CHAPTER – 2

REVIEW OF RELATED LITERATURE

In this chapter, a review of the literature relevant to this study is presented in the following four sections:

1. Studies on stress hormone
2. Studies on circulatory responses
3. Studies on metabolic responses

This chapter ends with a short summary on the impact of previous research on the present study.

A study of related literature is essential for the proper understanding of the problem under study. Such review brings out a deep and clear perspective of the overall field. The relevant literature pertaining to the present study has been abstracted in the chapter to provide the background material, to evaluate the significance of this study as well as to interpret its findings.

Studies on Stress Hormone

Jill A. Kanaley (2003) has stated that exercise of appropriate intensity is a potent stimulus for GH and cortisol secretion. Circadian and diurnal rhythms may modulate the GH and cortisol responses to exercise, but nutrition, sleep, prior exercise patterns, and body composition are potentially confounding factors. To determine the influence of the time of day on the GH and cortisol response to acute exercise, we studied 10 moderately trained young men (24.1 ± 1.1 yr old; maximal oxygen consumption, 47.9 ± 1.4 mL/kg-min; percent body fat, 13.2 ± 0.6%). After a supervised night of sleep and a standard meal 12 h before exercise, subjects exercised at a constant velocity (to elicit an initial blood lactate concentration of 2.5 mmol/L) on a treadmill for 30 min on 3 separate
occasions, starting at 0700, 1900, and 2400 h. Blood samples were obtained at 5-min intervals for 1 h before and 5 h after the start of exercise; subjects were not allowed to sleep during this period. Subjects were also studied on 3 control days under identical conditions without exercise. There were no significant differences with time of day in the mean blood lactate and submaximal oxygen consumption values during exercise. The differences over time in serum GH and cortisol concentrations between the exercise day and the control day were determined with 95% confidence limits for each time of day. Exercise stimulated a significant increase in serum GH concentrations over control day values for approximately 105–145 min (P < 0.05) with no significant difference in the magnitude of this response by time of day. The increase in serum GH concentrations with exercise was followed by a transient suppression of GH release (for 55–90 min; P < 0.05) after exercise at 0700 and 1900 h, but not at 2400 h. Although the duration of the increase in serum cortisol concentrations after exercise was similar (50–155 min; P < 0.05) at 0700, 1900, and 2400 h, the magnitude of this increase over control day levels was greatest at 2400 h. This difference was significant for approximately 130 min and approximately 40 min compared to exercise at 1900 and 0700 h, respectively (P < 0.05). The cortisol response to exercise at 0700 h was significantly greater than that at 1900 h for about 55 min (P < 0.05). A rebound suppression of cortisol release for about 50 min (P < 0.05) was observed after exercise at 2400 h, but not 0700 or 1900 h. Both baseline (before exercise) and peak cortisol concentrations were significantly higher at 0700 h than at 1900 or 2400 h (P < 0.01). We conclude that time of day does not alter the GH response to exercise; however, the exercise-induced cortisol response is modulated by time of day.

Jaya T. Venkatraman (2003) stated that healthy trained runners (males and females) consumed serially 15% fat diet (of daily energy), 30% fat diet and 40% fat diets for four weeks each. In the last week of each diet period the subjects ran to exhaustion at 80% of their VO$_2$ max and
blood was drawn pre- and post-run. Cortisol, IFN, PGE$_2$ and lipid peroxides were determined using standard techniques. Pre-exercise levels of plasma cortisol were elevated, IFN was unchanged and PGE$_2$ and lipid peroxides decreased on the 40%F diet compared to 30%F and 15%F. Post-exercise levels of plasma cortisol (P < 0.004), PGE$_2$ (P < 0.0057) and lipid peroxide levels increased (P < 0.0001) after endurance exercise on all diets. The rates of increase of plasma cortisol levels during exercise were similar on all three diets. Although absolute cortisol levels were higher in the high fat group, the rate of increase of plasma cortisol level during exercise was similar on each diet. The dietary fat levels did not affect IFN, however, PGE$_2$ and lipid peroxides decreased with increasing fat at baseline at 40%F level (P<0.01; 30%F vs. 40%F: P < 0.002; 15%F vs. 40%F: P < 0.007). Data from the present study suggest that higher levels of fat in the diet, up to 40%, increase endurance running time without adverse effects on plasma cortisol, IFN and lipid peroxide levels.

Richardo Jose Soares da Costa (2002) stated that prolonged exercise had an immunosuppressive effect on the body. If exercise time were to be distributed into two separate shorter bouts of exercise performed within the same 24 hour period, immunosuppression may be avoided, while exercise time is maintained. The aim of the present study was to compare the effects of a 3 hour exercise bout, with 2x1½ hour exercise bout at 55% VO$_2$max on leucocyte counts, neutrophil function, IgA secretion, plasma cortisol concentration, and plasma glutamine concentration. Ten trained male subjects (mean ± S.D. age 23 ± 4 years, VO$_2$max 66.59 ± 7.42 ml/kg/mm$^1$) cycled at 55% VO$_2$max on an electrically braked ergometer for 3 different exercise durations (Ride A:3 hours, Ride B:2x1½ hours, Ride C:1½ hours). Intravenous blood samples were obtained on the morning of each exercise bout, immediately post-exercise, and 16 hours post exercise. Ride B and C both caused a significant (P<0.05) elevation of blood leucocyte count, a reduction in plasma glutamine concentration, and no change in IgA secretion and in vitro neutrophil degranulation response to
bacterial lipopolysaccharide. The only difference that occurred between these two bouts was a significant larger increase in cortisol concentration that occurred during ride B. Ride A produced a significant elevation in blood leucocyte count; however, a higher and more prolonged neutrophilia was observed compared to rides B and C. A significantly larger increase in cortisol concentration, elastase degranulation, no change in IgA secretion, and a decrease in plasma glutamine concentration, was also observed in ride A. From the parameters of the immune system measured, it appears that 3 hours of exercise is more immunosuppressive than $2 \times 1\frac{1}{2}$ hours of exercise performed in the same 24 hour period. It has been suggested that this is the result of a decrease in glycogen that occurs during the 3 hour bout of exercise, which stimulates cortisol release to increase lipid metabolism. The increase in cortisol promotes the release of leukocytes that are immature, thus creating an immunosuppressive state. This immunosuppression can be avoided by the intake of carbohydrates during prolonged exercise bouts; thus, attenuating cortisol release by maintaining plasma glucose concentrations at homeostasis.

_Masanta, N.C._ (2000) stated that acute aerobic exercise and chronic heavy exercise can act as a stressor. To evaluate the effect of glucose on the reduction of stress response, thirty brick field workers were studied. They were grouped into two equal halves. One of the group is allowed to drink 75gm D-glucose in 200ml water before work. Blood samples were drawn from both the groups at rest and as recovery period. Samples were analysed for leukocyte count, haemoglobin, blood sugar, lipid profiles and cortisol estimation. Result showed significant neutropenia ($P<0.05$) and cortisol ($P<0.01$) are increased.

