"EFFECT OF INTEGRATED YOGA ON ANXIETY, STRESS AND HEART RATE VARIABILITY IN FIRST YEAR MEDICAL STUDENTS"

by

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A dissertation submitted to the Sri Devaraj Urs Academy of Higher Education & Research, Tamaka, Kolar, Karnataka

in partial fulfillment of the requirements for the degree of

DOCTOR OF MEDICINE
in
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Under the guidance of

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Sri Devaraj Urs Medical College, Kolar
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I **Dr. SUMITRA@SUDHARKODHY.S** hereby declare that dissertation entitled**, "EFFECT OF INTEGRATED YOGA ON ANXIETY, STRESS AND HEART RATE VARIABILITY IN FIRST YEAR MEDICAL STUDENTS"** is a bonafide and genuine research work carried out by me under the guidance of **Dr**.**KARTHIYANEE KUTTY,** Professor and Head of Department of Physiology, **Dr.PATIL N.J,** Assistant Professor Department of Allied Health Sciences, as Co-guide, Sri Devaraj Urs Medical College, Kolar.

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This is to certify that, the ethical committee of Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, has unanimously approved **DR. SUMITRA@SUDHARKODHY.S**, Post graduate student in the department of physiology of Sri Devaraj Urs Medical College to take up the dissertation work entitled **"EFFECT OF INTEGRATED YOGA ON ANXIETY, STRESS AND HEART RATE VARIABILITY IN FIRST YEAR MEDICAL STUDENTS"** To be submitted to the Sri Devaraj Urs Academy of Higher Education and Research, Tamaka, Kolar.

MEMBER SECRETARY **PRINCIPAL**

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LIST OF ABBREVIATIONS

ANS : Autonomic Nervous System.

HF : High Frequency

HR : Heart Rate

HRV : Heart rate Variability

LF : Low Frequency

PNS : Parasympathetic Nervous System

PSS : Perceived Stress Score

IRT : Instant Relaxation Technique

DRT : Deep Relaxation Technique

HPA : Hypothalamic Pituitary Adrenal Axis

GABA : Gamma Aminobutyric Acid

DALYS : Disability Adjusted Life Years

BP : Blood Pressure

BRS : Baroreflex Sensitivity

HRT : Heart Rate Turbulence

CHF : Chronic Heart Failure

SAN : Sino Atrial Node

BMI : Basal Metabolic Rate

REM : Rapid Eye Movement

CRF : Corticotrophin Releasing Factor

ACTH :Adreno Corticotrophic Hormone

PSD : Power Sepectral Density

FFT : Fast fourier transform

RMSSD : Square root of the mean squared difference of successive NN interval

SDNN : Standard Deviation of Normal to Normal

SNS : Sympathetic Nervous System.

STAI :Spielberger State – Trait Anxiety Inventory

ULF : Ultra low frequency

VLF : Very low frequency

ECG : Electrocardiography

ABSTRACT

Background and Objective

Medical students are exposed to various stresses in medical college like demanding medical education and different teaching protocols. Yoga is an ancient science established in India, which gives the practitioner not only a healthy body but also a sound mind. Regular practice of yoga is reported to improve cardiovascular fitness. Heart rate variability (HRV) is a simple noninvasive tool to assess the cardiac autonomic function.

The present study is taken up with the following objectives.

- To assess the anxiety and stress levels in first year medical students.
- To study the effect of one month of integrated yoga intervention on anxiety, stress and heart rate variability.

Material and Methods

Spielberger state-trait anxiety inventory (STAI) questionnaire and perceived stress scale (PSS) were administered to 150 first year medical students. 60 students were included in the study based on inclusion criteria after obtaining informed consent. Their STAI and PSS scores were used as baseline in addition, heart rate variability was assessed by using HRV device (AD Instruments).30 students those who were volunteered to practice yoga for a month were included in the study group rest were in control group. Study group intervened with Yoga intervention which comprises of Loosening exercises, Suryanamaskara, Instant Relaxation Technique (IRT), Kapahalabhati- 3 rounds, Nadisuddi pranayama and Deep Relaxation Technique (DRT) were performed for 45 mins/5 days/ week duration for one month under the guidance of a certified yoga instructor. Post interventional assessment of anxiety,

stress and HRV was done. Appropriate statistical analysis were done using SPSS software package version 16.

Results

The mean age of the subjects were 18.05 ± 0.21years. There was significant decrease in anxiety with yoga intervention. Analysis of heart rate variability revealed that SDNN was significantly higher after practice of yoga. Parasympathetic markers such as RMSSD was significantly higher after intervention. In the frequency domain parameters the LF power spectrum and LF/HF ratio were significantly reduced after one month practice of yoga.

Conclusion

Integrated Yoga intervention in first year medical students when compared to controls showed significant decrease in state anxiety, perceived stress and improved heart rate variability with a shift towards parasympathetic dominance. However, trait anxiety not showed significant improvement.

Key words: Yoga, Anxiety, Stress, Heart Rate Variability, Medical Student

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INTRODUCTION

Stress can be defined generally as responses to demands upon the body.[1] It is the body's reaction to a change that requires a physical, mental, or emotional adjustment or response.[2] Stressor is a stimulus, either internal or external, that activates the hypothalamic pituitary adrenal (HPA) axis and the sympathetic nervous system resulting in physiological change.[3]Long-term exposure to stressors can cause depression, post-traumatic stress disorder and anxiety disorders. Stress either physical or mental leads to cardiovascular morbidity.[4]

First year medical students are likely to be exposed to various stresses like demanding medical education and different teaching protocol in a medical college.[5] Previous studies have shown fairly high levels of distress, such as symptoms of depression and even suicide thoughts among medical undergraduates.[6,7,8] This emotional distress on medical students results in deteriorating performance in class-room. Further, stress-induced disorders have also been linked to forthcoming health problems.[5] Academic examinations clearly increase levels of anxiety and emotional distress, promote diverse endocrine alterations including catecholamine, thyroid, and glucocorticoid effects.[9]

Anxiety leads to autonomic imbalance with accentuated sympathetic activation often leading to cardiac dysfunction resulting in decrease in heart rate variability. The decrease in heart rate variability is a potential risk factor for hypertension and atherogenesis which progress to coronary artery disease and a clinical predictor of mortality due to cardiac causes.[10,11]

HRV is the temporal variation in consecutive heart beats measured from a standard electrocardiogram (ECG) and the assessment of this difference is performed in time domain and frequency domain. These parameters are used to assess cardiac autonomic balance or the balance between sympathetic and parasympathetic mediators of heart.[12]

Decreased HRV means that there is a sympatho-vagal imbalance with a tilt towards sympathetic predominance or a reduction parasympathetic activity.

Stress management is required for medical students to decrease depression and anxiety, and to improve sensitivity toward themselves, peers, and parents. Yoga is an ancient science established in India which gives the practitioner not only a healthy body but also a sound mind and has shown to have effects on most physiological systems of the body.[13,5] It is known to modulate autonomic output and helps achieve and maintain autonomic balance between two components (sympathetic and parasympathetic) of autonomic nervous system and stress.[14]

This study is designed to demonstrate the presence of stress in first year medical students and associated with altered heart variability, and the role of yoga as an effective intervention to reduce anxiety, perceived stress and improve HRV.

OBJECTIVES

The present study has been undertaken with following objectives.

- To assess the anxiety and stress in first year medical students.
- To study the effect of integrated yoga intervention on anxiety, stress and heart rate variability.

REVIEW OF LITERATURE

3.1 STRESS

Stress has been defined as “any change in the environment that changes or threatens to change an existing optimal steady state”.[15]Though this concept dates back to ancient Greek history its role in pathophysiology of specific illness like anxiety, depression and chronic inflammatory diseases are more recent.

3.1.1 Physiology of stress

The stress system that respond to stressors of any kind has central control stations located in the hypothalamus and the brain stem. They include the parvocellular corticotropin-releasing hormone (CRH) , arginine – vasopressin (AVP) neurons of the paraventricular nuclei (PVN) of the hypothalamus and the locus ceruleus (LC)–norepinephrine system (central sympathetic system) and underactivity of the gamma amino-butyric acid (GABA) system, the primary inhibitory neurotransmitter .These systems interact with several other transmitter systems in the brain and directly activate the hypothalamic-pituitary-adrenal (HPA) axis and the three components of the autonomic nervous system, namely the sympatho-adrenal, the cranio-sacral parasympathetic and the enteric nervous systems.

During acute stress, the amplitude and synchronization of the CRH and AVP pulsations in the hypophyseal portal system markedly increases, resulting in increases of ACTH and cortisol secretory episodes . CRH and CRH receptors were found in many sites in the brain outside of the hypothalamus, including parts of the limbic system and the central arousal sympathetic systems (LC/NE) in the brain stem and spinal cord . Stress is a potent general activator of CRH release from the

hypothalamus and extra hypothalamic sites. The mechanisms via which stress stimulates CRH neurons are unclear. Whether CRH or another transmitter (e.g., NE) is upstream in eliciting the neurocircuitry of stress remains to be determined. CRH-binding sites are also found in various peripheral tissues, such as the adrenal medulla, heart, prostate, gut, liver, kidney and testes. CRH binding stimulates the intracellular accumulation of cAMP. Depending on the type of stress, other factors such as AVP of magnocellular neuron origin, angiotensin II and various cytokines and lipid mediators of inflammation are secreted and act on hypothalamic, pituitary or adrenal components of the HPA axis, potentiating its activity. The locus ceruleus and other noradrenergic cell groups of the medulla and pons are collectively known as the LC/NE system. Brain epinephrine serves globally as an alarm system that decreases neuro vegetative functions, such as eating and sleeping and that contributes to accompanying increases in autonomic and neuroendocrine responses to stress including HPA axis activation. NE also activates the amygdala, the principal brain locus for fear-related behaviors, and enhances the long-term storage of aversively charged emotional memories in sites such as the hippocampus and striatum (fig 1).[16]

