Chapter II

REVIEW OF RELATED LITERATURE

A careful review and exploration of related literature and research studies are essentials to have an insight into the work already been done in the field, so that unwanted duplications can be avoided before completing a plan for conducting the research work. A researcher needs to search the literature in the area of the proposed investigation, in reviewing literature of the completed researches; the investigator may be able to understand valuable ideas of hypothesis, significance procedure and interpreting the results. The research scholar has tried to scan the available literature to selected studies which were directly or indirectly related with the present study. An attempt has been made to present a summary review of related literature, which may be helpful in understanding and bringing out meaningful outcomes about this study. Some of the important reviews of the related literature have been cited below:

Verma & Kapri\(^{22}\) (2013) conducted the study on the “effect of Pranayama on intensity of pain and Haemoglobin during menstruation phase of females. The purpose of the study was to explore the effect of Pranayama on intensity of pain and Haemoglobin during menstruation phase of females. Single and unmarried female groups of 30 subjects (20-24 years) were randomly selected for study from BHU, Varanasi. This 30 minutes package was given to the subject for two months. Pain was assessed by using the standardized questionnaire Moos (1968) “Menstrual Distress Questionnaire” version 2011 and the level of haemoglobin was assessed by a reputed pathological laboratory and their well trained technicians as per the direction & time given by the investigator. Pre-test of pain & Haemoglobin was conducted to all subjects during their menstruation phase. In training of Pranayama which included Anulom- Vilom, Ujjayi and Om recitation for thirty minutes for all the six days up to 2 months for each session of the day. After two months of training of Pranayama. Final test was conducted to all the subjects again during their menstruation phase. The obtained data were analyzed by using

It was found that the practice of Pranayama put significant effect to increase the level of Haemoglobin and decrease the intensity of pain during menstruation cycle of females.”

Ankad, Herur, Patil, Shashikala & Chinagudi (2011) conducted a study on the topic “Effect of short term pranayama and meditation on cardiovascular functions in healthy individuals. The present study was conducted to determine if a short-term practice of pranayama and meditation had improvements in cardiovascular functions in healthy individuals with respect, and body mass index (BMI). Fifty healthy subjects (24 males and 26 females) Age ranged of 20-60 years a, fulfilling the inclusion and exclusion criteria underwent two hours daily yoga program for Fifteen days taught by a specialized yoga teacher. Pre and post yoga cardiovascular functions were evaluated by recording pulse rate, systolic blood pressure, diastolic blood pressure, and mean blood pressure. There was significant decrease in resting pulse rate, systolic blood pressure, diastolic blood pressure, and mean arterial blood pressure after practicing pranayama and meditation for Fifteen days. The response was similar in both the genders, both the age groups, <40 yrs and >40 yrs and both the groups with BMI, <25 kg/m2 and >25 kg/m2. The study showed beneficial effects of short term (Fifteen days) regular pranayama and meditation practice on cardiovascular functions irrespective of age, gender, and BMI in normal healthy individuals.”

Santaella, Devesa, Rojo, Amato, Drage, Casali, Montano, & Lorenzi Filho (2011) conducted a study on the topic “Yoga respiratory training improves respiratory function and cardiac sympathovagal balance in elderly subjects: a randomized controlled trial. The investigation was aimed towards the findings of effects of yoga respiratory exercises may improve respiratory and cardiovascular function; they hypothesized that yoga respiratory training on respiratory function and cardiac autonomic modulation in

healthy elderly subjects. For the study 76 healthy elderly subjects were enrolled in a randomized control trial in Brazil and 29 completed the study (age 68±6 &emsp; years, 34% males, body mass index 25±3 &emsp; kg/m &emsp; (2)). Subjects were randomized into a 4-month training program (2&emsp;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 apnea with generation of intra thoracic negative pressure, and expiration through the left nostril. Pulmonary function, maximum expiratory and aspiratory pressures PE (max) and PI (max), respectively), heart rate variability and blood pressure variability for spontaneous bar reflex determination were determined at baseline and after 4&emsp;months. Subjects in both groups had similar demographic parameters. Physiological variables did not change after 4&emsp;months in the control group. However, in the yoga group, there were significant increases in PE (max) (34%, p&lt;0.0001) and PI (max) (26%, p&lt;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&lt;0.001). Spontaneous bar reflex did not change, and quality of life only marginally increased in the yoga group. Respiratory yoga training may be beneficial for the elderly healthy population by improving respiratory function and sympathovagal balance.”

Ankad, Ankad, Herur, Patil, Chinagudi & Shashikala (2011)25 conducted a study on the topic “Effect of short term pranayama and meditation on respiratory parameters in healthy individuals. The present study was done to evaluate the effects of pranayama and meditation on respiratory parameters. Participants fulfilling the inclusion and exclusion criteria undergo two hours daily yoga program for fifteen days taught by yoga teacher. Pre and post yoga respiratory functions were evaluated by measuring chest expansion, breath holding time and peak expiratory flow rate. The parameters were analyzed by Student t-test. The present study was a comparative prospective study

consisting of 50 (24 male and 26 female) healthy subjects of 20-60 years age. There was significant increase in chest expansion, breath holding time and peak expiratory flow rate compared to pre-yoga practice. The response was similar in both genders, both age groups under 40 years and above 40 years and both groups of 13 M1 <25 kg/m2 and >25 kg/m2. This study illustrated beneficial effects of short term (Fifteen days) regular pranayama and meditation practice on respiratory functions irrespective of age, gender and BMI in normal healthy individuals.”

Singh Vishaw and Parkash (2011)\(^{26}\) conducted a study on the topic “Effects of a six weeks nadi-shodhana pranayama training on cardio-pulmonary parameters. The purpose of the study was to assess the effects of a 6 weeks nadi-shodhana pranayama training on cardiopulmonary parameters. A group of 10 healthy male subjects were selected from department of physical education, Guru Nanak Dev University, Amritsar (Punjab, India), aged ranged between 18-24 years, and voluntarily participated in the study. Subjects were assigned into two groups: ‘A’ (experimental: N-15) and ‘B’ (control: N-15). The subjects from Group ‘A’ (experimental: N-15) were subjected to a six week nadi-shodhana pranayama training programme. This lasted six weeks and consisted of daily sessions; lasting 30 mm. Heart rate was measured by counting radial pulse for a minute. Vital capacity was measured by spirometer. Both Systolic and Diastolic Blood Pressures were measured with the auscultator method by using sphygmomanometer and stethoscope. Results showed that the vital capacity significantly improved in experimental group compared with the control group. A significant decline in Basal Heart Rate (P<0.01) and Systolic Blood Pressure (P<0.05) was observed. In contrast, control subjects did not show any significant change in these parameters. Nadi-shodhana Pranayama training programme may be recommended to improve vital capacity and control heart rate and blood pressure and may contribute to enhance health status and wellness.”

