CHAPTER – II

REVIEW OF RELATED LITERATURE

The review of literature related to the problem has been presented in this Chapter. The working bibliography was collected from the libraries of Annamalai University, Annamalai Nagar, Alagappa University, Karaikudi, Sports Authority of India and Nethaji Subash National Institute of Sports, Bangalore. The researcher also collected related information from the Internet.

John Parthiban and Nageswaran (2006) conducted a useful study with the aim to find out the influence of twelve weeks of Hypoxic Training programme on Resting pulse rate, breath holding Time and cardio respiratory endurance on college men. For this purpose 40 college men forming two groups-Hypoxic Training Group (20) and control Group (20), were selected, Experimental group performed Hypoxic Training, three days a week for a period of Twelve weeks. ANCOVA was used to find out the adjusted mean significant difference, between the groups. From the results it was concluded Resting Pulse Rate, Breath-Holding-Time and Cardio respiratory endurance were
significantly improved when compared to the control group due to the efficiency of Hypoxic Training.

Varghese (1999) examined the effect of Hypoxic Training at varied altitude on selected physiological variables and the performance of 1500 meters run. For her investigation she selected 60 male college students aged between 18 and 22 years. She then divided them into two equal groups of 30 (N=30) each for hypoxic training at high altitudes and hypoxic training at low altitudes. She found that hypoxic training at high altitudes showed better improvement in the VO$_2$ Max, resting pulse rate and 1500 meter running performance than at low altitudes.

Cross country skiers and triathletes (M = 17; F = 5) were observed while at training at sea level and living in simulated normobaric hypoxia (sea level pressure but altitude oxygen reduction). The simulated environment was experienced for 12-16 hours per day. The study lasted 25 days. VO$_2$ max was measured before, immediately after, and one week after the experience while red cell mass and erythropoietin (EPO) were before measured, on days 2, 11, 18, and 25, and 4-7 days after. On days 2 and 25, EPO was 60% and 14% higher than the before measure. EPO was not related to the increase in red cell mass, which changed +5% between before and immediately after the acclimatization period. VO$_2$ max changed in a different and delayed manner. It was only after the seven days post-
experience that it improved by +3%, for there was no significant change during the experience itself. The absence of any relationships between VO$_2$ max, red cell mass, and EPO concentration is puzzling. These factors are supposed to be interrelated. For example, EPO is purported to increase the oxygen carrying capacity of the blood, which is the principal reason for its popularity among endurance cyclists, but that was not observed here. In a similar vein, EPO is supposed to increase the concentration and number of red cells in the blood. However, here EPO concentrations and red cell mass were unrelated while VO$_2$ max was unrelated to either factor.

This study raises more questions than it answers and seems to "shake" some popular understandings about hemodynamic and usable oxygen capacity. An artificial environment of sea level pressure with simulated altitude oxygen reduction stimulates changes in red cell mass, EPO, and VO$_2$ max, but in a seemingly unrelated manner (Rusko et.al, 1999).

Another study wanted to find out if gender specific changes occurred in the decrement in VO$_2$ max from sea level at altitudes of 984 m (3,000 ft), 1,640 m (5,000 ft), and 2,625 m (8,000 ft). Ss (M = 7; F = 7) residing between 1640 and 2460 m completed cycle ergometry tests of VO$_2$ max at each altitude in a hypo/hyperbaric chamber. Females had significantly less decrement (10%) change
in VO2 max than males (23%) between sea level and 2,625 m. Detectable differences emerged at 984 m. Gender differences could not be attributed to differences in hypoxemia or fitness. Females retain a larger percent of their VO2 max during increasing hypobaric hypoxia (altitude) than males. This difference is unrelated to hemoglobin oxygen saturation and cardio respiratory endurance (Robergs et.al, 1997).

