Stress Reactions: Its Management

by

Preksha Meditation & Yoga

Chapter-2

Review of Literature
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Various scientific studies have been conducted by prominent yoga Institutions in India and abroad and also by scholars from the discipline of applied human physiology, yoga and health. Most of these studies are from the specialized components of composite yoga viz Asana, Pranayama, Mantra’s chanting and certain other sukshama vyayama. Summary of few of those significant and relevant studies with reference to our proposed work are reproduced here:

1. Blood Pressure, Pulse Rate & Stress

Pramanik (2009) studied immediate effect of slow pace bhasrika pranayama (respiratory rate 6/min) for 5 minutes on heart rate and blood pressure and the effect of the same breathing exercise for the same duration of time (5 minutes) following oral intake of hyoscine-N-butylbromide (Buscopan), a parasympathetic blocker drug. Heart rate and blood pressure of volunteers (n = 39, age = 25-40 years) was recorded following standard procedure. First, subjects had to sit comfortably in an easy and steady posture (sukhasana) on a fairly soft seat placed on the floor keeping head, neck, and trunk erect, eyes closed, and the other muscles reasonably loose. The subject is directed to inhale through both nostrils slowly up to the maximum for about 4 seconds and then exhale slowly up to the maximum through both nostrils for about 6 seconds. The breathing must not be abdominal. After 5 minutes of this breathing practice, the blood pressure and heart rate again were recorded in the aforesaid manner using the same instrument. The other group (n = 10) took part in another study where their blood pressure and heart rate were recorded following half an hour of oral intake of hyoscine-N-butylbromide 20 mg. Then they practiced the breathing exercise as stated above, and the abovementioned parameters were recorded again to study the effect of parasympathetic blockade on the same pranayama. It was noted that after slow bhasrika pranayamic breathing (respiratory
rate 6/min) for 5 minutes, both the systolic and diastolic blood pressure decreased significantly with a slight fall in heart rate. No significant alteration in both blood pressure and heart rate was observed in volunteers who performed the same breathing exercise for the same duration following oral intake of hyoscine-N-butylbromide. The study states that pranayama increases frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors during above tidal volume inhalation as in Hering Bruer reflex, which bring about withdrawal of sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing decrease in peripheral resistance and thus decreasing the diastolic blood pressure. After hyoscine-N-butylbromide, the parasympathetic blocker, it was observed that blood pressure was not decreased significantly as a result of pranayama, as it was observed when no drug was administered. It was concluded from the results that vagal cardiac and pulmonary mechanisms are linked, and improvement in one vagal limb might spill over into the other. Baroreceptor sensitivity can be enhanced significantly by slow breathing (supported by a small reduction in the heart rate observed during slow breathing and by reduction in both systolic and diastolic pressure). Slow pace bhastrika pranayama (respiratory rate 6/min) exercise thus shows a strong tendency to improving the autonomic nervous system through enhanced activation of the parasympathetic system

Cardiovascular disease (CVD) is the leading cause of death and disability in industrialized nations (Watkins, 2004), as well as in developing countries (Posner, 1994). Leading to premature morbidity and mortality, and to preventable losses of employment, earnings, and quality of life, CVD is clearly of pressing clinical and economic significance, underscoring the need for effective primary prevention efforts that target common, modifiable risk factors. Prominent among these are the physiologic and anthropometric risk factors associated with the insulin resistance syndrome (IRS), and the neuroendocrine and psychosocial alterations that may both predispose to and result from these IRS-related abnormalities.
Increased sympathetic activity, enhanced cardiovascular reactivity, and reduced parasympathetic tone have also been strongly implicated in the pathogenesis of IRS (Issoma, 2003) and in the development and progression of atherosclerosis and cardiovascular disease (Gadegbeku, 2002). In addition, recent research offers compelling evidence that chronic psychological stress and negative affective states contribute significantly to the pathogenesis and progression of insulin resistance (Bjorntorp, 1997), glucose intolerance (Vitaliano, 2002), hypertension (Levenstein, 2001), dyslipidemia (Vitaliano, 2002; Levenstein, 2001), and other IRS-related conditions (Von Kanel, 2001; Bjorntorp, 1997) and ultimately, increase risk for CVD morbidity and mortality (Rozanski, 1999; Everson, 1997).

Not only can IRS-related conditions be exacerbated by lifestyle variables, such as smoking, lack of exercise, and poor diet, but also these conditions can interact with one another in a destructive manner (Davidson, 1991), likely accounting for their synergistic effect on CVD risk (Carr, 2003). Thus, a vicious cycle is initiated, which, as time goes on, becomes increasingly difficult to treat, highlighting the importance of early intervention.

In light of the strong influence of psychosocial factors on the development of both IRS and CVD, the role of sympathetic activation in the pathogenesis of insulin-resistant states, and the mutually exacerbating effects of these and other IRS-related risk factors, mind-body therapies may have considerable potential in the prevention and treatment of CVD. Of particular interest in this regard is yoga, an ancient mind-body discipline that has been widely used in India for the management of hypertension, diabetes, and related chronic insulin resistance conditions (Damodaran, 2002) and may hold promise as a therapeutic intervention and health promotion measure.

Upadhyay (2008) The responses of Alternate Nostril Breathing (ANB) the Nadisudhi pranayama on some cardio-respiratory functions were investigated in healthy young adults. The subjects performed ANB exercise (15 minutes everyday in the morning) for four weeks. Cardio-respiratory parameters were recorded before
and after 4-weeks training period. A significant increment in Peak expiratory flow rate (PEFR L/min) and Pulse pressure (PP) was noted. Although Systolic blood pressure (SBP) was decreased insignificantly, the significant decrease in pulse rate (PR), respiratory rate (RR), diastolic blood pressure (DBP) was shown from their studies. Results indicate that regular practice of ANB (nadisudhi) increases parasympathetic activity.

Granath et al (2006) compared the psychological and physiological benefits of a Kundalini yoga program and a stress management program based on cognitive behavior therapy principles. Participants in the both groups shared significant improvement in both psychological (self rated stress and stress behavior as anger, exhaustion, quality of life) and physiological (blood pressure, heart rate, urinary catecholamine’s, salivary cortisol) outcomes. There was no significant difference between the two groups. The authors concluded that both “Cognitive behavior therapy and yoga are promising stress management techniques”.

Harinath et al (2004) have studied the Effects of Hatha yoga and Omkar meditation on cardiorespiratory performance, psychological profile, and melanin secretion. They find that Yogic practices for 3 months resulted in an improvement in cardiorespiratory performance and psychological profile. The systolic blood pressure, diastolic blood pressure, mean arterial pressure, and orthostatic tolerance did not show any significant correlation with plasma melanin. However, the maximum night time melanin levels in yoga group showed a significant correlation ($r = 0.71, p < 0.05$) with well-being score. They conclude that yogic practices can be used as psychophysiology stimuli to increase endogenous secretion of melanin, which, in turn, might be responsible for improved sense of well-being.

Telles et al (2004) in another study determined whether yoga reduced heart rate and whether the reduction would be more after 30 days of yoga training. Two groups (yoga and control, n = 12 each) were assessed on Day 1 and on Day 30. During the intervening 30 days, the yoga group received training in yoga techniques while the
control group carried on with their routine. At each assessment the baseline heart rate was recorded for one minute. This was followed by a six-minute period during which participants were asked to attempt to voluntarily reduce their heart rate, using any strategy. Both the baseline heart rate and the lowest heart rate achieved voluntarily during the six-minute period were significantly lower in the yoga group on Day 30 compared to Day 1 by a group average of 10.7 beats per minute (i.e., bpm) and 6.8 bpm, respectively. In contrast, there was no significant change in either the baseline heart rate or the lowest heart rate achieved voluntarily in the control group on Day 30 compared to Day 1.

