaluate the impact of yoga on survival.

This is a longitudinal study measuring various phases of yoga during treatment and survivorship, with a comparative analysis of different time points and the response to yoga, which will help integrating yoga as a complementary modality.

Also this study will help identify the long term and short term effects of this therapy in breast cancer patients and survivors.
Results

At present 746 women have been accrued on the study and 605 have a minimum one year follow up

Assessment of compliance to performing the exercise is 76.7% in phase 2 and 82.41% in phase 3

<table>
<thead>
<tr>
<th></th>
<th>CE</th>
<th>Yoga + CE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (Median)</strong></td>
<td>48</td>
<td>47</td>
</tr>
<tr>
<td><strong>Stage (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBC</td>
<td>80.5</td>
<td>84.2</td>
</tr>
<tr>
<td>LABC</td>
<td>19.5</td>
<td>15.8</td>
</tr>
<tr>
<td><strong>BCT (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRM</td>
<td>66.1</td>
<td>65.9</td>
</tr>
<tr>
<td><strong>BMI (Median) kg/m2</strong></td>
<td>25.77</td>
<td>24.65</td>
</tr>
</tbody>
</table>
• At 6-9 months (V3) there was no significant difference in global QOL scores (p = 0.08).

52% women on YCE showed an improvement

• No difference in median scores but (V5): Less number of women reported systemic side effects in YCE (56% vs 44%, p = NS)

• At 18-21 months (V5): median scores of emotional function were better in YCE compared to CE (78.68 vs 82.57, p = 0.002)
At 6-9 months (V3): Median score of fatigue after adjuvant therapy was lower in YCE vs CE (median score 17.37 vs 22.77, p = 0.003)

At 12-15 months (V3): Median scores of fatigue were lower in YCE compared to CE, (2.17 vs 1.72, p = 0.04)
Summary

In women undergoing treatment for breast cancer Yoga appears to

• Lower Fatigue
• Improve Emotional function
• Lower Systemic therapy side effects
• Prevent Mood detriment
• Improve General activity
Conclusions

• Yoga showed numerically better scores in all aspects of QOL, which reached statistical significance in domains related to fatigue, emotional score and pain score.

• Customisation of yoga exercises is desired for better patient involvement and compliance to practise.

• Yoga is a low-risk, low-cost, complementary therapy that may improve compliance to therapy by improving parameters that can affect day-to-day activity in women with breast cancer.
Yoga and Cancer Control: Research, Evidence and practice

DR RAGHAVENDRA RAO M, PhD
GM, Clinical Excellence & Head CAM Program
Healthcare Global Enterprises ltd, INDIA
drraghavendra@hcgoncology.com
Pan-India Presence Across 13 Cities and Towns in 8 States...

- Centre of Excellence (CoE) (1)
- Comprehensive Cancer Centre (14)\(^1\)
- Freestanding Diagnostic Centre (3)
- Day Care Chemotherapy Centre (1)
- Cancer Centres Under Development (12)

**Infrastructure Expansion Across The Network\(^2\)**

- 14 to 26 Comprehensive Cancer Centres\(^3\)
- 902 to 1,817 Operational Beds\(^4\)
- 17 to 31 LINACS\(^5\)
- 31 to 63 Operation Theatres
- 7 to 16 PET CT Scanners\(^6\)

Note: As of 31-Dec-2015

\(^1\) Including Bengaluru CoE; \(^2\) Includes expansion of Ahmedabad and Cuttack Centres; \(^3\) Expect to commence operations by Fiscal Years 2016, 2017 and 2018

\(^4\) Number of available operational beds includes ICU beds and day-care beds (as applicable) but excludes self-care beds; \(^5\) Includes a WBRRS system

\(^6\) PET-CT procedures are performed at the SMH DCA Imaging Centre, which is part of our comprehensive cancer centre in Delhi

---

HCG’s Cancer Care Network in India
EVIDENCE FOR YOGA & CANCER

~50% focus on QoL & Symptom Management
Prevalence of Symptom Burden and Distress in Cancer Patients

![Bar chart showing the prevalence of symptoms in cancer patients. The chart includes bars for Fatigue, Anaemia, Nausea and Emesis, Constipation, Diarrhoea, and Cognitive impairment. The bars indicate the percentage of patients experiencing each symptom.]
Yoga as a “Therapy”
Psycho-Oncology - Mechanisms

**Intervention Programs**
- Psychotherapy
- Support groups
- Yoga/Exercise
- Emotional expression
- Music Therapy

**Psychosocial Factors:**
- Coping
- Social support
- Optimism
- Finding meaning
- Positive growth
- Spirituality, etc.

- Symptom control & distress
- Psychological distress
- Mood states: anxiety & depression
- Perceived stress
- Cortisol rhythms
- Antitumor immune responses:
  - Natural killer cell counts
- Anti-inflammatory effects:
  - Cytokines, NF-κB
- Protection from DNA damage
- and geno-toxicity
What kind of Yoga?