_MacLean, C.R._ (1997) examined the effects of stress on several hormones both during the practice and longitudinally after regular practice of the transcendental meditation technique. In this prospective, random assignment study, changes in baseline levels and acute responses to
laboratory stressors were examined for four hormones—cortisol, growth hormone, thyroid-stimulating hormone and testosterone—before and after 4 months of either the TM technique or a stress education control condition. At pre- and post-test, blood was withdrawn continuously through an indwelling catheter, and plasma or serum samples were frozen for later analysis by radioimmunoassay. The results showed significantly different changes for the two groups, or trends toward significance, for each hormone over the 4 months. In the TM group, but not in the controls, basal cortisol level and average cortisol across the stress session decreased from pre- to post-test. Cortisol responsiveness to stressors, however, increased in the TM group compared to controls. The baselines and/or stress responsiveness for TSH and GH changed in opposite directions for the groups, as did the testosterone baseline. Overall, the cortisol and testosterone results appear to support previous data suggesting that repeated practice of the TM technique reverses effects of chronic stress significant for health. The observed group difference in the change of GH regulation may derive from the cortisol differences, while the TSH results are not related easily to earlier findings on the effects of chronic stress.

Udupa, K.N. (1996) conducted a study on biochemical changes following a selective combined practice of yoga namely yogic postures, pranayama and relaxation type of meditation of volunteers. Their age was 20 to 25 years. The volunteers who practiced the yoga practices for a period of six months. Note a marked reduction of neurohumors and a slight raise of plasma Cortisol indicating a better stress competence of these volunteers.

Harte, J.L., et.al. (1995) studied the relations between three hormones of the hypothalamic-pituitary-adrenocortical (HPA) axis, beta-endorphin (beta-EP), corticotropin-releasing hormone (CRH) and cortisol, and mood change were examined in 11 elite runners and 12 highly trained meditators matched in age, sex, and personality. Despite metabolic differences between running and meditation, we predicted that mood change after these
activities would be similar when associated with similar hormonal change. Compared to pre-test and control values, mood was elevated after both activities but not significantly different between the two groups at post-test. There were significant elevations of beta-EP and CRH after running and of CRH after meditation, but no significant differences in CRH increases between groups. CRH was correlated with positive mood changes after running and mediation. Cortisol levels were generally high but erratic in both groups. We conclude that positive affect is associated with plasma CRH immunoreactivity which itself is significantly associated with circulating beta-EP supporting a role for CRH in the release of beta-EP. Increased CRH immunoreactivity following meditation indicates, however, that physical exercise is not an essential requirement for CRH release.

**Luger, A. (1990)** stated that exercise stimulates the hypothalamic-pituitary-adrenal and renin-angiotensin-aldosterone axes and causes growth hormone and prolactin release in an intensity-dependent fashion. Activation of the different endocrine responses examined occur at different exercise intensities. Subjects of differing training status respond similarly to matched exercise intensities. Highly trained subjects have elevated basal concentrations of ACTH and cortisol and a blunted response to exogenous corticotropin releasing hormone. These data are compatible with mild sustained hypercortisolism in highly trained runners.

**Sahasi, G., et al. (1989)** evaluated the efficacy of selected yoga practices (Group 1, N = 38) as compared with drug (diazepam) therapy (Group 2, N = 53) in anxiety-neurotic outpatients (aged 18-47 years). Ss were administered a battery of tests pre- and post-treatment. Data indicated a significant rate of improvement in Group 1 Ss who completed the prescribed length (5 days/wk for 3 months) of yoga practices as compared with Group 2 Ss. At least 6.7% of Group 1 Ss were reported to be completely asymptomatic as compared with none of the Group 2 Ss.
Nagendra, H.R. (1986) gave after an initial integrated yoga training program of 2 to 4 weeks for 570 bronchial asthmatics who were followed up for 3 to 54 months. The training consisted of yoga practices-yogasanas, Pranayama, meditation, and kriyas-and theory of yoga. Results show highly significant improvement in most of the specific parameters. The regular practitioners showed the greatest improvement. Peak expiratory flow rate (PFR) values showed significant movement of patients toward normalcy after yoga, and 72, 69, and 66% of the patients have stopped or reduced parenteral, oral, and cortisone medication, respectively. These results establish the long-term efficacy of the integrated approach of yoga therapy in the management of bronchial asthma.

Udupa, K.N., et al. (1977) in their study on two groups of volunteers who practised vipassana meditation for 10 days, had found a significant increase in the levels of acetylcholine, cholinesterase, catecholamines, histaminase and level of cortisol. These findings suggest that volunteers were neurophysiologically more active following yogic meditation and yet were physically and metabolically stable.

Studies on Circulatory Responses

Kasiganesan Harinath (2004) studied that thirty healthy men in the age group of 25-35 years who volunteered for the study. They were randomly divided in two groups of 15 each. 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 asanas (postures) for 45 minutes and pranayama for 15 minutes during the morning, whereas during the evening hours these subjects performed preparatory yogic postures for 15 minutes, pranayama for 15 minutes, and meditation for 30 minutes daily, for 3 months. Orthostatic tolerance, heart rate, blood pressure, respiratory rate, dynamic lung function (such as forced vital capacity, forced expiratory
volume in 1 second, forced expiratory volume percentage, peak expiratory flow rate, and maximum voluntary ventilation), and psychologic profile were measured before and after 3 months of yogic practices. Serial blood samples were drawn at various time intervals to study effects of these yogic practices and Omkar meditation on melatonin levels. Yogic practices for 3 months resulted in an improvement in cardiorespiratory performance and psychologic profile. The plasma melatonin also showed an increase after three months of yogic practices. The systolic blood pressure, diastolic blood pressure, mean arterial pressure, and orthostatic tolerance did not show any significant correlation with plasma melatonin. However, the maximum night time melatonin levels in yoga group showed a significant correlation ($R = 0.71$, $P < 0.05$) with well-being score.

*Swami Vivekananda Yoga Research Foundation* (2002) examined 35 male volunteers whose ages ranged from 20 to 46 years were studied in two sessions of yoga-based guided relaxation and supine rest. Assessments of autonomic variables were made for 15 subjects, before, during, and after the practices, whereas oxygen consumption and breath volume were recorded for 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 during both types of relaxation. During guided relaxation the power of the low frequency component of the heart-rate variability spectrum reduced, whereas the power of the high frequency 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. yoga pose yoga clothing hatha yoga yoga journal yoga pants naked yoga yoga position yoga supply.
Anastasia Georgiades (2000) examined the effects of exercise and weight loss on cardiovascular responses during mental stress in mildly to moderately overweight patients with elevated blood pressure. Ninety-nine men and women with high normal or unmedicated stage 1 to stage 2
hypertension (systolic blood pressure 130 to 179 mm Hg, diastolic blood pressure 85 to 109 mm Hg) underwent a battery of mental stress tests, including simulated public speaking, anger recall interview, mirror trace, and cold pressor, before and after a 6-month treatment program. Subjects were randomly assigned to 1 of 3 treatments: (1) aerobic exercise, (2) weight management combining aerobic exercise with a behavioral weight loss program, or (3) waiting list control group. After 6 months, compared with control subjects, participants in both active treatment groups had lower levels of systolic blood pressure, diastolic blood pressure, total peripheral resistance, and heart rate at rest and during mental stress. Compared with subjects in the control group, subjects in the exercise and weight management groups also had greater resting stroke volume and cardiac output. Diastolic blood pressure was lower for the weight management group than for the exercise-only group during all mental stress tasks. These results demonstrate that exercise, particularly when combined with a weight loss program, can lower both resting and stress-induced blood pressure levels and produce a favorable hemodynamic pattern resembling that targeted for antihypertensive therapy.