Sinha et al (2004) measured energy cost and cardio respiratory changes during the practice of Surya Namaskar (SN). The pulmonary ventilation, carbon-dioxide output, oxygen consumption, HR and other cardio respiratory parameters were measured during the actual practice of SN. Oxygen consumption was highest in the eighth posture (1.22+/−0.073 l min. (-1) and lowest in the first posture (0.35+/−0.02 l min. (-1). Total energy cost throughout the practice of SN was 13.91 kcal and at an average of 3.79 kcal/min. During its practice highest HR was 101+/−13.5 b.p.m. As an aerobic exercise SN seemed to be ideal as it involves both static stretching and slow dynamic component of exercise with optimal stress on the cardiorespiratory system.

Madanmohan et al (2004) studied modulation of cardiovascular responses to exercise by yoga training. Exercise produced a significant increase in HR, systolic pressure, RRP (Rate-pressure Product) and Do P (Double Product) and a significant decrease in diastolic pressure. After two months of yoga training, exercise induced changes in these parameters were significantly reduced. It is concluded that after yoga training a given level of exercise leads to a milder cardiovascular response, suggesting better exercise tolerance.

Barnes et al (2004) conducted a research study to assess the impact of meditation on resting and ambulatory blood pressure and heart of youths. They observed significant
decrease in resting blood pressure, day time ambulatory blood pressure after school, and day time ambulatory heart rate after school. These finding demonstrated the potential beneficial impact of meditation on blood pressure and heart rate in the natural environment in healthy normotensive youth.

Madanmohan et al (2004) studied effect of six weeks of shavasan training on spectral measures of short-term heart rate variability in young healthy volunteers. This shows that shavasana training for 15 minutes a day, 4 days a week, for six weeks does not significantly affect heart rate variability in young healthy subjects.

Harinath et al (2004) in their study included thirty healthy men and they were randomly divided in two groups. Group 1 subjects served as controls and performed body flexibility exercises for 40 minutes and slow running for 20 minutes during morning hours and played games for 60 minutes during evening hours daily for 3 months. Group 2 subjects practiced selected yogic (postures) for 45 minutes. Yogic practices for 3 months resulted in an improvement in cardiorespiratory performance and psychological profile. The plasma melatonin also showed an increase after three months of yogic practices.

Mercuri et al (2003) carried out a scientific study with the aim to evaluate the clinical and metabolic changes in yoga practicing people with diabetes immediately and after practicing for 3 months. In that study it was concluded by the authors that the yoga practice brings about significant changes in blood pressure, heart rate and lipid profile of experimental group subject.

Udupa et al (2003) studied effect of pranayama training on cardiac function in normal young volunteers. For their study they selected few students. Pranayama group subjects were given training in nadishuddhi, mukh-bhastrika, pranav and savitri pranayamas and practiced the same for 20 minutes daily for duration of 3
months. Other group subjects were not given any pranayama training. Pranayama training produced an increase in RR interval variation (RRIV) and a decrease in QT1/QS2, suggesting an enhanced parasympathetic and blended sympathetic activity respectively. QS2, PEP and PEP/LVET increased significantly, whereas LEVT was reduced significantly in pranayama group. In contrast, the changes in STI and AFT were much less marked in the control group. To conclude, the study showed that three months of pranayama training modulates ventricular performance by increasing parasympathetic activity and decreasing sympathetic activity.

Cheng et al (2003) evaluated heart rate recovery following maximal exercise testing as a predictor of cardiovascular disease and all-cause mortality in men with diabetes. Heart rate recovery (HRR) is an independent prognostic indicator for cardiovascular disease (CVD) and all-cause mortality in healthy men. They examined the association of HRR to CVD-related and all-cause mortality in men with diabetes, and reported asymmetrical ratio in cardiovascular diseases and mortality rates.

Khadk et al (2003) recorded the effect of yoga on blood pressure response in stimulus and found the relevant and significant reduction in blood pressure of experimental group of subjects.

Barashankar et al (2003) conducted a study to examine the effect of yoga on cardiovascular function in subjects above 40 yrs of age. Pulse rate, systolic and diastolic blood pressure and valsalva ratio were studied in 50 control subjects (not doing any type of physical exercise) and 50 study subjects who had been practicing yoga for 5 years. From the study it was observed that significant reduction in the pulse rate occurs in subjects practicing yoga (P<0.001). The difference in the mean values of systolic and diastolic blood pressure between study group and control group was also statistically significant (P<0.01 and P<0.001 respectively). The systolic and diastolic blood pressure showed significant positive correlation with age in the study group (r1 systolic= 0.631 and r1 diastolic = 0.610) as well as in the control group (r2 systolic = 0.981 and r2 diastolic = 0.864). The significance of
difference between correlation coefficient of both the groups was also tested with the use of Z transformation and the difference was significant (Z systolic= 4.041 and Z diastolic= 2.901). Valsalva ratio was also found to be significantly higher in yoga practitioners than in controls (P<0.001). Results indicate that yoga reduces the age related deterioration in cardiovascular functions.

In the light of their extensive study Madanmohan et al (2002) stated that the shavasan is known to enhance one’s ability to combat stressful situations. They planned to determine if shavasan could modulate the physiological response to stress induced by cold pressor test (CPT) and the possible mechanisms involved. Ten normal adults were taught shavasan and practiced the same for a total duration of seven days. RR interval variation (RRIV), deep breathing difference (DBD), and heart rate, blood pressure and rate-pressure-product (RPP) response to CPT were measured before and immediately after shavasan. Shavasan produced a significant increase in DBD and an appreciable but statistically insignificant increase in RRIV suggesting an enhanced parasympathetic activity. Significant blunting of cold pressure induced increase in heart rate, blood pressure and RPP by shavasan was seen during and even five minutes after CPT suggesting that shavasan reduces the load on the heart by blunting the sympathetic response. It is concluded that shavasan can enhance one’s ability to withstand stress induced by CPT and this ability can be achieved even with seven days of shavasan training.

Roopakala et al (2002) have observed significant reduction in the systolic blood pressure following Pranayama.

Vyas et al (2002) in another scientific study demonstrated that respiratory and cardiovascular functions and lipid profile of those practicing Raj yoga Meditation (short and long term duration) were compared with those of non-meditators. Lipid profile showed a significant lowering of serum cholesterol in short term and long term meditators as compared to non-meditators. Lipid profile of short and long term meditators was better than the same of non-meditators in-spite of similar routine
physical activities. Vital capacity, tidal volume and breath holding were significantly higher in short and long term meditators than non-meditators. Diastolic blood pressure was significantly lower in both short and long term meditators. Heart rate was significantly lower in long term meditators than short term meditators. This proves that Raja yoga Meditation brings in significant improvement in lipid profile along with respiratory and cardiovascular parameters.

**Damodaran et al (2002)** observed twenty patients with mild to moderate essential hypertension underwent yogic practices daily for one hour for three months. Results showed decreased blood pressure, blood glucose, cholesterol and triglycerides and improved subjective well-being and quality of life.

**Jyotsana et al (2001)** studied the effect of yoga on cardiovascular system in subjects above 40 years. It was observed that significant reduction in the pulse rate occurs in subjects practicing yoga (p<0.001). The difference in the mean values of systolic and diastolic blood pressure between study group and control group was also statistically significant. The systolic and diastolic blood pressure showed significant positive correlation with age in the study group as well as in the control group. To conclude that cardiovascular parameters alters with age but these alterations are slower in persons aging with yoga.