The purposes of the findings are devoted to HIF-1a transcription factor; induction of its synthesis is regulated by the level of oxygen and its active forms. Data on the structure of the transcription factor, its subunits, HIF-1a regulation under conditions of normoxia, hypoxia, and increased formation of active oxygen forms are presented. The role of induction of HIF-1a and HIF-regulated proteins induction in intracellular redox signaling and the maintenance of cell homeostasis under conditions of hypoxia is discussed. The authors data on the time course of this transcription factor induction after acute hypoxia and stress, correlation of its level with changes in expression of urgent response defense proteins are presented. Different levels of defense proteins (HIF-1a, HOx-1, and HSP70) in response to ROS signal were observed in the myocardium, brain, and liver 3, 6, and 12 h after acute hypoxia. Correlations were detected between
HIF-1α and HOx-1 induction in the heart and liver, but not brain, and of HIF-1α and HSP70 in all three organs. (Zhukova and Sazontova, 2005).

Mishchenko et.al, (2002) studied the physiological reactions of the cardiorespiratory system (CRS) to respiratory homeostasis shifts in elite athletes with different directions of long-term adaptation (athletic training). A relationship between CRS characteristics and physical working capacity as well as mobilization of aerobic and anaerobic mechanisms of energy supply during exercise was shown. Taxonomic analysis demonstrated the types of individual reactions of elite runners, basing on the type of CRS reaction to hypercapnic shifts of respiratory homeostasis at rest. The CRS sensitivity to CO2-H+ and hypoxic stimuli underlies differences in the realization of anaerobic and aerobic energy potential of the body and the kinetics and limitations of CRS reactions under conditions of maximum exercise loading.

The efficiency of a course of interval hypoxic training added to the protocol of combined treatment of obesity was evaluated.
Interval hypoxic training notably decreased the stress effect of therapeutic measures and thus promoted a complex of favorable changes in lipid and carbohydrate metabolism (Fedorova, et.al, 2003).

Doloman, et.al, (2004) found out the effects of acute and chronic exposure to high-altitude hypoxia (2100, 3100, and 5642 m above sea level) on the concentrations of stable metabolites of nitric oxide (NO) in human blood. It was shown for the first time that blood concentrations of NO2- and NO3- increased in residents of the mountain regions in comparison with residents of the plain. Increase in the concentration of NO2- in erythrocytes was the most pronounced (almost 6-fold). In order to evaluate the effect of acute hypoxia on NO production, blood levels of its stable metabolites were measured in normal subjects during adaptation to the mountain conditions (2100 and 3100 m above sea level). Blood content of NOx (NO2- + NO3-) increased as early as on day 1 of being in the mountains (50.5% increase in the plasma and 101.1% increase in erythrocytes) and virtually did not change later. Examinations of a group of mountaineers before and immediately after they climbed the Elbrus showed that plasma NOx concentration surpassed the initial level by 31.8% and the erythrocyte concentration surpassed it by 39.9% (P<0.01). Hence,
being in the mountains is associated with hyperproduction of NO in human blood, which starts immediately after arrival in the mountains and correlates with the height above sea level. Presumably, activation of NO synthesis under high-altitude conditions is one of the first mechanisms of cardiovascular system adaptation to hypoxia, maintaining the optimal oxygen supply when its partial pressure in inhaled air is low.

The following report is worth considering: Intermittent hypoxia has been suggested to increase exercise tolerance by enhancing stress resistance and improving oxygen delivery. Because the improvement of exercise tolerance reduces mortality in the elderly with and without coronary artery disease, intermittent hypoxia might be a valuable preventive and therapeutic tool. However, controlled studies are lacking. Methods and results: Sixteen males (50-70 years, 8 with and 8 without prior myocardial infarction) were randomly assigned in a double-blind fashion to receive 15 sessions of passive intermittent hypoxia (hypoxia group) or normoxia (control group) within 3 weeks. For the hypoxia group each session consisted of three to five hypoxic (14-10% oxygen) periods (3-5 min) with 3-min normoxic intervals. Controls inhaled only normoxic air in the same way. Exercise tests were performed before and after the 3-
week breathing program. After 3 weeks of intermittent hypoxia peak oxygen consumption had increased compared to normoxic conditions (+6.2% vs. -3%, p<0.001). This improvement was closely related to the enhanced arterial oxygen content after hypoxia (r=0.9, p<0.001). Both higher haemoglobin concentration and less arterial oxygen desaturation during exercise contributed to the increase in arterial oxygen content. During sub-maximal exercise (cycling at 1 W/kg) heart rate, systolic blood pressure, blood lactate concentration, and the rating of perceived exertion were found to be diminished after intermittent hypoxia compared to control conditions (all p<0.05). Changes in responses to exercise after intermittent hypoxia were similar in subjects with and without prior myocardial infarction. Three weeks of passive short-term intermittent hypoxic exposures increased aerobic capacity and exercise tolerance in elderly men with and without coronary artery disease. (Burtscher et.al, 2005).