Telles, S. (2000) has stated that there have been quite a number of studies that show regular exercise improves stamina, but hardly any that evaluate the effect of yoga on stamina (perceived physical exertion). In a research project conducted at the Defense Institute of Physiology in Delhi, India, the effect of training in Hatha yogic exercises on aerobic capacity and stamina was performed on 40 young men who were recruited in the Indian army. These soldiers, whose age ranged from 19 to 23, initially worked out to maximal exercise capacity on a bicycle ergometer. The oxygen consumption, carbon dioxide output, pulmonary ventilation, respiratory rate, heart rate etc., at maximal exertion were immediately thereafter recorded. The subjects were then divided into two equal groups. One group practiced Hatha yogic exercises for 1 h every morning (6 days in a week) for six months. The other group underwent conventional physical exercise training during the same period common to what many soldiers
are required to do. In the 7th month, tests for perceived physical exertion were repeated on both groups of subjects. The results showed that those who engaged in daily yoga practice noticed that they did not get as tired after heavy physical exertion as those who just did regular exercises. Their aerobic capacity also improved. Therefore, it appears that yoga enhances stamina even better than regular exercise. This would indicate that athletes in many different fields may well improve their endurance and performance by adding yoga practices to their routine workouts. Yoga could also certainly be helpful for those who have fatigue or low energy. I personally notice that regular yoga practice enhances my stamina in terms of how long I can hike, bike, or dance.

Shin, et.al. (1997) studied the effects of endurance training on autonomic function in athletes with spectral analysis of cardiovascular variability signals. Continuous ECG, arterial blood pressure (ABP), and respiratory signals were recorded from 15 athletes (VO2max > 55 ml.min-1.kg-1) and 15 nonathletic (VO2max < 45 mL.min-1.kg-1) during 10 min of sitting position. Autonomic function was assessed by low frequency power (LF power: 0.06-0.14 Hz) and high frequency power (HF power: the region of the respiratory frequency based on respiratory spectrum) obtained from the auto spectra of RR interval, systolic arterial pressure (SAP), and diastolic arterial pressure (DAP) variability signals. The spontaneous baroreflex sensitivity was evaluated by the moduli, BRSLF and BRSHF, of the transfer function between RR interval and SAP variability in LF and HF bands. The resting HR in athletes was significantly lower than that in nonathletic. The HF power, an index of parasympathetic activity, in RR interval spectra was significantly higher in athletes than in nonathletic. Meanwhile, the LF power (an indicator of sympathetic activities contributing to RR interval and of ABP variabilities) showed no significant difference between both groups, although that of athletes was slightly less than that of nonathletic. Also, BRSLF and BRSHF were not significantly different between athletes and nonathletic. These results
indicate that endurance training results in the enhanced vagal activities in athletes, which may contribute in part to the resting bradycardia.

Davy, Willis and Seals (1997) investigated the influence of exercise training on heart rate variability in post-menopausal women with elevated arterial blood pressure. Low heart rate variability (HRV) has been reported to be an independent risk factor for the development of coronary heart disease in women and has recently been identified as a risk factor for cardiac sudden death and all-cause mortality. We have recently demonstrated that endurance-trained post-menopausal women demonstrate higher levels of HRV than sedentary control subjects. The purpose of the present study was to test the hypothesis that 12 weeks of regular aerobic exercise would increase HRV in sedentary post-menopausal women with elevated arterial blood pressure (BP) (i.e. either high normal BP or stage I hypertension). A secondary aim was to test the hypothesis that the increase in HRV with exercise would increase HRV in sedentary post-menopausal women with elevated arterial blood pressure (BP) (i.e. either high normal BP or stage I hypertension). A secondary aim was to test the hypothesis that the increase in HRV with exercise, if observed, would be associated with an increase in spontaneous cardiac baroreflex sensitivity (SBRS), an important physiological determinant of HRV. To accomplish these aims, we studied eight sedentary post-menopausal women (age = 54.5 +/- 1.3 years) before and after 12 weeks of aerobic exercise training (3.3 +/- 0.3 days per week at 70% +/- 2% of maximal heart rate for 43 +/- 3 min per day). Maximal oxygen uptake and body weight did not change (P<0.05) with training, but percentage fat (35.5 +/- 2.65 vs. 34.5 +/- 2.3%, P<0.05) decreased and treadmill time to exhaustion increased (9.8 +/- 0.5 vs. 11.3 +/- 0.5 min, P<0.005). Supine resting levels of heart rate, RR interval and the standard deviation of the RR interval (time domain measure of HRV) were unchanged (all P>0.05) from baseline levels after 12 weeks of aerobic training. Similarly, the high-frequency, low-frequency and total power of HRV (frequency domain measures) were also unchanged from
baseline (all P>0.05). SBRS was also not different before and after aerobic exercise training (10 +/- 2 vs. 13 +/- 3 ms mm/Hg-1 respectively, P>0.05). In contrast, systolic and diastolic BP were reduced approximately 8 and approximately 5 mm/Hg with training (both P<0.05) respectively. These results indicate that 12 weeks of moderate-intensity aerobic exercise training does not increase HRV or SBRS, despite producing a clinically significant reduction in HP at rest in post-menopausal women and elevated BP. Considered together with our previous findings in female master endurance athletes, these findings suggest that more intense and prolonged exercise training may be required to produce increases in HRV and SBRS in sedentary post-menopausal women.

Khanam, A.A. (1996) investigated whether autonomic functions and pulmonary functions improved in asthma patients after short term yoga training or not and the study was conducted with nine diagnosed bronchial asthma patients. Yoga training was given for seven days in a camp in Adhyatma Sadhna Kendra, New Delhi. The autonomic function tests to measure the parasympathetic reactivity (Deep Breathing test, Valsalva Manouever), Sympathetic reactivity (Hand Grip test, Cold Pressure test), and pulmonary function tests FVC, FEV1, PEFR, PIF, BHT and CE were recorded before and after yoga training. The resting heart rate after yoga training (P < 0.05) was significantly decreased (89.55 +/- 18.46/min to 76.22 +/- 16.44/min). The sympathetic reactivity was reduced following yoga training as indicated by significant (P < 0.01) reduction in DBP after HGT. There was no change in parasympathetic reactivity. The FVC, FEV1, PEFR did not show any significant change. The PIF (P < 0.01), BHT (P < 0.01) and CE (P < 0.01) showed significant improvement. The results closely indicated the reduction in sympathetic reactivity and improvement in the pulmonary ventilation by way of relaxation of voluntary inspiratory and expiratory muscles. The “comprehensive yogic life style change programme for patients of Bronchial Asthma” have shown significant benefit even within a short period.
Telles, et.al. (1993) studied the physiological changes in sports teachers following 3 months of training in Yoga. The report shows that in a group of 40 physical education teachers who already had an average of 8.9 years physical training, 3 months of yogis training produced significant improvement in general health (in terms of body weight and BP reduction and improved lung functions.) There was also evidence of decreased autonomic arousal and more of psycho physiological relaxation (heart rate and respiratory rate reduction) and improved somatic steadiness (decreased errors in the steadiness test). The changes at the end of 3 months in volar GSR in different direction (increase/decrease/no change), depending on the initial values, suggests that practicing yoga may help to bring about a balance in different autonomic functions, so that functioning is optimised.

