REVIEW OF LITERATURE

Bhavanani (2011) Hypertension is one of the most common health disorders, and yoga has been shown to be an effective adjunct therapy in its management. Earlier studies have reported blood pressure (BP)-lowering effects of slow, deep breathing after 3 weeks and 3 months of training and beneficial immediate effects of slow, deep breathing in reducing premature ventricular complexes and lowering blood pressure. None of these immediate studies used the concept of pranayama, involving conscious internal awareness of the whole breathing process. This study was undertaken to determine the immediate cardiovascular effects of sukha pranayama in hypertensive patients. Methods: Twenty-three hypertensive patients attending the Yoga OPD at JIPMER were recruited for the study and instructed to perform sukha pranayama for 5 minutes at the rate of 6 breaths/min. This pranayama involves conscious, slow and deep breathing with equal duration for inhalation and exhalation. Heart rate (HR) and BP were recorded before and immediately after the intervention. Results: Post-intervention statistical analysis revealed a significant (p < .05) reduction in HR and a highly significant (p < .001) reduction in systolic pressure, pulse pressure, mean arterial pressure, rate-pressure product, and double product with an insignificant fall in diastolic pressure. Discussion: It is concluded that sukha pranayama at the rate of 6 breaths/minute can reduce HR and BP in hypertensive patients within 5 minutes of practice. This may be due to a normalization of autonomic cardiovascular rhythms as a result of increased vagal modulation and/or decreased sympathetic activity and improved bar reflex sensitivity. Further studies are required to understand possible mechanisms underlying this beneficial immediate effect and to determine how long such a beneficial effect persists.

Sinha et al. (2002) Studied suggested that Energy Cost and Cardiorespiratory Changes During the Practice of Surya Namaskar. Surya Namaskar (SN), a group of Yogic exercise consists of a set of twelve postures which is practiced by some of the yoga practitioners. The present study was undertaken to observe critically the energy cost and different cardio respiratory changes during the practice of SN. Twenty-one male volunteers from the Indian Army practiced selected Yogic exercises for six days in a week for three months duration. The Yogic practice schedule consisted of Hatha Yogic Asanas (28 min), Pranayama (10.5 min) and Meditation (5 min). In the Yogic practice schedule 1st they practiced Kapalbhati (breathing
maneuvers) for 2 min then Yogamudra (yogic postural exercise) for 2 min, after that they took rest until oxygen consumption and heart rate (HR) came to resting value. Subsequently subjects performed SN for 3 min 40 seconds on an average. After three months of training at the beginning of the fourth month subjects performed entire Yogic practice schedule in the laboratory as they practiced during their training session and experiments were carried out. Their pulmonary ventilation, carbon dioxide output, Oxygen consumption, HR and other cardio respiratory parameters were measured during the actual practice of SN. Oxygen consumption was highest in the eighth posture (1.22 ± 0.073 1 min⁻¹) and lowest in the first posture (0.35 ± 0.02 1 min⁻¹). Total energy cost throughout the practice of SN was 13.91 kcal and at an average of 3.79 kcal/min. During its practice highest HR was 101 ± 13.5 b.p.m. As an aerobic exercise SN seemed to be ideal as it involves both static stretching and slow dynamic component of exercise with optimal stress on the cardio respiratory system.

Gnanabakthan and Elangovan (2012) studied to investigate the effects of the selected Yogic practices of Swami Satyananda Saraswati (Group A) and Swami Kuvalayananda (Group-B) on Police men with Health fitness components, Physiological and Psychologically. To facilitate the study, 90 Police men were selected from Tamil Nadu Police Academy at vandalur, Chennai were selected as subjects and their aged between 30 to 45 years. In this study yogic practices were given to experimental group for the period of Twelve weeks in progression. The pre test was taken from the subjects before administering the training. The subjects were involved with their respective training for a period of Twelve weeks. At the end of the Twelfth week training post test were taken. After the experimental period of Twelve weeks post test scores were obtained from all the three groups. The scores on Health fitness components, Physiological and Psychological variables were considered as the effect of varied training of yogic practices on Police men. The mean differences were tested for significance using Analysis of Covariance (ANCOVA) among three groups on selected Health fitness components, Physiological and Psychological variables on Police men. To find out the paired mean differences, scheffe’s post hoc test was used.