FLEXIBILITY OF BODY

Or

FLEXIBILITY OF MIND
Defining Yoga

Manah Prasamanah Upayah ||
- Yoga Vasishta

Yogah Chitta Vritti Nirodhah ||
- Patanjali Yoga Sutra

Samatvam Yoga Uchyate ||
Yoga Karmasukousalam ||
- Bhagavat Gita

Integrate (yuj)

Prasamana

Various Practices
To Control the mind
Yoga Concepts

- Concept of Personality
  - Anna
  - Prana
  - Manas
  - Vijnana
  - Ananda

- Concept of Disease
  - Patanjali
    - Klesha (5)
  - Krishna-Gita
    - Dhyayato Vishayan
    - Dukha
    - Pranashyati
  - Vasistha
    - Adhi
    - Vyadhi
## Yoga in Oncology

<table>
<thead>
<tr>
<th>Category</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>Wound Healing, Immunity, Inflammatory cytokines, Anxiety</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>Mood, Nausea and Emesis, Fatigue, Stress</td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>Speech Articulation, Fatigue, Myofascial Pain</td>
</tr>
<tr>
<td>Supportive Care</td>
<td>Pain management, Immunity, QoL, Constipation, Fatigue</td>
</tr>
</tbody>
</table>

21 International Peer Reviewed Publications
RESEARCH EVIDENCE

Beneficial effects of Yoga

Psychologic outcomes & Distress
Symptom Management
Neuroendocrine Modulation
Immune modulation
Effect of Long-term Yoga Practice on Psychological outcomes in Breast Cancer Survivors

Ram R Amritanshu, Rao M Raghavendra, Raghuram Nagavara*, Vidyarthi Harini Velmur, MR Usha Rani, Kodagandur S Srinath*, BS Ajikumar

Department of CAM, Healthcare Global Enterprises Ltd, "Department of life sciences, S.N.M.A. Yoga University, "Department of Surgical Oncology, HCG Bangalore Institute of Oncology Specialty Center, Bangalore, Karnataka, India

Abstract

Aim: Breast cancer has become a pandemic with an ever-increasing incidence. Although better diagnostics and treatment modalities have reduced mortality, a large number of survivors face cancer and treatment-related long-term symptoms. Many survivors are taking up yoga for improving the quality of life (QoL). The present study attempts to evaluate predictors of psychological states in breast cancer survivors with long-term yoga experience. Materials and Methods: A case-control study recruited early breast cancer survivors, 30–55 years, completing treatment > 6 months before recruitment, and grouped them based on prior yoga experience (BCY, n = 27) or naïve (BCN, n = 25). Demography, cancer history, diet, exercise habits, and yoga schedule were collected and tools to assess stress, anxiety, depression, general health, and QoL were administered. Multivariate linear regression was done to identify predictors of psychological variables. Results: BCY had significantly lower stress, anxiety, depression, better general health, and QoL (P < 0.001). Global QoL and trait anxiety were significantly predicted by yoga practice; depression was predicted by yoga practice, annual income, and sleep quality; state anxiety was predicted by Yoga practice and income, and stress was predicted by Yoga practice and sleep quality. Conclusion: Results indicate that breast cancer survivors doing yoga, have better psychological profiles and are able to deal with demanding situations better. The psycho-oncogenic model of cancer etiology suggests that a better psychological state in survival has the potential to improve prognosis and survival outcomes and Yoga may be a suitable practice for staying cancer-free for a longer time.