Prokofyer and his Colleagues (2005) studied the effect of adaptation to low-pressure chamber interval hypoxia (PCIHA) on the serum lipid spectrum in 30 patients with myocardial infarction during cicatrization in comparison with exercise therapy in 15 patients (control). Adaptation therapy led to a significant reduction of the levels of total cholesterol,
triacylglycerides, and atherogenicity index. A course of PCIHA was associated with a significant decrease in the blood levels of apoproteins A and B (by 8 and 17%, respectively) in experimental group, this being paralleled by an increase in the ApoA/ApoB ratio, indicating a lower probability of uncontrolled transport of cholesterol into the vascular intima. In controls the ApoA/ApoB ratio decreased, despite positive shifts in the studied parameters of cholesterol metabolism, this, no doubt, indicating the absence of positive molecular shifts in the metabolic pathways of cholesterol metabolism and hence, persisting high risk of further development of atherosclerosis.

A study by Pedlar et.al, (2008) showed that training in normobaric hypoxia prior to ascent to high altitude induces acclimazation to altitude in mountaineers. It is therefore likely that a similar training paradigm will be useful for athletes travelling to moderate altitude for training or competition. To test this contention, the acute effects of normobaric hypoxia upon selected physiological and performance parameters during treadmill exercise were examined. The parameters chosen were heart rate, blood lactate concentration, ventilation, oxyhaemoglobin saturation, and 5-km treadmill time-trial performance. The participants were 12 endurance-trained
athletes (mean age 29.4 years, s=5.3; stature 1.80 m, s=0.8; body mass 78.3 kg, s=9.6). Tests were conducted once in sham conditions (F\textsubscript{I}O\textsubscript{2}=0.209, P\textsubscript{I}O\textsubscript{2}=159 mmHg, sea level; ST trial) and once in normobaric hypoxic conditions (F\textsubscript{I}O\textsubscript{2}=0.149, P\textsubscript{I}O\textsubscript{2}=85 mmHg, ~2500 m; HT1 trial) using a normobaric hypoxic chamber system. Subsequently, the participants were assigned to two groups to train (75 min·day\textsuperscript{-1}, 8 days, at a running speed corresponding to ≤2 mmol·l\textsuperscript{-1}) in normobaric hypoxia (F\textsubscript{I}O\textsubscript{2}=0.149; n=6, hypoxia group) or sham conditions (F\textsubscript{I}O\textsubscript{2}=0.209; n=6, sham group). Acutely (ST vs. HT1), 5-km time-trial performance time was significantly extended in HT1 (13.6%, range 6.3-22.5%; P<0.01). Following training (HT2), performance improved by 0.8% and 2.3% for the sham and hypoxia training group respectively, but the improvement was not significant for either group (P>0.05). The individual data showed wide heterogeneity. In conclusion, aerobic training in normobaric hypoxia for 75 min·day\textsuperscript{-1} for 8 days does not enhance performance in hypoxia. However, due to the heterogeneity of response, it is evident that it may be effective at improving performance in hypoxia in some individuals.

**Nummela and Rusko (2000)** investigated the benefits of 'living high and training low' on anaerobic performance at sea level, eight 400-m runners lived for 10 days in normobaric
hypoxia in an altitude house (oxygen content = 15.8%) and trained outdoors in ambient normoxia at sea level. A maximal anaerobic running test and 400-m race were performed before and within 1 week of living in the altitude house to determine the maximum speed and the speeds at different submaximal blood lactate concentrations (3, 5, 7, 10 and 13 mmol x l(-1)) and 400-m race time. At the same time, ten 400-m runners lived and trained at sea level and were subjected to identical test procedures. Multivariate analysis of variance indicated that the altitude house group but not the sea-level group improved their 400-m race time during the experimental period (P < 0.05). The speeds at blood lactate concentrations of 5-13 mmol x l(-1) tended to increase in the altitude house group but the response was significant only at 5 and 7 mmol x l(-1) (P < 0.05). Furthermore, resting blood pH was increased in six of the eight altitude house athletes from 0.003 to 0.067 pH unit (P < 0.05). The results of this study demonstrate improved 400-m performance after 10 days of living in normobaric hypoxia and training at sea level. Furthermore, the present study provides evidence that changes in the acid-base balance and lactate metabolism might be responsible for the improvement in sprint performance.
Oxygen transport by red blood cells is regulated by erythropoiesis and Hb-O2-affinity. The O2 carrying capacity is characterized by changes in hematocrit, red blood count or the mass of circulating red blood cells. Erythropoiesis is controlled by the hormone erythropoietin, which induces slow changes of the O2-transport capacity.