**Arambula et al (2001)** in their study explored the physiological correlates of a highly experienced Kundalini yoga meditator. Thoracic and abdominal breathing patterns, heart rate (HR), occipital and parietal electroencephalograph (EEG), skin conductance level (SCL), and blood volume pulse (BVP) were monitored during prebaseline, meditation, and postbaseline periods. Visual analyses of the data showed a decrease in respiration rate during the meditation from a mean of 11 breaths/min. for the pre and 13 breaths/min. for the post baseline to a mean of 5 breaths/min. during the meditation, with a predominance of abdominal/diaphragmatic breathing. There was also more alpha EEG activity during the meditation (M = 1.71 microV) compared to the pre- (M = .47 µV) and

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postbaseline (M = .78 µV) periods, and an increase in theta EEG activity immediately following the meditation (M = .62 µV) compared to the pre baseline and meditative periods (each with M = .26 µV). These findings suggest that a shift in breathing patterns may contribute to the development of alpha EEG.

Raichur et al (2001) showed in their study that significant reduction in Resting Heart Rate (RHR) diastolic blood pressure, respiratory rate, minute volume anxiety scores and increase in tidal volume were recorded after regular practice of meditation.

Barnes et al (2001) examined the impact of the Transcendental Meditation (TM) program on cardiovascular (CV) reactivity in adolescents with high BP. Thirty-five adolescents [ages 15-18 years] with resting systolic blood pressure (SBP) between the 85th and 95th percentile for their age and gender on three consecutive occasions, were randomly assigned to either TM (n=17) or health education control (CTL, n=18) groups. The TM group engaged in 15-min meditation twice each day for 2 months including sessions during school lunch break. Primary CV outcome measures were changes in blood pressure (BP), heart rate (HR), and cardiac output (CO) at rest and in response to two laboratory stressors, a simulated car driving stressor and an interpersonal social stressor interview. The TM group exhibited greater decreases in resting SBP (P<.03) from pre- to post-intervention, compared to the CTL group. The TM group exhibited greater decreases from pre to post intervention in SBP, HR, and CO reactivity (P<.03) to the simulated car driving stressor, and in SBP reactivity (P<.03) to the social stressor interview. The TM program appears to have a beneficial impact upon CV functioning at rest and during acute laboratory stress in adolescents at-risk for hypertension.

Bernardi et al (2001) conducted a study to test whether rhythmic formulas such as the rosary and yoga mantras can synchronise and reinforce inherent cardiovascular rhythms and modify baroreflex sensitivity. Comparison of effects of recitation of the
Ave Maria (in Latin) or of a mantra, during spontaneous and metronome controlled breathing, on breathing rate and on spontaneous oscillations in respiratory rate interval, and on blood pressure and cerebral circulation. Breathing rate, regularity of breathing, baroreflex sensitivity, frequency of cardiovascular oscillations were the main variables of observation. Both prayer and mantra caused striking, powerful, and synchronous increases in existing cardiovascular rhythms when recited six times a minute. Baroreflex sensitivity also increased significantly, from 9.5 (SD 4.6) to 11.5 (4.9) ms/mm Hg, P<0.05. Rhythm formulas that involve breathing at 9 breaths per minute induce favourable psychological and possibly physiological effects.

Murugesan et al (2000) assessed thirty-three hypertensives, on systolic and diastolic blood pressure, pulse rate and body weight. The subjects were randomly assigned to three groups: a yoga group, a group who received medical treatment by the physician and a control group. Yoga was offered in the morning and in the evening for 1 hr/session for 11 weeks. Medical treatment comprised drug intake every day for the experimental period. The result of pre-post tests revealed that both the treatment stimuli (i.e. yoga and drug) were effective in controlling the measures of hypertension.

Lehrer et al (1999) in their study examined the effects of Tanden Breathing by Zen practitioners on cardiac variability. Tanden breathing involves slow breathing into the lower abdomen. Eleven Zen practitioners, six Rinzai and five Soto, were each studied during 20 minutes of tanden breathing, preceded and followed by 5 minute periods of quiet sitting. During this time, we measured heart rate and respiration rate. For most subjects, respiration rates fell to within the frequency range of 0.05 to 0.15 Hz during tanden breathing. Heart rate variability significantly increased within this low-frequency range but decreased in the high-frequency range (0.14–0.4 Hz), reflecting a shift of respiratory sinus arrhythmia from high-frequency to slower waves. Rinzai practitioners breathed at a slower rate and showed higher amplitude of low frequency heart rate waves than observed among Soto Zen...
participants. One rinzai master breathed approximately once per minute and showed an increase in very-low frequency waves (<0.05 Hz). Total amplitude of heart rate oscillations (across frequency spectra) also increased. More experienced Zen practitioners had frequent heart rhythm irregularities during and after the nadir of heart rate oscillations (i.e. during inhalation). These data are consistent with the theory that increased oscillation amplitude during slow breathing is caused by resonance between cardiac variability caused by respiration and that produced by physiological processes underlying slower rhythms. The rhythm irregularities during inhalation may be related to inhibition of vagal modulation during the cardioacceleratory phase. It is not known whether they reflect any cardio-pathology.

**Peng et al (1999)** reported extremely prominent heart rate oscillations associated with slow breathing during specific traditional forms of Chinese Chi and Kundalini yoga meditation techniques in healthy young adults. They applied both spectral analysis and a novel analytic technique based on the Hilbert transform to quantify these heart rate dynamics. The amplitude of these oscillations during meditation was significantly greater than in the pre-meditation control state and also in three non-meditation control groups: i) elite athletes during sleep, ii) healthy young adults during metronomic breathing, and iii) healthy young adults during spontaneous nocturnal breathing. This finding, along with the marked variability of the beat-to-beat heart rate dynamics during such profound meditative states, challenges the notion of meditation as only an autonomically quiescent state.

**Raghuraj (1998)** studied effect of two selected yogic breathing techniques of heart rate virility. The present study was conducted to study the HRV in two yoga practices which have been previously reported to have opposite effects, viz, sympathetic stimulation (kapalabhati, breathing at high frequency, i.e. 2.0 Hz) and reduced sympathetic activity (nadisuddhi, alternate nostril breathing). The results showed a significant increase in low frequency (LF) power and LF/HF ratio while high frequency (HF) power was significantly lower following kapalabhati. There
were no significant changes following *nadisuddhi*. The results suggest that *kapalabhati* modifies the autonomic status by increasing sympathetic activity with reduced vagal activity. The study also suggests that HRV is a more useful psychological measure than heart rate alone.

**Bowman et al (1997)** observed the effects of aerobic exercise training and yoga, a non-aerobic control intervention, on the baroreflex of elderly persons. Baroreflex sensitivity was quantified by the alpha-index, at high frequency (reflecting parasympathetic activity) and mid-frequency (reflecting sympathetic activity as well), derived from spectral and cross-spectral analysis of spontaneous fluctuations in heart rate and blood pressure. Twenty six (10 women) sedentary, healthy, normotensive elderly (mean age 68 years) subjects were studied. Fourteen (4 women) of the sedentary elderly subjects completed 6 weeks of aerobic training, while the other 12 (6 women) subjects completed 6 weeks of yoga. Heart rate decreased following yoga but not after aerobic training. VO2 max increased by 11% following yoga and by 24% following aerobic training. No significant change in alpha medium frequency or alpha high frequency occurred after aerobic training. Following yoga, alpha HF but not alpha MF increased. Heart rate variability (HRV) was studied in cyclic meditation (CM) and supine rest (SR). CM included yoga postures followed by guided relaxation. Forty two male volunteers were assessed in CM and SR sessions of 35 minutes, where CM or SR practice was preceded and followed by 5 minutes of SR. During the yoga postures of CM and after CM, low frequency power and the low frequency to high frequency power ratio decreased, whereas high frequency power increased. Heart rate increased during the yoga postures and decreased in guided relaxation and after CM. There was no change in SR. Hence, it appeared that predominantly sympathetic activation occurred in the yoga posture phases of CM while parasympathetic dominance increased after CM.