Keywords: Anxiety and depression, breast cancer survivors, perceived stress, quality of life, Yoga
### Decrease in Psychological Distress - Meta-analysis

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Yoga</th>
<th>Control</th>
<th>Std. Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Total</td>
</tr>
<tr>
<td>Danhauer 2009</td>
<td>14</td>
<td>3.9</td>
<td>13</td>
</tr>
<tr>
<td>Kovacic 2010</td>
<td>7.06</td>
<td>2.35</td>
<td>16</td>
</tr>
<tr>
<td>Moadel 2010</td>
<td>17.16</td>
<td>16.57</td>
<td>84</td>
</tr>
<tr>
<td>Raghavendra 2007</td>
<td>16.6</td>
<td>10.1</td>
<td>28</td>
</tr>
<tr>
<td>Vadiraja 2009</td>
<td>12.91</td>
<td>10.39</td>
<td>42</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>183</td>
<td></td>
<td>141</td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.47$; $\chi^2 = 26.84$, df = 4 ($P < 0.0001$); $I^2 = 85$

Test for overall effect: $Z = 3.23$ ($P = 0.001$)
Effects of a Yoga Program on Mood States, Quality of Life, and Toxicity in Breast Cancer Patients Receiving Conventional Treatment: A Randomized Controlled Trial

Raghavendra Mohan Rao, Nagaratna Raghuram¹, Hongasandra Ramarao Nagendra², Gopinath S Kodaganur³, Ramesh S Bilimagga⁴, HP Shashidhara⁵, Ravi B Divakar⁶, Shekhar Patil⁷, Nalini Rao⁸

Department of Complementary and Alternative Medicine, Healthcare Global Enterprises Ltd., ¹Department of Life Sciences and ²Department of Research and Development, Swami Vivekananda Yoga Anusandhana Samsthana, ³Department of Surgical Oncology, ⁴Department of Radiation Oncology, ⁵Department of Medical Oncology, HCG Bangalore institute of Oncology Specialty Center, Bengaluru, Karnataka, India.

Abstract

Aims: The aim of this study is to compare the effects of yoga program with supportive therapy counseling on mood states, treatment-related symptoms, toxicity, and quality of life in Stage II and III breast cancer patients on conventional treatment. Methods: Ninety-eight Stage II and III breast cancer patients underwent surgery followed by adjuvant radiotherapy (RT) or chemotherapy (CT) or both at a cancer center were randomly assigned to receive yoga (n = 43) and supportive therapy counseling (n = 55) over a 24-week period. Intervention consisted of 60-min yoga sessions, daily while the control group was imparted supportive therapy during their hospital visits. Assessments included state-trait anxiety inventory, Beck's depression inventory, symptom checklist, common toxicity criteria, and functional living index-cancer. Assessments were done at baseline, after surgery, before, during, and after RT and six cycles of CT. Results: Both groups had similar baseline scores. There were 29 dropouts 12 (yoga) and 17 (controls) following surgery. Sixty-nine participants contributed data to the current analysis (33 in yoga, and 36 in controls). An ANCOVA, adjusting for baseline differences, showed a significant decrease for the yoga intervention as compared to the control group during RT (first result) and CT (second result), in (i) anxiety state by 4.72 and 7.7 points, (ii) depression by 5.74 and 7.25 points, (iii) treatment-related symptoms by 2.34 and 2.97 points, (iv) severity of symptoms by 6.43 and 8.83 points, (v) distress by 7.19 and 13.11 points, and (vi) improved overall quality of life by 23.9 and 31.2 points as compared to controls. Toxicity was significantly less in the yoga group (P = 0.01) during CT. Conclusion: The results suggest a possible use for yoga as a psychotherapeutic intervention in breast cancer patients undergoing conventional treatment.

Keywords: Cancer, depression, meditation, quality of life, yoga


## Anxiety

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Yoga Mean</th>
<th>SD</th>
<th>Total</th>
<th>Control Mean</th>
<th>SD</th>
<th>Total</th>
<th>Weight</th>
<th>Std. Mean Difference IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banerjee 2007</td>
<td>4.1</td>
<td>1</td>
<td>35</td>
<td>10.5</td>
<td>1.8</td>
<td>23</td>
<td>17.5%</td>
<td>-4.60 [-5.62, -3.59]</td>
</tr>
<tr>
<td>Chandwani 2010</td>
<td>28</td>
<td>2.2</td>
<td>27</td>
<td>30.2</td>
<td>2.4</td>
<td>31</td>
<td>20.4%</td>
<td>-0.94 [-1.49, -0.39]</td>
</tr>
<tr>
<td>Moadel 2010</td>
<td>8.1</td>
<td>7.64</td>
<td>84</td>
<td>10.26</td>
<td>8.08</td>
<td>44</td>
<td>21.1%</td>
<td>-0.28 [-0.64, 0.09]</td>
</tr>
<tr>
<td>Raghavendra 2007</td>
<td>29.2</td>
<td>3.8</td>
<td>28</td>
<td>37.5</td>
<td>7.6</td>
<td>34</td>
<td>20.3%</td>
<td>-1.32 [-1.88, -0.77]</td>
</tr>
<tr>
<td>Vadiraja 2009</td>
<td>4.88</td>
<td>3.34</td>
<td>42</td>
<td>8.12</td>
<td>3.8</td>
<td>33</td>
<td>20.7%</td>
<td>-0.90 [-1.38, -0.42]</td>
</tr>
</tbody>
</table>