The Hb-O2-affinity is modified mainly by pH and 2,3-DPG. Despite their apparently diverse effects e.g. in hypoxia at high altitude, a compromise seems to be adopted optimizing both arterial O2-loading and peripheral O2-unloading. In contrast to erythropoiesis, adjustments of the Hb-O2-affinity occur fast and allow rapid adjustments of O2-binding and release. In the intact organism the significance of changes in Hb-O2-affinity for tissue oxygen supply relative to adjustments of cardiac output, microcirculation and O2-transport capacity is not completely understood yet, but beneficial effects were demonstrated in isolated organs. It is, however, the least energy-demanding way of optimizing tissue O2-supply, which might be of significance in extreme situations. In severe hypoxia adjustments of both, hematocrit and Hb-O2-affinity are insufficient to maintain tissue O2-supply. Alterations of Hb-O2-affinity are also insufficient to compensate for severe anemia (Mairbaurl, 1994).
Benoit et al., (1997) examined the effect of acute hypoxia on oxygen uptake (VO2) during incremental (IE) and constant work load exercises. Twenty-two healthy subjects performed two incremental exercises on a bicycle ergometer under normoxic (21% O2) and hypoxic (10.4% O2) conditions. Fifteen subjects performed a constant work load exercise at the same absolute power (CAP) (116 +/- 33 W), while seven other subjects performed three constant work load exercises at the same relative power (CRP) (50, 60 and 70% of VO2 max) in both conditions. VO2 was defined as extraventilatory when the estimation of respiratory muscles O2 consumption was subtracted from the total VO2. During IE, the slope of the linear regression relating VO2 to work rate was higher in normoxia than in hypoxia (11.6 +/- 1.2 ml.l-1.W-1 vs 10.1 +/- 1.1 ml.l-1.W-1, p < 0.01).

During CAP, VO2 was lower in normoxia than in hypoxia (1.88 +/- 0.45).min-1 vs 1.96 +/- 0.42 l.min-1, p < 0.01) whereas extraventilatory VO2 was not significantly different (1.80 +/- 0.441.min-1 vs 1.77 +/- 0.36) l.min-1). During CRP, the slope relating VO2 to power output computed from the three workloads was not statistically different between normoxia and
hypoxia (delta VO$_2$ /delta w = 11.9 +/- 3.1 ml.min$^{-1}$W$^{-1}$ vs 12.3 +/- 1.2 ml.min$^{-1}$W$^{-1}$). These findings showed that during CRP, the metabolic efficiency (delta VO$_2$ /delta W) was the same in normoxia and in hypoxia. During CAP, the respiratory muscles O2 consumption might have accounted for the difference in VO$_2$ consumption between hypoxia and normoxia.

The findings of Peltonen et al., (1999): Male endurance athletes were measured at rest and during progressive cycling in hyperoxia (30% O2), normoxia (21% O2), and hypoxia (15% O2). Starting at 0 W, power was increased 100 W in 5-minute increments in the exercise task. Maximal cardiac output, VO$_2$ max, and maximal performance were diminished in hypoxia. Diminished COmax in hypoxia was affected both by decreased maximal stroke volume and heart rate. In hyperoxia, COmax was increased only slightly despite a correspondingly greater increase in VO$_2$ max. Changes in oxygen saturation in the atmosphere are only partially related to observe changes in parameters associated with cardiac output.