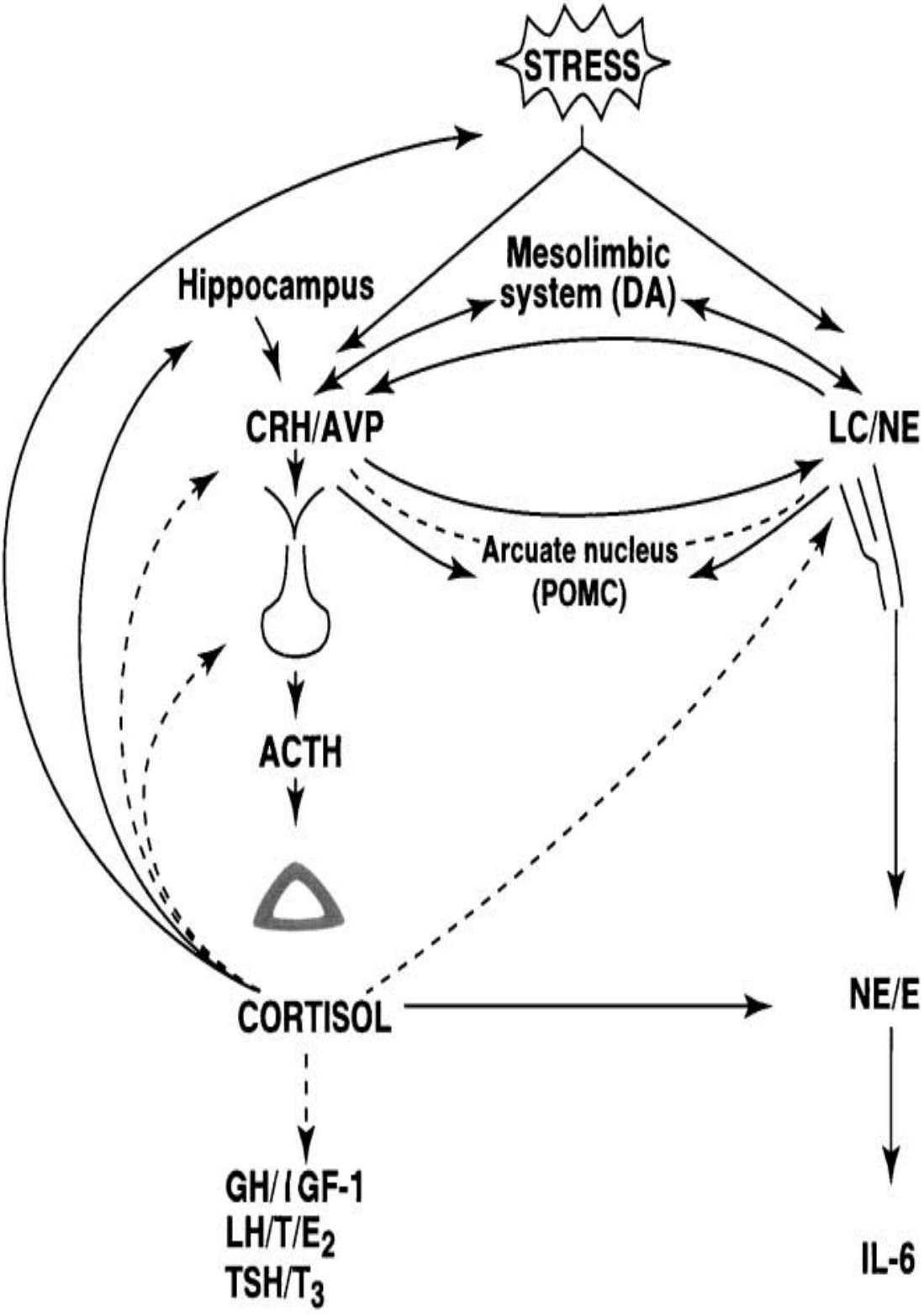


Fig. 1. A simplified schematic representation of the central and peripheral components of the stress system, their functional interrelations and their relations to other central systems involved in the stress response.

3.1.2 Stress in medical students

Medical education is believed to be highly stressful. Students in the medical school are admitted after a stringent entrance examination and they find themselves in unfamiliar grounds in academic and non-academic fields. Most Indian medical students move from the security of home to hostel for the first time. They find themselves in new surroundings with lack of familiar social support and are further under tremendous parental expectations.[5]As far as academic goes they are overwhelmed by the vastness of curriculum, unfamiliar teaching learning practices and inability to cope up with frequent tests and assignments, most of which are compounded with lack of time and sleep. Previous studies have shown high levels of distress and even symptoms of depression and suicidal thoughts among medical undergraduates.[7,8,9] This emotional distress in medical students results in deteriorating performance in class-room which further aggravates anxiety.[17] Many students use alcohol and drugs to help cope with stress which further deteriorates social health and academic performance. Examination stress has consistently shown to cause changes in catecholamine levels, whereas the changes in cortisol and Adrenocorticotropic Hormone (ACTH) were somewhat contradictory, with some studies showing an increase and others showing no relation. International studies have indicated a high prevalence of depression and a lack of coping with stress in medical students.[52,53,54]

3.2 AUTONOMIC NERVOUS SYSTEM

Anatomically and functionally, the autonomic nervous system is divided into the sympathetic and the parasympathetic divisions (fig.2).Sympathetic neurons arise from thoraco-lumbar and parasympathetic neurons arise from cranio-sacral regions. Physiological functions of preganglionic sympathetic and parasympathetic neurons are mediated through acetylcholine. Postganglionic neurotransmitters are

norepinephrine and acetylcholine in sympathetic and parasympathetic neurons respectively. Circulatory homeostasis of the organism is regulated by autonomic nervous system mediated through sympathetic and parasympathetic neurons innervating the heart. Afferent nerve fibers convey mechanosensory and chemosensory inputs to the integration centers located in medulla. The efferent fibers from medulla in turn innervate heart and blood vessels. The medullary centers also receive input from higher brain centers like frontal cortex, limbic system and hypothalamus. These are important for influencing cardiovascular responses to emotion, stress and exercise.

3.2.1 Autonomic control of the heart

Heart is innervated by postganglionic sympathetic neurons arising from the right, left stellate ganglia and the caudal halves of the cervical sympathetic trunks (fig:3) Anterior region and infero-posterior region of heart is innervated by sympathetic neurons arising from the right stellate ganglia and left stellate ganglia respectively.[33] Parasympathetic innervation of the heart is through vagus nerve. There are differences in the intrinsic distribution of cardiac autonomic neurons. The atria are more densely innervated than the ventricles and the basal areas of the ventricles are more densely innervated than the apical areas. Atria have more parasympathetic than sympathetic nerve fibers whereas ventricles have more sympathetic and sparse parasympathetic innervation. Sympathetic innervation is denser in the anterior as compared with the posterior parts of the ventricles. Epicardium is predominantly supplied by sympathetic and endocardium by parasympathetic neurons.[34]

Cardiac automaticity is mainly due to intrinsic pacemaker properties of different cardiac tissues. This intrinsic rhythm is largely modulated by ANS. Interplay between sympathetic and parasympathetic outflow helps in neural regulation of the heart. The

sympathetic system enhances automaticity, whereas the parasympathetic system inhibits it. Sympathetic stimulation on cardiac pacemaker cells cause chronotropic effects by increasing the rate of pacemaker depolarization. Parasympathetic stimulation of the cardiac pacemaker cells cause hyperpolarization and reduce the rate of depolarization.[35]