**Total (95% CI)**

- **Yoga Mean:** 216
- **Control Mean:** 165
- **Total (100.0%)**
  - **Mean Difference:** -1.51 [-2.47, -0.55]

*Heterogeneity: Tau^2 = 1.10; Chi^2 = 64.57, df = 4 (P < 0.00001); I^2 = 94%*

*Test for overall effect: Z = 3.09 (P = 0.002)*

## Depression

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Yoga Mean</th>
<th>SD</th>
<th>Total</th>
<th>Control Mean</th>
<th>SD</th>
<th>Total</th>
<th>Weight</th>
<th>Std. Mean Difference IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banerjee 2007</td>
<td>3.4</td>
<td>0.5</td>
<td>35</td>
<td>9.7</td>
<td>1.2</td>
<td>23</td>
<td>16.9%</td>
<td>-7.34 [-8.82, -5.86]</td>
</tr>
<tr>
<td>Chandwani 2010</td>
<td>6.6</td>
<td>2.1</td>
<td>27</td>
<td>7</td>
<td>2.2</td>
<td>31</td>
<td>21.0%</td>
<td>-0.18 [-0.70, 0.33]</td>
</tr>
<tr>
<td>Danhauer 2009</td>
<td>8.1</td>
<td>8.9</td>
<td>13</td>
<td>17.8</td>
<td>16.9</td>
<td>14</td>
<td>20.1%</td>
<td>-0.69 [-1.47, 0.09]</td>
</tr>
<tr>
<td>Raghavendra 2007</td>
<td>6.6</td>
<td>4.6</td>
<td>28</td>
<td>14.2</td>
<td>6.6</td>
<td>34</td>
<td>20.9%</td>
<td>-1.30 [-1.85, -0.74]</td>
</tr>
<tr>
<td>Vadiraja 2009</td>
<td>4.14</td>
<td>3.45</td>
<td>42</td>
<td>6.53</td>
<td>3.78</td>
<td>33</td>
<td>21.1%</td>
<td>-0.66 [-1.13, -0.19]</td>
</tr>
</tbody>
</table>

**Total (95% CI)**

- **Yoga Mean:** 145
- **Control Mean:** 135
- **Total (100.0%)**
  - **Mean Difference:** -1.83 [-3.13, -0.53]

*Heterogeneity: Tau^2 = 2.04; Chi^2 = 83.37, df = 4 (P < 0.00001); I^2 = 95%*

*Test for overall effect: Z = 2.75 (P = 0.006)*
What type of YOGA

ANXIETY
Slow breathing practices
Emphasis on “exhalation”
“Internal awareness”
Relaxation techniques – QRT, CM etc

DEPRESSION
HYPERVENTILLATION BREATHING - Bhashrika, kapalabhati, Ujjayi can be used
Caution in patients with lung mets
Relaxation techniques- Cyclic Meditation
Breathing exercises
Asanas if bone mets not present
Yoga for CINV

OBJECTIVES

- To evaluate effects of Yoga on progressive muscle relaxations on
  - Chemotherapy induced nausea and emesis
  - Quality of life and Anxiety states

- To understand underlying neural mechanisms
  - Gastric motility changes (Electrogastrogram)
  - Sympathovagal changes (HRV)
Yoga for CINV

Group A – Yoga

Group A – Jacobson’s Relaxation

Group A – Waitlist Control

Cardiac, Gastric, Autonomic

Psychological
Yoga Group
• ↓ Nausea and Emesis Frequency and Severity
• ↓ anxiety and depression
• ↓ sympathetic Arousal (LF/HF Ratio)
• Normalization of Gastric motility on EGG by 3rd Cycle

Relaxation Group
• ↓ Nausea and Emesis Frequency and Severity
• ↓ anxiety and depression
• ↓ sympathetic Arousal (LF/HF Ratio)
• Gastric motility on EGG stayed normal

Control Group
• No ↓ Nausea and Emesis Frequency and Severity
• ↑ sympathetic Arousal (LF/HF Ratio)
• Gastric motility on EGG stayed abnormal
Role of Yoga in Fatigue

Mental and physical fatigue can be lessened by asana practice, which rests the brain and rejuvenates the body and the mind.