Bhimani, Kulkarni, Kowale & Salvi (2011)\(^{27}\) conducted a study on the topic “effect of pranayama on Stress and cardiovascular autonomic tone & reactivity. The aim of the study was to find out the effect of pranayama on Stress and cardiovascular autonomic tone. The subjects were first M.B.B.S students and the sample size was 59 consisting of 27 males and 32 females. The selected group of students was briefed about the study. After the orientation session, informed written consent was taken, stress questionnaire was put and the autonomic function tests were done. This was followed by practice of Pranayama for 2 months, One hour per day for 5 days per week and again stress questionnaire was put and the autonomic function tests were performed on the study group. The above tests were done before and after the practice of Pranayama. The results obtained were analyzed by using SPSS software. The stress level was reduced after two months of practicing various pranayama as evident by decrease in total stress score which is highly significant. VLF and LF in n.u have reduced significantly after practice of pranayama signifying reduction in sympathetic drive to heart. HF in n.u has increased significantly after practice of pranayama for 2 months showing the increase in parasympathetic output to the heart. LF/HF ratio reduced significantly after 2 months of practice of pranayama indicating a better sympatho vagal balance with resting balance tilting toward better parasympathetic control.”

Kasundra, Thumar & Mungra (2010)\(^{28}\) conducted a study on the topic “Impact of pranayama on selected components of blood- an analytical study. The objectives of the study were to assess the impact of pranayama training on selected components of blood. The study was conducted on 30 B.A. students studying in Mahadev Desai Gram Seva Mahavidyalaya. 30 subjects are divided into two groups i.e. one experimental and one control group. Experimental group participated in various activities like-yogic exercise, Omkar, Suryabhedan, Chandrabhedan, Bhastrika, Brahmi and Anulom-Vilom. t-test was used to compare pre- value and post- value of the pranayama. On comparing the mean scores of cholesterol, blood glucose, haemoglobin, White Blood Cells, Red Blood Cells and Platelets of pre- test and post-test of experimental group, significant difference were


found, whereas in control group, insignificant difference was found. The pranayama training has an effect on selected blood components.”

**Bal (2010)** conducted a study on the topic “Effect of Anulom- Vilom and Bhastrika Pranayama on the vital capacity and maximal ventilatory volume. The purpose of the study was to determine the effect of Anulom- Vilom and Bhastrika pranayama on vital capacity and maximal ventilator volume. Before the start of the pranayama training pre-value of vital capacity and maximal ventilator volume was measured in thirty randomly selected male students aged 18 to 26 years. The subjects were subjected to the 8 weeks pranayama training programme that includes Anulom- Vilom and Bhastrika Pranayama. “t-test” was used to compare vital capacity and maximal ventilator volume. Significant difference in vital capacity and maximal ventilatory volume were found in experimental group. In control group no significant difference were found. Pranayama training may be recommended to improve vital capacity and ventilatory volume.”

**Pramanik, Pudasaini & Prajapati (2010)** conducted a study on the topic “Immediate effect of a slow pace breathing exercise Bhramari pranayama on blood pressure and heart rate. The study was carried out to evaluate the immediate effect of Bhramari pranayama, a slow breathing exercise for 5 minutes on heart rate and blood pressure. Heart rate and blood pressure of volunteers were recorded. The subject was directed to inhale slowly up to the maximum for about 5 seconds and then to exhale slowly up to the maximum for about 15 sec keeping two thumbs on two external auditory canal, index and middle finger together on two closed eyes and ring finger on the two sides of the nose. During exhalation the subject must chant the word ‘O-U-Mmmm’ with a humming nasal sound mimicking the sound of a humming wasp, so that the laryngeal walls and the inner walls of the nostril mildly vibrate (Bhramari pranayama, respiratory rate 3/min). After 5 minutes of this exercise, the blood pressure and heart rate

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were recorded again. Both the systolic and diastolic blood pressure was found to be decreased with a slight fall in heart rate. Fall of diastolic pressure and mean pressure were significant. The result indicated that slow pace Bhramari pranayama for 5 minutes, induced parasympathetic dominance on cardiovascular system.”

**Jerath, Edry, Barnes & Jerath (2010)**[^31] conducted a study on the topic “Physiology of long pranayamic breathing: neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts the autonomic nervous system. The objective of study was to find out how physiology of long pranayamic breathing: neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts the autonomic nervous system. Pranayamic breathing, defined as a manipulation of breath movement, has been shown to contribute to a physiologic response characterized by the presence of decreased oxygen consumption, decreased heart rate, and decreased blood pressure, as well as increased theta wave amplitude in EEG recordings, increased parasympathetic activity accompanied by the experience of alertness and reinvigoration. The mechanism of how pranayamic breathing interacts with the nervous system affecting metabolism and autonomic functions remains to be clearly understood. It is our hypothesis that voluntary slow deep breathing functionally resets the autonomic nervous system through stretch-induced inhibitory signals and hyperpolarization currents propagated through both neural and non-neural tissue which synchronizes neural elements in the heart, lungs, limbic system and cortex. During inspiration, stretching of lung tissue produces inhibitory signals by action of slowly adapting stretch receptors and hyperpolarization current by action of fibroblasts. Both inhibitory impulses and hyperpolarization current are known to synchronize neural elements leading to the modulation of the nervous system and decreased metabolic activity indicative of the parasympathetic state. Paper proposes pranayama's physiologic mechanism through a cellular and systems level perspective, involving both neural and non-neural elements. This theoretical description describes a common physiological mechanism underlying pranayama and elucidates the role of the respiratory and

cardiovascular system on modulating the autonomic nervous system. Along with facilitating the design of clinical breathing techniques for the treatment of autonomic nervous system and other disorders, this model will also validate pranayama as a topic requiring more research.”

**Ulger & Yaglı (2010)**[^32] conducted a study on the topic “[Effects of yoga on balance and gait properties in women with musculoskeletal problems: a pilot study](http://ozlemulger@yahoo.com). The purpose of the present study is to investigate the effects of yoga on balance and gait properties in women with musculoskeletal problems. 27 women (age ranged 30-45 years) with musculoskeletal problems, such as osteoarthritis and low-back pain, were included in the present study. The patients participated in 8 sessions (twice weekly for 4 weeks) of a yoga program which included asanas, stretching exercises, and breathing techniques. Patients' static balance measurements and gait parameters were determined before and after the study using a stabilometer and a gait trainer, respectively. Post-study values of patients' gait parameters were found to be statistically higher than their pre-study values (p < 0.05) the values of patients' balance addressed anterior and right positions with patients' eyes open and subsequently closed pre-treatment. However, it was notable that balance post-treatment was minimal when subject’s eyes were open or closed. Anterior-posterior values and right-left values were almost equal after treatment. The results showed that yoga has a positive effect on balance and gait parameters of women with gait and balance disturbances that are caused by musculoskeletal problems. It is feasible to conclude that asanas and stretching exercises included in the yoga program brought about such a positive effect, and therefore it is possible to use yoga programs to solve problems caused by musculoskeletal disorders.”