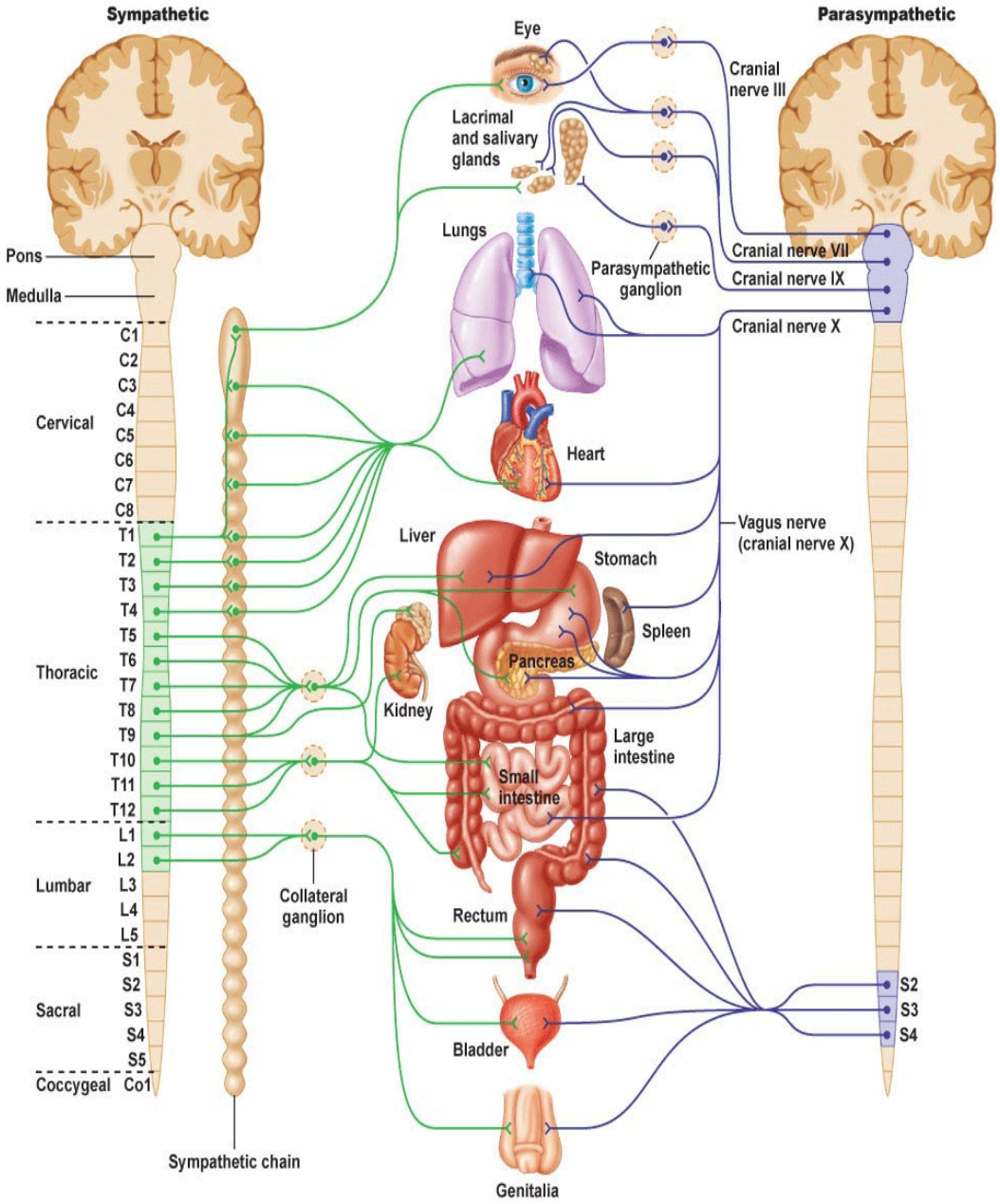


Fig. 2: Autonomic nervous system

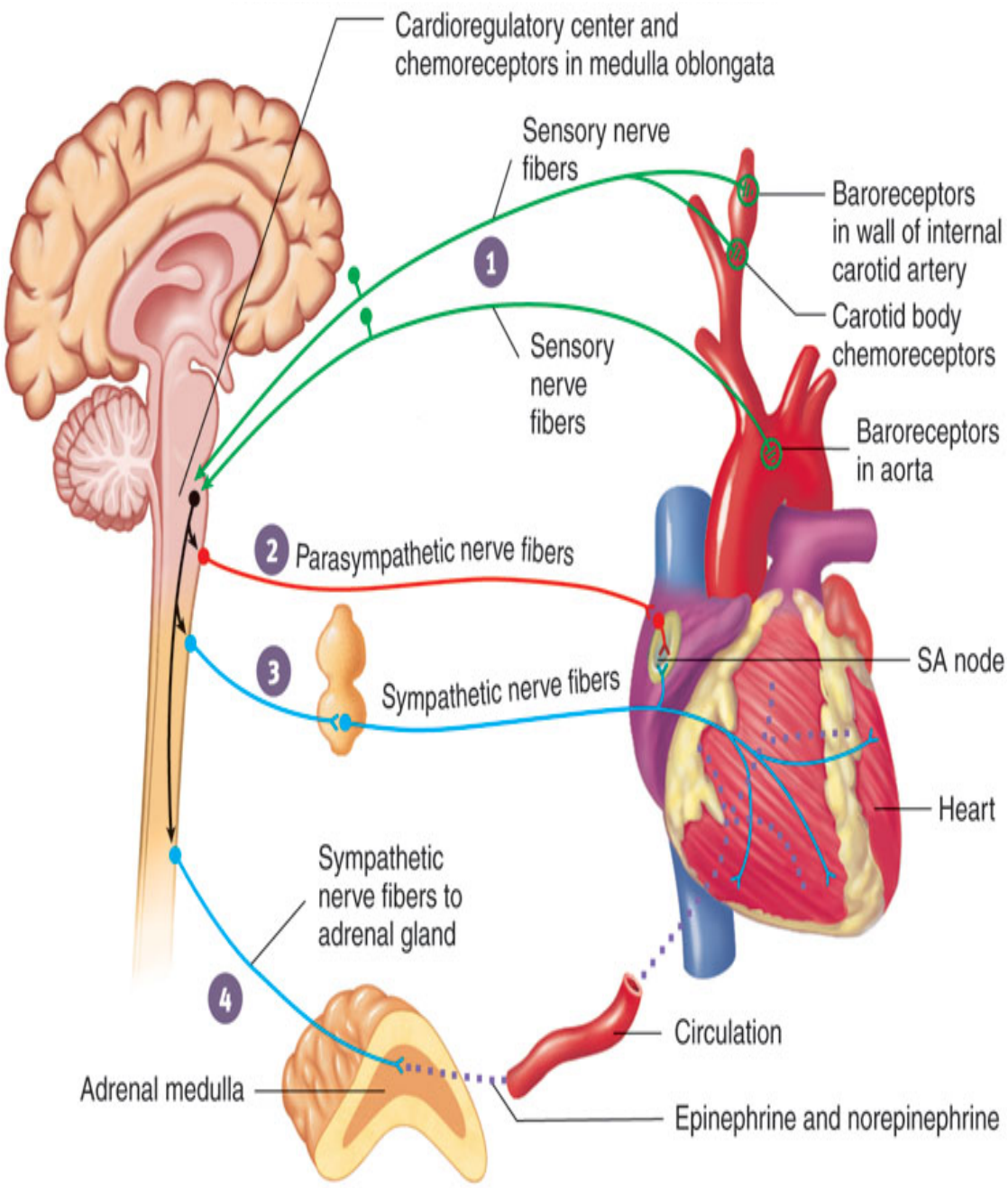


Fig. 3: Innervation of heart

3.3 Heart rate variability (HRV)

Heart rate variability is defined as oscillation in consecutive cardiac cycles and is predominantly dependent on the extrinsic regulation of the heart rate. Cycle length variability, heart period variability, RR variability, RR interval tachogram are few synonyms of HRV. The normal average heart rate is about 75 beats/ min and the duration of normal cardiac cycle is 800 ms. But heart rate is not constant as the duration of cardiac cycle varies from beat to beat. This has led to conceptualization of instantaneous heart rate which is the extrapolation of heart rate from each cardiac cycle. The normal variability in heart rate is due to autonomic neural regulation of the heart and the circulatory system. Balance between sympathetic nervous system (SNS) and parasympathetic nervous system, (PNS), divisions of the ANS control the heart rate.

The variability in the heart rate is due to the action of balance and synergy between the two branches of the autonomic system, which is mainly enforced through neural, mechanical, humoral and other physiological mechanisms. It maintains cardiovascular parameters in their most favorable ranges and permits suitable reactions to change in external or internal stimuli.[20] This balance between the effect of the SNS and the PNS is known as the sympathovagal balance and is believed to be echoed in the beat-to-beat changes of the cardiac cycle.[21]

Vagal stimulation on the cardiac pacemaker cells causes hyperpolarisation and reduces the rate of depolarization whereas sympathetic stimulation causes chronotropic effects by increasing the rate of pacemaker depolarisation. The SAN responds to vagal activity within one or two heart beats but its overall effects are relatively short lived. Vagal induced changes in heart rate typically occur within 5 s whereas cardiac responses to SNS regulation occur more slowly with initial response

delays of up to 5 s, followed by a progressive change and a maximum response after 20 to 30 s. These differences in response times are due in part to the relatively slow exocytotic release of noradrenaline from sympathetic nerve terminal through which the SNS regulates cardiac activity. Also, unlike PNS acetylcholine mechanisms, a secondary messenger (adenylyl cyclase) is involved in SNS regulation which further slows the process. Ach released from the postganglionic parasympathetic terminal binds to the muscarinic cholinergic receptor and activates transmembrane potassium channel and hence reduces HR. Other anatomical disparities between the autonomic branches may also contribute to the slower response rate associated with SNS regulation. For instance, the preganglionic cell bodies of the PNS neurons are located within the heart itself, whereas those of the sympathetic neurons are comparatively isolated in the paravertebral ganglia. Furthermore, preganglionic fibres are also myelinated contributing to faster electrical transmission of vagal regulatory signals compared to transmission rates in unmyelinated SNS fibres.[22] Thus, increased HRV shows parasympathetic dominance and reduced HRV indicates sympathetic dominance of the heart. Hence, HRV analyses the tonic baseline autonomic function. In a normal heart with an intact ANS, there will be continuous physiological variations of the sinus cycles reflecting a balanced sympthovagal state and normal HRV. The changes in activity in the afferent and efferent fibers of the ANS and in the local neural regulation will contribute to the resulting sympathovagal imbalance, reflected by changes in HRV.

3.3.1 Analysis of heart rate variability

Analysis of HRV is used as a tool to assess overall cardiac health and the state of ANS responsible for regulating cardiac activity. HRV can be analyzed based on the short and long term recordings of ECG. Short-term HRV is derived from recording

ECG for 5-minutes. Long-term HRV, derived from 24-hour ECG recordings (Holter recording of ECG). In both short-term and long-term recordings of HRV, time domain and frequency domain analysis can be performed.The standard values of HRV parameters are calculated using 24 hour Holter recording for time domain parameters and 5 minutes recording of ECG for frequency domain parameters.[23] Short term HRV assessment is useful in evaluating the influence of any intervention.

3.3.2 Methods to evaluate time domain parameters

There are number of methods to evaluate variations in HR. Simplest of them are the time domain measures. Using these methods, the intervals between successive normal complexes or the HR at any given time can be determined. In a continuous ECG recording, each QRS complex is identified by complex exceeding the pre-determined amplitude. Then normal-to-normal (NN) intervals (intervals between consecutive QRS complexes resulting from sinus node depolarization), or the instantaneous HR is determined. Time domain variables that can be calculated are the mean NN interval, the mean heart rate, the difference between the longest and shortest NN interval, the difference between heart rate during night and day.

Two classes of complex statistical time domain measures can be calculated using instantaneous HR or cycle intervals. (a) those derived from direct measurements of NN intervals or instantaneous heart rate, and (b) those derived from the differences between NN intervals. These variables may be derived from analysis of total electrocardiographic recording or may be calculated using smaller segments of the recording period. The segmental analysis allows comparison of HRV to be made during various activities, like rest, sleep.

The simplest variable to calculate is the standard deviation of the NN interval (SDNN), i.e. the square root of variance. Since variance is mathematically equal to

total power of spectral analysis, SDNN is a marker of overall variability of the heart and reflects the range of fluctuation in the duration of cardiac cycle. SDNN calculated over a 24 hour period reveals resultant variation of both high frequency and low frequency components. As the period of monitoring decreases, SDNN estimates shorter cycle lengths. The total variance of HRV increases with the length of analysed recording. Hence SDNN is not a well-defined statistical entity in an arbitrary recording of ECG. Thus, in practice, it is inappropriate to compare SDNN measures obtained from recordings of different durations as it depends on the length of recording period.

The measures derived from interval differences include RMSSD, the square root of the mean squared differences of successive NN intervals, NN50, the number of interval differences of successive NN intervals greater than 50 ms, and PNN50, the proportion derived by dividing NN50 by the total number of NN intervals. All these measurements estimate high frequency variations in heart rate and thus are markers of parasympathetic activity.

3.3.3 Frequency domain methods

Various spectral methods for the analysis of the tachogram have been applied since the late 1960s. Power spectral density (PSD) analysis provides the basic information about distribution of power (i.e. variance) as a function of frequency. Fast Fourier Transform— FFT, a non-parametric mathematical algorithm is usually employed to estimate the true PSD of the signals. Non parametric methods are relatively simple, and have high processing speed. Parametric methods yield smoother spectral components, which can be distinguished independent of preselected frequency bands. It helps in easy post-processing of the spectrum with an automatic calculation of low and high frequency power components, identification of the central frequency of each

component. They also provide an accurate estimate of PSD on a small number of samples on which the signal is maintained stationary. Disadvantage of parametric methods is the need to verify the suitability of the chosen model and its complexity.

3.3.4 Spectral components

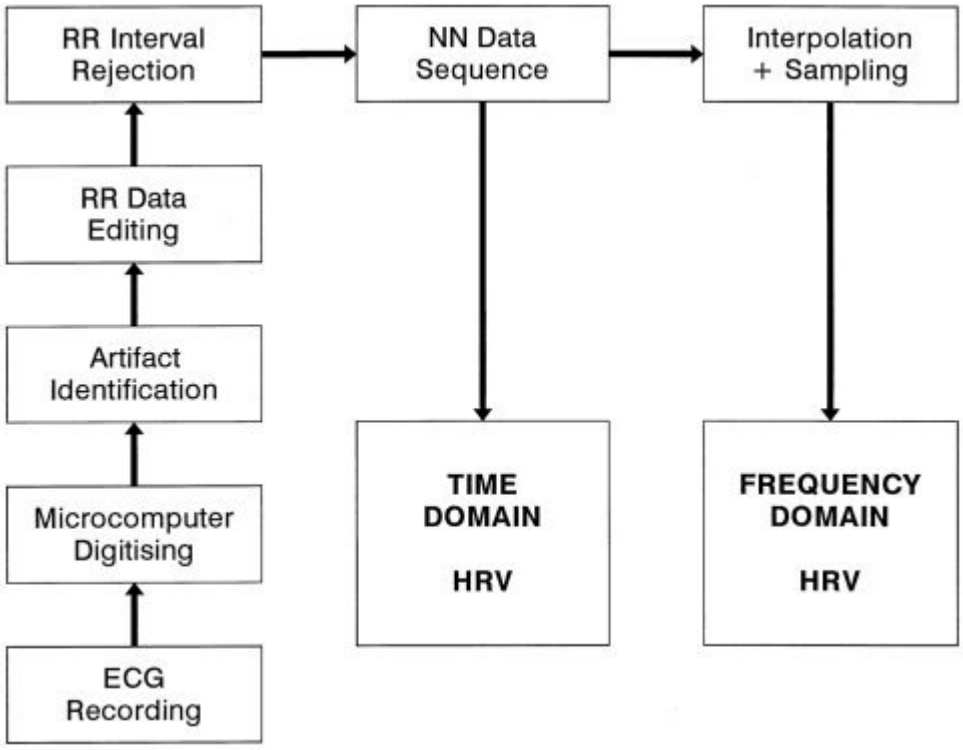
In the short-term recording, three main spectral components are identified. They are very low frequency (VLF), low frequency (LF), and high frequency (HF) components. The distribution of the power, the central frequency of LF and HF are not fixed but may vary in relation to changes in autonomic modulations of the heart rate. The physiological basis for VLF is non-neuronal components affecting the cardio like Renin-angiotensin system, thermoregulatory mechanism and other local hormonal factors. Measurement of VLF, LF and HF power components are usually expressed in absolute values power of millisecond^2 (ms^2). Their values are expressed in power percentage to evaluate the influence of both neuronal and non-neuronal factors affecting the heart. LF and HF may also be measured in normalized units (n.u.) which represent the relative value of each power component in proportion to the total power minus the VLF component. The representation of LF and HF in n.u. emphasizes the effect of neuronal component alone from two division of the autonomic nervous system.