- Back Bends enables deeper breathing
- Twists keeps spine supple and removes laziness
- Better Energy Conservation than exercise

<table>
<thead>
<tr>
<th>Type of Study</th>
<th>Number of articles in Pubmed in 5 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meta analysis</td>
<td>4</td>
</tr>
<tr>
<td>Systematic review</td>
<td>3</td>
</tr>
<tr>
<td>RCTs</td>
<td>19</td>
</tr>
<tr>
<td>CCTs</td>
<td>4</td>
</tr>
<tr>
<td>Cohort / Observational</td>
<td>3</td>
</tr>
<tr>
<td>Review</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>41</strong></td>
</tr>
</tbody>
</table>
Study 2: Stage II/III Breast cancer patients undergoing Radiotherapy a RCT

Group A (n=44) – Yoga (60 minutes daily)
Group B (n=44) – Control

6 weeks
Pre Radiotherapy Post
6 weeks
Pre Radiotherapy Post
Fatigue Scale Inventory Scale

- p<0.05 for Wilcoxon signed rank test
- * p<0.05 for Mann Whitney U test
- †
Yoga- Psycho-Neuro Immunology Mechanisms
The HPA mechanism

Demanding Situation

Intrusive Repetition

Perception

Speed

Tumor Microenvironment

Tumor Progression

Response

Negative Emotions
- Anxiety / Fear
- Depression
- Lethargy

Positive emotions
- Excitement
- Hypomania

Suppression (programmed)

Expression (instinctual)

Antoni M K, et al., 2006
ANOREXIA & FATIGUE

ANOREXIA & FATIGUE

Outpatient walk-ins (182)
Breast Cancer (110)
Completed treatment (65)
Inclusion Criteria (52)
Previous Yoga Experience (27) BCY group
No Yoga Experience (25) BCN Group
Drop Outs
Other Illnesses (72)
Presently Undergoing treatment (45)
Exclusion Criteria (13)

Battery of 12 cytokines TH1/TH2/ Inflammation & NFkB

Outpatient walk-ins (182)
Breast Cancer (110)
Completed treatment (65)
Inclusion Criteria (52)
Previous Yoga Experience (27) BCY group
No Yoga Experience (25) BCN Group
Drop Outs
Other Illnesses (72)
Presently Undergoing treatment (45)
Exclusion Criteria (13)

Battery of 12 cytokines TH1/TH2/ Inflammation & NFkB

Nature Reviews | Disease Primers
Health Spectrum – a DNA Paradigm

Breast cancer

Stage 2 and 3

Just prior to radiation

Normal

Disease free (Acute / Chronic)

No prior exposure to yoga

Yoga

Disease free (Acute / Chronic)

Regular practice of yoga for 10yrs
Immune Outcomes

Lower levels of Inflammatory cytokines

Other trends in immune markers

<table>
<thead>
<tr>
<th>Variable</th>
<th>BCY</th>
<th>BCN</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL1-β</td>
<td>0.54 ± 1.43</td>
<td>1.18 ± 1.92</td>
<td>0.079*</td>
</tr>
<tr>
<td>IL6</td>
<td>2.85±1.56</td>
<td>4.68 ± 4.03</td>
<td>0.070*</td>
</tr>
<tr>
<td>IL8</td>
<td>35.16 ± 43.62</td>
<td>100.89 ± 131.94</td>
<td>0.057*</td>
</tr>
</tbody>
</table>

‡: p-value of Independent Samples t-Test; *: p-value of Mann-Whitney U
Between group comparisons of apoptotic index and % comets by one way ANOVA (n=9 in each group)

