CHAPTER-4

Review of Scientific Literature

4.0 REVIEW OF SCIENTIFIC LITERATURE

Cardiovascular functions are controlled by multiple factors which are both intrinsic and extrinsic to an individual. These are not limited to physical and physiological demands but also regulated by autonomic nervous system (ANS). The neural regulation is further influenced by chemical and humoral factors, which plays a major role in maintaining and regulating cardiac functions. Imbalances in these lead to cardiovascular disorders such as hypertension, ischemia, infarction, etc. Numerous studies indicate a strong association between compromised ANS (e.g. decreased vagal activity or increased sympathetic activity) and sudden and non-sudden cardiac death (Muralikrishnan et al., 2012).Cardiovascular disease is the leading cause of death in both men and women (Chaddha, 2015).

Lifestyle modifications are important factors in the treatment, prevention, and rehabilitation of cardiovascular disorders (Muralikrishnan et al., 2012). Yoga is an ancient *vedic* science thought to have originated in India in 5000 years back (Iyengar, 2002). It includes practice of specific postures (*asana*), regulated breathing (*Pranayama)* etc. Breath is the dynamic bridge between body and mind and *Pranayama* (breathing techniques) is one of the most important yogic practices (Muktibodhananda, 1984).

Effects of Various Pranayamas in General:

The stress either physical or mental, leads to cardiovascular morbidity. In a study on 2 month practice of various *Pranayama* was shown to reduce stress level; low frequency (LF) of heart rate variability (HRV) spectrum (indicative of reduction in sympathetic drive to heart); and increase in high frequency (HF) of HRV spectrum (indicative of increase in parasympathetic output to the heart) along with reduction in LF/HF ratio (indicative of a better sympatho-vagal balance.) (Bhimani et al., 2011). Hence, *Pranayama* produces relaxed state and in this state parasympathetic activity overrides sympathetic activity (Goyal et al., 2014).

Regular practice of *Pranayama* was shown to produce reduction in the sympathetic tone within a period as short as 7 days (Turankar et al., 2013). Another study reported the mechanism underlying the alteration in autonomic responses to breath holding as increased vagal tone and decreased sympathetic discharge (Bhargava et al., 1988). In patients with hypertension (Goyal et al., 2014) and arrhythmia (Dabhade et al., 2012), addition of *Pranayama* has shown to produce better control of blood pressure (BP) (Goyal et al., 2014), and significant reduction in the indices of ventricular repolarization dispersion (Dabhade et al., 2012) respectively.

Effects of Slow and Fast Pranayamas:

In a previous study on slow *Pranayama* such as *Nadishuddhi, Mukhbhastrika, Pranav* and *Savitri Pranayams* practiced for 20 minutes daily for the duration of 3 months shown to modulate ventricular performance by increasing parasympathetic activity and decreasing sympathetic activity (Udupa et al., 2003).

Effects of Individual Pranayama (Breathing Technique)

Breath Awareness:

Breath awareness is being aware of or concentrating one's own breath. In a previous study on 30 minutes of breath awareness, no significant changes in either SBP or DBP were observed in healthy male volunteers (Raghuraj et al., 2008). However, another study on 10 minutes of breath awareness showed a significant decrease in SBP in patients with hypertension (Telles et al., 2013).

Slow Breathing/Slow Deep Breathing:

Slow deep breathing has a therapeutic effect on autonomic tone. Repeated practice of *Pranayama* was shown to strengthen cardio-respiratory coupling (Dick et al., 2014); increases the parasympathetic activity in healthy individuals (Chandla et al., 2013); and reducesBP and enhancesthe baroreflex sensitivity in hypertensive patients (Joseph et al., 2005). Hence, these studies demonstrate the potentially beneficial effects of slow deep breathing in the management of hypertension.

The best technique for improving baroreflex sensitivity and reduce BP in yoga-naïve subjects is doing slow breathing with equal inspiration and expiration (Mason et al., 2013). Whereas, another study reported that the increase in baroreflex sensitivity depends on the slow breathing rate and not on the regularization obtained by controlling the breathing because controlled breathing at a fixed and faster frequency (15/min) did not produce such effect (Cernes et al., 2015).