In long-term recordings, spectral analysis is used to determine the sequence of NN intervals in the entire period of 24-hours. The result includes an ultra-low frequency component (ULF) in addition to VLF, LF and HF components. Power spectral density (PSD) analysis provides the basic information about the distribution of power as a function of frequency. An estimate of true PSD of the signals can be obtained by proper mathematical algorithms independent of duration of recording.

3.3.5 Geometrical methods

The NN intervals can also be converted into a geometric pattern, such as the sample density distribution of NN interval durations, sample density distribution of differences between consecutive NN intervals, Lorenz plot of NN or RR intervals. A formula is used to assess the variability based on the geometric and/or graphic properties of the resulting pattern.

REPRESENTATION OF THE CIRCUIT INVOLVED IN HRV RECORDING[2]



3.3.6 Factors affecting HRV

Physiological factors modulate activity of sympathetic and parasympathetic system acting through central and peripheral receptors. This is demonstrated by a decrease in HR with expiration and increase with inspiration (respiratory sinus arrhythmia). These effects are apparent on the HF power spectrum. Circadian alterations in HRV are observed in normal subjects, with higher LF power spectrum in the daytime and higher HF power spectrum during night.[39] Exercise and standing increase sympathetic drive and LF power spectrum. Conversely, stimulation by cooling the face increases parasympathetic drive and HF Power spectrum.[40] Physiological factors influencing HRV are age, BMI, sleep patterns and circadian rhythm. Diseases like hypertension, coronary artery disease, diabetes mellitus, asthma and diseases affecting the autonomic regulation also influence HRV.

3.3.7 Effect of stress on HRV

Stressors are often associated with an increase in sympathetic cardiac control, a decrease in parasympathetic control, or both. Stressors increases heart rate, time domain parameters SDNN and RMSSD. It increases frequency domain parameters like LF power spectrum,LF/HF spectrum and decrease HF spectrum. [41]

3.4 YOGA

Yoga is a science of ancient civilization which throws light upon healthy way of living.[18] Yoga works on various aspects of physical, mental, emotional, psychological and spiritual health of an individual. Swami Satyananda Saraswathi describes yoga as a valuable inheritance. It's not an ancient myth but is an essential need for culture of today and tomorrow. In spiritual terms yoga is described as union of individual and universal consciousness, where as in practical application it aids in balancing and harmonizing body, mind and emotions. It is one of the six orthodox systems of Indian

philosophy. It was collated, co-ordinated and systematized by saint Patanjali in his work Yoga Sutras.[24] He describes it as a way of merging human spirit *(Jivathma)* with universal spirit *(Paramathma).* Yoga as described by saint Patanjali has eight limbs, y*ama, niyama, asana, pranayama, prathyahara, dharana, dhyana and samadhi*. Maximum benefits of yoga can be reaped on practice of these aspects. [18,25]

Yoga begins to work on the outermost aspect of the personality, the physical body, which for most people is a practical and familiar starting point. When imbalance is experienced at this level, the organs, muscle and nerves no longer function in harmony, rather they act in opposition to each other. Yoga is directed at bringing different bodily functions into perfect coordination and maintaining it to achieve good health. It also acts at mental and emotional level aiding to achieve integration, harmony between thought, feeling and deeds. It helps in developing awareness of interrelationship between emotional, mental, physical levels and how a disturbance in one can affect the others. Yoga may not provide a cure for illness but it is a proven method in coping with it.In present scenario, it's important to establish an authentic scientific basis for the claims of yoga, as it can be complementary to the present discipline of preventive and therapeutic medicine.

In recent days, many schools of yoga have emerged based on Patanjali ashtanga yoga like Hatha yoga, BKS Iyenger school of yoga, power yoga, Bihar school of yoga, to name a few. The most common aspects of yoga practiced in western world are physical postures and breathing techniques of Hatha yoga and meditation.[26] Hatha yoga enhances the capacity of the physical body through the use of a series of *asanas* and *pranayama*. The *pranayama* of Hatha yoga focuses on conscious prolongation of inhalation, breath retention, and exhalation. This is achieved through the unification of the physical body, breath, and concentration, while performing the postures. It

emphasizes that upon unification, blockages in the energy channels of the body are cleared and the body energy system becomes more balanced.

The Iyengar method of yoga is based on the teachings of the yoga master B.K.S. Iyengar. Iyengar yoga emphasizes on physical postures to develop strength, stability, stamina, concentration and body alignment. It promotes the use of props (additional aids like rope, pillow and chair) for adjusting the postures during practice.

The practice of pranayama is claimed to clear "blockages from these channels and thus achieve better flow of vital energy and improved health Pranayama is considered by core ancient and contemporary yoga texts an important tool for improving health, preventing and curing diseases and also for facilitating concentration and calming the mind as an essential foundation practice for higher spiritual practice, as in pranayama practice the breath and the mind are closely interlinked.[36]

Deep relaxation technique emphasizes on part by part relaxation of whole body. It works at all level ie physical, mental, emotional, intellectual and spiritual levels. It is the relaxation technique where one relaxes the whole body, part by part by directing the attention of the mind on different parts of the body, starting from toes and ending with the head. A feeling of relaxation is propagated.

Surya namaskara is integral part of yoga practice and consists of a sequence of movements synchronized with deep breathing. Surya Namaskara is a series of 12 physical postures made up of a variety of forward and backward bends.[20] The series of movements stretch the spinal column and upper and lower body through their full range of motion, massaging, toning and stimulating vital organs by alternately flexing the body forwards and backwards.[19] It builds upper body strength through the inherent weight bearing positions, especially in the arms and shoulders, throughout the series.[20] The simulated push-up movement and upper body weight bearing positions in the

series may help to develop muscular strength and endurance in the pectoral, triceps, as well as the muscles of the trunk.[20,35] The series gives such a profound stretch to the body that it is considered to be a complete yoga practice by itself.[21]

3.4.1 Role of Yoga in stress and anxiety

Stress, anxiety and depression may have a significant negative impact on quality of life. Several studies have shown yoga practice may alleviate stress, anxiety and depression pointing to a possible mechanism by which yoga practice may improve sleep quality in individuals suffering from stress, anxiety or depression and comorbid sleep disturbance.

A study of an Iyengar yoga intervention for stress reduction in 24 self-referred females found that two weekly classes over a period of three months led to significant improvements on self-reported measures of stress, psychological and physical well-being outcomes. Salivary cortisol hormone was found to decrease significantly after participating in a yoga class demonstrating decreased stress in these individuals.[37]

In a study where Iyengar yoga intervention was compared to walking intervention for 60 minutes three times a week for 12 weeks in metabolically matched subjects , there was improvement in mood and anxiety measure and a nearly significant (p=.09) increase in acute thalamic GABA levels in the yoga group. There was a positive correlation between improved mood and decreased anxiety and thalamic GABA levels. The researchers suggest a possible role of GABA in mediating the beneficial effects of yoga on mood and anxiety as pharmacologic drugs prescribed to improve mood and decrease anxiety also stimulate GABA production .[38]Regular practice of yoga is known to elevate mood and relieve the stress by increasing serotonin levels. It reduces monoamine oxidase which breaks down serotonin, thus maintaining serotonin for longer duration in the brain.[46] Further, fMRI showed increase activity in the

prefrontal lobe that correlated with better temperament and outlook that helps in reducing stress.[63] It is believed that practice of yoga helps to achieve emotional balance, inhibits the areas in amygdala responsible for fear, aggression and rage. It stimulates the reward or pleasure centers in the median forebrain and other areas leading to a state of bliss and pleasure. This in turn lowers anxiety, respiratory rate, heart rate and blood pressure.[46,47,48,49,50]

3.4.2 Role of yoga on cardiovascular system

Yoga has been demonstrated to be a complementary or non -pharmacological tool to control blood pressure in hypertensive patients.[27] Madanmohan et.al showed that 2 months of yoga training significantly decreased basal heart rate and blood pressure.[28] Ray et al reported reduction in diastolic blood pressure with practice of yoga.[29] Yoga training improves physical fitness measured by Harvard step test indicating increase in cardiac recovery index.[30] and yoga has been reported to reduce the risk factors related to insulin resistance syndrome for cardiovascular disease.[31] Comprehensive lifestyle modifications brought about through practice of yoga has reduced the effect of atherosclerosis in a year.[32] Yoga is reported to have aided in the management and has shown improvement in clinical outcomes of cardiovascular disease and insulin resistance syndrome. Beneficial changes have been noted in glucose tolerance, lipid profile, oxidative stress, sympathetic activation and cardiovagal function of an individual.[31] Yoga based lifestyle modifications have shown a regression of coronary lesions as well as improve the myocardial perfusion in patients with coronary artery disease.[32]

A number of studies have been done to demonstrate the effect of yoga on HRV. Muralikrishnan K *et al* demonstrated significant improvement in time domain parameters SDNN, and PNN50. Frequency domain parameters showed a fall in LF

power spectrum and rise in HF spectrum in people practicing yoga for 8 weeks suggestive of improvement in parasympathetic tone.[42] Eight week Hatha yoga program showed a significant increase in time and frequency domain parasympathetic marker PNN50 and HF power spectrum respectively.[43] Decrease in LF/HF ratio has been demonstrated by Papp ME et an indicator of parasympathetic dominance. Sympathetic activation demonstrated by increase in LF power spectrum during practice of yoga. LF power and LF/HF ratio reduced with increase in HF power after the practice.[44] Sarang P et.al demonstrated that sympathetic activation occurred due to postures assumed during phases of cyclic meditation. Parasympathetic dominance increased after cyclic meditation. Satyapriya M et.al reported decrease in LF power and LF/HF ratio but no alteration in HF power spectrum in healthy pregnant women. Yoga was reported to be beneficial in reducing perceived stress and improving adaptive response of autonomic nervous system in healthy pregnant women.[45] Decreased LF/HF ratio (low frequency/high frequency) after yoga indicates transition from sympathetic to parasympathetic dominance.

MATERIALS AND METHODS

4.1 Source of data

The subjects were first M.B.B.S students volunteers staying in hostel /campus from Sri Devaraj Urs medical college, Tamaka, Kolar.

4.2 Sample size calculation

$$n = \frac{2\ \sigma^2\ (Z_{1-\alpha} + Z_{1-\beta})}{(M_1 - M_2)}$$

- Sample size was determined considering,
- SD of LF in yoga group 12.88,
- SD of LF at base line 13.5,
- Estimated difference in mean 10.24,
- Desired confidence interval 99%,
- Required sample size 27 in each group,
- Hence, 30 subjects will be recruited in each group.

4.3 Sample size

- Sample size was 60 consisting of males and females.

The protocol was approved by ethical committee of the Institute. Pretested and prevalidated Spielberger state-trait anxiety inventory (STAI) questionnaire and perceived stress scale were administered to all 150 first year medical students and they were recruited based on the following inclusion and exclusion criteria.

4.4.1 INCLUSION CRITERIA

- First year medical students of age group 18 to 20 years.
- Spielberger state-trait anxiety inventory (STAI) score above 40 and Perceived stress scale (PSS) score 13 and above.