**Muzumdar & Suryavanshi (2010)**[^33] conducted a study on the topic “[Effect of Ujjayi and Bhastrika pranayama on selected physiological variables of physically challenged students](https://journal-of-advanced-development-of-research.org/index.php/jadr/article/view/86). The purpose of the study was to find out the effect of ujjayi and

bhashrika pranayama on selected physiological variables of physically challenged students. For this 60 physically challenged male students were randomly selected. Further the subjects were divided into two groups that are experimental and control group. The experimental group followed of ujjayi and bhashrika pranayama for a period of six weeks. Pre and post data were recorded. Paired t-test statistical technique was used. t-ratio was insignificant in case of resting pulse rate and diastolic blood pressure. However increase of vital capacity and positive breath holding time was significant. The present study stated that ujjayi and bhashrika pranayama affects the vital capacity and positive holding time of physically challenged students.”

Sivapriya Suba and Shyamala (2010) conducted a study on the topic “Effect of Nadi Shodhana Pranayama on Respiratory Parameters in School Students. Current study was undertaken to create awareness in the health benefits of pranayama and to pound yoga in school students so that they can get a healthy life in future. This study was designed to estimate the effects of a 45 days daily practice of Nadi-Shodhana Pranayama yoga practice on peak expiratory flow rate (PEFR), forced vital capacity (FVC), forced expiatory volume in 1 sec (FEV1) and respiratory rate (RR) in school students of both sexes. 115 school students aged 8-14 years studying in Visa Nursery & primary school, Chennai were recruited for the study. Healthy students with no history of present and past illness were included in the present study. The participants were trained to perform Nadi-Shodhana Pranayama and the study was done for 45 days. The respiratory parameters peak expiratory flow rate (PEFR), forced vital capacity (FVC), forced expiatory volume in one second (FEV1) & respiratory rate (RR) were measured before and after practice of Pranayama. Significant increase found in peak expiratory flow rate (PEFR), forced vital capacity (FVC), and forced expiatory volume in one second (FEV1). The respiratory rate (RR) declined after the practice of Nadi-Shodhana Pranayama. The positive results found in the present study can be applied to all schools to improve the pulmonary functions of the students. A few minutes practice daily may help in setting the mind better on works and studies. The daily practice could maintain better physical and mental health to have a better future.”

Saxena & Saxena (2009) conducted a study on the topic “Effect of various breathing exercises (pranayama) on patients with bronchial asthma of mild to moderate severity. The purpose of the study was to study the effect of breathing exercises in patients with bronchial asthma of mild to moderate severity. 50 cases of bronchial asthma (Forced Expiratory Volume in one second (FEV)>70%) were studied for 12 weeks. Patients were allocated to two group i.e. patients in group ‘A’ were treated with breathing exercises (Deep breathing, Brahmani Omkara etc.) for 20 minutes twice daily for a period of 12 weeks t- test was used to compare the pre-value and post-value. After 12 weeks, group ‘A’ subject had significant improvement in symptoms, FEV and PEFR as compared to group B subjects. Breathing exercises mainly expiratory exercises improved lung function subjectively and objectively and should be regular portal therapy.”

Prajapati, Singh, Sharma, Mishra & Mishra (2009) conducted a study on the topic “Immediate effect of slow pace bhashrika pranayama on blood pressure and heart rate. The objective of this study was to evaluate the immediate effect of slow pace bhashrika pranayama (respiratory rate 6/min) for 5 minutes on heart rate and blood pressure and the effect of the same breathing exercise for the same duration of time (5 minutes) following oral intake of hyoscine-N-butyryl bromide (Buscopan), a parasympathetic blocker drug. Heart rate and blood pressure of volunteers (n = 39, age = 25-40 years) was recorded following standard procedure. First, subjects had to sit comfortably in an easy and steady posture (sukhasana) on a fairly soft seat placed on the floor keeping head, neck, and trunk erect, eyes closed, and the other muscles reasonably loose. The subject was 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 afore said manner using the same instrument. The other group (n = 10) took part in another study where their blood pressure and heart rate were recorded following half an hour of oral intake of hyoscine-N-butylbromide 20 mg. Then they practiced the breathing exercise as stated above, and the above mentioned parameters were recorded again to study the effect of parasympathetic blockade on the same pranayama. It was noted that after slow bhastrika pranayamic breathing (respiratory rate 6/min) for 5 minutes, both the systolic and diastolic blood pressure decreased significantly with a slight fall in heart rate. No significant alteration in both blood pressure and heart rate was observed in volunteers who performed the same breathing exercise for the same duration following oral intake of hyoscine-N-butylbromide. Valve cardiac and pulmonary mechanisms are linked, and improvement in one vagal limb might spill over into the other. Baroreceptor sensitivity can be enhanced significantly by slow breathing (supported by a small reduction in the heart rate observed during slow breathing and by reduction in both systolic and diastolic pressure). Slow pace bhastrika pranayama (respiratory rate 6/min) exercise thus shows a strong tendency to improving the autonomic nervous system through enhanced activation of the parasympathetic system.”

Pal, Velkumary & Madanmohan (2009) conducted a study on the topic “Effect of short-term practice of breathing exercises on autonomic function of human volunteers. Practice of breathing exercises like pranayama is known to improve autonomic function by changing sympathetic or parasympathetic activity. Therefore, in the present study the effect of breathing exercises on autonomic functions was performed in young volunteers in the age group of 17-19 years. A total number of 60 male undergraduate medical students were randomly divided into two groups: slow breathing group (that practiced slow breathing exercise) and the fast breathing group (that practiced fast breathing exercise). The breathing exercises were practiced for a period of three months. Autonomic function tests were performed before and after the practice of

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breathing exercises. The increased parasympathetic activity and decreased sympathetic activity were observed in slow breathing group, whereas no significant change in autonomic functions was observed in the fast breathing group. The findings of the present study showed that regular practice of slow breathing exercise for three months improves autonomic functions, while practice of fast breathing exercise for the same duration does not affect the autonomic functions.”