Steinhaus, et.al. (1988) studied the cardio respiratory fitness of young and older active and sedentary men. Physiological profiles are described for 30 healthy young (20-31 years) and 30 healthy older (50-72 years) men. Half of the individuals in each group reported that during the previous five years they participated frequently in strenuous physical exercises; the other half reported sedentary life styles. A treadmill exercise test was used to determine maximal aerobic power (VO$_2$ max) Heart rate and blood pressure were measured during rest, maximal exercise and recovery. The active older men demonstrated significantly lower resting hear rates, lower systolic and diastolic blood pressure, higher VO$_2$ max, walked longer on treadmill, had lower recovery heart rates and weighed less. Older active men also had higher VO$_2$ max levels than young sedentary men. These results emphasis the range of benefits associated with exercise.

Palatini (1988) studied the blood pressure behaviour during physical activity. Aerobic exercise is currently being recommended in addition to pharmacological therapy for lowering blood pressure levels in hypertensive patients, i.e. in subjects whose resting blood pressure levels exceed 145/90 mm/Hg. On the other hand competitive sports are generally contraindicated.
in hypertensive, who are though to be at increased risk of morbidity or mortality from their blood pressure levels. The present knowledge of blood pressure behaviour during isotonic physical activity is almost wholly based on the results obtained by means of the ergometric tests. Several maximal and submaximal exercise protocols have been introduced, but none has proved to be superior for diagnostic purpose. There is general agreement that the systolic blood pressure increase determined by isotonic exercise usually ranges from 50 to 70 mm/Hg in both normotensive and hypertensive subjects. Diastolic blood pressure shows only minor changes in the normotensives, while in the hypertensive it tends to substantially increase because of their inability to adequately reduce their peripheral resistance. This mechanism may also explain the delay shown by the hypertensive in reaching pre-exercise blood pressure values during the recovery. On average diastolic blood pressure increases to a greater extent during bicycle ergometry than during treadmill, while no differences in external systolic blood pressure have been observed between the 2 tests. The results of several studies indicate that the blood pressure response to isotonic exercise is a marker for detection of hypertension earlier in the course of the disease, while resting blood pressure is still normal. According to some authors it is also of value in predicting future hypertension in individuals with borderline pressure levels. There are no conclusive data on the effect of training in blood pressure response to exercise. The majority of the published studies report small external pressure reductions after conditioning, which would merely reflect the reduction in resting blood pressure. Vasodilatation greatly influences the exercise-induced rise in blood pressure; in fact the external pressure increase is blunted when the test is preceded by an adequate warm-up session. Isometric effort is though to be contraindicated in hypertensive subjects, as it causes a pronounced increase not only of systolic but also of diastolic pressure. Mean blood pressure is, however, increased to the same extent by isotonic and isometric exercise, even though minor discrepancies have been reported by some authors.
Rivera Cisneros, Diaz and Lopex (1984) investigated the heart rate (HR), systolic (SBP), diastolic (DBP) and mean blood pressures (MBP) of fifty seven highly trained runners with a maximal oxygen consumption equal or superior to 55 ml/kg.min. during, resting, sitting and upright moveless positions (V\textsubscript{O}\textsubscript{2max} greater than or equal to 55 ml/kg. Min., groups I), and in fifty seven sedentary untrained men (group II). During sitting position the members of groups I, had a significantly lower DBP and MBP than the members of group II. In the members of group II the assumption of upright posture did not produce significance drop in SBP, DBP and MBP. The results of this investigation indicated that in human, vigorous physical activity produce lower values of arterial blood pressure, and might be of value in the prevention of high blood pressure. On the other hand, the observed responses in group I during orthostatisam, reveal a different regulation of the cardiovascular system. Changes in sympathetic and parasympathetic nervous system, venous compliance and plasma volume are designated as responsible of observed differences. This finding might also support the tendency to faintness reported by some authors in athletes.

Gary Hunter and McCarthy (1983) examined the effect of high-intensity anaerobic training on resting blood pressure and a vary other physiological performance, and psychological variable in eight adult male competitive cyclists who trained five days a week for eight weeks in two training programmes. Resting systolic blood pressure was significantly elevated in the both training programmes, and no differences were found in resting diastolic blood pressure or body weight. Significant training effects were found in both programmes for V\textsubscript{O}\textsubscript{2max} resting heart rate and maximal performance on a bicycle ergometer test.

Uppal (1982) in his study of secondary school level boys investigated endurance training employing slow continuous running method which significantly reduced resting systolic and diastolic blood pressure after exercise and found out that in the case of control group there was no significant change as it was obviously a reflection of inactivity.
Denis Massicotte, Avon and Corrivead (1979) investigated comparative effects of aerobic type training on men and women. Pre and post training Cardio-respiratory, muscular blood tests revealed significant and similar increases of the maximal VO$_2$, oxygenated pulse, physical performance, muscular strength and resistance in both sexes, significant decrease of oxygen uptake, heart rate, ventilation, respiratory quotient, respiratory equivalent and systolic pressure at given sub-maximal work levels.

Datey (1977) who examined the comparative effect of relation practices on stress, divided 86 patients of hypertension into three groups. Group-I consisted of persons who were not taking any antihypertensive drug, Group-II comprised persons whose blood pressure was adequately controlled with drugs, and Group-III consisted of persons whose blood pressure was not adequately controlled despite of drugs. All the three groups were taught savasana. After practising this asanas for a period of three months Group-I mean B.P. decreased from 134 to 107 mm/Hg., Group-II drug requirement was reduced by 32 percent and in Group-III mean B.P. was reduced from 120 to 110 mm of Hg. and drug requirement by 29 percent.

Gettman Larry (1977) studied the influence of body weight and physical condition on bicycle and treadmill sub maximal work. Sixty male college subjects’ comprising four groups light and heavy, conditioned and unconditioned were examined on the bicycle and treadmill PWC-150 tests. The sub maximal PWC tests on both ergometers consisted of 3 steady state work loads used to predict the work at a heart rate of 150 bpm. The treadmill work was expressed as % grade attained, vertical work, and total work accomplished. ANOVA showed that heavy and conditioned subjects has significantly higher PWCs on the bicycle, treadmill vertical, and total work tests than the light and unconditioned subjects. The Light and conditioned subjects had significantly higher PWCs on the percentage grade test and on the work per kg body weight tests than the Heavy
unconditioned subjects. In assessing the PWC-15, either the bicycle or treadmill total work tests can be used since they give comparable results for the same individual. Heavy persons have an advantage over light individuals for producing more total work at the same Heart Rate on both ergo meters. Light individuals can produce more work per kg body weight than heavy persons on both the bicycle and treadmill.

**Blackwell B.** (1976) selected seven 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.

**Patel C.** (1975) examined 34 hypertensive patients were assigned at random either to six weeks’ treatment by yoga relaxation methods with bio-feedback or to placebo therapy (general relaxation). Both groups showed a reduction in blood-pressure (from 168/100 to 141/84 mm/Hg in the treated group and from 169/101 to 160/96 mm/Hg in the control group). The difference was highly significant. The control group was then trained in yoga relaxation, and their blood-pressure fell to that of the other group (now used as controls).

**Patel, C.** (1975) also examined twenty hypertensive patients who were treated by psychophysical relaxation exercises for 12 months. Age and sex matched hypertensive controls were similarly followed up for 9 months. Statistically significant reductions in blood-pressure (BP) and antihypertensive drug requirements were satisfactorily maintained in the treatment group. Mere repetition of B.P. measurements and increased medical attention did not in themselves reduce B.P. significantly in control patients.
Udupa, et.al. (1975) observed that average systolic blood pressure decreased after three months of haltha yoga practice but returned to the pre-experiment value after 6 months. The average changes involved were small.