Kapalbhati: A Yogic Kriya

It involves forceful exhalation followed by passive inhalation (Saraswati, 2008). A previous study reported a decrease in cardiac vagal tone during *Kapalbhati* due to changes in respiratory pattern and decreased sensitivity of arterial baroreflex; and decreased respiratory rate (RR) and increased SBP and low frequency BP oscillations after *Kapalbhati* which suggested a differentiated pattern of vegetative activation and inhibition associated with *Kapalbhati* exercise (Stancák et al., 1991). Kapalbhati has shown to promote decarboxylation, oxidation mechanisms (Desai et al., 1990) and improve psychomotor performance (Pradhan et al., 2013) In a case study, a case of spontaneous pneumo-thorax caused by *Kapalbhati* was reported (Johnson et al., 2004). Hence, high frequency breathing technique should be practiced under the supervision of qualified yoga practitioners.

Yogic Breathing Techniques:

In a study on 2:1 yogic breathing technique (exhalation is twice of inhalation), maintaining RR of around 6 breaths/min for the duration of 5-7 minutes twice a day for 3 months was shown to reduce SBP, DBP, HR and RR in patient with essential hypertension. Hence, suggested as an effective modality for management of essential hypertension (Adhana et al., 2013). According to a previous study report, a yogic breathing technique that consists of 1 breath/minute (inspiration = 20 seconds, breath retention = 20 seconds, and expiration = 20 seconds) for 31 consecutive minutes appear to have a unique effect on the brain stem cardio-respiratory center regulating the Mayer wave (0.1 - 0.01 Hz) patterns of the cardiovascular system (Shannahoff-Khalsa et al., 2004).

Specific Nostril Yogic Breathing:

Right, left uninostril yogic breathing and alternate nostril yogic breathing (ANYB) techniques have differential physiological effects that are in tune with the traditional *swara yoga* concept (Bhavanani et al., 2014). The science of *swara* (nasal cycle) is an ultradian rhythm and a marker for psycho-physiological states which had been analyzed extensively by Indian *yogis* (Bhavanani et al., 2012, Samantaray et al., 2008 & Shannahoff-Khalsa et al., 2007). It is dependent upon tonic activity of the limbic ANS with hypothalamus as the control centre, as well as levels of circulating catecholamines and other neuro-hormones (Bhavanani AB et al., 2012) and characterized by alternating patency of the left and right nostrils, with a periodicity of two to eight hours (Samantaray et al., 2008).

The sympathetic activity is induced by left brain hemisphere stimulation and while the parasympathetic activity is induced by right hemisphere stimulation (Backon et al., 1990). The previous studies had shown that forced unilateral nostril breathing/specific nostril yogic breathing induces selective contra-lateral hemispheric activation (Shannahoff-Khalsa, 2007, Backon et al., 199 & Sinha et al., 2013) as measured by relative increases in the electroencephalographic amplitude in the contra-lateral hemisphere as well as alternating lateralisation of plasma catecholamines (Backon et al., 1990) and the forced alternate nostril breathing has a balancing effect on the functional activity of left and right hemisphere (Stancák et al., 1994). Hence, the left nostril dominance is associated with parasympathetic response and the right nostril dominance is associated with sympathetic response. If, due to some reason the nostril switching is not proper that will lead to autonomic imbalance resulting in some somatic or psychosomatic problems like hypertension (Srinivasan,1991).

A previous study suggests that breathing selectively through either nostril could have a marked activating effect or a relaxing effect on the sympathetic nervous system (Telles et al., 1994). In contrast, another study reported no significant changes in HR, pulse amplitude, temperature, skin conductance response, or respiration force following uninostril Yoga breathing (Larson et al., 1993).

Right Nostril Yoga Breathing (RNYB):

It involves both inhalation and exhalation through right nostril. A previous study reported that the air flow through right nostril (*suryanadi/pingalaswara*) is activatory in nature (Bhavanani et al., 2014).