4.4.2 EXCLUSION CRITERIA:

Students who were

- Practicing any known stress relieving or relaxation technique.
- On any drugs which affect the autonomic nervous system like anticholinergic,sympathomimetic,sympatholytic and beverages like caffeine.
- Having any major illness which is known to affect the autonomic nervous system.

4.5 Study protocol:

The group of students thus selected was briefed about the study and informed consent was taken. Then heart rate variability was recorded as baseline parameters.

Those students who have volunteered for yoga intervention were assigned to the study group (30) and control group (30).

4.6 State-Trait Anxiety Inventory

The state trait anxiety inventory for adults (STAI-A) is the questionnaire for measuring anxiety in adults. It measures both state anxiety and trait anxiety. The STAI has forty questions with four responses to each.The questionnaire were scored by adding the weighted (1 to 4) scores of each item, using the directions and scoring key provided in the Manual for State-Trait Inventory (Form Y). The scores could vary from a minimum of 20 to a maximum of 80.

4.7 Perceived stress score:

The PSS-10 measures the psychological stress over the previous week with a 5-point Likert scale (0 = “never”, 1 = “almost never”, 2 = “sometimes”, 3 = “fairly often”, 4 = “very often”). PSS-10 scores are obtained by reversing the responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1, and 4 = 0) to the 4 positively stated items (items 4, 5, 7, and 8) and then summing across all scale items. The scores range from 0–40, with higher scores

indicating greater stress. Scores around 13 are considered average. Scores of 20 or higher are considered high stress.

4.8 Heart Rate Variability:

HRV was performed in a quiet room and participants were advised to abstain from caffeinated food and beverages on the day of their assessments. They were instructed to close the eyes,avoid talking, moving of hands, legs and body, coughing and sleeping during the test. After 15 minutes of supine rest with a regular and calm breathing pattern, a continuous 5-minute ECG recording was collected using HRV software (AD INSTRUMENT) and following parameters was analyzed using HRV software.

SL No.	HEART RATE VARIABILITY PARAMETRES	
	TIME DOMAIN	
1	MEAN HR	Mean heart rate
2	SDNN	Standard deviation of Normal to Normal RR interval, SDNN reflects all the cyclical components responsible for variability in the period of recording.
3	RMSSD	It is square root of the mean squared difference of successive Normal to Normal RR interval
	FREQUENCY DOMAIN	
4	Low Frequency (LF)	Normal range is (0.04-0.15 Hz) is influenced by both parasympathetic and sympathetic activity.
5	High Frequency (HF)	Normal range is (0.15-0.4 Hz) influenced by parasympathetic data
6	LF/HF	Is influenced by both parasympathetic and sympathetic activity

Students who volunteered for yoga were given a yoga intervention for 1 month, 45mins/day for 5 days/week. Details of which are given below:

Sl. No	Integrated Yoga Practices	Time (Minutes)
1	Loosening exercises	8
2	Suryanamaskara 12 steps	15
3	Instant Relaxation Technique (IRT)	2
4	Kapahalabhati- 3 rounds	5
5	Nadisuddi pranayama	5
6	Deep Relaxation Technique (DRT)	10
7	Total	45

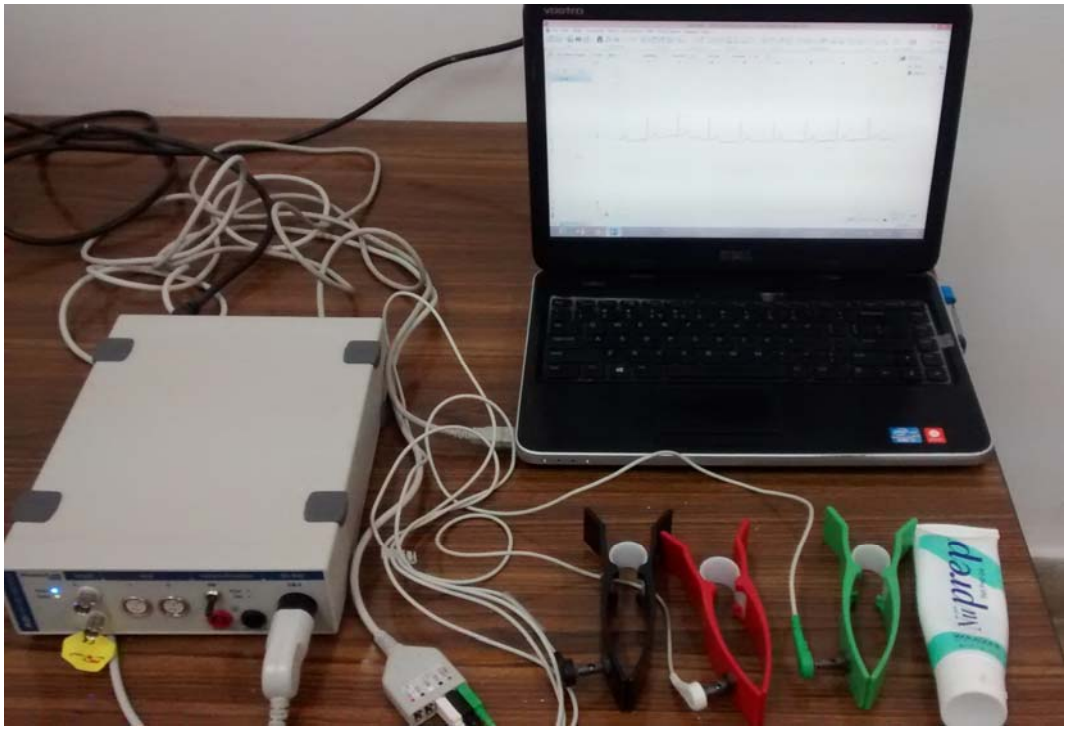
Daily monitoring was done and at the end of one month, again Spielberger state-trait anxiety inventory (STAI) questionnaire and perceived stress scale were evaluated and heart rate variability was recorded in both the groups.

STATISTICAL ANALYSIS

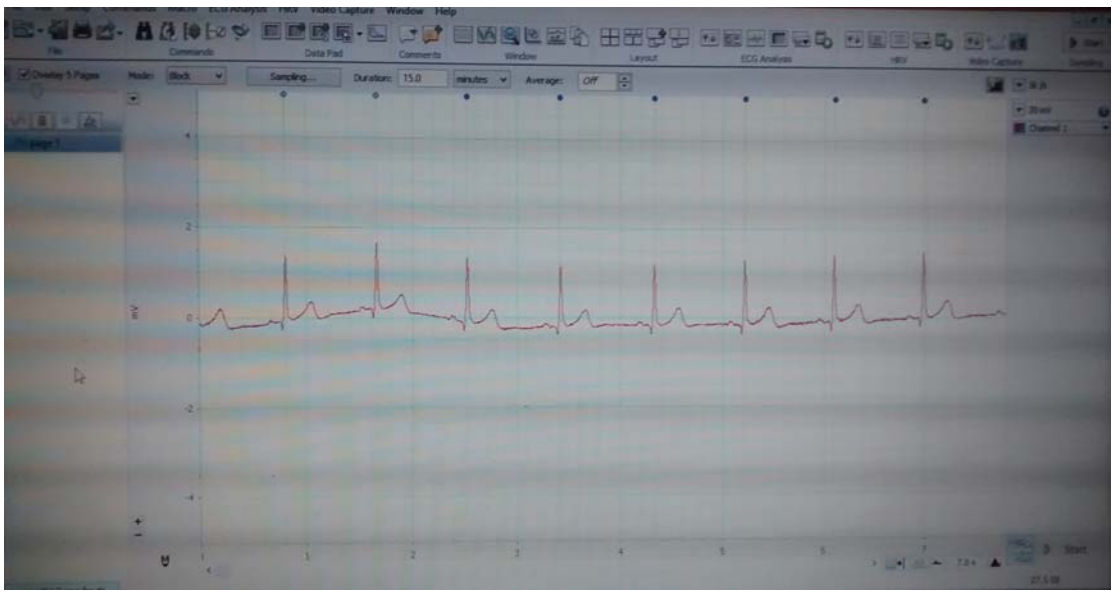
Data analysis was carried out by using Statistical Package for Social Science (SPSS Software, Version 16) package. The data following normal distribution was expressed as averaged (mean $\pm$ standard deviation). The level of significance was fixed at $p < 0.05$.

1. Paired t test was used to determine the statistical difference in pre and post intervention.
2. Independent t test was used to determine the statistical difference between control and yoga group after intervention.

HRV data acquisition and analysis system

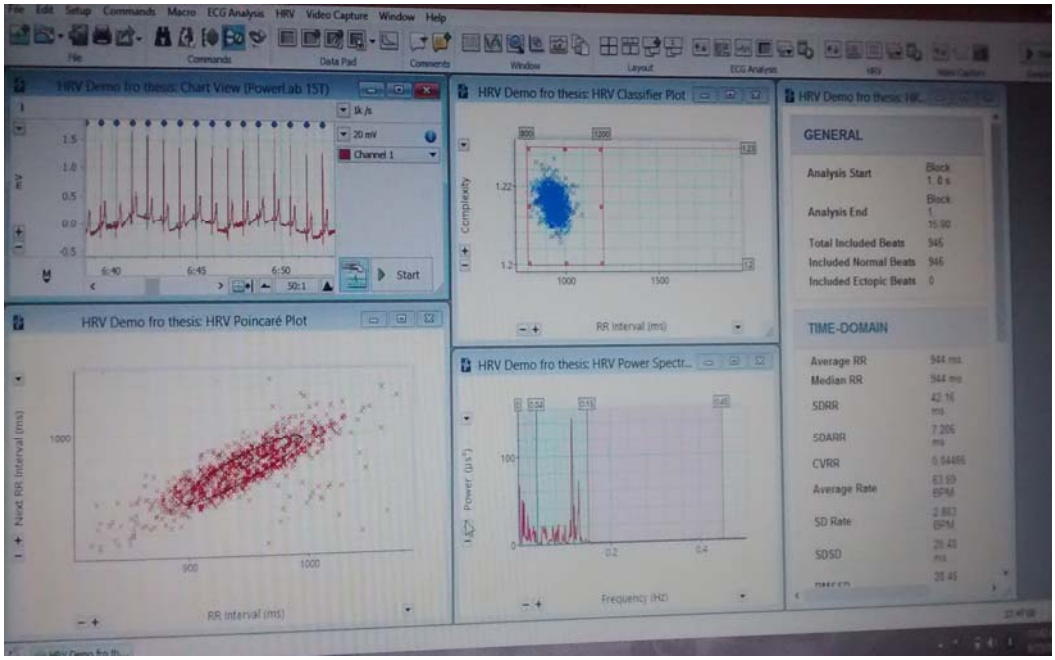


Data sheet



Recording in progress

Final Report Generated by HRV machine



Students performing loosening exercise

Students performing Kapahalabhati

Students performing Nadisuddi pranayama

RESULTS

Table 1: Anthropometric parameters of the subjects

Anthropometric measurements	Mean ±Standard deviation
Age (in years)	18.05 ± 0.21
Height (in meters)	2.68 ± 0.41
Weight (in kg)	60.15 ± 12.40