**Sakakibara et al (1996)** studied Effect of slowed respiration on cardiac parasympathetic response to threat. The present study was designed to examine the
effect of voluntarily slowed respiration on the cardiac parasympathetic response to a threat: the anticipation of an electric shock. The amplitude of the high frequency (HF) component of the heart rate variability, an index of cardiac parasympathetic tone, significantly decreased during the threat in the fast and non paced breathing groups, whereas it was unchanged in the slow paced breathing group. No significant difference was observed among the three groups in the amplitude of respiration during the threat. Results suggest that a slowed respiration decreases the cardiac parasympathetic withdrawal response to the threat. This study provides a rationale for the therapeutic uses of the slowed respiration maneuver in attenuating the cardiac autonomic responses in patients with anxiety disorder.

In a scientific study conducted by Vempati et al (1994) 35 male volunteers with ages ranged from 20 to 46 yrs were studied in two sessions, of yoga based guided relaxation and supine rest. Assessments of autonomic parameters were made in 15 subjects, before, during and after the practices, whereas oxygen consumption and breath volume were recorded in 25 subjects, before and after both types of relaxation. A significant decrease in oxygen consumption and increase in breath volume were recorded after guided relaxation (paired t test). There were comparable reductions in heart rate and skin conductance level during both types of relaxation. During guided relaxation the power of the low frequency (LF) component of the heart rate variability spectrum reduced, whereas the power of the high frequency (HF) component increased, suggesting reduced sympathetic activity. Also subjects with a baseline ratio of LF/HF >0.5 showed a significant decrease in the ratio after guided relaxation, while subjects with a ratio < 0.5 at baseline showed no such change. The results suggest that sympathetic activity decreased after guided relaxation based on yoga, depending on the baseline levels.

Telles et al (1995) studied in seven experienced meditators (with experience ranging from 5 to 20 years). Each subject was studied in two types of sessions – meditation (with a period of mental chanting of "OM") and control (with a period of non-targeted thinking). The meditators showed a statistically significant reduction in
heart rate during meditation compared to the control period (paired "t" test). During both types of sessions there was a comparable increase in the cutaneous peripheral vascular resistance. Keeping in mind similar results of other authors, this was interpreted as a sign of increased mental alertness, even while being physiologically relaxed (as shown by the reduced heart rate).

**Bera and Rajpurkar (1993)** scientifically investigated Body composition, cardiovascular endurance and anaerobic power of yogic practitioner. They reported that yoga training results in significant improvement in cardiovascular endurance and anaerobic threshold.

**Telles et al (1994)** studied the heart rate alterations in different types of pranayama. The report presents the differences in heart rate changes in 4 different kinds of pranayama, practiced by a subject who had several years of experience. The results revealed an overall increase of heart rate during two of the four Pranayama, compared to the respective pre-pranayamic baseline values of the **sukhasana** sitting state. These 2 Pranayama have end-inspiratory **kumbhaka**, and have only a short end-expiratory **kumbhaka**. In the other two Pranayama the two varieties, which had end-inspiratory and end-expiratory **kumbhaka** phases, the mean of overall heart rate was not significantly altered. They found that, in two Pranayama the heart rate was more during inspiration and less during expiration. Both values were significantly higher than corresponding values of quiet breathing in the preceding baseline period. In the remaining Pranayama the heart rate was higher during expiration than during inspiration. However, the highest value was during the end-inspiratory **kumbhaka** and lowest during-expiratory **kumbhaka**. The inspiratory and expiratory heart rate values did not differ significantly from the corresponding values of the preceding baseline period.
Khalsa et al (1993) conduct three experiments to monitor the effects of unilateral forced nostril breathing (UFNB) on the heart. Experiment 1 includes 7 subjects (4 males, 3 females) with a respiratory rate of 6 breaths/minute (BPM). Experiment 2 includes 16 trials using one subject to examine the intra-individual variability, at 6 BPM. Experiment 3 includes 10 trials with the same subject in experiment 2, but with a respiratory rate of 2-3 breaths. This rapid rate of respiration is a yogic breathing technique called "breath of fire" or kapalabhati and employs a very shallow but rapid breath in which the abdominal region acts like a bellows. All 3 experiments demonstrated that right UFNB increases heart rate (HR) compared to left. Experiment 1 gave 7 negative slopes, or lowering in HR with left nostril breathing and 7 positive slopes, or increases in HR with right nostril breathing, p = .001. The second and third experiments showed differences in HR means in which right UFNB increases HR more than left, p = .013, p = .001, respectively. In experiment 2 stroke volume was higher with left UFNB, p = .045, compensating for lower HR. Left UFNB increased end diastolic volume as measured in both experiments 1 and 2, p = .006, p = .001, respectively. These results demonstrate a unique unilateral effect on sympathetic stimulation of the heart that may have therapeutic value.

Telles et al (1992) in their another study noted a significant increase in heart rate during the ‘single thought’ state compared to the baseline (eyes closed sakhasan), and a further increase during the ‘no thought’ state. In contrast, the changes in respiration were different for the 2 states: during ‘single thought’ state there was an increase in rate and regularity of respiration, whereas during the ‘no thought’ state there was a significant reduction in the rate and regularity. It is noteworthy that although the respiratory changes are in opposite directions, the heart rate changes are in the same direction (increase). This is an example showing changes of heart rate and respiration accompanying a yogic subjective activity intended to alter the state of mind alone.
**Cusumano et al (1992)** in his study explored the effects of hatha yoga and progressive relaxation on heart rate, blood pressure, physical self-efficacy, and self-esteem. Ninety-five female Japanese undergraduates participated in the three weekly treatment sessions. Results showed that both treatments were effective in lowering heart rate and blood pressure and increasing self-esteem; however, perceptions of physical self-efficacy declined over time. No significant differences were found between the treatments.

**Blumenthal et al (1991)** studied effects of exercise training on cardiorespiratory function in men and women older than 60 years of age. This study reports the physiologic effects of up to 14 months of aerobic exercise in 101 older (greater than 60 years) men and women. After an extensive baseline physiologic assessment (Time 1), in which aerobic capacity and blood lipids were measured, subjects were randomized to an aerobic exercise condition (cycle ergometry, 3 times per week for 1 hour), nonaerobic yoga (2 times per week for 1 hour), or a waiting list nonexercise control group for 4 months, and then underwent a second (Time 2) assessment. At the completion of the second assessment, all remaining subjects completed 4 months of aerobic exercise and were reevaluated (Time 3). Subjects were given the option of participating in 6 additional months of supervised aerobic exercise, and all available subjects completed a fourth assessment (Time 4) 14 months after their initial baseline evaluation. Results indicated that subjects generally exhibited a 10 to 15% improvement in peak oxygen consumption after 4 months of aerobic exercise training, and a 1 to 6% improvement in aerobic power with additional aerobic exercise training. On the other hand, subjects, especially men, continued to have improvements in sub-maximal exercise performance (i.e., anaerobic threshold). In addition, aerobic exercise was associated with an improved lipid profile; subjects participating in aerobic exercise for up to 14 months exhibited increased levels of high-density lipoprotein cholesterol. Maintenance of regular aerobic exercise for an extended time interval is associated with greater cardiovascular benefits among older adults than has been reported previously.
Stancak et al (1991) studied cardiovascular and respiratory changes during yogic breathing exercise kapalabhati (KB) in 17 advanced yoga practitioners. The results point to decreased cardiac vagal tone during KB, which was due to changes in respiratory pattern and due to decreased sensitivity of arterial baroreflex. Decreased respiratory rate and increased SBP and low-frequency blood pressure oscillations after KB suggest a differentiated pattern of vegetative activation and inhibition associated with KB exercise.