The practice of RNYB shown to produce increase in oxygen consumption (which could be due to increased sympathetic discharge to the adrenal medulla) (Telles et al., 1994), SBP (Telles et al., 1996 & Dane et al., 2002) and HR (Dane et al., 2002 & Shannahoff-Khalsa et al., 1993) along with significant decrease in digit pulse volume. Hence, it evident from the above mentioned literature that RNYB produces sympathetic stimulation. In contrast, there are also studies on RNYB which showed, no significant changes in either SBP or DSP in healthy males volunteers (Raghurajet al., 2008); and a significant change in HR along with a significant reduction in SBP and DBP in healthy male subjects with no significant changes in female subjects (Jain et al., 2005).

Left Nostril Yogic Breathing(LNYB):

It involves both inhalation and exhalation through left nostril. A previous study reported that the air flow through left nostril (*chandranadi/idaswara*) is relaxatory in nature (Bhavanani et al., 2014). Previous studies on LNYB had shown to produce significant reduction in RR, HR, SBP and DBP in healthy (Jain et al., 2005) and significant reduction in HR and SBP in hypertensive patients who were on regular standard medical management (Bhavanani et al., 2012). In another study, increase in volar galvanic skin resistance was observed following LNYB which was interpreted as a reduction in sympathetic nervous system activity supplying the sweat glands (Telles et al., 1994). In contrast, thereare also studies on LNYB was shown to produce no significant changes in either SBP or DBP (Raghuraj et al., 2008); and significant increase in SBP and HR in healthy men (Dane et al.,2002).

Alternate Nostril Yogic Breathing:

It involves inhalation through left nostril followed by exhalation through right nostril and vise versa. In previous studies a significant reduction in HR, SBP in healthy individuals (Srivastava et al., 2005); significant reduction in both SBP and DBP in patient with hypertension (Telles et al., 2013); and significant increase in parasympathetic activity during (Telles S et al., 2014) and after ANYB (Telles et al., 2014 & Upadhyay et al., 2008) were reported. In contrast, the few studies also showed a significant increase in HR (Ghiya et al., 2012); no effect in HRV (Raghuraj et al., 1998); and a significant increase in LF and LF/HF ratio along withreduction in HF spectrum of HRV immediately after 6 and 12 minutes of ANYB (Subramanian et al.,2016).

Bhramari Pranayama:

It involves inhalation through both nostrils and while exhaling produce a humming beesound. Five minutes of slow pace *Bhramari Pranayama* has reported to influence parasympathetic dominance on cardiovascular system due to its effects in reducing SBP, DBP, mean arterial BP and HR (Pramanik et al., 2010).A 45-min practice of Bhramari pranayama has shown to produces significant reduction in HR and BP (Kuppusamy et al., 2016). The practice of Bhramari has also shown to enhance response inhibition, cognitive control (Rajesh et al., 2014), pulmonary function (Mooventhan et al., 2014)and paroxysmal gamma waves (PGW) appearances (Vialatte et al., 2009).

Pranava Pranayama:

Pranava Pranayama is one of the slow and deep yogic breathing techniques which was shown to be effective in reducing HR, SBP, pulse pressure, RRP and Do P in hypertensive patients within five minutes of the practice. The result was said to be due to a normalization of autonomic cardiovascular rhythms as a result of increased vagal modulation and/or decreased sympathetic activity and improved baroreflex sensitivity along with an augmentation of endogenous nitric oxide production (Bhavanani et al., 2012).

Sukha Pranayama:

Sukha Pranayama consists of a conscious, slow and deep breathing with equal duration for inhalation and exhalation at the rate of 6 breaths/minute which was shown to reduces the HR and BP in hypertensive patients within 5 minutes of practice (Bhavanani et al., 2011).

Bhastrika:

Yoga respiratory exercises (*Bhastrika*) consisted of rapid forced expirations followed by inspiration through the right nostril, inspiratory apnoea with generation of intrathoracic negative pressure, and expiration through the left nostril showed a significant decrease in the LF component of HRV in elderly healthy population (Santaella et al., 2011).