Arlene Schmid, Marieke Van Puymbroeck & David Koceja (2009)\textsuperscript{38} conducted the study on the topic “Effect of a 12-week yoga intervention on fear of falling and balance in older adults: a pilot study. The purpose of the study was to determine whether fear of falling (FoF) and balance improved after a 12-week yoga intervention among older adults. A convenience sample of adults (N=14) over the age of 65 years who all endorsed an FoF, measured FoF with the Illinois FoF Measure and balance with the Berg Balance Scale. Upper and lower-body flexibility were measured with the back scratch test and chair sit and reach test, respectively. Each participant took part in a biweekly 12-week yoga intervention. The yoga sessions included both physical postures and breathing exercises. Postures were completed in sitting and standing positions. FoF decreased by 6\%, static balance increased by 4\% (P=.045), and lower-body flexibility increased by 34\%. The results indicate that yoga may be a promising intervention to manage FoF and improve balance, thereby reducing fall risk for older adults. Rehabilitation therapists may wish to explore yoga as a modality for balance and falls programming; however, future research is needed to confirm the use of yoga in such programming.”

Nancy Glenmore Tatum, Charles Christopher Igel, M.S., Rodney, C., & Bradley, M.S. (2009)\textsuperscript{39} conducted the study on the topic “Effect of Therapeutic Yoga on Balance and the Ability to Transfer from the Floor in an Older Adult Population. The


The purpose of this study was to determine if a therapeutic Yoga program could improve the ability of older adults to transfer from the floor. The study also examined how balance, quadriceps strength, and ankle flexibility influence transfer ability in older adults. Yoga training group classes were held at a Yoga center in Richmond, Virginia. Additional practice was performed in the participants' homes. Pre and post assessments were performed in a physical therapy office at the Yoga center. Fifty older adults, age ranged from 58 to 83 years, most of whom were new to Yoga. A total of 45 participants completed the program. A 13-week therapeutic Hatha Yoga program specifically tailored to older adults and designed to strengthen the quadriceps, increase ankle flexibility and balance, and improve the ability to transfer to and from the floor. Participants attended one 90-minute Yoga class per week and were asked to complete a 30-minute guided home practice, using a video, five days per week. Improvement was noted across all measures. Specifically, a paired sample t-test revealed significant improvement in participants' ability to transfer from the floor (t = 11.25, p < .001) with a large magnitude of effect (d = 1.36). These improvements were reflected by participants' own perception of their transfer ability and general level of fitness. A series of nested regression models revealed balance and quadriceps strength to be the largest contributors to transfer ability. These improvements were reflected by participants' own perception of their transfer ability and general level of fitness. A series of nested regression models revealed balance and quadriceps strength to be the largest contributors to transfer ability.

Jimenez, Torres, Medrano, Daw, Duran & Oropeza (2009) conducted a study on the topic “Cardiovascular and metabolic effects of intensive Hatha Yoga training in middle-aged and older women from northern Mexico. Hatha Yoga (HY) can be an alternative to improve physical activity in middle-aged and older women. However, conventional HY (CHY) exercising may not result in enough training stimulus to improve cardiovascular fitness. The purpose of this study was to evaluate the effect of

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an intensive HY intervention (IHY) on cardiovascular risk factors in middle-aged and older women from Northern Mexico. In this prospective quasiexperimental design, four middle-aged and nine older CHY practicing females (yoginis) were enrolled into an 11-week IHY program consisting of 5 sessions/week for 90 min (55 sessions). The program adherence, asana performance, and work intensity were assessed along the intervention. Anthropometric [body mass index (BMI), % body fat and $\sum$ skin folds], cardiovascular fitness [maximal expired air volume (VE max ), maximal O 2 consumption (VO 2max ), maximal heart rate (HR max ), systolic (BPs) and diastolic blood pressure (BPd)], biochemical [glucose, triacglycerols (TAG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C)], and dietary parameters were evaluated before and after IHY. Results: Daily caloric intake (~1,916 kcal/day), program adherence (~85%), and exercising skills (asana performance) were similar in both middle-aged and older women. The IHY program did not modify any anthropometric measurements. However, it increased VO 2max and VE max and HDL-C while TAG and LDL-C remained stable in both middle-aged and older groups (P < 0.01). The proposed IHY program improves different cardiovascular risk factors (namely VO 2max and HDL-C) in middle-aged and older women.”

Pramanik, Sharma, Mishra, Prajapati, & Singh (2009) conducted a study on the topic “Immediate effect of slow pace bhastrika pranayama on blood pressure and heart rate. The objective of this study was to evaluate the immediate effect of slow pace bhastrika pranayama (respiratory rate 6/min) for 5 minutes on heart rate and blood pressure and the effect of the same breathing exercise for the same duration of time (5 minutes) following oral intake of hyoscine-N-butylbromide (Buscopan), a parasympathetic blocker drug. Heart rate and blood pressure of volunteers (n = 39, age = 25-40 years) was recorded following standard procedure. First, subjects had to sit comfortably in an easy and steady posture (sukhasana) on a fairly soft seat placed on the

floor keeping head, neck, and trunk erect, eyes closed, and the other muscles reasonably loose. The subject is directed to inhale through both nostrils slowly up to the maximum for about 4 seconds and then exhale slowly up to the maximum through both nostrils for about 6 seconds. The breathing must not be abdominal. These steps complete one cycle of slow pace bhastrika 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-butylbromide 20 mg. Then they practiced the breathing exercise as stated above, and the above mentioned parameters were recorded again to study the effect of parasympathetic blockade on the same pranayama. It was noted that after slow bhastrika pranayamic breathing (respiratory rate 6/min) for 5 minutes, both the systolic and diastolic blood pressure decreased significantly with a slight fall in heart rate. No significant alteration in both blood pressure and heart rate was observed in volunteers who performed the same breathing exercise for the same duration following oral intake of hyoscine-N-butylbromide. Discussion: Pranayama increases frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors during above tidal volume inhalation as in Hering Bruer reflex, which bring about withdrawal of sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing decrease in peripheral resistance and thus decreasing the diastolic blood pressure. After hyoscine-N-butylbromide, the parasympathetic blocker, it was observed that blood pressure was not decreased significantly as a result of pranayama, as it was observed when no drug was administered. Vagal cardiac and pulmonary mechanisms are linked, and improvement in one vagal limb might spill over into the other. Baroreceptor sensitivity can be enhanced significantly by slow breathing (supported by a small reduction in the heart rate observed during slow breathing and by reduction in both systolic and diastolic pressure). Slow pace bhastrika pranayama
(respiratory rate 6/min) exercise thus shows a strong tendency to improving the autonomic nervous system through enhanced activation of the parasympathetic system.”