Table 1 shows the age in yrs, height in meters, weight in Kg were comparable

Fig 1:Anxiety levels in first year medical students

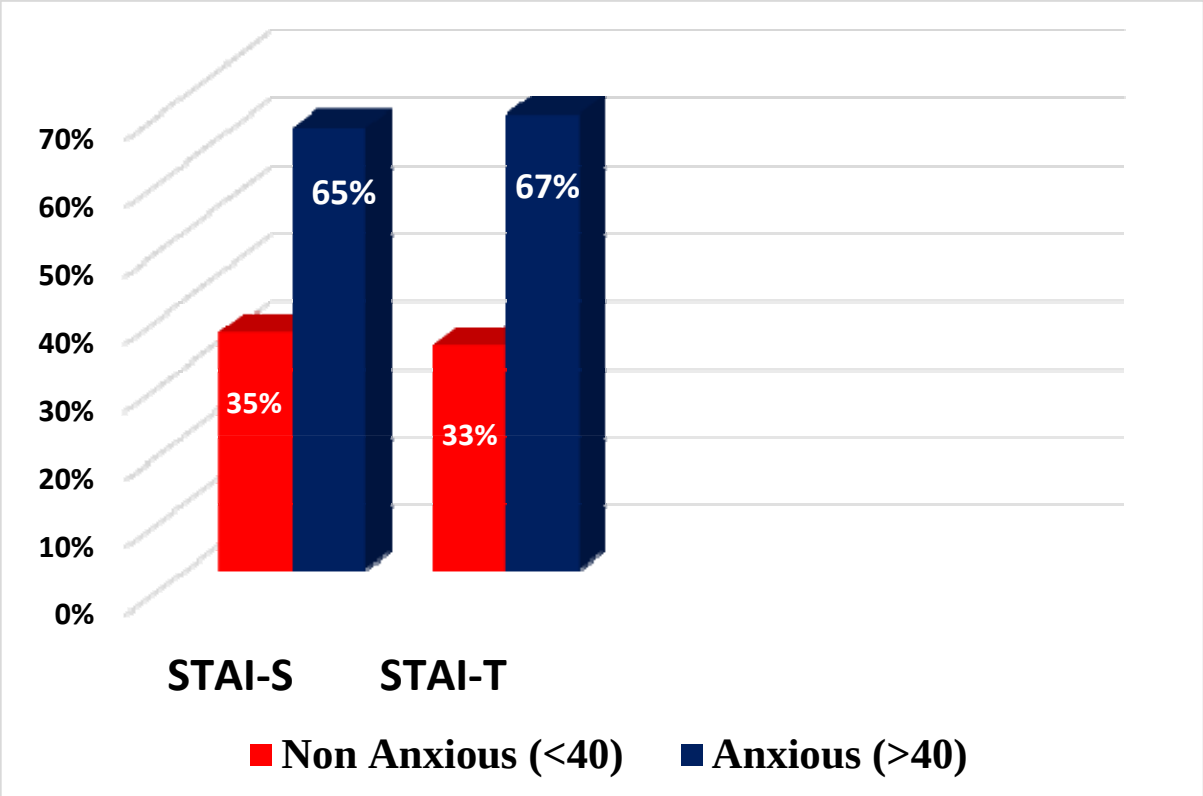


Fig 2:Stress levels in first year medical students

Table 2:Paired t test in control group before and after one month of yoga

	PRE CONTROL (n=30)	POST CONTROL (n=30)	P VALUE
STAI –S	45.87 ± 6.296	45.47 ± 5.244	0.393
STAI-T	42.27 ± 1.081	42.33 ± 2.040	0.841
PSS	20.63 ± 3.64	20.97 ± 3.643	0.353
HR	8.46 ± 12.14	8.43 ± 10.86	0.622
SDNN	3.71 ± 15.03	3.69 ± 14.82	0.483
RMSSD	3.12 ± 15.26	3.09 ± 15.62	0.352
LF	4.58 ± 15.39	4.01 ± 16.02	0.028
HF	2.99 ± 11.49	2.98 ± 10.60	0.825
LF/HF	1.64 ± 0.66	1.40 ± 0.093	0.039

Table 2: shows comparison of anxiety, stress and heart rate variability of controls four weeks apart by applying paired 't' test. There was no significant difference between the two recording among controls.

Table 3:Paired t test in study group before and after yoga intervention

	PRE YOGA (n=30)	POST YOGA (n=30)	P VALUE
STAI -S	56 ± 8.21	40.50 ± 6.86	0.000
STAI-T	56.27 ± 8.46	41.87 ± 6.91	0.000
PSS	17.00 ± 2.691	15.70 ± 4.061	0.068
HR	8.58 ± 11.10	7.67 ± 11.45	0.000
SDNN	3.81 ± 13.87	5.43 ± 22.78	0.001
RMSSD	3.84 ± 16.79	4.63 ± 19.47	0.053
LF	4.61 ±16.50	2.80 ±12.49	0.000
HF	3.22 ± 11.28	5.69 ± 16.35	0.000
LF/HF	1.68 ± 1.08	0.55 ± 0.34	0.000

Table 3: shows comparison of anxiety, stress and heart rate variability of study group four weeks apart by applying paired 't' test. There were significant differences in STAI-S, STAI-T, HR, SDNN, LF, HFand LF/HF.There was no significant difference in PSS.

Table 4: Independent t test after one month intervention

	POST CONTROL (n=30)	POST YOGA (n=30)	P VALUE
STAI -S	45.47± 5.24	40.20± 6.86	0.001
STAI-T	42.33± 2.04	41.87± 6.91	0.724
PSS	20.97± 3.57	15.70± 4.06	0.000
HR	8.43± 10.86	7.67± 11.45	0.011
SDNN	3.69± 14.82	5.43± 22.789	0.001
RMSSD	3.09± 15.62	4.637± 19.47	0.001
LF	4.01±16.02	2.80±12.49	0.002
HF	2.98± 10.60	5.69± 16.35	0.000
LF/HF	1.40± 0.510	0.55 ± 0.34	0.000

Table 4 show significant decrease in STAT-S, PSS and heart rate variability. There was no significant difference in STAI- T.

DISCUSSION

Medical profession is believed to be highly stressful. The three important stressors identified in the first year are social, cultural and financial. Optimal stress enhances performance but increased stress results in anxiety. Anxiety results in psychological problems resulting in deterioration of academic performance. This further affects autonomic balance resulting in cardiac dysfunction. This may be assessed by HRV. Regular practice of yoga have shown to decrease mental stress and is also reported to modulate autonomic output to achieve autonomic balance between two components (sympathetic and parasympathetic) of autonomic nervous system.[5] So this study was designed to study the effect of integrated yoga on stress, anxiety and heart rate variability.

The extent of anxiety and stress is subjective, but can be quantified using the scales like state trait inventory anxiety and perceived stress scale. We found that 91 % of the first year medical students were found to be stressed which parallels the studies elsewhere where they showed stress was highest among students of the first year of medical school.[42] Studies from Iran and Saudi Arabia reported stress in over 60% of respondents.[43,44]An US study suggested psychiatric illness in 15-20% of medical students needing some kind of medical intervention.[45]The incidence of reported emotional disturbances in British medical students was 31.2% .[51] Some other studies have also revealed high prevalence of depression and anxiety among medical students, with levels of overall psychological distress consistently higher than in the general population.[42,52,53,54,55]

Our study demonstrated a significant decline in anxiety scale scores from baseline after one month of yoga intervention unlike in the controls where there was no significant change in anxiety scores. This effect of yoga was similar to other

studies where yoga group when compared to the control group showed significant reduction in STAI state and trait anxiety scores.[56]In a non – randomized but controlled study of 50 medical students(25 yoga participants,25 controls)over 3 months has shown significant reduction in anxiety scores following yoga practice and even on the day of examinations.[14] Deep relaxation technique one of our yoga intervention has been shown to decrease STAI anxiety scores in the yoga.[57] Regular practice of yoga is known to elevate mood and relieve the stress by increasing serotonin levels. It reduces monoamine oxidase which breaks down serotonin, thus maintaining serotonin for longer duration in the brain.[46] Further, fMRI showed increase activity in the prefrontal lobe that correlated with better temperament and outlook that helps in reducing stress.[63] It is believed that practice of yoga helps to achieve emotional balance, inhibits the areas in amygdala responsible for fear, aggression and rage. It stimulates the reward or pleasure centers in the median forebrain and other areas leading to a state of bliss and pleasure. This in turn lowers anxiety, respiratory rate, heart rate and blood pressure.[47,48,49,50] It is reasonable to postulate that the practice of yoga not only influences the autonomic balance at subconscious level but also controls this balance by regulating emotional changes. In medical students who underwent yoga, there was no significant increase in examination stress however students did not undergo yoga intervention had significantly higher state anxiety score from baseline.[62] In contrast to the aforementioned studies, which, despite their limitations, indicated that yoga or meditation reduces anxiety, some studies have failed to show the same positive results. A study which had well devised methodology, appropriate randomization and blinding of the researchers did not demonstrate significant difference in anxiety scores even after 10 weeks of intervention in treatment of chronic anxiety neurosis.[58]

Perceived stress score (PSS) is an index of an individual's perception to events in one's life that is perceived as stressful. This will helps to plan stress coping techniques like yoga. In our study, a one month yoga intervention did not significantly decrease PSS in contrary to an Indian study that showed significant reduction in PSS with 12 weeks intervention. The difference may be due the difference in duration of intervention.[60] Similarly, in a non –randomized, non-controlled study, PSS scores were significantly decreased in medical students.[61] In a study where work place intervention of yoga was planned for back pain and stress, there was significant decrease in PSS from pre-yoga scores. Here again it was a 8 week intervention.[59]

When anxiety scores and PSS were compared between the study and control groups after one month, we have been able to observe a significant decrease in anxiety state levels which assesses the state of the student when the questionnaire was administered, and decrease PSS indicating decrease in perceived stress in last one week in yoga group. This showed the usefulness of yoga in coping with stress and anxiety in spite of non-significant influence on anxiety trait of the students.

Stress and anxiety are often associated with autonomic dysfunction which adversely impact the functioning of the heart. We have used HRV for assessing the influence of autonomic nervous system. In our study, after one month practice of yoga, the time domain markers SDNN and RMSSD were found to be significantly increased which may be attributed to shift of autonomic balance from the sympathetic nervous system to the parasympathetic system. SDNN indicates variability in duration of diastole which in turn influences the functioning ability of the heart. Increase in RMSSD suggests parasympathetic predominance evidenced by increased duration of cardiac cycle. [46] In the controls there was no change in time domain parameters. In the frequency domain parameters we have been able to demonstrate significant reduction

in LF power spectrum. This may be attributed to inhibition of posterior or sympathetic area of the hypothalamus which optimizes the body's sympathetic responses to stressful stimuli. This helps to restore autonomic regulatory reflex mechanisms associated with stress. It may be concluded from our observations that even a one month practice of yoga reduces sympathetic tone. HF power spectrum an indicator of parasympathetic activity showed a significant increase. LF/HF ratio, a marker of autonomic balance was found to be significantly reduced suggesting the shift of autonomic balance towards parasympathetic predominance. Other studies have shown that practice of yoga lead to decrease in respiratory and heart rate, reduce blood pressure, lowering of cortisol levels, increase in blood flow to the intestines and vital organs, all of which points to increase in parasympathetic activity.[24]

In our study, we have been able to show significant decrease in Spielberg's anxiety and trait score and HRV showing a parasympathetic dominance with one month yoga intervention. However, the PSS not showed significant improvement which may be because of shorter yoga intervention. Practice of yoga which involves lifestyle modification can be used as a non-pharmacological technique to help students to cope with stress and prevent cardiovascular complications. However it is worthwhile to recommend continued practice of yoga to preserve and enhance beneficial effects obtained by short term practice of yoga.