Mukh Bhastrika:

It involves inhalation and exhalation quickly ten times like the bellows of the blacksmith i.e., with hissing sound. Starting with rapid expulsion of breath following one another in rapid succession, after ten expulsions, the final expulsion is followed by the deepest possible inhalation. Breath is suspended as long as it can be done with comfort. Deepest possible exhalation is done very slowly. This *Pranayama* technique has shown to increase the parasympathetic activity (i.e., reduce basal HR, increase valsalva ratio and deep breathingdifference in HR) and reduce sympathetic activity (i.e., reduction in fall of SBP on posture variation). Hence, Mukh Bhastrika was reported as having beneficial effect on cardiac autonomic reactivity, when practiced for a longer duration (Veerabhadrappa et al., 2011).

Slow Pace Bhastrika:

It involves Inhalation 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 (at the rate of 6 breaths / min). The breathing must not be abdominal. These steps complete one cycle of *Slow Pace Bhastrika Pranayama*. Five minutes practice of slow bhastrika was shown to produce significant reduction in both SBP and DBP with a slight fall in HR unlike volunteers who performed the same breathing exercise for the same duration following oral intake of hyoscine-N-butylbromide (Parasympathetic blocker). Hence, *Slow Pace Bhastrika Pranayama* is effective in improving ANS through enhanced activation of the parasympathetic system (Pramanik et al., 2009).

Pranayama with meditation:

Short term (15 days) practice of regular *Pranayama* and *meditation* practice shown to improve cardiovascular functions, irrespective of age, gender, and BMI in normal healthy individuals (Ankad et al., 2011).

The Hypothesis and the Possible Mechanism:

The mechanism of how *Pranayamic* breathing interacts with the nervous system affecting metabolic and autonomic functions was hypothesized by Jerath, et al. as the voluntary slow deep breathing functionally resets the ANS 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 (SARs) and hyperpolarization current by action of fibroblasts. Bothinhibitory 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 (Jerath et al., 2006).

Another study reported that the *Pranayama* practices increase the frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors during inhalation above tidal volume 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 BP. After hyoscine-N-butylbromide, the parasympathetic blocker, it was observed that blood pressure was not decreased significantly as a result of Pranayama, as it was observed when no drug was administered. It indicates the parasympathetic activation during the practice of pranayama (Pramanik et al., 2009).

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Table 1: Summary of the Review of Scientific Literature

Author and year ofpublication	Sample size (n)	Design	Intervention	Variables studied	Findings
Joshua Backon, Nelson Matamoros, Manuel Alberto Brown, Uriel Ticho. 1990	51	Pre and post comparative trial	20 minutes of forced unilateral right nostril breathing, with the contra lateral nostril stuffed with cotton packing.	Intraocular pressure	Using functional vagotomy, left hemispheric stimulation by 20 minutes of forced unilateral right nostril breathing led to a significant bilateral decrease of 4.6 mmHg (25%) in intraocular pressure in 46 patients with open and closed angle glaucoma. However, it significantly increased the IOP in three patients with neovascular, one with juvenile onset, and one with closed angle glaucoma.
Ghiya , Lee . 2012.	20	Comparative study on alternative nostril breathing	20 individuals with no prior experience with alternate nostril breathing (ANB) engaged in 30 min of both ANB and paced breathing	Mean arterial pressure (MAP) and heart rate variability (HRV)	Immediate increase in cardiac autonomic modulation following ANB and PB without a shift in autonomic balance in individuals inexperienced with yogic breathing.

		paced breathing.	(PB) which were preceded and followed by 5 min of normal breathing.		
Telles , Yadav , Kumar , Sharma, Visweshwaraiah, Balkrishna. 2013	90	Randomized controlled trial	3 groups, with 30 participants in each group. 1st group: Alternate nostril yoga breathing for 10 mints, 2nd group: Breath awareness for 10 mints, and 3rd group: A control intervention (i.e., reading a magazine with neutral content).	Blood pressure and performance in the Purdue pegboard task.	Immediate effect of ANYB is to reduce the BP while improving the performing in a task requiring attention, bimanual dexterity and visuo-motor co-ordination.
Srivastava, Jain, Singhal. 2005.	40	Pre and post comparative trial	Alternate nostril breathing once as control and then after 15 min (acute exposure) and following 8 wks of training in ANB (15 min daily)	Respiratory rate (RR/min), heart rate (HR/ min), systolic blood pressure (SBP; mm Hg),	In general there is a tilt towards parasympathetic dominance by alternate nostril breathing. This breathing may be a useful adjuvant to medical therapy of hypertension andCOPD.