Richard Covey (1972) studied the effects of training at various heart rate intensities and he formed a control and four experimental groups which ran a mile for four days per week for six weeks on a motor driven treadmill at different intensity levels (60, 70, 80 and 90% of maximal heart rate level) Among the significant results were the following: @ Resting and maximal heart rates were lowered and maximal heart rates were lowered and maximum oxygen consumption was increased when heart rate intensity reached the 80 or 90% level.

Arthur Henry Pilch (1971) investigated the effect of regular periods of exercise, using a sub-maximal work load on the bicycle ergometer on selected cardio-vascular respiratory measurements of randomly assigned, middle aged volunteers and also tried to determine whether the cardio-vascular measurements of these subjects after physical training would be similar to those of younger, active male volunteers. The experimental group pedaled the bicycle ergometer thirty minutes per day, four days per week, for six weeks at a work load that kept the heart rate at 135 beats/minutes. The cardio-vascular parameters that were measured before and after training were heart-rate, ventilation-rate, blood pressure, oxygen uptake and carbon dioxide expired. The analysis of data by using ‘t’ test revealed that there was a significant improvement in heart rate at 750 and 1200 kilo pound meters work load, and recovery levels. There was a significant improvement in systolic pressure at all levels except at the 1200 kilo pound meters work load. Diastolic blood pressure showed a significant improvement at the 300 and 740 kilo pound meter work load. There was no significant change in oxygen uptake and carbon dioxide expired. There was no significant change in hemoglobin from pre to post training on the experimental group.
Bruce Sherwood Harger (1971) studied the effects of two frequencies of high volume interval training on the metabolic and cardio respiratory response of untrained college men. Specially, the following variables were compared and analyzed before and after training. Maximum oxygen consumption, physical work capacity, blood lactic acid concentration, maximum aerobic power, maximum ventilation, resting blood volume, resting heart rates, resting heart size, resting systolic intervals and resting hemoglobin concentration. He found that four times weekly is not better than training two times week in causing a decrease in maximal heart rate: both frequencies of training shows a tendency to reduce resting hemoglobin as a result of seven weeks of high volume interval training.

Charles A. Wallin and Schendal (1969) investigated the difference between the tests taken before and after ten weeks of training. Twenty one middle aged males who participated in a jogging programme performed a six minute submaximal exercise on a bicycle ergometer. Heart rate was obtained from electrocardiograph and blood pressure was measured by a manual sphygmomanometer. They reached the conclusion that ten weeks of jogging programme produced reduction is heart rate for middle aged men at rest and did not produce any significant change in either systolic or diastolic blood pressure.

Wallin Charles, C. and Schendal (1969) studied the changes in heart rate and blood pressure in 21 sedentary business and professional men 31 to 60 years of age after participation in a 10 week jogging program three days per week. The result showed heart rates were reduced significantly in the resting state, at six minutes during exercise, and at five minutes post exercise. The final diastolic blood pressure and significantly lower than the initial mean. The difference in systolic blood pressure was not significant. The investigator concluded that the decrease in heart rate and diastolic blood pressure at rest, during sub-maximal
exercise and during the recovery period indicate more efficient blood transport, less strain on the cardiovascular system and functional reserves and an increase in sub-maximal work capacity.

_Susane Milton_ (1966) investigated the women's jogging programmer at the Begun YM. YWCA, and vaulted the progress of 12 married women, 27 to 58 years of age. The women jogged three morning per week for twelve weeks with emphasis on increasing distance and time jogged rather than speed significant results included the following: Maximum heart rate during exercise and the recovery heart rate for each minute dropped, oxygen consumption increased, and lung ventilation volume increased in both the resting and working states. The mean resting heart rate dropped from 80.5 to 73.7 beats per minute. The jogging programme had little effect on diastolic and systolic blood pressures.

_Bkulund_ and _Holagren_ (1965) investigated the circulatory and respiratory adaptation during long term non-steady state exercise in sitting position. Six healthy male volunteers in average condition were studied by them during 60 minutes of exercise in the sitting position. Exercise intensity for each subject was selected such that the heart rate was 140 - 150 after 10 minutes and 170-180 after 60 minutes. The conventional right heart gatherisation technique was employed. As the exercise progressed the following results occurred. Continuously falling systemic arterial blood pressure, constant cardiac output and increasing heart rate (therefore decreasing stroke volume) as well as increasing total ventilation (both respiratory rate and tidal volume). Although progressive changes did not show in pH, there was a compensated metabolic acidosis in exercise and the blood volume was lower than in the resting supine position. The authors concluded that the changes may be explained by the gravitational shift in blood volume distribution.
Studies on Metabolic Responses

Tandon, G.K. (2002) in his study effect of light and exhaustive ergometric exercise on blood sugar, total cholesterol and pH in untrained young human subjects stated that light and exhaustive ergometric exercise in untrained male and female medical students in the age group 18 to 21 years resulted in significant lowering of the blood sugar, cholesterol and pH.

Prasad, K.V.V., et.al. (2001) have stated that pranayama is a basic yogic breathing technique, of which one of the methods is nadisodhana wherein breathing is performed through alternate nostrils. Their study aims at indentifying the energy cost of nadisodhana and compare it with standard physical activities such as controlled treadmill-walking and field-walking. The present study was conducted on twelve normal healthy male volunteers who have been practicing yoga and pranayama over a period of three years. The energy cost of nadisodhana and field-walking was derived from individual regression equations using oxygen consumption and heart rates recorded during a maximal graded exercise test on treadmill carried out in a thermoneutral environment. The predicted oxygen consumption and heart rate during nadisodhana were significantly lower than in field-walking (P < 0.05 & 0.01) and treadmill-walking (P < 0.01 & 0.01) indicating that the energy cost for nadisodhana is lower. Oxygen pulse during nadisodhana was also significantly lower than field-walking (P < 0.05) and treadmill-walking (P < 0.05). It was also observed that during nadisodhana blood lactate was significantly lower (P < 0.01 & 0.05) than during the other two tests studied and pyruvate was significantly lower (P < 0.01 & 0.05) than during the other two tests studied and pyruvate was significantly higher (P<0.01) than during treadmill-walking. The results indicate low exertion on the subjects, based on Borg scale during nadisodhana than in other forms of physical exercises. This low exertion may be attributed to efficient metabolic adaptations during nadisodhana. In view of the above findings nadisodhana can be included in the battery of fitness programs for both healthy and diseased individuals.
Telles, S. (2000) has stated that certain yoga asanas, if practiced regularly, are known to have beneficial effects on human body. Researchers at the University College of Medical Sciences, in Shahdara, New Delhi evaluated 24 patients aged 30 to 60 years old who had non-insulin dependent diabetes mellitus, also called Type II diabetes. Diabetics who require insulin are called Type I, while Type II diabetics are treated with diet, exercise, and oral medicines that lower blood sugar. The researchers evaluated the baseline fasting blood sugar levels of the patients, and they also performed pulmonary function studies. These pulmonary function studies measure lung capacity and the amount of air that can be exhaled within the first second of a rapid exhale. After performing these basic tests, yoga experts gave these patients training in yoga asanas. The yoga practice was done 40 minutes a day for 40 days. These asanas consisted of 13 well known and common postures, done in a sequence. After 40 days of yoga asanas regimen, the testing was repeated. The results indicate that there was significant decrease in fasting blood sugar levels from about 190 initially to 140 after the 40 day period of yoga activity. Fasting blood sugar in people without diabetes is usually below 120. The lung studies showed an average improvement of about 10 percent in lung capacity. These findings suggest that better blood sugar control and pulmonary functions can be obtained in type I diabetics when they stick to a daily schedule of yoga asanas and pranayama. The exact mechanism as to how these postures and controlled breathing interact with physiomedrol neuro-endocrine mechanisms affecting blood sugar.