CONCLUSION

One month of Integrated Yoga intervention in first year medical students when compared to controls showed:

1. Significant decrease in state anxiety.
2. Significant decrease in perceived stress.
3. Improved cardio autonomic function with a shifting of sympatho-vagal balance towards parasympathetic dominance in heart rate variability.
4. No significant improvement in trait anxiety.

SUMMARY

Yoga is a way of life involving lifestyle modifications intended to promote positive physical and mental health. In our study, efforts were made to assess the health benefits of short term practice of yoga on anxiety, stress and HRV. Cardiovascular functions and benefits of intervention were evaluated by HRV. It was observed that practice of yoga beneficially altered the HRV resulting in alteration in sympatho-vagal balance with parasympathetic dominance. Yoga is a desirable non-pharmacological intervention to decrease anxiety among medical students and improve cardio autonomic function.

BIBLIOGRAPHY

1. Koob GF. Corticotropin-releasing factor, norepinephrine, and stress. Biol Psychiatry. 1999;46:1167–80.
2. Selye H. A syndrome produced by diverse noxious agents. Nature. 1936;32:138.
3. Maier SF, Watkins LR. Cytokines for psychologists: Implications of bidirectional immune-to-brain communication for understanding behavior, mood, and cognition. Psychol Rev. 1998;105:83–107.
4. Nirmal J, Babu CS, Harisudhan T, Ramanathan M. Evaluation of behavioural and antioxidant activity of Cytisus scoparius Link in rats exposed to chronic unpredictable mild stress. BMC Complement Altern Med. 2008;8:15.
5. Bhimani NT, Kulkarni NB, Kowale A, Salvi S. Effect of Pranayama on stress and cardiovascular autonomic function. Indian J Physiol Pharmacol. 2011;55(4):370–7.
6. Dahlin M, Joneborg N, Runeson B. Stress and depression among medical students a cross sectional study. Med Educ. 2005;39:594–604.
7. Tyssen R, Vaglum P, Gronvold NT, Ekeberg O. Suicide ideation among medical students and youth physicians: a nationwide and prospective of prevalence and predictors. J Affect Disord.2001;64:69–79.
8. Tyssen R, Hem E, Vaglum P, Gronvold NT, Ekeberg O. The process of suicidal planning among medical doctors: predictors in a longitudinal Norwegian sample. J Affect Disord. 2004;80:191–198.
9. Yusoff MS, Abdul Rahim AF, Yaacob MJ. Prevalence and Sources of Stress among Universiti Sains Malaysia Medical Students. Malays J Med Sci. 2010;17(1):30-37.

10. Huikuri HV, Jokinen V, Syvänne M, Nieminen MS et al. Heart Rate Variability and Progression of Coronary Atherosclerosis**.** Arterioscler Thromb Vasc Biol 1999;19: 1979-1985.
11. Majercak I. The use of heart rate variability in cardiology. Bratisl Lek Listy 2002; 103(10):368-377.
12. Heart rate variability. Standards of measurement, physiological interpretation, and clinical use. Task for of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Eur Heart J 1996;17:354–81.
13. Shankarapillai R, Nair MA, George R. The effect of yoga in stress reduction for dental students performing their first periodontal surgery: A randomized controlled study. Int J Yoga. 2012;5(1):48-51.
14. Malathi A, Damodaran A. Stress due to exams in medical students--role of yoga.Indian J Physiol Pharmacol. 1999;43(2):218-24.
15. Ganong WF, Barrett KE. Review of medical physiology. New York: McGraw-Hill; 2012.
16. Lightman SL. The neuroendocrinology of stress: a never ending story. J Neuroendocrinol. 2008;20(6):880-4.
17. Mohsin Shah, Shahid Hasan, Samina Malik, Chandrashekhar T Sreeramareddy. Perceived Stress, Sources and Severity of Stress among medical undergraduates in a Pakistani Medical School.BMC Med Educ. 2010;10: 2.
18. Iyengar BKS, Iyengar. The illustrated light on yoga: yoga dipika. New Delhi: HarperCollins Publishers India; 1997.

19. Satyananda Saraswati. Asana pranayama mudra bandha. Bihar: Yoga Publications Trust; 1996.
20. Borg-Oliver S, Machliss B. Applied Anatomy & Physiology of Yoga : Yoga Synergy Pty Limited; 2005.
21. Santaella DF, Devesa CRS, Rojo MR, Amato MBP, Drager LF, Casali KR, et al. Yoga respiratory training improves respiratory function and cardiac sympathovagal balance in elderly subjects: a randomised controlled trial. BMJ Open. 2011;1(1):e000085–e000085.
22. Electrophysiology TF o. t. ES o. C t. NAS. Heart Rate Variability : Standards of Measurement, Physiological Interpretation, and Clinical Use. Circulation. 1996 ;93(5):1043–65.
23. Sinha A. Efficacy of breathing exercises and walking exercises on resting heart rate among overweight college students. International Journal of Physical Education Sports Management and Yogic Sciences. 2014;4(2):28.
24. Woodyard C. Exploring the therapeutic effects of yoga and its ability to increase quality of life. Int J Yoga. 2011;4(2):49–54.
25. Mizuno J, Monteiro HL. An assessment of a sequence of yoga exercises to patients with arterial hypertension. J Bodyw Mov Ther. 2013;17(1):35–41.
26. Madanmohan null, Udupa K, Bhavanani AB, Shatapathy CC, Sahai A. Modulation of cardiovascular response to exercise by yoga training. Indian J Physiol Pharmacol. 2004;48(4):461–5.
27. Ray US, Mukhopadhyaya S, Purkayastha SS, Asnani V, Tomer OS, Prashad R, et al. Effect of yogic exercises on physical and mental health of young fellowship course trainees. Indian J Physiol Pharmacol. 2001;45(1):37–53.

28. Muralidhara DV, Ranganathan KV. Effect of yoga practice on Cardiac Recovery Index. Indian J Physiol Pharmacol. 1982;26(4):279–83.
29. Innes KE, Bourguignon C, Taylor AG. Risk indices associated with the insulin resistance syndrome, cardiovascular disease, and possible protection with yoga: a systematic review. J Am Board Fam Pract. 2005;18(6):491–519.
30. Ornish D, Brown SE, Scherwitz LW, Billings JH, Armstrong WT, Ports TA, et al. Can lifestyle changes reverse coronary heart disease? The Lifestyle Heart Trial. Lancet. 1990;336(8708):129–33.
31. Janes RD, Brandys JC, Hopkins DA, Johnstone DE, Murphy DA, Armour JA. Anatomy of human extrinsic cardiac nerves and ganglia. Am J Cardiol. 1986 ;57(4):299–309.
32. Kawano H, Okada R, Yano K. Histological study on the distribution of autonomic nerves in the human heart. Heart Vessels. 2003;18(1):32–9.
33. Sztajzel J. Heart rate variability: a noninvasive electrocardiographic method to measure the autonomic nervous system. Swiss Med Wkly. 2004;134(35-36):514–22.
34. Malliani A, Pagani M, Lombardi F, Cerruti S. Cardiovascular neural regulation explored in the frequency domain. Circulation 1991; 84:1482–92.
35. Kamath MV, Fallen EL. Power spectral analysis of heart rate variability: a non-invasive signature of cardiac autonomic function. Crit Revs Biomed Eng 1993; 21:245–311.
36. Iyengar, B. K. S. (2010). Light on Pranayama. USA: CrossRoad.
37. Michalsen, A., Grossman, P., Acil, A., Langhorst, J., Lüdtke, R., Esch, T., et al. Rapid stress reduction and anxiolysis among distressed women as a

consequence of a three-month intensive yoga program. Med Sci Monit.2005; 11(12),555-561.

38. Streeter, C. C., Whitfield, T. H., Owen, L., Rein, T., Karri, S. K., Yakhkind, A., et al. (2010). Effects of Yoga Versus Walking on Mood, Anxiety, and Brain GABA
39. Weise F, Heydenreich F, Kropf S, Krell D. Intercorrelation analyses among age, spectral parameters of heart rate variability and respiration in human volunteers. J Interdiscipl Cycle Res. 1990;21:17-24.
40. Lipsitz LA, Mietus J, Moody GB, Goldberger AL. Spectral characteristics of heart rate variability before and during postural tilt: relations to aging and risk of syncope. Circulation 1990;81:1803-10.
41. Hjortskov N, Rissén D, Blangsted AK, Fallentin N, Lundberg U, Søgaard K. The effect of mental stress on heart rate variability and blood pressure during computer work. Eur J Appl Physiol. 2004;92(1-2):84-9.
42. Park J, Chung S, An H, Park S, Lee C, Kim SY, Lee JD, Kim KS. A structural model of stress, motivation, and academic performance in medical students. Psychiatry Investig. 2012;9(2):143-9.
43. Koochaki GM, Charkazi A, Hasanzadeh A, Saedani M, Qorbani M, Marjani A. Prevalence of stress among Iranian medical students: A questionnaire survey. East Mediterr Health J 2011;17:593-8.
44. Abdulghani HM, AlKanhal AA, Mahmoud ES, Ponnamperuma GG, Alfaris EA. Stress and its effects on medical students: A cross-sectional study at a college of medicine in Saudi Arabia. J Health Popul Nutr 2011;29:516-22.
45. Lloyd C, Gartrell NK. Psychiatric symptoms in medical students. Compr Psychiatry 1984;25:552-65.

46. McCall T. Yoga as Medicine. New York: Bantam Dell a division of Random House Inc; 2007.
47. Birkel DA, Edgren L. Hatha yoga: improved vital capacity of college students. Altern Ther Health Med. 2000; 6(6):55–63.
48. Bharshankar JR, Bharshankar RN, Deshpande VN, Kaore SB, Gosavi GB. Effect of yoga on cardiovascular system in subjects above 40 years. Indian J Physiol Pharmacol. 2003;47:202–6.
49. Harinath K, Malhotra AS, Pal K, Prasad R, Kumar R, Kain TC, et al. Effects of hatha yoga and omkar meditation on cardiorespiratory performance, psychologic profile, and melatonin secretion. J Altern Complement Med. 2004;10:261–8.
50. Desikachar K, Bragdon L, Bossart C. The yoga of healing: Exploring yoga's holistic model for health and well-being. Int J Yoga Ther. 2005;15:17–39.
51. Firth J. Levels and sources of stress in medical students. Br Med J 1986;292:1177-80.
52. Jurkat HB, Richter L, Cramer M, Vetter A, Bedau S, Leweke F, et al. Depression and stress management in medical students. A comparative study between freshman and advanced medical students. Nervenarzt 2011;82:646-52.
53. Haight SJ, Chibnall JT, Schindler DL, Slavin SJ. Associations of medical student personality and health/wellness characteristics with their medical school performance across the curriculum. Acad Med 2012;87:476-85.
54. Prinz P, Hertrich K, Hirschfelder U, de Zwaan M. Burnout, depression and depersonalisation- Psychological factors and coping strategies in dental and medical students. GMS Z Med Ausbild 2012;29.