				mm Hg), peak expiratory flow rate (PEFR; L/min) and galvanic skin	
Tharion, Samuel, Rajalakshmi, Gnanasenthil, Subramanian. 2012.	36	Randomized controlled trial	Intervention group performed daily deep breathing exercise at 6 breaths/min (0.1 Hz) for one month, and a control group did not perform any breathing exercise.	Respiratory rate and heart rate variability.	Practice of deep slow breathing exercise improves heart rate variability in healthy subjects, without altering their cardiac autonomic balance. These findings have implications in the use of deep breathing exercises to improve cardiac autonomic control in subjects known to have reduced heart rate variability.
Ananda Balayogi Bhavanani, Madanmohan, and Zeena Sanjay.2012.	22	Pre and post comparative trial.	27 rounds of chandranadi pranayama (CNP) with a regularity of 6 breaths/min	Heart rate (HR) and blood pressure (BP) measurements, pulse pressure,	Twenty seven rounds of CNP produced an immediate decrease in all the measured cardiovascular parameters with the decrease in HR, systolic pressure (SP), pulse pressure, rate-pressure product and double product being

				product	statistically significant.
Ananda Balayogi Bhavanani, Madanmohan and Zeena Sanjay. 2012.	20	Pre and post comparative trial.	Suryanadi Pranayama with a regularity of 6 breaths/min	Heart rate (HR) and blood pressure (BP) measurements, pulse pressure, rate-pressure product and double product	Exclusive right nostril breathing as performed in SNP may be safe in patients of HT. We also conclude that the cardiovascular effects of SNP in hypertensives are different than those reported by previous studies done in normal subjects.
Sinha, Deepakpak, Gusain. 2013.	25	Pre and post comparative trial.	Alternate Nostril Breathing, training for 6 weeks, for 15 minutes daily.	The deep breathing test (the E:I ratio) and the orthostatic tolerance test (the 30:15 test), Heart Rate.	Yogic exercise of A.N.B. influences the parasympathetic nervous system significantly.
Jain, Srivastava, Singhal A. 2005.	40	Comparative study on right and left nostril breathing.	Right nostril breathing (RNB) group: Right nostril breathing for 15 min (acute exposure) and 8 wks of training for Left nostril breathing (LNB)	Respiratory rate (RR), heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBF), peak expiratory	There are no sharp distinctions between effects of RNB and LNB either acute exposure (15 min) or after training (8 wks). However, there is a general parasympathetic dominance evoked by both these breathing patterns

			group: Left nostril breathing for 15 min (acute exposure) and 8 wks of training	galvanic skin resistance (GSR).	
Raghuraj, Telles. 2008.	21	Repeated measures design	Right, left, alternate nostril yoga breathing, breath awareness, and normal breathing sessions for 40 min; 30 min for the breathing practice, preceded and followed by 5 min of quiet sitting.	Heart rate variability, skin conductance, finger plethysmogram amplitude, breath rate, and blood pressure.	Right nostril yogic breathing there was a significant increase in systolic, diastolic and mean pressure. In contrast, the systolic and diastolic pressure decreased after Alternate nostril yogic breathing and the systolic and mean pressure were lower after Left nostril yogic breathing. Hence, unilateral nostril yoga breathing practices appear to influence the blood pressure in different ways. These effects suggest possible therapeutic applications.
Telles, Nagarathna, Nagendra. 1998.	48	Randomized trial with 3 groups.	Each group was asked to practice one out of three pranayamas (viz. right nostril breathing, left nostril breathing or alternate nostril	Oxygen consumption and Galvani c skin	'Right nostril pranayama': Significant increase, of 37% in baseline oxygen consumption. The 'alternate nostril' pranayama: 18% increase, and the left nostril pranayama: Increase, of 24%. This increase in metabolism could be due to