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*Udupa, K.N.* (1996) conducted a study on biochemical changes following a selective combined practice of yoga namely yogic postures, pranayama and relaxation type of meditation of volunteers. Their age was 20 to 25 years. The volunteers who practiced the yoga practices for a period of six months. At end of six month yogic practises showed there was a reduction of blood sugar and serum cholesterol, on the other hand the serum protein improved during the same period.

*Udupa, K.N.* (1996) stated that there occurred a generalized reduction in all the biochemical parameters except in the urinary 17-hydroxycorticoid (by product of cortisol) which was found increased. Otherwise, serum cholinesterases, plasma catecholamines, serum lipids, serum cholesterol and blood sugar were all found reduced at the end of six months of breath
control practice. This indicated that pranayama produces a good effect on all the organs and tissues and helps in maintaining their activity at the optimum level. The EEG studies during pranayama revealed increased alpha waves throughout the period which tend to suggest enhance mental tranquillity of the person during the period.

**Jain, S.C., et al.** (1993) investigated changes in blood glucose and glucose tolerance by oral glucose tolerance test (OGTT) after 40 days of yoga therapy in 149 non-insulin-dependent diabetics (NIDDM). The response to yoga in these subjects was categorized according to a severity scale index (SSI) based on area index total (AIT) under OGTT curve. One hundred and four patients showed a fair to good response to the yoga therapy. There was a significant reduction in hyperglycemia and AIT with decrease in oral hypoglycemia and AIT with decrease in oral hypoglycemic drugs required for maintenance of normoglycemia. It is concluded that yoga, a simple and economical therapy, may be considered a beneficial adjuvant for NIDDM patients.

**Gore, M.M.** (1988) conducted a study yoga cure of diabetes. Dhanurasana, Paschimottanasana, padangusthasana, Bhujangasana, Sarvangasana, Ardha-matsyendrasana, Halasana, Yoga mudrasana, Supta vajrasana, Chakrasana and Shalabhasana were given to diabetes voluteers for a period of 4 weeks. He found that asanas found to be effective in the control of blood sugar level and cure of diabetes.

**Ramaiah, S.A.A.** (1986) conducted a study in Washington D.C., comparing the effects of walking, treadmill, static cycling with amarantha kokkuasana (sitting crane), nidra kokkuasana (standing crane) and vil asana (bow pose, rocking especially side to side). The most effective were found to be the latter, it was concluded that the direct stimulation of the pancreas by the postures rejuvenated its capacity to produce insulin thereby decreased the blood sugar level.
Singh, R.H. and Udupa, K.N. (1977) conducted a series of comparative psychological studies on apparently normal educated male volunteers who had been practising certain meditative and cultural six months. They found that six months of yogic practices induced a feeling of well-being, a reduction in body weight and increased vital capacity. It was also observed that blood sugar and serum cholesterol levels of fasting were lowered and certain endocrine functions, specially adrenocortical, thyroid and testicular functions were accelerated. On the other hand, psychological studies revealed an improvement in memory and performance, lowered mental fatigue rate, a reduction in neuroticism index and a lowered incidence of physiological and psychological complaints assessed using the Cornell Medical Index.

Studies on Stress Management

Parshad, O. (2004) has stated that the state of the mind and that of the body are intimately related. If the mind is relaxed, the muscles in the body will also be relaxed. Stress produces a state of physical and mental tension. Yoga, developed thousands of years ago, is recognized as a form of mind-body medicine. In yoga, physical postures and breathing exercises improve muscle strength, flexibility, blood circulation and oxygen uptake as well as hormone function. In addition, the relaxation induced by meditation helps to stabilize the autonomic nervous system with a tendency towards parasympathetic dominance. Physiological benefits which follow, help yoga practitioners become more resilient to stressful conditions and reduce a variety of important risk factors for various diseases, especially cardiorespiratory diseases.

Astin, J.A. (1997) examined the effects of an 8-week stress reduction program based on training in mindfulness meditation. Twenty-eight individuals who volunteered to participate in the present study were randomized into either an experimental group or a nonintervention control group. Following participation, experimental subjects, when compared with
controls, evidenced significantly greater changes in terms of: (1) reductions in overall psychological symptomatology; (2) increase in overall domain-specific sense of control and utilization of an accepting or yielding mode of control in their lives, and (3) higher scores on a measure of spiritual experiences. The techniques of mindfulness meditation, with their emphasis on developing detached observation and awareness of the contents of consciousness, may represent a powerful cognitive behavioral coping strategy for transforming the ways in which we respond to life events. They may also have potential for relapse prevention in affective disorders.

Bowman, A.J., et al. (1997) stated that the effects of aerobic exercise training and yoga, a non-aerobic control intervention, on the baroreflex of elderly persons was determined. Baroreflex sensitivity was quantified by the alpha-index, at high frequency (HF: 0.15-0.35 Hz, reflecting parasympathetic activity) and mid-frequency (MF: 0.05-0.15 Hz, 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 68 years, range 62-81 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 (69 +/- 8 vs. 61 +/- 7 min-1, P < 0.05) but not aerobic training (66 +/- 8 vs. 63 +/- 9 min-1, P = 0.29). VO2 max increased by 11% following yoga (P < 0.01) and by 24% following aerobic training (P < 0.01). No significant change in alpha MF (6.5 +/- 3.5 vs. 6.2 +/- 3.0 ms mm/Hg-1, P = 0.69) or alpha HF (8.5 +/- 4.7 vs. 8.9 +/- 3.5 ms mm/Hg-1, P = 0.65) occurred after aerobic training. Following yoga, alpha HF (8.0 +/- 3.6 vs. 11.5 +/- 5.2 ms mm/Hg-1, P < 0.01) but not alpha MF (6.5 +/- 3.0 vs. 7.6 +/- 2.8 ms mm/Hg-1, P = 0.29) increased. Short-duration aerobic training does not modify the alpha-index at alpha MF or alpha HF in healthy normotensive elderly subjects. alpha HF but not alpha MF increased following yoga, suggesting that these parameters are measuring distinct aspects of the baroreflex that are separately modifiable.
**Panjwani, U.** (1996) studied the effect of Sahaja yoga meditation on seizure control and electroencephalographic alterations was assessed in 32 patients of idiopathic epilepsy. The subjects were randomly divided into 3 groups. Group-I (n = 10) practiced Sahaja yoga for 6 months, Group-II (n = 10) practiced exercises mimicking Sahaja yoga for 6 months and Group-III (n = 12) served as the epileptic control group. Group I subjects reported a 62 percent decrease in seizure frequency at 3 months and a further decrease of 86 per cent at 6 months of intervention. Power spectral analysis of EEG showed a shift in frequency from 0-8 Hz towards 8-20 Hz. The ratios of EEG powers in delta (D), theta (T), alpha (A) and beta (B) bands i.e., A/D, A/D + T, A/T and A + B/D + T were increased, percent D power decreased and per cent A increased. No significant changes in any of the parameters were found in Groups-II and III, indicating that Sahaja yoga practice brings about seizure reduction and EEG changes. Sahaja yoga could prove to be beneficial in the management of patients of epilepsy.