A study focusing on the usefulness of Breathing exercises reports as follows:

The incidence of bronchial asthma is on the increase. Chemotherapy is helpful during early course of the disease, but
later on morbidity and mortality increase. The efficacy of yoga therapy though appreciated is yet to be defined and modified. The aim was to study the effect of breathing exercises (pranayama) in patients with bronchial asthma of mild to moderate severity. Fifty cases of bronchial asthma (Forced Expiratory Volume in one second (FEV1) > 70%) were studied for 12 weeks. Patients were allocated to two groups: group A and group B (control group). Patients in group A were treated with breathing exercises (deep breathing, Brahmari and Omkara, etc.) for 20 minutes twice daily for a period of 12 weeks. Patients were trained to perform Omkara at high pitch (forceful) with prolonged exhalation as compared to normal Omkara. Group B was treated with medication for 20 minutes twice daily for a period of 12 weeks. Subjective assessment, FEV1%, and Peak Expiratory Flow Rate (PEFR) were done in each case initially and after 12 weeks. After 12 weeks, group A subjects had significant improvement in symptoms, FEV1, and PEFR as compared to group B subjects. Breathing exercises (pranayama), mainly expiratory exercises, improved lung function subjectively and objectively and should be regular part of therapy (Saxena and Saxena, 2009).

Telles and Desiraju, (1991) determined the yogic Ujjayi pranayamic type of breathing that involves sensory awareness
and consciously controlled, extremely slow-rate breathing including at least a period of end-inspiration breath holding in each respiratory cycle that might alter oxygen consumption. Ten males with long standing experience in pranayama, and volunteering to participate in the laboratory study were assessed. These subjects aged 28-59 years, had normal health appropriate to their age. Since Kumbhak (timed breath holding) is considered as an important phase of the respiratory cycle in the pranayama, they were categorised into two groups of five each, one group practising the short Kumbhak varieties of pranayama, and the other the long Kumbhak varieties of pranayama. The duration of Kumbhak phase was on an average 22.2 per cent of the respiratory cycle in the short Kumbhak group and 50.4 per cent in the long Kumbhak group. The oxygen consumption was measured in test sessions using the closed circuit method of breathing oxygen through the Benedict-Roth spirometer. Each subject was tested in several repeat sessions. Values of oxygen consumption of the period of pranayamic breathing, and of post-pranayamic breathing period, were compared to control value of oxygen consumption of the pre-pranayamic breathing period of each test session. The results revealed that the short Kumbhak pranayamic breathing caused a statistically significant increase (52%) in the oxygen consumption (and metabolic rate) compared
to the pre-pranayamic base-line period of breathing. In contrast to the above, the long Kumbhak pranayamic breathing caused a statistically significant lowering (19%) of the oxygen consumption (and metabolic rate). The values returned to near normal in the post-pranayamic periods. The data provide a basis to indicate that different types of pranayamic breathing may lead to different types of alterations in the oxygen consumption and metabolic rate.

There is increasing interest in the fact that breathing exclusively through one nostril may alter the autonomic functions. Another study aimed at checking whether such changes actually do occur, and whether breathing is consciously regulated. 48 male subjects, with ages ranging from 25 to 48 years were randomly assigned to different groups. Each group was asked to practise one out of three pranayamas (viz. right nostril breathing, left nostril breathing or alternate nostril breathing). These practices were carried out as 27 respiratory cycles, repeated 4 times a day for one month. Parameters were assessed at the beginning and end of the month, but not during the practice. The ‘right nostril pranayama’ group showed a significant increase, of 37% in baseline oxygen consumption. The ‘alternate nostril pranayam’ a group showed an 18% increase, and the left nostril pranayama group also showed an increase, of 24%.
This increase in metabolism could be due to increased sympathetic discharge to the adrenal medulla.

The ‘left nostril pranayama’ group showed an increase in volar galvanic skin resistance, interpreted as a reduction in sympathetic nervous system activity supplying the sweat glands. These results suggest that breathing selectively through either nostril could have a marked activating effect or a relaxing effect on the sympathetic nervous system. The therapeutic implications of being able to alter metabolism by changing the breathing pattern have been mentioned *(Telles, et. al, 1993)*

A study on the usefulness of HRV Reports thus:

The heart rate variability (HRV) is an indicator of the cardiac autonomic control. Two spectral components are usually recorded, viz. high frequency (0.15- 0.50 Hz), which is due to vagal efferent activity and a low frequency component (0.05- 0.15 Hz), due to sympathetic activity. 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).
Twelve male volunteers (age range, 21 to 33 years) were assessed before and after each practice on separate days. The electrocardiogram (lead 1) was digitized on-line and off-line. An analysis was done. 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 nadi suddhi. 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 psychophysiological measure than heart rate alone (Raghuraj et al., 1998).