Shashikala et al. (2011) Yoga is an ancient science, which originated in India. Pranayama has been assigned a very important role in yogic system of exercises. It is known that regular practice of breathing exercises (pranayama) increases parasympathetic tone,
decreases sympathetic activity, and improves cardiovascular functions. Different types of breathing exercises alter autonomic balance for good by either decrease in sympathetic or increase in parasympathetic activity. *Mukh Bhastraika* (yogic bellows), a type of *pranayama* breathing when practiced alone, has demonstrated increase in sympathetic activity and load on heart, but when practiced along with other types of *pranayama* has showed improved cardiac performance.

Madhanmohan et al. (2004) studied 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 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 supine position before exercise and at 1, 2, 3, 4, 5, 7 and 10 minutes after the exercise. Rate-pressure product \[RPP = (HR \times SP)/100\] and double product \[DoP = HR \times MP\], which are indices of work done by the heart were also calculated. Exercise produced a significant increase in HR, systolic pressure, RPP & DOP and a significant decrease in diastolic pressure. After two months of yoga training, exercise induced changes in these parameters were significantly reduced. It is Concluded that after yoga training a given level of exercise leads to a milder cardiovascular response, suggesting better exercise tolerance.

Manjunath and Telles (2001) Introduced the Effects of Sirsasana (Headstand) Practice on Autonomic and Respiratory Variables. The present study had two aims: (1) To assess heart rate variability (HRV) along with non-specific autonomic measures (used in earlier studies), before and after two minutes of the head stand. (2) To compare changes in two categories of subjects, i.e., those who practiced the headstand in a traditional way (without any support) and those who used the support of the wall (a present day adaptation). The subjects were forty male volunteers (age range 19 to 36 years), with twenty subjects under each category. The following changes were significant after the practice, compared to values at baseline. (i) Both categories had an increase in the power of the low frequency component (LF) and a decrease in the high frequency component (HF) of the HRV spectrum, increased LF/HF ratio, and decreased heart rate. (ii) Subjects who practiced the headstand with the support of a wall showed reduced finger plethysmogram amplitude suggesting increased sympathetic vasomotor tone. (iii) Practicing the
headstand without support was associated with an increase in the skin conductance level, suggestive of increased sympathetic sudomotor tone. Hence, both categories showed similar changes in the HRV components though changes in sympathetic vasomotor and sudomotor activity were different. These changes suggest sympathetic activation, irrespective of the method of practice.

Shashidhar et al (2011) Pranayama has a very important role in the yogic system of exercises and it has been said to be much more important than yogasanas for keeping sound health. The practice of Mukh Bhastrika, a type of pranayama, is known to improve human performance. The studies which have been conducted till date were on the effect of the short term practice of Mukh Bhastrika, other types of pranayamas and yoga in general. The Reaction Time (RT) is a means of determining the sensory motor association and the performance.

Parshad et al (2011) Studied Sixty-four healthy medical students (57 females and 7 males), mean age 21.3 ±2.6 years, attending a Special Study Module 'Role of Dhyana Yoga in Stress Management', participated in this study. Systolic (SYS) and Diastolic (DIA) blood pressure, Heart Rate (HR), Stroke Volume (SV), Cardiac output (CO), Total Peripheral Resistance (TPR), Interbeat Interval (IBI), Left Ventricular Ejection Time (LVET), Arterial Compliance (Cwk) and Ascending Aorta Impedance (Zao) were measured before and after six weeks of yogic exercises. Various exercises included asanas (Postures), pranayama (Breathing), and dhyana (Meditation). Data were analyzed using Stat for Windows. Two-tailed paired t-test revealed that practice of yoga caused significant increases in HR (p < 0.05), SV (p < 0.01), CO (p < 0.001) and Cwk (p < 0.01) and decreases in TPR (p < 0.001), IBI (p < 0.05) and Zao (p < 0.001) after practicing yoga for 6 weeks as compared to before yoga practice. No significant differences were, however, observed in SYS, DIA, Mean arterial blood pressure (MAP) and LVET.