Sudsuang et al (1991) evaluated serum cortisol and total protein levels, blood pressure, heart rate, lung volume, and reaction time in 52 males, 20-25 years of age, practicing Dhammakaya Buddhist meditation, and in 30 males of the same age group not practicing meditation. It was found that after meditation, serum cortisol levels were significantly reduced, serum total protein level significantly increased, and systolic pressure, diastolic pressure and pulse rate significantly reduced. Vital capacity, tidal volume and maximal voluntary ventilation were significantly lower after meditation than before. There were also significant decreases in reaction time after meditation practice. The percentage decrease in reaction time during meditation was 22%, while in subjects untrained in meditation; the percentage decrease was only 7%. Results from these studies indicate that practicing Dhammakaya Buddhist meditation produces biochemical and physiological changes and reduces the reaction time. Most studies of Transcendental Meditation (TM), Zen Buddhist sitting, Herbert Benson's "relaxation response," and other calming forms of meditation indicate that meditating subjects generally experience a lowering of the heart rate. The results of such studies vary to some degree, since they depend on different kinds of subject groups and various experimental procedures, with some showing an average decline of seven beats or more per minute among their subjects and some showing two or three beats per minute among some of their subjects.

and women (mean age = 67 years). Subjects were randomly assigned to an aerobic exercise group, yoga and flexibility control group, or a waiting list control group. Prior to and following the 4-month program, subjects underwent comprehensive physiological and psychological evaluations. Physiological measures included measurement of blood pressure, lipids, bone density, and cardiorespiratory fitness including direct measurements of peak oxygen consumption (VO2) and anaerobic threshold. Psychological measures included measures of mood, psychiatric symptoms, and neuropsychological functioning. This study demonstrated that 4 months of aerobic exercise training produced an overall 11.6% improvement in peak VO2 and a 13% increase in anaerobic threshold. In contrast, the yoga and waiting list control groups experienced no change in cardio-respiratory fitness. Other favorable physiological changes observed among aerobic exercise participants included lower cholesterol levels, diastolic blood pressure levels, and for subjects at risk for bone fracture, a trend toward an increase in bone mineral content. Although few significant psychological changes could be attributed to aerobic exercise training, participants in the two active treatment groups perceived themselves as improving on a number of psychological and behavioral dimensions.

Cort (1989) has hypothesized that the large the variability of results in different studies on the effect of meditation on hypertension may be due to differences in compliance to the meditation regimens. This study of fifty-one black adults supports the claim that greater compliance to a meditation program leads to greater decreases in blood pressure.

Bhargava et al (1988) have shown that base line heart rate and blood pressure (Systolic and Diastolic) showed a tendency to decrease and both these autonomic parameters were significantly decreased at breaking point after pranayamic breathing. Although the GSR was recorded in all subjects the observations made were not conclusive. Thus Pranayama breathing exercises appear to alter autonomic responses to breathe holding probably by increasing vagal tone and decreasing sympathetic discharges.
Bhargava (1988) observed autonomic responses to breath holding and its variations following pranayama. Autonomic responses to breath holding were studied in twenty healthy young men. Breath was held at different phases of respiration and parameters recorded were breath holding time, heart rate systolic and diastolic blood pressure and galvanic skin resistance (GSR). After taking initial recordings all the subjects practiced Nadi-Shodhana Pranayama for a period of 4 weeks. At the end of 4 weeks same parameters were again recorded and the results compared. Baseline heart rate and blood pressure (systolic and diastolic) showed a tendency to decrease and both these autonomic parameters were significantly decreased at breaking point after pranayamic breathing. Although the GSR was recorded in all subjects the observations made were not conclusive. Thus pranayama appear to alter autonomic responses to breath holding probably by increasing vagal tone and decreasing sympathetic discharges.

Shrikrishna (1985) has scientifically investigated the essence of pranayama and stated that different practices of pranayama do show widespread effects on the various body functions and the changes in the respiratory, cardio-vascular, biochemical, metabolic, and neural functions. The changes in the respiratory functions during these practices are of such a nature that they do not lead to any significant disturbance in the body homeostasis. Their effect on the level of oxygen and carbon dioxide in the blood doesn’t show any significant change. Thus confirming that though these practices involves a lot of change in the respiratory parameters like respiration rate, tidal volume, minute ventilation etc. they actually do not making more oxygen available to the body (unless the previous values are abnormally low due to some disease state like bronchial asthma). The real value of pranayama is not its oxygen value but its effect on the nervous system. The observation on the effect of pranayama on cardio-vascular, biochemical and metabolic functions shows that the magnitude of the response depends on the physical efforts involved in the different techniques of pranayama. The intensity of
these responses is least in *Ujjayi* pranayama and highest in *kapalabhati kriya* with *bhastrika* pranayama in between. However all the practices lead to identical neural response in the form of increased Alpha pattern of the brain waves as seen in EEG. This increase in alpha waves all over the brain is called synchronization and it was always more when objects reported a subjective feeling of more mental calmness and alert restfulness.

**Delmonte et al (1985)** reviewed the research findings on biochemical responsivity to meditation. Although there are some contradictory and inconclusive outcomes, there is nevertheless sufficient evidence of interest to warrant further investigation of this area. However, in the meantime, there is no compelling basis to conclude that meditation practice is associated with special state or trait effects at the biochemical level. Biochemical markers examined included: blood lactate and blood flow; cortisol, testosterone, growth hormone, thyroxine and triiodothyronine; plasma rennin, aldosterone and dopamine—betahydroxylase; catecholamines; serum cholesterol; plasma phenylalanine; neuro-transmitter metabolites; prolactin; salivary translucency, proteins, minerals and pH.

According to **Delmonte et al (1984)**, meditation has been extensively researched in terms of physiological responsivity. Although practice is associated with both state and trait (long-term) decrements in arousal (especially in blood pressure, muscle tension and respiratory indices) there is, generally, no compelling evidence to suggest superiority to other established relaxation techniques (except, perhaps, in the case of blood pressures). At best, meditation appears to be somewhat more relaxing than eyes-closed rest. There is little to support the notion of unique state effects associated with practice. However, meditators appear to show stronger recovery responses to stressful stimuli than controls. Meditation is increasingly gaining prominence as a self-management and personal development technique as well as becoming more prevalent in the clinical setting as an adjunct to psychotherapy. This is particularly true in the case of Transcendental Meditation.
(TM) and its non-cultic or clinically adapted variants. However, there is no extensive up-to-date review of the research literature dealing with the psycho-physiological effects of meditation practice.

**Cummings (1984)** observed reduced heart rates for those practicing a combination of meditation and exercise.

**Throll (1982)** has stated that a Transcendental meditation group displayed a more significant decrease in heart rate than a group using Jacobson's progressive relaxation. Another study in the sequence showed a decrease in heart rate during meditation.

**Bono (1984)** reported that the reduction of heart rate during TM was greater than the reduction resulting from sitting quietly with eyes closed.

**Delmonte (1984)** found that heart rates were slightly lower during meditation than rest for fifty-two subjects. **Holmes et al (1983)**, however, found that while meditators had lower heart rates while practicing TM, they did not experience lower arousal than control subjects who were simply resting. These findings were also supported by **Dillbeck and Orme-Johnson (1987)**, **Morrell (1986)**, and **Holmes (1984)**.


**Wallace et al (1983)** measured systolic blood pressure using a standard mercury sphygmomanometer on 112 transcendental meditators. The subjects had a mean systolic blood pressure 13.7 to 24.5 less than the population mean. The analysis also showed that meditators with more than five years of experience had a mean
systolic blood pressure 7.5 lower than meditators with less than five years of experience.