**Bal and Kaur (2009)**⁴² conducted a study on the topic “effects of selected asanas in hatha yoga on agility and flexibility level. The present study was conducted to determine the effects of selected asanas in hatha yoga on agility and flexibility level. The subjects for the study were selected on the basis of random group design. Thirty (N=30) male students were selected as subject for the present study from D.A.V. Institute of Engineering and Technology, Jalandhar (Punjab). All the subjects ranged between the chronological age of 18 to 25 years. The selected subjects were further divided into two equal groups. Experimental treatment was then assigned to group ‘A’ while group ‘B’ acts as control group and excluded to give any type of treatment. Hexagonal Obstacle Test was used to measure agility whereas Sit and Reach test was used to measure flexibility. The subjects were subjected to the six weeks yogasanas training programme that includes Mayurasana, Swastikasana, Matsyendrasana, Paschimottanasana and Gomukhasana. The difference in the mean of each group for selected variable was tested for the significance of difference by t-test. The level of significance was set at 0.05. The results shown the significant improvement in flexibility, since calculated $t = 8.122 > \text{tabulated } t .05 (14) (= 2.145)$. The treatment of six weeks yogasanas training programme also shown significant improvement in case of agility, since calculated $t = 7.376 > \text{tabulated } t .05 (14) (= 2.145)$. It is concluded that different types of asanas in hatha yoga improve agility and flexibility level.”

**Chen, Chen, Hong, Chao, Lin & Li (2008)**⁴³ conducted a study on the topic “Physical fitness of older adults in senior activity centres after 24-week silver yoga exercises. Promoting physical fitness of young-older adults was essential in reducing

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healthcare expenditures which would occur in the future for those with chronic health problems. The silver yoga exercise programme was developed to accommodate the reduced body flexibility experienced by many older adults and was critically reviewed by experts and pilot-tested with community-dwelling older adults. This study aimed to test older adults’ physical fitness after a 24-week silver yoga exercise programme and to examine whether the programme could be further shortened to fit senior activity centres’ programme designs. Convenience samples of 204 subjects were recruited from eight senior activity centres and 176 subjects completed the study. Subjects were randomly assigned into three groups based on the centres: Experiment I: complete silver yoga with stretching and meditation, Experiment II: shortened silver yoga without the guided-imagery meditation and Wait-list control III. A quasi-experimental, pre–post tests design was used: baseline, at 12-week and at 24-week periods. The interventions were conducted three times per week for 24 weeks. Physical fitness indicators included body compositions, cardiovascular–respiratory functions, physical functions and the range of motion. At the end of the 24-week period, the physical fitness of subjects in Experiments I and II had significantly improved whether or not guided-imagery meditation was used and all had better physical fitness than subjects in the control group (all p < 0.05). The physical fitness of older adults in both the 70-minute complete silver yoga group and the 55-minute shortened silver yoga group had significantly improved after the interventions. It was recommended that the silver yoga programme be shortened by eliminating the guided-imagery meditation. The shortened silver yoga exercise programme is recommended to be incorporated as an activity programme in community-settings to promote the physical fitness of older adults.”


Out of them, 30 shooters were given training in the techniques of Pranayama and Kriya for 3 weeks. The rest served as control. Variables were measured before and after the training in both the groups. They found highly significant improvement (p<0.001) in all the three variables. So they concluded that Pranayama and Kriya are efficacious for better performance of shooters.”

**Upadhyay, Malhotra, Sarkar & Prajapati (2008)**\(^{45}\) conducted a study on the topic “Effect of alternate nostril breathing exercise on cardiorespiratory functions The objective of this study was to evaluate the effect of alternate nostril breathing exercise on cardiorespiratory functions. Pranayama (breathing exercise), one of the yogic techniques can produce different physiological responses in healthy individuals. The responses of Alternate Nostril Breathing (ANB) the Nadisudhi Pranayama on some cardio-respiratory functions were investigated in healthy young adults. The subjects performed ANB exercise (15 minutes every day in the morning) for four weeks. Cardio-respiratory parameters were recorded before and after 4-weeks training period. A significant increment in Peak expiratory flow rate (PEFR L/min) and Pulse pressure (PP) was noted. Although Systolic blood pressure (SBP) was decreased insignificantly, the decreases in pulse rate (PR), respiratory rate (RR), diastolic blood pressure (DBP) were significant. Results indicate that regular practice of ANB (Nadisudhi) increases parasympathetic activity.”

**Hart and Tracy (2008)**\(^{46}\) conducted a study on the topic “Yoga as steadiness training: effects on motor variability in young adults. The objective of the study was to observe the Yoga as steadiness training: effects on motor variability in young adults. Exercise training programs can increase strength and improve sub maximal force control, but the effects of yoga as an alternative form of steadiness training are not well described. The purpose was to explore the effect of a popular type of yoga (Bikram) on strength,


steadiness, and balance. Young adults performed yoga training (n = 10, 29 +/- 6 years, 24 yoga sessions in 8 weeks) or served as controls (n = 11, 26 +/- 7 years). Yoga sessions consisted of 1.5 hours of supervised, standardized postures. Measures before and after training included maximum voluntary contraction (MVC) force of the elbow flexors (EF) and knee extensors (KE), steadiness of isometric EF and KE contractions, steadiness of concentric (CON) and eccentric (ECC) KE contractions, and timed balance. The standard deviation (SD) and coefficient of variation (CV, SD/mean force) of isometric force and the SD of acceleration during CON and ECC contractions were measured. After yoga training, MVC force increased 14% for KE (479 +/- 175 to 544 +/- 187 N, p < 0.05) and was unchanged for the EF muscles (219 +/- 85 to 230 +/- 72 N, p > 0.05). The CV of force was unchanged for EF (1.68 to 1.73%, p > 0.05) but was reduced in the KE muscles similarly for yoga and control groups (2.04 to 1.55%, p < 0.05). The variability of CON and ECC contractions was unchanged. For the yoga group, improvement in KE steadiness was correlated with pre training steadiness (r = -0.62 to -0.84, p < 0.05); subjects with the greatest KE force fluctuations before training experienced the greatest reductions with training. Percent change in balance time for individual yoga subjects averaged +228% (19.5 +/- 14 to 34.3 +/- 18 seconds, p < 0.05), with no change in controls. For young adults, a short-term yoga program of this type can improve balance substantially, produce modest improvements in leg strength, and improve leg muscle control for less-steady subjects.