**Panjwani, U.** (1995) evaluated the effect of Sahaja yoga meditation in stress management in patients of epilepsy. The study was carried out on 32 patients of epilepsy who were randomly divided into 3 groups: group I subjects practiced Sahaja yoga meditation for 6 months, group II subjects practiced postural exercises mimicking Sahaja yoga and group III served as the epileptic control group. Galvanic skin resistance (GSR), blood lactate and urinary vinyl mandelic acid (U-VMA) were recorded at 0, 3 and 6 months. There were significant changes at 3 & 6 months as compared to 0 month values in GSR, blood lactate and U-VMA levels in group I subjects, but not in group II and group III subjects. The results indicate that reduction in stress following Sahaja yoga practice may be responsible for clinical improvement which had been earlier reported in patients who practiced Sahaja yoga.

**Miller, J.J.** (1995) in his study of 22 medical patients with DSM-III-R-defined anxiety disorders showed clinically and statistically significant
improvements in subjective and objective symptoms of anxiety and panic following an 8-week outpatient physician-referred group stress reduction intervention based on mindfulness meditation. Twenty subjects demonstrated significant reductions in Hamilton and Beck Anxiety and Depression scores post intervention and at 3-month follow-up. In this study, 3-year follow-up data were obtained and analyzed on 18 of the original 22 subjects to probe long-term effects. Repeated measures analysis showed maintenance of the gains obtained in the original study on the Hamilton [F(2,32) = 13.22; P < 0.001] and Beck [F(2,32) = 9.83; P < 0.001] anxiety scales as well as on their respective depression scales, on the Hamilton panic score, the number and severity of panic attacks, and on the Mobility Index-Accompanied and the Fear Survey. A 3-year follow-up comparison of this cohort with a larger group of subjects from the intervention who had met criteria for screening for the original study suggests generalizability of the results obtained with the smaller, more intensively studied cohort. Ongoing compliance with the meditation practice was also demonstrated in the majority of subjects at 3 years. We conclude that an intensive but time-limited group stress reduction intervention based on mindfulness meditation can have long-term beneficial effects in the treatment of people diagnosed with anxiety disorders.

Rao, P.V.K. (1995) in his paper has dealt with the scientific and psychological significance of yoga as a mean of affiancing spiritual emancipation. Within the yogic fold, the has described the nature and significance of raja yoga, kriyas, asanas, pranayamas, bandhas and mudras. Findings from the empirical studies on yoga revealed that long-term practitioners of yoga hand acquired a remarkable voluntary control over their autonomic processes, which helped them in coping with psychological stress. The author described yoga as a system of psychotherapy and called upon clinicians to perfect yoga therapy so as to make its application universal.
**Schell, F.J., et.al.** (1994) stated that Hatha-Yoga has become increasingly popular in western countries as a method for coping with stress. However, little is known about the physiological and psychological effects of yoga practice. We measured heart rate, blood pressure, the hormones cortisol, prolactin and growth hormone and certain psychological parameters in a yoga practicing group and a control group of young female volunteers reading in a comfortable position during the experimental period. There were no substantial differences between the groups concerning endocrine parameters and blood pressure. The course of heart rate was significantly different, the yoga group had a decrease during the yoga practice. Significant differences between both groups were found in psychological parameters. In the personality inventory the yoga group showed markedly higher scores in life satisfaction and lower scores in excitability, aggressiveness, openness, emotionality and somatic complaints. Significant differences could also be observed concerning coping with stress and the mood at the end of the experiment. The yoga group had significant higher scores in high spirits and extravertedness.

**Dostaleck, C.** (1994) discussed possible physiological mechanisms of hatha-yogic exercises, including changes in the intensity and distribution of excitation and inhibition in the brain, habituation of reflexogenic areas, and modification of the rhythmicity of the functions. Other possible mechanisms include attainment of homeostasis of regulations by disbalancing them, classical conditioned reflex, restricted consciousness, and shifting of vegetative balance toward a relative parasympaticotony. Hatha yoga can be used for prevention and therapy of psychosomatic diseases, rehabilitation (both orthopedic and visceral), and research of physiological regulations. It includes psychohygienic and autopsychotherapeutic approaches and, properly practiced, poses no risk.

**Khumar, S.S.** (1993) examined the effectiveness of Shavasana (a type of yoga exercise) as a therapeutic technique to alleviate depression. 50 female university students were diagnosed with severe depression; 25
were subjected to 30 sessions of Shavasana, and 25 served as controls. Results reveal that (1) Shavasana was an effective technique for alleviating depression and (2) continuation of the treatment for a longer period resulted in a significantly increased positive change in the subjects.

**Berger, B.G.** (1992) examined the benefits of Hatha yoga and swimming, two activities that differ greatly in aerobic training benefits. College students (N = 87) in two swimming classes, a yoga class, and a lecture-control class completed mood and personality inventories before and after class on three occasions. A multivariate analysis of variance indicated that both yoga participants (n = 22) and swimmers (n = 37) reported greater decreases in scores on Anxiety, Confusion, Tension, and Depression than did the control students (n = 28). The consistent mood benefits of yoga supported our earlier observation that the exercise need not be aerobic to be associated with mood enhancement. However, underlying and causal mechanisms remain uncertain. Among the men, the acute decreases in Tension, Fatigue, and Anger after yoga were significantly greater than those after swimming. Yoga may be even more beneficial than swimming for men who personally select to participate. The women reported fairly similar mood benefits after swimming and yoga. It seems that aerobic exercise may not be necessary to facilitate the mood benefits. Also, students with greater mood changes attended class more regularly than those who reported fewer psychological benefits. Maximizing the immediate psychological benefits of exercise might be one way to encourage adults to be physically active.

**Latha, D.** (1992) investigated the effect of yoga as a therapeutic aid in the treatment of migraine and tension headaches in 20 patients. Ss were randomly assigned to 4 months of yoga therapy and no treatment control conditions. Ss in both groups were assessed for headache activity (in terms of frequency, duration, and intensity), sources of stress, coping patterns, and somatic symptoms before and after the therapeutic intervention. There was significant reduction in the headache activity, medication intake, symptoms, and stress perception for the therapy group. They also showed significant improvement in coping behavior.
Platania-Solazzo, A., et al. (1992) assessed the immediate effects of relaxation therapy (RT) in 40 hospitalized children and adolescents with diagnoses of adjustment disorder and depression. These effects were assessed using a within subjects pre-test/post-test design and by comparison with a control group of 20 depressed and adjustment disorder patients who watched a 1-h relaxing videotape. The 1-h RT class consisted of yoga exercise, a brief massage and progressive muscle relaxation. Decreases were noted in both self-reported anxiety and in anxious behavior and fidgeting as well as increases in positive affect in the RT but not the video group.