**Bagga and Gandhi (1983)** found an average decline as high as fifteen beats per minute among some of their subjects. Some studies indicate that meditation lowers the heart rate more than biofeedback, progressive relaxation, other therapies, or simple sitting, while other studies indicate that these various activities have an equivalent effect on the heart rate. Once again, such differences in outcome can be accounted for by differences among subjects and experimental designs. A decline in heart rate is more pronounced among experienced meditators, according to a few studies, though here too the evidence is not unanimous. The only generalization we can make safely now is that some subject groups demonstrate an average lowering of heart rate during meditation, and that some experienced individuals may achieve a permanent lowering of the heart rate with continued practice.

**Bagga and Gandhi (1983)** compared groups of six TM practitioners and six shavasana practitioners (relaxing while lying on one's back) with six controls, and found significantly reduced heart rates for both experimental groups versus the control group.

**Hafner (1982)** assessed twenty-one hypertension patients who had been randomly assigned to eight one-hour sessions of meditation training, meditation plus biofeedback-aided relaxation, or a non-treatment control group. Statistically significant fall in systolic and diastolic blood pressure occurred after both training programs, although overall reductions in blood pressure were not significantly

**Pollard and Ashton (1982)** divided sixty subjects into six groups in a comparison of heart rate decrease obtained by visual feedback, auditory feedback, combined visual and auditory feedback, instructions to decrease heart rate without
biofeedback, sitting quietly, and abbreviated relaxation training. A comparison group of meditators with a minimum of six years of experience was also studied. The results indicated that there was no advantage of a heart rate decrease task for subjects receiving visual, auditory, or combined biofeedback, though all groups showed evidence of a decline in heart rate over the testing session. The meditation group showed the greatest overall decline, with a decrease in heart rate of approximately seven beats per minute, versus three beats per minute for the groups using biofeedback techniques.

Cuthbert et al. (1981) had results demonstrating clear superiority for meditators using Benson's relaxation response versus heart rate biofeedback, especially when the subject experimenter relationship was supportive. Lang et al (1979) placed the heart rate decrease for advanced TM meditators with more than four years of practice at 9%. Bauhofer (1978) found that the heart rates of experienced TM meditators were lowered by TM more than those of less experienced TM meditators. Corey (1977) and Routt (1977) reported that Transcendental Meditation appeared to decrease heart rate under nonstress conditions. Glueck and Stroebel (1975), Wallace and Benson (1972), Wallace et al (1971), and Wallace (1971) found that the heart rate decreased from three to five beats per minute during Transcendental Meditation. Reports of reduced heart rates during meditation extend back to Paul (1969), Karambelkar et al (1968), Anand and Chhina (1961), Wenger and Bagchi (1961), Bagchi and Wenger (1957), and Das and Gastaut (1955).

Seer and Raeburn (1980) conducted a research in which forty-one un-medicated hypertensive’s were randomly assigned to three groups: TM training, placebo control (TM training without a mantra), and no-treatment control. The results showed modest reductions in blood pressure in both treatment groups, compared with no treatment, with diastolic percentage reductions reaching significance. There
was considerable subject variation in response, with an overall mean decline in diastolic blood pressure of 8-10% on a three-month follow-up.

**Surwit et al (1978)** compared the separate effects of three procedures for the reduction of high blood pressure in three treatment groups of eight patients, each with medically verified borderline hypertension. The three treatment groups used the following procedures: (a) biofeedback for simultaneous reductions in systolic blood pressure and heart rate; (b) biofeedback for reductions in integrated forearm and frontalis muscle electromyographic activity; and (c) meditation relaxation based on the relaxation response procedure developed by Herbert Benson. Each patient was studied in two baseline sessions, eight training sessions, and a six-week follow-up. Half of the sample returned for a one-year follow-up. Analysis of variance of the three treatment groups over eight training sessions, with twenty trials per session, revealed significant effects for trials within sessions. However, there were no significant main effects or interactions related to differences between the treatment conditions or to changes in blood pressure over the course of training sessions. Although all groups showed moderate reductions in blood pressure as compared to initial values, no technique could be seen to produce a reduction in pressure greater than that observed in the baseline sessions. Blood pressures of patients reporting for the one-year follow-up were not different from pretreatment baseline levels.

In a study conducted by **Pollack et al (1977)** twenty hypertensive patients, nine of whom were on stable dosages of hypotensive medication, were taught TM. Blood pressure reductions were 10 mmHg systolic/2 mmHg diastolic after three months and 6 mmHg systolic/2 mmHg diastolic after six months. The only statistically significant reduction in blood pressure occurred after three months. Meditation plus biofeedback produced decreases in diastolic blood pressure earlier in the training program than meditation alone.
Patel (1975) selected thirty-two subjects—twenty-one females and eleven males—between the ages of thirty-four and seventy-five years with essential hypertension of known duration from six months to thirteen years, were randomly divided into a treatment group and a control group. Fourteen subjects in the treatment group and fifteen in the control group were receiving antihypertensive drugs. Baseline blood pressure was first obtained after a twenty-minute rest in the supine position. The patients were given two stress tests: an exercise test (climbing a nine-inch step twenty-five times) and a cold pressor test (immersing the left hand in cold water after alerting the patient sixty seconds in advance) at the beginning and again after six weeks. Blood pressure was taken during the alert, at the end of each test, and every five minutes until it returned to the original value or up to a maximum of forty minutes. In the six weeks between test periods, all subjects attended a twice-weekly training sessions. The treatment group was given training in relaxation and meditation based on yogic principles, which was reinforced with biofeedback instruments, and group members were asked to practice relaxation and meditation at home twice daily for twenty minutes. In the treatment group there was a significant reduction in the pressure rises as well as in recovery time. Mere repetition of the tests did not influence these indications of stress. When the differences between the groups were compared, all measurements except the systolic pressure rise after exercise showed significant improvement in the treated group.

Patel et al (1975) conduct a scientific study on 34 hypertensive patients for six weeks of yoga methods with biofeedback or to general relaxation and showed a reduction in blood-pressure although the decrease was significantly greater for the yoga group. The control group was then trained in yoga relaxation and their blood-pressure fell to that of the other group.

Benson et al (1974) found that twenty-two borderline hypertensives not using drugs when taught TM, their mean blood pressure decreased from 146.5/94.6 mmHg
during the premeditation control period, lasting 5-7 weeks, to 139.6/90.8 mmHg during the post-meditation experimental period, lasting an average of twenty-five weeks. They were tested throughout the premeditation and postmeditation periods.

**Benson et al (1974)** have stated that fourteen hypertension subjects, on drugs were taught the relaxation response. During a control period of 5.6 weeks, blood pressure did not change significantly from day to day, and averaged 145.6/91.9 mmHg. During an experimental period of twenty weeks, blood pressure decreased to 135.0/87.0 mmHg.

**Patel (1973)** has stated that when twenty hypertension patients using hypotensive drugs were taught yoga, breath meditation, muscle relaxation, and meditation concentration, their average blood pressure was reduced from 159.1/100.1 mmHg to 138.7/85.9 mmHg. The average blood pressure of twenty control subjects, who rested on a couch for the same number of sessions and who were given no relaxation training, was reduced from 163.1/99.1 mmHg to 162.6/97.0 mmHg.

**Benson and Wallace (1972)** have said that twenty-two hypertensive’s with no meditation experience were given the standard TM training. Their mean blood pressure before meditation was 150/94 mmHg. After four to sixty-three weeks of meditation practice their mean blood pressure was reduced to 141/87 mmHg.

**Datey et al (1969)** has concluded that 47 subjects practicing Shavasana, for approximately thirty weeks, of these forty-seven subjects, ten who did not use antihypertensive drugs had an average systolic blood pressure reduction from 134 to 107 mmHg. A second group of twenty-two subjects, with blood pressure well controlled by antihypertensive drugs, had an average systolic blood pressure reduction from 102 to 100 mmHg. A third group of fifteen subjects, with inadequately controlled blood pressure using antihypertensive drugs, had an average systolic blood pressure reduction from 120 to 110 mmHg. The subjects' average
drug requirement was reduced to 32% of the original dosages for the second group. In group three, six patients reduced their drug requirement to 29% of the original, seven patients' dosages were unchanged, and two patients required an increased dosage.