Tran, Holly, Lashbrook & Amsterdam (2007)\(^{47}\) conducted a study on the topic “Effects of Hatha Yoga Practice on the Health-Related Aspects of Physical Fitness. The objective of this study was to find out the effects of Hatha yoga practice on the health-related aspects of physical fitness. Ten healthy, untrained volunteers (nine females and one male), ranging in age from 18–27 years, were studied to determine the effects of hatha yoga practice on the health-related aspects of physical fitness, including muscular strength and endurance, flexibility, cardiorespiratory fitness, body composition, and

pulmonary function. Subjects were required to attend a minimum of two yoga classes per week for a total of 8 weeks. Each yoga session consisted of 10 minutes of pranayamas (breath-control exercises), 15 minutes of dynamic warm-up exercises, 50 minutes of asanas (yoga postures), and 10 minutes of supine relaxation in savasana (corpse pose). The subjects were evaluated before and after the 8-week training program. Isokinetic muscular strength for elbow extension, elbow flexion, and knee extension increased by 31%, 19%, and 28% (p<0.05), respectively, whereas isometric muscular endurance for knee flexion increased 57% (p<0.01). Ankle flexibility, shoulder elevation, trunk extension, and trunk flexion increased by 13% (p<0.01), 155% (p<0.001), 188% (p<0.001), and 14% (p<0.05), respectively. Absolute and relative maximal oxygen uptake increased by 7% and 6%, respectively (p<0.01). These findings indicate that regular hatha yoga practice can elicit improvements in the health-related aspects of physical fitness.

**Hagins, Moore & Rundle (2007)**\(^{48}\) conducted a study on the topic “Does practicing hatha yoga satisfy recommendations for intensity of physical activity which improves and maintains health and cardiovascular fitness? Little is known about the metabolic and heart rate responses to a typical hatha yoga session. The purposes of this study were to determine whether a typical yoga practice using various postures meets the current recommendations for levels of physical activity required to improve and maintain health and cardiovascular fitness; the second purpose of the study was to determine the reliability of metabolic costs of yoga across sessions and the third purpose of the study to compare the metabolic costs of yoga practice to those of treadmill walking. In this observational study, 20 intermediate-to-advanced level yoga practitioners, age 31.4 ± 8.3 years, performed an exercise routine inside a human respiratory chamber (indirect calorimeter) while wearing heart rate monitors. The exercise routine consisted of 30 minutes of sitting, 56 minutes of beginner-level hatha yoga administered by video, and 10

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minutes of treadmill walking at 3.2 and 4.8 kph each. Measures were mean oxygen consumption (VO2), heart rate (HR), percentage predicted maximal heart rate (%MHR), metabolic equivalents (METs), and energy expenditure (kcal). Seven subjects repeated the protocol so that measurement reliability could be established. Mean values across the entire yoga session for VO2, HR, %MHR, METs, and energy/min were 0.6 L/kg/min; 93.2 beats/min; 49.4%; 2.5; and 3.2 kcal/min; respectively. Results of the ICCs (2, 1) for mean values across the entire yoga session for kcal, METs, and %MHR were 0.979 and 0.973, and 0.865, respectively. Metabolic costs of yoga averaged across the entire session represent low levels of physical activity, are similar to walking on a treadmill at 3.2 kph, and do not meet recommendations for levels of physical activity for improving or maintaining health or cardiovascular fitness. Yoga practice incorporating sun salutation postures exceeding the minimum bout of 10 minutes may contribute some portion of sufficiently intense physical activity to improve cardio-respiratory fitness in unfit or sedentary individuals. The measurement of energy expenditure across yoga sessions is highly reliable.”

Howe, Rochester, Jackson, Banks & Blair (2007) conducted a study on the topic “Exercise for improving balance in older people. To present the best evidence for effectiveness of exercise interventions designed to improve balance in older people living in the community or in institutional care. Randomized controlled trials and quasi-randomized trials testing exercise interventions designed to improve balance in older people were included. They excluded trials of interventions targeting individuals with specific conditions in order not to broaden the scope of this review too widely. Trials were included where participants were randomized to receive the following: a single exercise intervention or a multiple exercise intervention and a control group (usual activities or attention or recreational activity). Trials comparing two or more exercise interventions and a control group were also included. Three pairs of members of the review team independently assessed trial quality and extracted data. For each trial, relative risk and 95% confidence intervals were calculated for dichotomous outcomes,

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and mean differences and 95% confidence intervals calculated for continuous outcomes. Where appropriate, results of comparable groups of trials were pooled and 95% confidence intervals calculated. For the 34 included studies there were 2883 participants at entry. Statistically significant improvements in balance ability were observed for exercise interventions compared to usual activity. Interventions involving gait; balance; co-ordination and functional exercises; muscle strengthening; and multiple exercise types appear to have the greatest impact on indirect measures of balance. There was trend towards an improvement in balance with cycling on a static cycle. However, there was limited evidence that effects were long-lasting. Exercise appears to have statistically significant beneficial effects on balance ability in the short term but the strength of evidence contained within these trials is limited. Many of these mainly small studies demonstrated a range of methodological weaknesses. The failure across the included studies to apply a core set of standardized outcome measures to determine balance ability restricts the capacity to compare or pool different trials from which firm conclusions regarding efficacy can be made. Further standardization in timing of outcome assessment is also required as is longer term follow-up of outcomes to determine any lasting effects.”

**Upadhyay, Dhungel, Malhotra, Sarkar & Prajapati (2008)**\(^{50}\) conducted a study on the topic “Effect of alternate nostril breathing exercise on cardio respiratory functions. Pranayama (breathing exercise), one of the yogic techniques can produce different physiological responses in healthy individuals. The responses of Alternate Nostril Breathing (ANB) the Nadisudhi Pranayama on some cardio-respiratory functions were investigated in healthy young adults. The subjects performed ANB exercise (15 minutes every day in the morning) for four weeks. Cardio-respiratory parameters were recorded before and after 4-weeks training period. A significant increment in Peak expiratory flow rate (PEFR L/min) and Pulse pressure (PP) was noted. Although Systolic blood pressure (SBP) was decreased insignificantly, the decrease in pulse rate (PR), respiratory rate (RR), diastolic blood pressure (DBP) was significant. Results: Results indicate that regular practice of ANB (Nadisudhi) increases parasympathetic activity. Pranayama

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(breathing exercise), one of the yogic techniques can produce different physiological responses in healthy individuals.”

**Sharma, Das, Mondal, Goswami & Gandhi (2006)**\(^{51}\) conducted a study on the topic “Effect of Sahaj Yoga on neuro-cognitive functions in patients suffering from major depression. The objective of the study was to find out the effect of Sahaj Yoga on neuro-cognitive functions in patients suffering from major depression. Cognitive functions are impaired in Major Depression. Studies on the effects of Yoga on cognitive functions have shown improvement in memory, vigilance and anxiety levels. 30 patients suffering from Major depression (age 18 to 45 years) were randomly divided into two groups: Group 1: (10 males and 5 Females) Patients who practised Sahaj Yoga meditation and also received conventional anti-depressant medication. Group 2: (9 males and 6 Females) Patients who only received conventional antidepressant medication. Group 1 patients were administered Sahaj Yoga practice for 8 weeks. Neuro-cognitive test battery consisting of Letter cancellation test (LCT), Trail making test 'A' (TTA), Trail making test 'B' (TTB), Ruff figural fluency test (RFFT), Forward digit span (FDS) & Reverse digit span test (RDS) was used to assess following cognitive domains: Attention span, visuo-motor speed, short-term memory, working memory and executive functions. Results: After 8 weeks, both Group 1 and Group 2 subjects showed significant improvement in LCT, TTA & TTB but improvement in LCT was more marked in Group 1 subjects. Also, there was significant improvement in RDS scores in only Group 1 subjects (\(P < 0.05\)). The results thereby, demonstrate that Sahaj Yoga practice in addition to the improvement in various other cognitive domains seen with conventional anti-depressants, can lead to additional improvement in executive functions like manipulation of information in the verbal working memory and added improvement in attention span and visuo-motor speed of the depressives.”