<table>
<thead>
<tr>
<th>Group</th>
<th>% Apoptosis</th>
<th>% comet</th>
<th>Post-hoc* Sig.</th>
<th>Post-hoc* Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ANOVA, p=0.016</td>
<td>ANOVA, P=0.045</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast Cancer</td>
<td>10.05 ± 3.24</td>
<td>3.13 ± 1.74</td>
<td>BC:SY 0.687</td>
<td>BC:SY <strong>0.047</strong></td>
</tr>
<tr>
<td>Yoga Practitioners</td>
<td>8.79 ± 3.08</td>
<td>1.53 ± 1.00</td>
<td>SY:NV <strong>0.019</strong></td>
<td>SY:NV 0.313</td>
</tr>
<tr>
<td>Normal Volunteers</td>
<td>13.17 ± 2.77</td>
<td>2.47 ± 0.93</td>
<td>NV:BC 0.113</td>
<td>NV:BC 0.564</td>
</tr>
</tbody>
</table>

* Post hoc analysis by Scheffe test.
Discussion

Disease – high DNA damage & low Apoptosis
Body is vulnerable to DNA damage but is incapable of restorative activity

Normal – Moderate DNA damage & High Apoptosis
Heightened restorative activity in response to Normal DNA damage

Yoga - Low DNA Damage & Low Apoptosis
Body is maintained with lower damage and requiring lower repair activity
DNA Damage in Immune effector cells following adjuvant Radiotherapy

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yoga</td>
<td>2.6</td>
<td>24.3</td>
</tr>
<tr>
<td>Control</td>
<td>2.8</td>
<td>28.8</td>
</tr>
</tbody>
</table>

* p<0.01 between groups

2007 6(3):242-50
Assessing DNA Damage – Comet Assay

a) Metaphase with dicentric chromosomes

b) Binucleated cells with MN

c) Metaphase with SCEs

d) Lymphocyte tail comet

Untreated Cells

H₂O₂ treated

Image Analyzer
Effect of Yoga on Sleep Quality and Neuroendocrine Immune Response in Metastatic Breast Cancer Patients

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Abstract

Background: Studies have shown that distress and accompanying neuroendocrine stress responses as important predictor of survival in advanced breast cancer patients. Some psychotherapeutic intervention studies have shown have modulation of neuroendocrine-immune responses in advanced breast cancer patients. In this study, we evaluate the effects of yoga on perceived stress, sleep, diurnal cortisol, and natural killer (NK) cell counts in patients with metastatic cancer. Methods: In this study, 91 patients with metastatic breast cancer who satisfied selection criteria and consented to participate were recruited and randomized to receive “integrated yoga based stress reduction program” (n = 45) or standard “education and supportive therapy sessions” (n = 46) over a 3 month period. Psychometric assessments for sleep quality were done before and after intervention. Blood draws for NK cell counts were collected before and after the intervention. Data were analyzed using the analysis of covariance on postmeasures using respective baseline measure as a covariate. Results: There was a significant decrease in scales of symptom distress (P < 0.001), sleep parameters (P = 0.02), and improvement in quality of sleep (P = 0.001) and Insomnia Rating Scale sleep score (P = 0.001) following intervention. There was a decrease in morning waking cortisol in yoga group (P = 0.003) alone following intervention. There was a significant improvement in NK cell percent (P = 0.03) following intervention in yoga group compared to control group. Conclusion: The results suggest modulation of neuroendocrine responses and improvement in sleep in patients with advanced breast cancer following yoga intervention.

Keywords: Cortisol, immune, natural killer cell, sleep, yoga
PRINCIPLE OF MANAGEMENT

STRESS REDUCTION
RELAXATION RESPONSE
LOWER LEVELS OF STRESS HORMONES ACTH, CORTISOL
Post Operative Outcomes

- Drain retention
- Duration of hospital stay
- Interval for suture removal
- Post operative complications
- Post operative duration
- Improved Wound Healing

Wound healing: Duration for Suture Removal

- **Yoga**: 10.34 days
- **Control**: 12.74 days

* p<0.05
Immune Outcomes

TNF Alfa levels in yoga and control groups following conventional treatment intervals

- Yoga
- Control

* p<0.05

Immune Outcomes

CD 56% counts during conventional treatments

* p<0.05

Conventional treatment interval

- Yoga
- Control
YOGA BENEFITS

Improvement in Psychological outcomes
Reduction in Symptom Clusters
Improved Immune Response
Improved Qol.
ACKNOWLEDGEMENTS

• Supported with grants from
• CCRYN, Ministry of AYUSH, Govt of India
• DST, Govt of India.
• Oncologists and supporting staff at Bangalore Institute of Oncology and Svyasa
• Cancer Patients