**Respiratory Rate**

Pramanik (2009) studied immediate effect of slow pace *bhastrika* pranayama (respiratory rate 6/min) for 5 minutes on heart rate and blood pressure and the effect of the same breathing exercise for the same duration of time (5 minutes) following oral intake of hyoscine-N-butylbromide (Buscopan), a parasympathetic blocker drug. Heart rate and blood pressure of volunteers (*n* = 39, age = 25-40 years) was recorded following standard procedure. First, subjects had to sit comfortably in an easy and steady posture (sukhasana) on a fairly soft seat placed on the floor keeping head, neck, and trunk erect, eyes closed, and the other muscles reasonably loose. The subject is directed to inhale through both nostrils slowly up to the maximum for about 4 seconds and then exhale slowly up to the maximum through both nostrils for about 6 seconds. The breathing must not be abdominal. After 5 minutes of this breathing practice, the blood pressure and heart rate again were recorded in the aforesaid manner using the same instrument. The other group (*n* = 10) took part in another study where their blood pressure and heart rate were recorded following half an hour of oral intake of hyoscine-N-butylbromide 20 mg. Then they practiced the breathing exercise as stated above, and the abovementioned parameters were recorded again to study the effect of parasympathetic blockade on the same pranayama. It was noted that after slow *bhastrika* pranayamic breathing (respiratory rate 6/min) for 5 minutes, both the systolic and diastolic blood pressure decreased significantly with a slight fall in heart rate. No significant alteration in both blood pressure and heart rate was observed in volunteers who performed the same breathing exercise for the same duration following oral intake of hyoscine-N-butylbromide. The study states that pranayama increases frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors during above
tidal volume inhalation as in Hering Bruer reflex, which bring about withdrawal of sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing decrease in peripheral resistance and thus decreasing the diastolic blood pressure. After hyoscine-N-butylbromide, the parasympathetic blocker, it was observed that blood pressure was not decreased significantly as a result of pranayama, as it was observed when no drug was administered. It was concluded from the results that vagal cardiac and pulmonary mechanisms are linked, and improvement in one vagal limb might spill over into the other. Baroreceptor sensitivity can be enhanced significantly by slow breathing (supported by a small reduction in the heart rate observed during slow breathing and by reduction in both systolic and diastolic pressure). Slow pace bhasrika pranayama (respiratory rate 6/min) exercise thus shows a strong tendency to improving the autonomic nervous system through enhanced activation of the parasympathetic system

Udupa et al (1975) have reported a decrease in pulse rate but no change in blood pressure after short duration pranayama training.

Cortisol & Stress

Moyer AE, Rodin J, Grilo CM, Cummings N, Larson LM, Rebuffé-Scrive M.(2011) in their recent studies have shown an association between uncontrollable stress and abdominal fat distribution. It has been suggested that changes in cortisol secretion might represent one possible mechanism for this relationship. This study investigated whether body fat distribution, determined by waist-to-hip ratio (WHR), is related to salivary cortisol levels in response to laboratory stressors. Subjects were 41 overweight women with a Low or a High WHR. Multiple measures of cortisol and mood were obtained during a session of stressful tasks (eg., timed arithmetic) and during a time-matched, control rest session. Also, background life stress and psychological trait variables were assessed. Compared to Low WHR subjects, High WHR subjects secreted significantly more cortisol during the stressful session after 60 minutes of stress, and considering the total area under the curve of secretion.
This difference was not seen on the rest day. In terms of background and psychological measures, High WHR subjects were characterized by poorer coping skills and differences in mood reactivity. Specifically, although all subjects became more angry in response to the stressful session, High WHR subjects showed smaller increases in anger. This could indicate that they are more likely to evidence a helpless reaction to uncontrollable stress. These findings support the hypothesis that cortisol secretion might represent a mechanism for the observed association between stress and abdominal fat distribution. Furthermore, differences in coping and appraisal may suggest that a particular psychological pattern might influence the reactivity of the adrenal-cortical system to stress, and subsequent fat distribution.

**Jens C. Pruessner, Dirk H. Hellhammer, and Clemens Kirschbaum, (2001)** studied the effects of burnout and perceived stress on early morning free cortisol levels after awakening were investigated in a group of teachers. Previous studies revealed that cortisol levels show a significant increase after awakening, with high intraindividual stability. Sixty-six teachers from local public schools (42 women and 24 men, mean age 42 ± 5 years) were asked to sample saliva for cortisol analysis on 3 consecutive days. On each day, cortisol levels were measured at the time of awakening and 15, 30, and 60 minutes thereafter. On the night before the third day, subjects took 0.5 mg dexamethasone orally for testing glucocorticoid feedback inhibition. Burnout and perceived stress were measured by three different questionnaires. **RESULTS:** Perceived stress correlated with increases of cortisol levels during the first hour after awakening after dexamethasone pretreatment. In addition, teachers scoring high on burnout showed lower overall cortisol secretion on all sampling days, and a higher suppression of cortisol secretion after dexamethasone administration. In the subgroup of teachers with both high levels of perceived stress and high levels of burnout, a lower overall cortisol secretion was observed on the first 2 days, with stronger increases during the first hour after awakening after dexamethasone suppression. This subgroup also showed the lowest
self-esteem, the highest external locus of control, and the highest number of somatic complaints.

**Roland Rosmond (1999)** has reported that abdominal obesity has been suggested to be associated with perturbations of the regulation of the hypothalamic-pituitary-adrenal (HPA) axis. In a population of 51-yr-old men (n = 284) salivary cortisol concentrations were determined on repeated (n = 7) occasions over a random working day, and perceived stress was reported in parallel. Cortisol values were then related to reported stress (stress-related cortisol). A standardized lunch was used as a physiological challenge. A low dose (0.5 mg) dexamethasone suppression test was also performed as well as determinations of testosterone and insulin-like growth factor I (IGF-I). Body mass index [weight (kilograms)/height (meters)^2]; waist/hip circumference ratio (WHR); sagittal trunk recumbent diameter (D); fasting insulin; blood glucose; triglycerides; and total, low density (LDL), and high density (HDL) lipoprotein cholesterol were also determined.

Cortisol concentrations were highest in the morning, and lunch was followed by a peak (P = 0.044). Two types of diurnal cortisol curves were identified, one characterized by a high variability with high morning values, and another with low variability and low morning values. Both correlated strongly with suppression of salivary cortisol by dexamethasone (P < 0.001).

Stress-related cortisol secretion was associated with D (P = 0.051), low IGF-I (P = 0.006), and diastolic blood pressure (P = 0.078). When the type of diurnal cortisol curve was taken into consideration by statistical weighting, stress-related cortisol secretion in subjects with high variability showed associations with testosterone (P < 0.001), D, total and LDL cholesterol, diastolic blood pressure (P < 0.001), fasting insulin (P = 0.039), and glucose (P = 0.030) as well as, negatively, triglycerides (P < 0.001).

When weighted for a low variability of diurnal cortisol secretion, stress-related cortisol secretion showed strong negative relationships with IGF-I, testosterone, and HDL. Furthermore, strong, consistent relationships (all P < 0.001) were found with
obesity factors (body mass index, WHR, and D), and with metabolic (insulin, glucose, triglycerides, and total and LDL cholesterol) as well as hemodynamic variables (systolic and diastolic blood pressure and heart rate).