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Singh (2006) conducted a study on the topic “A Study on Effects of Selected Yogic Practices on Physical and Psychological Variables of Deaf and Dumb Children. The first objective of this study was to find out the effects of selected yogic practices on physical and psychological variables of deaf and dumb children and second to find out the effect of selected yogic practices on physical and psychological variables of different age group 14 to 20 years. In the present study random sampling procedure was followed. A group of 100 deaf and dumb children was selected randomly from the Mata Prakash Kaur Hearing & speech Handicapped Welfare Center, Kamal and Rotary Club School for Deaf, at Ambala (Haryana). These students went through yogic exercises (for nine week) through training programme under strict supervision of the researcher and deaf and dumb teacher. However, for present study 100 students were selected from the students studying in these schools. The age group ranged from 14 to 20 years. These students were equally divided in two groups, each consisting of 50 students. Experimental group practiced following asana and Pranayama during the training i.e. Asana (Uttanpadasana, Sarvangasana, Halasana, Matsyasana, Chakrasana, Ustrasana, Suptvazrasana, Ardhamatsyenderasana, Padmasana, Vazrasana) Pranayams (Anuloma Viloma, Surya Bhedana, Chandra Bhedana, Shitali, Sitkari). The students were taught yogic practices (for nine week) through training programme under strict supervision of the researcher and deaf and dumb teacher. However, these students were equally divided in two groups; each consisting of 50 students forming experimental and controlled group. Data was analyzed by using student t-test. The result indicated statistical significant difference on physical and psychological variables. Amongst the physical variables of experimental group has recorded, statistical significant difference (P<.01 and P<.05) in their levels on Eight Pound Shot put test and Bend and reach test with t= 2.25, 3.79, respectively. While no statistically significant difference have been observed between post test mean scores of experimental group and post test mean scores of controlled group on other physical variables i.e. Zigzag run test and TMT. Experimental group has shown statistically better results on psychological variables as compared to physical variables i.e. self confidence,

over all adjustment, emotional stability, intelligence and mental health are found statistically significant with t=2.20, 2.30, 3.37, 4.88, and 3.76 respectively which is significant at .05 and .01 level respectively. It is found that the subjects of experimental group significantly improve their Physical fitness and Psychological status, since the result indicated statistical significant difference on physical and psychological variables.”

Subbalakshmi, Saxena, Urminala & Souza (2005) conducted a study on the topic “Immediate effect of Nadi-shodhana pranayama on some selected parameters of cardio vascular, pulmonary and higher functions of Brain. To study the immediate effect of Nadi-shodhana pranayama on some selected parameters of cardio vascular, pulmonary and higher functions of brain.10 subjects (5 males and 5 females) performed the exercise as instructed. Their average body mass index was 21.59 + 2.83. All the selected physiological parameters were measured before and after performing Nadi-shodhana pranayama. Student paired t -test was used for comparison. Nadi-shodhana pranayama of 20 min., a significant decline in basal heart rate (p<0.0001) and systolic blood pressure (p<0.001) was observed. Peak Expiratory flow rate was significantly improved (p<0.01) and the time taken for simple problem solving was significantly less following pranayama practice (p<0.0001) .In contrast, both control subjects did not show any significant change in respiratory and cardio vascular parameters with 20 minutes. Conclusion: The present study suggests that the Nadi-shodhana pranayama rapidly alters cardio pulmonary responses and improves sample problem solving.”

Hemadri (2005) conducted a study on the topic “Physiological and behavioral responses of human subjects following japa, yagya and selected yogic exercises. This study investigated the impact of Japa, Yagya, Nadishodhan Pranayama and Shavasana on diagnostic physiological, haematological, biochemical and psychological parameters of human subjects in order to find out possible remedial and preventive applications against certain diseases and psychosomatic disorders.480 male Subjects recruited from the

regular visiting devotees to Shantikunj Haridwar. Four experimental groups were made of 120 subjects (20 to 40 years of age) in each through randomization and randomly assigned and subjected to corresponding Japa, Yagya, Pranayama and Shavasana activities for the period of one month. Data was analysed by using student t-test. Clinically significant effect was found in various parameters at .01 levels implies that Japa, Yagya, Nadishodhan Pranayama and Shavasana can be very effective as preventive tools against certain diseases.”

Madanmohan, Udupa, Bhavanani, Vijayalakshmi, Surendiran (2005) conducted a study on the topic “Effect of slow and fast pranayams on reaction time and cardio respiratory variables. The objective of this study was to find out the effect of slow and fast pranayams on reaction time and cardio respiratory variables. They planned to undertake a comparative study of the effect of short term (three weeks) training in savitri (slow breathing) and bhashrika (fast breathing) pranayama on respiratory pressures and endurance, reaction time, blood pressure, heart rate, rate-pressure product and double product. Thirty student volunteers were divided into two groups of fifteen each. Group I was given training in savitri pranayam that involves slow, rhythmic, and deep breathing. Group II was given training in bhashrika pranayam, which is bellows-type rapid and deep breathing. Parameters were measured before and after three week training period. Results: Savitri pranayam produced a significant increase in respiratory pressures and respiratory endurance. In both the groups, there was an appreciable but statistically insignificant shortening of reaction time. Heart rate, rate-pressure product and double product decreased in savitri pranayam group but increased significantly in bhashrika group. It is concluded that different types of pranayams produce different physiological responses in normal young volunteers.”

Pal, Velkumary, and Madanmohan (2004)\textsuperscript{56} conducted a study on the topic “Effect of short-term practice of breathing exercises on autonomic functions in normal human volunteers. Practice of breathing exercises like pranayama is known to improve autonomic function by changing sympathetic or parasympathetic activity. Therefore, in the present study the effect of breathing exercises on autonomic functions was performed in young volunteers in the age group of 17-19 years. A total of 60 male undergraduate medical students were randomly divided into two groups: slow breathing group (that practiced slow breathing exercise) and the fast breathing group (that practiced fast breathing exercise). The breathing exercises were practiced for a period of three months. Autonomic function tests were performed before and after the practice of breathing exercises. The increased parasympathetic activity and decreased sympathetic activity were observed in slow breathing group, whereas no significant change in autonomic functions was observed in the fast breathing group. The findings of the present study show that regular practice of slow breathing exercise for three months improves autonomic functions, while practice of fast breathing exercise for the same duration does not affect the autonomic functions.”