Santaella et al. (2011) Studied 76 healthy elderly subjects were enrolled in a randomized control trial in Brazil and 29 completed the study (age 68±6 years, 34% males, body mass index 25±3 kg/m²). Subjects were randomized into a 4-month training program (2 classes/week plus home exercises) of either stretching (control, n=14) or respiratory exercises (yoga, n=15). Yoga respiratory exercises (Bhastrika) consisted of rapid forced expirations followed by inspiration through the right nostril, aspiratory apneas with generation of intrathoracic negative pressure,
and expiration through the left nostril. Pulmonary function, maximum expiratory and inspiratory pressures (PE$_{\text{max}}$ and PI$_{\text{max}}$, respectively), heart rate variability and blood pressure variability for spontaneous bar reflex determination were determined at baseline and after 4 months. Subjects in both groups had similar demographic parameters. Physiological variables did not change after 4 months in the control group. However, in the yoga group, there were significant increases in PE$_{\text{max}}$ (34%, p<0.0001) and PI$_{\text{max}}$ (26%, p<0.0001) and a significant decrease in the low frequency component (a marker of cardiac sympathetic modulation) and low frequency/high frequency ratio (marker of sympathovagal balance) of heart rate variability (40%, p<0.001). Spontaneous bar reflex did not change, and quality of life only marginally increased in the yoga group.

Pramanik et al. (2009) Heart rate and blood pressure of volunteers (n = 39, age = 25-40 years) was recorded following standard procedure. First, subjects had to sit comfortably in an easy and steady posture (sukhasana) on a fairly soft seat placed on the floor keeping head, neck, and trunk erect, eyes closed, and the other muscles reasonably loose. The subject is directed to inhale through both nostrils slowly up to the maximum for about 4 seconds and then exhale slowly up to the maximum through both nostrils for about 6 seconds. The breathing must not be abdominal. These steps complete one cycle of slow pace Bhashrika pranayama (respiratory rate 6/min). During the practice the subject is asked not to think much about the inhalation and exhalation time, but rather was requested to imagine the open blue sky. The pranayama was conducted in a cool, well-ventilated room (18-20 degrees C). After 5 minutes of this breathing practice, the blood pressure and heart rate again were recorded in the aforesaid manner using the same instrument. The other group (n = 10) took part in another study where their blood pressure and heart rate were recorded following half an hour of oral intake of hyoscine-N-butylibromide 20 mg. Then they practiced the breathing exercise as stated above, and the abovementioned parameters were recorded again to study the effect of parasympathetic blockade on the same pranayama. It was noted that after slow Bhashrika pranayam breathing (respiratory rate 6/min) for 5 minutes, both the systolic and diastolic blood pressure decreased significantly with a slight fall in heart rate. No significant alteration in both blood pressure and heart rate was observed in volunteers who performed the same breathing exercise for the same duration following oral intake of hyoscine-N-butilbromide. Vagal cardiac and pulmonary mechanisms are linked, and
improvement in one vagal limb might spill over into the other. Bar receptor sensitivity can be enhanced significantly by slow breathing (supported by a small reduction in the heart rate observed during slow breathing and by reduction in both systolic and diastolic pressure). Slow pace Bhasrika pranayama (respiratory rate 6/min) exercise thus shows a strong tendency to improving the autonomic nervous system through enhanced activation of the parasympathetic system.