These results clearly show interactions between diurnal cortisol secretion related to perceived stress and anthropometric, endocrine, metabolic, and hemodynamic variables. This seems to occur with apparently normal regulation of the HPA axis (high morning peaks and variability as well as dexamethasone suppression of cortisol), where other endocrine variables are not affected. With a low diurnal cortisol variation and blunted dexamethasone suppression, indicating abnormal regulation of the HPA axis, perceived stress-dependent cortisol values were strongly related to perturbations of other endocrine axes as well as abdominal obesity with metabolic and hemodynamic abnormalities. Perturbations of the regulation of the HPA axis such as those described in combination with low dexamethasone suppressibility are known to follow long term overactivation of the axis by factors such as environmental stress.

**Oliver T. Wolf, Nicole C. Schommer, Dirk H. Hellhammer, Bruce S. McEwen, C. Kirschbaum, 1994** Epidemiological as well as experimental studies in elderly subjects have suggested that postmenopausal women are more susceptible to the memory impairing effects of elevated cortisol levels than elderly men. Little is known however about gender differences in the susceptibility to acute stress in young subjects. In the present study a total of 58 healthy young subjects learned a word list, with recall being tested after a brief distraction task. Twenty-two subjects had to learn the list after exposure to a psychosocial stressor (Trier Social Stress Test: TSST), while the remaining subjects served as controls. Free cortisol was determined via saliva samples taken before and 10 minutes after stress. Subjects exposed to the stressor, did not show impaired memory performance per se when compared to the control group. However the cortisol increase in response to the stressor was negatively correlated ($r=-0.43$, $P<0.05$) with the memory performance within the stressed group (i.e., subjects showing a larger cortisol response recalling
less words than subjects showing only a small cortisol increase). Additional analysis revealed, that this correlation was solely caused by the strong association observed in men ($r=-0.82, P<0.05$), while no association was observed in women ($r=-0.05, P=ns$). Our data suggests that gender modulates the association between cortisol and memory after stress. Whether these differences reflect activational effects of sex steroids or developmentally-programmed sex differences waits to be determined.

Woodyard C 1981 Hypertension, Vol 3, 496-505, Copyright © 1981 by American Heart Association

The objective of this study is to assess the findings of selected articles regarding the therapeutic effects of yoga and to provide a comprehensive review of the benefits of regular yoga practice. As participation rates in mind-body fitness programs such as yoga continue to increase, it is important for health care professionals to be informed about the nature of yoga and the evidence of its many therapeutic effects. Thus, this manuscript provides information regarding the therapeutic effects of yoga as it has been studied in various populations concerning a multitude of different ailments and conditions. Therapeutic yoga is defined as the application of yoga postures and practice to the treatment of health conditions and involves instruction in yogic practices and teachings to prevent reduce or alleviate structural, physiological, emotional and spiritual pain, suffering or limitations. Results from this study show that yogic practices enhance muscular strength and body flexibility, promote and improve respiratory and cardiovascular function, promote recovery from and treatment of addiction, reduce stress, anxiety, depression, and chronic pain, improve sleep patterns, and enhance overall well-being and quality of life.

Anxiety and Frustration

Gupta N at el (2006) Considerable evidence exists for the place of mind body medicine in the treatment of anxiety disorders. Excessive anxiety is maladaptive. It is often considered to be the major component of unhealthy lifestyle that contributes
significantly to the pathogenesis of not only psychiatric but also many other systemic disorders. Among the approaches to reduce the level of anxiety has been the search for healthy lifestyles. The aim of the study was to study the short-term impact of a comprehensive but brief lifestyle intervention, based on yoga, on anxiety levels in normal and diseased subjects. The study was the result of operational research carried out in the Integral Health Clinic (IHC) at the Department of Physiology of All India Institute of Medical Sciences. The subjects had history of hypertension, coronary artery disease, diabetes mellitus, obesity, psychiatric disorders (depression, anxiety, 'stress'), gastrointestinal problems (non ulcer dyspepsia, duodenal ulcers, irritable bowel disease, Crohn's disease, chronic constipation) and thyroid disorders (hyperthyroidism and hypothyroidism). The intervention consisted of asanas, pranayama, relaxation techniques, group support, individualized advice, and lectures and films on philosophy of yoga, the place of yoga in daily life, meditation, stress management, nutrition, and knowledge about the illness. The outcome measures were anxiety scores, taken on the first and last day of the course. Anxiety scores, both state and trait anxiety were significantly reduced. Among the diseased subjects significant improvement was seen in the anxiety levels of patients of hypertension, coronary artery disease, obesity, cervical spondylitis and those with psychiatric disorders. The observations suggest that a short educational programme for lifestyle modification and stress management leads to remarkable reduction in the anxiety scores within a period of 10 days.

P S Shekhawat and J P N Mishra, 2008 Preksha Meditation is a technique of meditation for attitudinal change, behavioural modification, health promotion and integrated development of personality. It is based on wisdom of ancient philosophy and has been formulated in terms of modern scientific concepts. The present study was conducted to demonstrate the effects of Preksha Meditation on various psychophysiological components of healthy human subjects. Subjects were selected randomly and divided into two groups – Experimental and control group, each group consists of 10 subjects. The experimental group of subjects was first trained
in the practice of Preksha Meditation Capsule which includes kayotsarga (Relaxation with self awareness), perception of breathing (Deep scientific breathing), internal trip, perception of psychic-centers and perception of psychic-colours. There after they practiced it vigorously in three sessions a day for two weeks. The data was analyzed using student’s paired ‘t’ test. ‘p’ value of less then 0.05 were accepted as indicating significant difference between the values of experimental and control groups. A significant decline was observed in Heart Rate, Systolic pressure, Diastolic pressure, Mean pressure, Rate pulse pressure, Anxiety level, Fear level and Frustration levels (Aggression, Reservation, Fixation and Regression). On the basis of results obtained it was inferred that practice of Preksha Meditation has brought down the level of these components by modulating the functions of Autonomic and Central nervous system.

**Dill and Anderson (1995)** present a study that questions whether frustration that is justified or not plays a role on future aggression. The frustration-aggression theory has been studied since 1939, and there have been modifications. The experiment consisted of three groups of subjects performing a folding origami task that was timed. The participants were split into the control, justified frustration and unjustified frustration groups. In each condition the experimenter states how they will only present the instructions one time and then start the timer. At a predetermined fold the confederate in the condition interrupts the experimenter and asks them to please slow down.

In the unjustified group, the experimenter responds, “I cannot slow down. My girlfriend/boyfriend is picking me up after this and I do not want to make them wait.” In the justified condition the experimenter responds, “I cannot slow down. My supervisor booked this room for another project afterwards and we must continue.” Finally, the experimenter in the control condition responded, “Oh, okay I did not realize I was going too quickly. I will slow down.

The subjects were then given questionnaires on their levels of aggression as well as questionnaires about the quality of the research staff. They were told that these
questionnaires would determine if the research staff would be awarded financial aid, or would result in verbal reprimands and a reduction in financial award. The questions presented on the questionnaire were designed to reflect the research staff's ability and likeability.

Dill and Anderson found that participants in the unjustified frustration group rated the research staff to have less ability and likeability, knowing this would affect their financial situation as graduate students. The justified frustration group rated the staff as less likeable and having less ability than the control group. However, the results were not as extreme. These results support the hypothesis that frustration can lead to aggression. This study presents data concerning behavioral aggression as well as introducing the level of frustration that needs to be taken into account.

Blackwell et al (1976) conduct a study in which seven selected hypertensive patients were stabilized on drugs at a research clinic. Subjects learned transcendental meditation (T.M.), were seen weekly, and took their own blood pressure several times daily. After 12 weeks of T.M. six subjects showed psychological changes and reduced anxiety scores. Six subjects also showed significant reductions in home and four in clinic blood pressures. Six months later four subjects continued to derive psychological benefit and two showed significant blood-pressure reductions attributable to T.M. at home and clinic.