Udupa, Madanmohan, Bhavanani, Vijayalakshmi, Krishnamurthy (2003)\textsuperscript{57} conducted a study on the topic “Effect of pranayam training on cardiac function in normal young volunteers. The objective of this study was to find out the effect of pranayama training on cardiac function in normal young volunteers. Systolic time intervals (STI) are non-invasive and sensitive tests for measuring the ventricular performance. It has been reported that practice of pranayama modulates cardiac autonomic status and improves cardio-respiratory functions. Keeping this in view, the present study was designed to determine whether pranayama training has any effect on ventricular performance as measured by STI and cardiac autonomic function tests (AFT). Twenty four school children were randomly divided into two groups of twelve each.

Group I (pranayam group) subjects were given training in nadishuddhi, mukh-bhastrika, pranav and savitri pranayams and practiced the same for 20 minutes daily for a duration of 3 months. Group II (control group) subjects were not given any pranayam training. STI (QS2, LVET and PEP) and AFT (RRIV and QT/QS2) were measured in both the groups at the beginning and again at the end of three months study period. Pranayama training produced an increase in RRIV and a decrease in QT/QS2, suggesting an enhanced parasympathetic and blunted sympathetic activity respectively. QS2, PEP and PEP/LVET increased significantly, whereas LVET was reduced significantly in pranayama group. In contrast, the changes in STI and AFT were much less marked in the control group. Our study shows that three months of pranayama training modulates ventricular performance by increasing parasympathetic activity and decreasing sympathetic activity. Further studies on a larger sample size may illustrate the underlying mechanism(s) involved in this alteration.

Bowman, Clayton, Murray, Reed, Subhan, and Ford (2003) conducted a study on the topic “Effects of aerobic exercise training and yoga on the baroreflex in healthy elderly persons. The objective of this study was to find out the effects of aerobic exercise training and yoga on the baroreflex in healthy elderly persons. It is unclear whether the age-associated reduction in baroreflex sensitivity is modifiable by exercise training. 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

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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 α MF (6.5 ± 3.5 vs. 6.2 ± 3.0 ms mmHg⁻¹, P = 0.69) or α HF (8.5 ± 4.7 vs. 8.9 ± 3.5 ms mmHg⁻¹, P = 0.65) occurred after aerobic training. Following yoga, α HF (8.0 ± 3.6 vs. 11.5 ± 5.2 ms mmHg⁻¹, P < 0.01) but not α MF (6.5 ± 3.0 vs. 7.6 ± 2.8 ms mmHg⁻¹, P = 0.29) increased. Short-duration aerobic training does not modify the α-index at α MF or α HF in healthy normotensive elderly subjects. A HF but not α MF increased following yoga, suggesting that these parameters are measuring distinct aspects of the baro reflex that are separately modifiable.”

Malhotra, Singh, Singh, Gupta, Sharma, Madhu, Tandon, (2002) conducted a study on the topic “Study of yoga asanas in assessment of pulmonary function in NIDDM patients. Certain yoga asanas if practiced regularly are known to have beneficial effects on human body. These yoga practices might be interacting with various, somatoneuro-endocrine mechanisms to have therapeutic effects. The present study done in twenty four NIDDM patients of 30 to 60 year old provides metabolic and clinical evidence of improvement in glycaemic control and pulmonary functions. These middle-aged subjects were type II diabetics on antihyperglycaemic and dietary regimen. Their baseline fasting and postprandial blood glucose and glycosylated Hb were monitored along with pulmonary function studies. The expert gave these patients training in yoga asanas and was pursed 30-40 min/day for 40 days under guidance. These asanas consisted of 13 well known postures, done in a sequence. After 40 days of yoga asanas regimen, the parameters were repeated. The results indicate that there was significant decrease in fasting blood glucose levels (basal 190.08 +/- 90.8 in mg/dl to 141.5 +/- 79.8 in mg/dl). The postprandial blood glucose levels also decreased (276.54 +/- 101.0 in mg/dl to 201.75 +/- 104.1 in mg/dl), glycosylated hemoglobin showed a decrease (9.03 +/- 1.4%}

to 7.83 +/- 2.6%). The FEV1, FVC, PEFR, MVV increased significantly (1.81 +/- 0.4 lt to 2.08 +/- 0.4 lt, 2.20 +/- 0.6 lt to 2.37 +/- 0.5 lt, 3.30 +/- 1.0 lt/s to 4.43 +/- 1.4 lt/s and 64.59 +/- 25.7 lt min to 76.28 +/- 28.1 lt/min respectively). FEV1/FVC% improved (85 +/- 0.2% to 89 +/- 0.1%). These findings suggest that better glycaemic control and pulmonary functions can be obtained in NIDDM cases with yoga asanas and pranayama. The exact mechanism as to how these postures and controlled breathing interact with somato-neuro-endocrine mechanism affecting metabolic and pulmonary functions remains to be worked out.”

Ghosh (2002)\(^{60}\) conducted a study on the topic “A comparative study of coordinative abilities between the athletes of track events and field events. The objective of the study was to find out the of co-ordinate ability between the all of track events and abilities & fields events. 15 male sprinters and 15 male jumpers were selected as subject for the present study from L.N.I.P.E. The variables selected for the study were orientation ability, Differentiation ability, Reaction ability, Balance ability and Rhythm ability, t-ratio on all the variables for males and females was applied. In case of Orientation ability and reaction ability there was a significant difference between the sprinters and jumpers. On the other hand in case of differentiation ability, Balance ability and Rhythm ability there was no significant difference between the sprinter and jumper. It was observed from the findings of the study that the coordinative abilities of sprinters and jumpers did not differ completely.”

Kapri (1995)\(^{61}\) conducted a study on the topic “Effect of strength training on selected motor abilities of the subjects belonging to different body composition groups. The objective of the study was to find out the effect of strength training on selected motor abilities of the subjects belonging to different body composition groups. 120 college students as subjects found that, twelve week strength training programme had significant

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effect on the subjects belonging to different body composition groups. The body composition groups were divided on the basis of body fat percentage i.e. under 12% body fat, 12.1% of body fat to 20% body fat and above 20.1% body fat group. Maximum influence of strength training were found in the second group i.e. body composition group from 12.1% body fat to 20% body fat.