The following reports on the effects of yoga and yogic breathing exercises are worthy of consideration:

Increasing rates of psychosocial disturbances give rise to increased risks and vulnerability for a wide variety of stress-related chronic pain and other illnesses. Relaxation exercises aim at reducing stress and thereby help prevent these unwanted outcomes. One of the widely used relaxation practices is yoga and yogic breathing exercises. One specific form of these exercises is Sudarshan Kriya and related practices (SK&P) which are understood to have favourable effects on the mind-body system. The goal of this pilot study was to
design a protocol that can investigate whether SK&P can lead to increased feeling of wellness in healthy volunteers. Participants were recruited in a small university city in Sweden and were instructed in a 6-day intensive program of SK&P which they practised daily for six weeks. The control group was instructed to relax in an armchair each day during the same period. Subjects included a total of 103 adults, 55 in the intervention (SK&P) group and 48 in the control group. Various instruments were administered before and after the intervention. Hospital Anxiety Depression Scale measured the degree of anxiety and depression, Life Orientation Test measured dispositional optimism, Stress and Energy Test measured individual's energy and stress experiences. Experienced Deviation from Normal State measured the experience of altered state of consciousness. There were no safety issues. Compliance was high (only 1 dropout in the SK&P group, and 5 in the control group). Outcome measures appeared to be appropriate for assessing the differences between the groups. Subjective reports generally correlated with the findings from the instruments. The data suggest that participants in the SK&P group, but not the control group, lowered their degree of anxiety, depression and stress, and also increased their degree of optimism (ANOVA; p < 0.001). The participants in the yoga group experienced the practices as a positive event that induced beneficial effects. These data indicate that the experimental protocol that is developed here is
safe, compliance level is good, and a full scale trial is feasible. The data obtained suggest that adult participants may improve their wellness by learning and applying a program based on yoga and yogic breathing exercises; this can be conclusively assessed in a large-scale trial (Kjellgren, et.al, 2007).

Researchers like Brown and Gerbarg (2005) claim that yogic breathing is a unique method for balancing the autonomic nervous system and influencing psychologic and stress-related disorders. One part of their report presented a neurophysiologic theory of the effects of Sudarshan Kriya Yoga (SKY) and another part reviewed clinical studies, their own clinical observations, and guidelines for the safe and effective use of yoga breath techniques in a wide range of clinical conditions. Although more clinical studies are needed to document the benefits of programs that combine pranayama (yogic breathing) asanas (yoga postures), and meditation, there is sufficient evidence to consider Sudarshan Kriya Yoga to be a beneficial, low-risk, low-cost adjunct to the treatment of stress, anxiety, post-traumatic stress disorder (PTSD), depression, stress-related medical illnesses, substance abuse, and rehabilitation of criminal offenders. SKY has been used as a public health intervention to alleviate PTSD in survivors of mass disasters. Yoga techniques enhance well-being, mood, attention, mental focus, and stress tolerance. Proper training
by a skilled teacher and a 30-minute practice every day will maximize the benefits. Health care providers play a crucial role in encouraging patients to maintain their yoga practices.

Stress affects different systems in the body, including the immune system and the endocrine system, and thereby affects the whole physiology. Stress is also linked to the habit of tobacco consumption and substance abuse, which in turn leads to disease states. Previous research has suggested that Sudarshan Kriya (SK) and Pranayama (P), rhythmic breathing processes derived from yoga, reduce stress and improve immune functions. The following is a brief report of another interesting study: the possible affect of SK&P on natural killer (NK) cells, a critical cell type in the immune system which helps fight pathogens and cancer was assessed in cancer patients who completed their standard therapy. SK&P practice correlated with increases in NK cell numbers, but not in the number of other immune cells. Furthermore, SK&P helped to reduce tobacco use in 21% of the individuals at 6 months of practice. Larger and randomized studies are needed, but these findings suggest that SK&P may help boost the immune system in cancer patients (Kochupillai, et.al, 2005).
A novel study employing Buteyko breathing technique report thus:

Patients with asthma are interested in the use of breathing exercises but their role is uncertain. The effects of the Buteyko breathing technique, a device which mimics pranayama (a yoga breathing technique), and a dummy pranayama device on bronchial responsiveness and symptoms were compared over 6 months in a parallel group study. Ninety patients with asthma taking an inhaled corticosteroid were randomised after a 2 week run in period to Eucapnic Buteyko breathing, use of a Pink City Lung Exerciser (PCLE) to mimic pranayama, or a PCLE placebo device. Subjects practised the techniques at home twice daily for 6 months followed by an optional steroid reduction phase. Primary outcome measures were symptom scores and change in the dose of methacholine provoking a 20% fall in FEV₁ (PD₂₀) during the first 6 months. Sixty nine patients (78%) completed the study. There was no significant difference in PD₂₀ between the three groups at 3 or 6 months. Symptoms remained relatively stable in the PCLE and placebo groups but were reduced in the Buteyko group. Median change in symptom scores at 6 months was 0 (interquartile range −1 to 1) in the placebo group, −1 (−2 to 0.75) in the PCLE group, and −3 (−4 to 0) in the Buteyko group (p=0.003 for difference between groups).
Bronchodilator use was reduced in the Buteyko group by two puffs/day at 6 months; there was no change in the other two groups (p=0.005). No difference was seen between the groups in FEV\textsubscript{1}, exacerbations, or ability to reduce inhaled corticosteroids. The Buteyko breathing technique can improve symptoms and reduce bronchodilator use but does not appear to change bronchial responsiveness or lung function in patients with asthma. No benefit was shown for the Pink City Lung Exerciser (Cooper, et.al, 2003).

**Katiyar and Bihari,**(2006) studied the Effects of Pranayama on COPD patients considering PFT, blood gases, 6MWT and SGRQ scores and compared with control. Forty eight patients with severe COPD were randomly divided (24 each) into two groups. Group 1 patients were trained to do paranayama for 3 months for at least half hour duration. Both the groups were allowed to continue with their usual physical activity and medications. Spirometry, ABG, 6MWT was done and SGRQ scores were measured before and after study.

Training-induced changes were greater in group 1 than 2 for following variables: increase of FVC (% predicted) from 68 ± 4.2 to 72 ± 3.9 (p=0.11), FEV\textsubscript{1} (% predicted) from 48 ± 2.4 to 52 ±2.1,
(p=0.15), PEF (%predicted) from 24.2 ± 0.9 to 30.1 ± 0.8 (p<0.05), 
6MWT from 262 ± 38 to 312 ± 47 m (p<0.05). There was decrease 
in scores of symptoms (72 ± 2.5 to 66 ± 2.9, p<0.03), activity (66± 
2.1 to 50 ± 1.7, p<0.005), impact (53± 2.9 to 39 ± 1.8, p<0.008) 
and total score (55± 2.9 to 48 ±2.3 p<0.02) in group 1 but not in 
group 2 patients.

The effects of a yoga therapy program were studied by Jain 
and Talukdar (1993) on 46 patients of chronic bronchial asthma 
including exercise capacity, pulmonary functions and blood 
gases. Exercise capacity was measured by 3 tests: (i) 12 min walk 
test: (ii) physical fitness index by modified Harvard step test; and 
(iii) Exercise-Liability index. Yoga therapy resulted in an increase 
in pulmonary functions and exercise tolerance. A one-year follow-
up study showed a good to fair response with reduced symptoms 
scores and drug requirements in these subjects.

In a study by Jain et.al (1991) forty six young asthmatics 
with a history of childhood asthma were admitted for yoga 
training. Effects of training on resting pulmonary functions, 
exercise capacity, and exercise-induced bronchial liability index 
were measured. Yoga training resulted in a significant increase in 
pulmonary function and exercise capacity. A follow-up study
spanning two years showed a good response with reduced symptom score and drug requirements in these subjects.