			breathing). These practices were carried out as 27 respiratory cycles, repeated 4 times a day for onemonth.		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.
Bhimani, Kulkarni, Kowale, Salvi. 2011.	59	Pre and post comparative trial.	Various pranayama 1 hour/day for 5 days/week for 2 months.	Stress questionnaire was put and the autonomic function tests	Significant reduction in stress score which is highly. Very low frequency and low frequency in normalised unit have reduced significantly after practice of pranayama signifying reduction in sympathetic drive to heart. High frequency in normalised unit 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.
Pal, Velkumary, Madanmohan. 2004.	60	Randomized trial	Slow breathing group: Slow breathing exercise Fast breathing group: Fast breathing exercise. Duration: 3 months.	Autonomic function tests	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.
Telles, Nagarathna, Nagendra. 1996.	12	Repeated measures design	2 Sessions: 1) Surya anulomaviloma pranayama for 45 minutes. 2) Normal breath for 45 minutes.	oxygen consumption, Blood pressure, digit pulse	Surya anuloma viloma pranayama has a sympathetic stimulatingeffect.
Singh, Malhotra, Singh, Madhu, Tandon. 2004	24	Pre and post comparative trial.	Training in yoga asanas (13 well known postures, done in a sequence) for 30-40	Fasting and postprandial blood	Better glycaemic control and stable autonomic functions can be obtained in Type 2 DM cases with yoga asanas and pranayama.

			min/day for 40 days under guidance.	glycosylated Hb with autonomic function	
Roopa,Ankad, Anita Herur, ShailajaPatil, Shashikala, and Surekharani. 2011.	50	Interventional study	two hours daily yoga program for 15 days	Pulse rate, systolic blood pressure, diastolic blood pressure, and mean blood pressure.	Significant reduction in resting pulse rate, systolic blood pressure, diastolic blood pressure, and mean arterial blood pressure after practicing pranayama and meditation for 15 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.
Bhavanani, Ramanathan, Balaji, Pushpa. 2014	22	Repeated measures trial	Dhanurasana (DA), Vakrasana (VA) (both sides), Janusirasasana (JSA) (both sides), Matsyasana and Shavasana for 30 second.	Heart rate (HR), systolic pressure (SP), and diastolic pressure (DP), blood pressure (BP),	Significant changes in HR and BP both immediately after the Asanas as well as during the recovery period. Significant differences with regard to HR that increased significantly after Dhanurasana (DA). In the recovery phase, there were significant intergroup differences from2minonwardinbothSPandDP.The

					decrease of SP after Vakrasana (VA) (right side) was significantly greater than Shavasana (4(th), 6(th), and 8(th) min) and Janusirasasana (JSA) (left side) at 6(th) and 8(th) min. Diastolic pressure decreased significantly after performing JSA-Left compared to VA-Right at the 6(th) and 8(th)min.
Selvamurthy, Sridharan, Ray, Tiwary, Hegde, Radhakrishan, Sinha. 1998	20	Randomized trial	Group-I was subjected to a 3 week course of 70 degrees head-up tilt for 30 min daily. Group-II was subjected to specific yogic exercises equivalentto head-up or head-down tilt were administered for the same duration.	cardiovascular responses to head up tilt, cold pressor response at 4 degrees C water (CPR), alpha index of EEG (AI), level of blood catecholamines	A significant reduction ($P < 0.001$) in blood pressure in both the groups. Progressive changes in BP and HR response to tilt during 3 weeks course of tilt and yogic exercise clearly indicated gradual improvement in baroreflex sensitivity. Likewise, changes in other indices like CPR, AI, CA and PRA indicated progressive attenuation of sypatho-adrenal and renin-angiotensin activity.
Raghavendra,	50	Repeated	Two trials (12 minutes):	Electrocardiogra m	Yoga practitioners with an average of 16

Telles, Manjunath, Deepak, Naveen, Subramanya		measures design	Trial I- Subjects were asked to sit at ease with their eyes closed, for six minutes. This was the 'pre' state. In the next six minutes subjects were asked to attempt to voluntarily reduce their heart rate.	(EKG)	months of experience in yoga were effectively able to reduce their heart rates by 19.6 beats per minute when they used strategies oftheir choice, and were able to achieve a reduction of 22.2 beats per minute when all of them used breath regulation as a strategy for heartrate reduction.