Dhume, R.R. (1991) work is aimed to compare the relative strength of dextroamphetamine and yogic meditation on the performance of 3 different groups of medical students to concentrate on the task to balance on a balance board. Group A subjects were meditators, group B subjects were given orally 5 and 10 mg of dextroamphetamine in a capsule, 1 hr prior to the test. Group C subjects were given same capsule but with lactose in place of the drug (placebo). This last group served as a control for the study. The balance index was calculated taking into account their balance time and error score at each trial of 5 min duration showed that the performance of the group B (drug) had declined with overall percentile fall of 40.6% as compared to the performance of the controls (placebo) whereas, the performance of Group A (meditators) went on steadily and progressively increasing throughout the period of 10 trial days with overall percentile rise of 27.8%. The results were conclusive to confirm earlier reports that amphetamine is not of use for improvement of task rather, it deteriorates the task performance. Contrary to that, yogic meditation is of merit to achieve concentration for mental as well as physical task.

Samraj (1991) conducted a study on the effect of practice of asanas alone and a combination of asanas, pranayama and meditation on anxiety and aggression. In this study ninety school boys were selected at random.
Subjects were tested on anxiety and aggression before and after ten weeks of yogic training and found that anxiety level was significantly reduced but there was no change in aggression after practising yoga.

_Narayan, R., et al._ (1990) work is aimed to quantify the degree of relaxation of muscle under the effects of Kundalini Yoga with the help of EMG integrator. The data collected from 8 individuals (4 males 4 females) on the degree of muscle relaxation at the end of meditation revealed a significantly decreased muscle activity amounting to 58% of the basal level in both the sexes.

_Latha, D._ (1987) conducted a study on 20 patients (aged 16-55 years) with migraine and tension headaches were randomly assigned to yoga therapy (YT) or no therapy. YT Ss compared with controls showed a significant reduction in headache activity, medication intake, symptoms, and perceived stress, and they had a significant improvement in coping behavior. It is suggested that YT is superior to drug therapy in controlling headaches.

_Cummings_ (1984) investigated as study to evaluate the effectiveness of six weeks endurance training, progressive relaxation meditation and their combinations for changing stress levels as reflected by change in heart rate, state anxiety levels, urinary catecholamines at rest and after twenty minutes of examination stress. The effect of the treatment on PWC 170, trait anxiety levels and resting systolic and diastolic blood pressure were also determined. Thirty seven healthy female subjects were randomly assigned to one of four treatment groups success. 1) control and specific training, 2) exercise 20min/day, 2 days/week at 75% of age related maximum heart rate, 3) meditation 20min/day, 3 days/week, 4) combination exercises and meditation. The result showed that post treatment adjusted mean trait anxiety, resting systolic pressure and stress heart rate were of significantly reduced in the exercises, meditation and combination groups. The exercise and combination treatment also showed a significant increase in post treatment
adjusted mean PWC 170. The groups trained in progressive relaxation meditation showed a greater effect on heart rate and blood pressure than the exercise group. The exercise group on the other hand had its greater, effect on trait anxiety scores and urinary catecholamine concentration.

Harvey, J.R. (1983) studied the importance of breath in relation to achieving physiological self-control in behavioral therapies and in its relation to emotional state in Gestalt and Reichian psychology. Several Eastern traditions also emphasize the importance of breath regulation in achieving emotional self-control. In this study, 6 Ss (aged 20-55 years) participated in a 4-wk class of yogic breathing exercises, 6 Ss (aged 22-35 years) took a 6-wk on the philosophy of meditation, and 8 Ss (aged 25-48 years) took a course in psychology. Ss who learned breathing exercises showed significant changes on several dimensions of mood, (including the Profile Mood States), including increased vigor and decreased tension, fatigue and depression relative to subjects in control groups. Results suggest that yogic breathing exercises positively affect mood and that they have clinical potential as a self-control technique for improving and stabilizing affective states.

Karwande (1981) made a study on the comparative effect of yogic and physical exercises on anxiety level and mental fatigue of children. This study was carried with sixty male students from VII and VIII standard. The average age of the subjects was 12 years. The test of anxiety level and the test of mental fatigue were taken as criterion measures for the purpose of the study. The tests were taken before and after the experimental period of six weeks. He concluded that anxiety level can be reduced either by training in selected asanas or related physical exercises. Mental fatigue can be reduced either by training in selected asanas or is related physical exercise and the training in selected asanas was superior to the training in physical exercise for both variables though the difference was not statistically significant.
Tandon, M.K. (1978) studied eleven patients with severe chronic airways obstruction were given training in yogic breathing exercises and postures. A matched group of 11 patients were given physiotherapy breathing exercises. Both groups of patients were followed up at monthly intervals for nine months with pulmonary function tests, tests of exercise tolerance, and inquiry into their symptoms. After training in yoga the mean maximum work increased significantly by 60.55 kpm; whereas no such rise occurred after training in physiotherapy. This objective improvement was associated with symptomatic improvement in a significantly higher number of patients given training in yoga.

Corby, J.C. (1978) examined autonomic and electroencephalographic (EEG) correlates of Tantric Yoga meditation were studied in three groups of subjects as they progressed from normal consciousness into meditation. Groups differed in their level of meditation proficiency. Measures of skin resistance, heart rate, respiration, autonomic orienting responses, resting EEG, EEG alpha and theta frequencies, sleep-scored EEG, averaged evoked responses, and subjective experience were employed. Unlike most previously reported meditation studies, proficient meditators demonstrated increased autonomic activation during meditation while unexperienced meditators demonstrated autonomic relaxation. During meditation, proficient meditators demonstrated increased alpha and theta power, minimal evidence of EEG-defined sleep, and decreased autonomic orienting to external stimulation. An episode of sudden autonomic activation was observed that was characterized by the meditator as an approach to the Yogic ecstatic state of intense concentration. These findings challenge the current “relaxation” model of meditative states.

Kocher (1973) made a study on yoga practices as a variable in neuroticism, anxiety and hostility. He concluded that significant reduction in total neuroticism, anxiety level and general hostility was observed in twenty subjects of experimental groups as compared to seventeen subjects of control group after eight months training programme in yoga.
There are 11 reviews referred to in this section about stress hormone cortisol responses. In the light of the review of the literature it was found that exercises increased the production of cortisol. The level of cortisol was raised during exercises of both moderate and severe intensity and fell rapidly to the basal level within a few hours of completion of exercises. However it was reported that highly trained athletes had a raised basal level of cortisol. It was found that the training effects of yogic practices and aerobic exercises elevated the stress hormone cortisol level considerably.

There are 28 reviews referred to in this section about circulatory responses. From the review of the literature it was found that the resting heart rate was the lowered adaptation to training. The para sympathetic nervous system was activated reducing the biochemicals epinephrine and norepinephrine. Hence the resting heart rate was lowered. It was reported that yogic practices and aerobic exercises lowered the resting heart rate effectively. Besides the systolic blood pressure and diastolic blood pressure were significantly reduced.

There are 10 reviews referred to in this section about the metabolic responses namely blood sugar, serum cholesterol and serum protein. They revealed that the blood sugar level and the serum cholesterol level can be reduced while the serum protein level can be increased significantly. It was reported that the training effects of yogic practices and also aerobic exercises reduced the blood sugar level and serum cholesterol level while raising the serum protein level beneficially.

There are 23 reviews referred to in this section about stress management. As evident from the above review of the literature it was
found that exercises decreased the stress level leading to the effective management of stress. The capability of stress threshold was also improved. The stress tolerance capacity was increased by improving stress competency. It was reported that the training effects of yogic practices and aerobic exercises significantly decrease the stress level there by enhancing the stress tolerance capacity and bettered the physical, mental and emotional health leading to a healthy well-being of players.