Another study reports as follows:

Nine diagnosed bronchial asthma patients were given yoga training for seven days. The autonomic function tests to measure parasympathetic reactivity (Deep Breathing test, Valsalva Maneouver), sympathetic reactivity (Hand Grip test, Cold Pressure test), and pulmonary function tests were recorded before and after yoga training. The resting heart rate after yoga training was significantly decreased. The sympathetic reactivity was reduced following yoga training. There was no change in parasympathetic reactivity. The results indicated the reduction in sympathetic reactivity and improvement in pulmonary ventilation by way of relaxation of voluntary inspiratory and expiratory muscles (Khanam et al., 1996).

According to Marks et al., (2002) yoga and control groups attended a 2 hour session once a week for 4 months. Asthma related quality of life (AQLQ), Profile of Mood States (POMS), level of airway hype responsiveness to methacholine (AHR), and a diary card based combined asthma score (CAS) reflecting symptoms, bronchodilator usage, and peak expiratory flow rates were
measured at the end of the treatment period and again 2 months later. The AHR and the AQLQ mood subscale improved more in the yoga group, as did the summary POMS score.

One previous study reports the following:

Fifty three patients with asthma underwent training for two weeks in an integrated set of yoga exercises including breathing exercises, physical postures, breath slowing techniques, meditation, and a devotional session, and were told to practise these exercises for 65 minutes daily. They were then compared with a control group of 53 patients with asthma matched for age, sex, and type and severity of asthma, who continued to take their usual drugs. There was a significantly greater improvement in the group who practiced yoga in the weekly number of attacks of asthma, scores for drug treatment, and peak flow rate (Nagarathna and Nagendra, 1985).

The present study was aimed at finding the efficacy of a non-pharmacological approach of naturopathy and Yoga in bronchial asthma. 37 patients received treatment including 1. Diet therapy 2. Nature cures treatment and 3. Yoga therapy. The various parameters including lung function test were measured on admission and once a week. The results showed
significant improvement in PEFR, VC, FVC, FEV1, FEV/FEC %, MVV, ESR and absolute eosinophil count. The patients reported a feeling of well being, freshness and comfortable breathing (Sathyaprabha, 2001).

This study reports the effects of yoga training on cardiovascular response to exercise and the time course of recovery after the exercise. Cardiovascular response to exercise was determined by the Harvard step test using a platform of 45 cm height. The subjects were asked to step up and down the platform at a rate of 30/min for a total duration of 5 min or until fatigue, whichever was earlier. Heart rate (HR) and blood pressure response to exercise were measured in the supine position before exercise and at 1, 2, 3, 4, 5, 7 and 10 minutes after the exercise. Exercise produced a significant increase in HR, systolic pressure and a significant decrease in diastolic pressure. After two months of yoga training, exercise-induced changes in these parameters were significantly reduced (Udupa, et.al, 2004).

In yet another research, after an initial integrated yoga training program of 2 to 4 weeks, 570 bronchial asthmatics were followed up for 3 to 54 months and the results showed significant
improvement in most of the specific parameters. The regular practitioners showed the greatest improvement. Peak expiratory flow rate (PFR) values showed significant movement after yoga, and 72, 69, and 66% of the patients stopped or reduced parenteral, oral, and cortisone medication, respectively (Nagendra and Nagarathna, 1986).

Another set of researcher investigated the changes in cardiorespiratory and metabolic intensity brought about by the practice of pranayamas (breathing exercises of yoga) and meditation during the same hatha-yoga session. The technique applied was the one advocated by the hatha-yoga system. Nine yoga instructors—five females and four males, mean age of 44+/-11, 6, were subjected to analysis of the gases expired during three distinct periods of 30 min: rest, respiratory exercises and meditative practice. A metabolic open circuit computerized system was applied (VO₂ 000, MedGraphics-USA). The oxygen uptake (VO(2)) and the carbon dioxide output (VCO(2)) were statistically different (P <or= 0.05) during meditation and pranayama practices when compared with rest. The heart rate also suffered relevant reductions when results at rest were compared with those during meditation. A smaller proportion of lipids were metabolized during meditation practice compared with rest. The results suggest that
the meditation used in this study reduces the metabolic rate whereas the specific pranayama technique in this study increases it when compared with the rest state (Danucalov et.al, 2008).