55. Fan AP, Kosik RO, Su TP, Lee FY, Hou MC, Chen YA, et al. Factors associated with suicidal ideation in Taiwanese medical students. Med Teach 2011;33:256-7.
56. Javnbakht M, Hejazi Kenari R, Ghasemi M. Effects of yoga on depression and anxiety of women. Complement Ther Clin Pract. 2009;15(2):102-4.
57. Khemka SS, Rao NH, Nagarathna R. Immediate effects of two relaxation techniques on healthy volunteers. Indian J Physiol Pharmacol. 2009;53(1):67-72.
58. Girodo M.Yoga meditation and flooding in the treatment of anxiety neurosis.J behave Ther Exp Psychiatry 1947;5:157-160.
59. Hartfiel N, Burton C, Rycroft-Malone J, Clarke G, Havenhand J, Khalsa SB,Edwards RT. Yoga for reducing perceived stress and back pain at work. Occup Med. 2012;62(8):606-12.
60. Sharma VK, Trakroo M, Subramaniam V, Rajajeyakumar M, Bhavanani AB, Sahai A. Effect of fast and slow pranayama on perceived stress and cardiovascular parameters in young health-care students. Int J Yoga. 2013;6(2):104-10.
61. Simard AA, Henry M. Impact of a short yoga intervention on medical students' health: a pilot study. Med Teach. 2009;31(10):950-2.
62. Gopal A, Mondal S, Gandhi A, Arora S, Bhattacharjee J. Effect of integrated Yoga practices on immune responses in examination stress - A preliminary study. Int J Yoga. 2011;4(1):26-32.
63. Baron Short E, Kose S, Mu Q, et al. Regional Brain Activation During Meditation Shows Time and Practice Effects: An Exploratory FMRI Study. Evidence Based Complimentary Alternative Medicine. 2007; 7(1):121–127.

ANNEXURE – I

INFORMED CONSENT FORM

I have read and understood the purpose of this study and benefits associated with my involvement in the study. I have also understood the confidential nature of the information that will be collected and disclosed during the study.

I have had the opportunity to ask my questions regarding the various aspects of this study and my questions have been answered to my satisfaction.

I, the undersigned agree to participate in this study and authorized the collection as outlined in this consent form.

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Subject's Name & Signature Date

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Signature of the principal investigators Date

Annexure II

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts during the last week. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

Name _____

Date_____

Age _____ Gender (*Circle*): M F

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1	**In the last week, how often have you been upset because of something that happened unexpectedly?**	**0**	**1**	**2**	**3**	**4**
2	**In the last week, how often have you felt that you were unable to control the important things in your life?**	**0**	**1**	**2**	**3**	**4**
3	**In the last week, how often have you felt nervous and "stressed"?**	**0**	**1**	**2**	**3**	**4**
4	**In the last week, how often have you felt confident about your ability to handle your personal problems?**	**0**	**1**	**2**	**3**	**4**
5	**In the last week, how often have you felt that things were going your way?**	**0**	**1**	**2**	**3**	**4**
6	**In the last week, how often have you found that you could not cope with all the things that you had to do?**	**0**	**1**	**2**	**3**	**4**
7	**In the last week, how often have you been able to control irritations in your life?**	**0**	**1**	**2**	**3**	**4**
8	**In the last week, how often have you felt that you were on top of things?**	**0**	**1**	**2**	**3**	**4**
9	**In the last week, how often have you been angered because of things that were outside of your control?**	**0**	**1**	**2**	**3**	**4**
10	**In the last week, how often have you felt difficulties were piling up so high that you could not overcome them?**	**0**	**1**	**2**	**3**	**4**

Annexure III

SELF-EVALUATION QUESTIONNAIRE STAI Form Y-1

Please provide the following information:

Name_____Date_____S_____

Age_____ Gender (*Circle*) **M** **F** T_____

DIRECTIONS:

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I feel strained	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel satisfied	1	2	3	4
9. I feel frightened	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel indecisive	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel confused	1	2	3	4
19. I feel steady	1	2	3	4
20. I feel pleasant	1	2	3	4

STAIP-AD Test Form Y
www.mindgarden.com

SELF-EVALUATION QUESTIONNAIRE

STAI Form Y-2

Name_____ Date_____

DIRECTIONS

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	1	2	3	4
22. I feel nervous and restless	1	2	3	4
23. I feel satisfied with myself	1	2	3	4
24. I wish I could be as happy as others seem to be	1	2	3	4
25. I feel like a failure	1	2	3	4
26. I feel rested	1	2	3	4
27. I am "calm, cool, and collected"	1	2	3	4
28. I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
29. I worry too much over something that really doesn't matter	1	2	3	4
30. I am happy	1	2	3	4
31. I have disturbing thoughts	1	2	3	4
32. I lack self-confidence	1	2	3	4
33. I feel secure	1	2	3	4
34. I make decisions easily	1	2	3	4
35. I feel inadequate	1	2	3	4
36. I am content	1	2	3	4
37. Some unimportant thought runs through my mind and bothers me	1	2	3	4
38. I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
39. I am a steady person	1	2	3	4
40. I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

STAIP-AD Test Form Y
www.mindgarden.com

MASTER CHART:

Group	Sex	Ht	Wt	STAI-S 1	STAI-S2	STAI-T 1	STAI-T2	PSS 1	PSS2	HR 1	HR 2
1	f	163	54	49	46	41	42	21	22	90.43	92.43
1	m	168	64	40	42	45	45	15	14	79.12	78.12
1	m	164	54	46	48	42	43	23	24	98.66	99.66
1	m	170	68	55	51	45	46	30	28	93.03	92.03
1	m	168	62	46	46	41	39	21	22	73.76	74.76
1	f	154	43	53	50	42	41	16	14	85.57	86.57
1	m	152	50	41	40	40	40	19	19	78.84	77.84
1	m	152	45	55	52	42	43	23	23	75.39	76.39
1	f	158	80	44	40	41	41	22	23	81.22	82.22
1	f	156	60	53	55	42	43	19	19	91.75	90.75
1	m	163	57	63	58	42	48	13	15	83.31	82.31
1	f	169	54	50	47	42	43	24	22	77.43	78.69
1	f	152	69	43	44	43	43	20	22	89.79	88.79
1	f	157	64	35	37	43	42	20	19	72.56	73.56
1	f	174	49	41	42	43	42	18	20	76.57	77.57
1	f	175	66	41	40	42	44	19	23	60.83	62.83
1	f	162	60	45	44	42	40	22	20	98.66	97.66
1	f	160	55	50	52	43	40	20	22	68.83	67.83
1	f	139	34	41	39	43	42	18	16	79.44	88.34
1	m	170	57	46	44	42	41	18	19	106.56	105.56
1	m	172	58	43	42	42	41	18	20	94.14	93.14
1	m	167	84	46	48	42	41	22	24	89.30	87.30
1	f	158	40	41	40	44	44	19	23	92.78	91.78
1	f	157	62	35	39	42	46	23	20	94.28	95.28
1	f	156	65	54	52	41	42	19	20	80.07	79.07
1	m	182	58	43	42	42	43	30	28	87.56	88.56
1	f	165	81	42	46	43	43	20	19	116.82	100.82
1	f	169	54	49	50	42	41	20	18	76.98	77.98
1	f	165	62	40	44	42	41	22	25	63.85	60.85
1	f	172	64	46	44	42	40	25	26	81.76	80.76

SDNN 1	SDNN 2	RMSSD 1	RMSSD 2	LF 1	LF 2	HF 1	HF 2	LF/HF 1	LF/HF 2
44.67	42.67	25.13	24.13	51.95	50.95	20.06	24.06	2.58	2.11
33.12	34.12	43.07	42.07	40.09	21.09	26.23	25.23	1.52	0.83
20.68	22.68	11.47	10.47	52.13	50.13	22.20	24.20	2.34	2.07
38.89	37.89	21.87	20.87	67.18	66.18	55.33	53.33	1.21	1.24
66.30	65.30	43.97	44.97	80.72	31.72	20.95	22.95	3.85	1.38
74.24	76.24	42.43	43.43	52.06	50.06	38.98	39.98	1.33	1.25
58.03	56.03	30.78	34.78	25.19	26.19	18.24	19.24	1.38	1.36
55.70	54.70	29.77	26.77	22.73	24.73	24.77	25.77	0.91	0.95
41.58	43.58	22.08	20.08	31.71	32.71	26.13	25.13	1.21	1.30
39.44	37.44	38.80	36.80	37.71	36.71	28.57	29.57	1.31	1.24
50.14	49.14	49.42	48.42	47.04	43.04	22.048	23.04	2.13	1.86
50.91	53.74	46.42	45.45	31.71	28.19	21.69	19.80	1.46	1.42
36.86	37.86	35.24	38.24	47.12	46.12	38.57	37.57	1.22	1.22
40.39	38.39	32.43	33.43	50.56	16.56	48.72	37.72	1.03	0.43
45.96	43.96	31.02	30.02	42.00	43.00	23.68	24.68	1.77	1.74
35.57	32.57	22.89	20.89	58.64	56.64	45.64	44.64	1.28	1.26
20.68	22.68	11.47	10.47	52.13	50.13	22.20	21.20	2.34	2.36
28.06	29.06	73.68	74.68	24.15	25.15	20.18	23.18	1.19	1.08
43.78	40.52	48.43	46.59	55.13	57.24	35.56	34.18	1.55	1.67
21.97	20.97	8.95	10.95	76.69	75.69	29.89	26.89	2.56	2.81
38.15	37.15	40.09	36.09	60.13	23.13	20.32	23.32	2.95	0.99
26.82	26.82	23.01	20.01	58.94	59.94	44.82	45.82	1.31	1.30
20.25	21.25	20.54	22.54	29.71	30.71	18.23	16.23	1.62	1.89
30.84	29.84	26.39	27.39	35.64	34.64	22.55	24.55	1.57	1.41
21.11	22.11	20.11	21.11	40.27	43.27	38.50	37.50	1.04	1.15
44.21	45.21	19.23	17.23	23.38	25.38	17.15	18.15	1.36	1.39
12.32	13.32	8.11	7.11	50.03	54.03	43.69	42.69	1.14	1.26
11.64	10.64	50.97	52.97	28.09	26.09	17.35	16.35	1.61	1.59
32.78	31.78	13.53	12.53	40.70	13.70	32.32	33.32	1.25	0.41
28.72	29.72	46.99	47.99	61.41	62.41	53.30	54.30	1.15	1.14

Group	Sex	Ht	Wt	STAI-S 1	STAI-S2	STAI-T 1	STAI-T2	PSS 1	PSS2	HR 1	HR 2
2	m	178	64	60	49	55	35	15	12	91.09	86.28
2	m	171	48	56	42	68	55	14	12	92.92	83.31
2	f	158	56	61	43	53	44	19	15	93.07	74.54
2	f	161	50	49	36	53	40	19	16	81.22	67.15
2	m	169	65	57	52	66	55	18	16	76.28	65.39
2	f	158	62	56	44	56	41	15	12	92.48	88.48
2	f	160	58	54	38	52	41	16	14	95.56	90.42
2	f	169	74	56	45	60	40	19	18	77.73	72.56
2	f	158	105	51	34	49	42	16	21	92.48	88.34
2	f	154	52	48	28	51	31	15	11	80.64	60.36
2	f	154	48	80	38	80	45	20	12	89.97	80.23
2	f	149	44	53	46	51	47	15	11	73.92	67.43
2	m	170	70	51	43	54	45	16	14	92.63	74.63
2	f	164	50	56	40	56	48	20	16	104.70	76.82
2	m	177	76	57	28	69	38	15	16	86.35	74.54
2	m	175	63	50	41	53	49	21	30	67.68	60.83
2	m	172	75	54	45	51	44	16	15	69.44	60.83
2	m	175	64	57	43	53	42	17	16	65.22	63.85
2	f	160	46	54	26	51	28	20	19	112.88	96.64
2	m	170	45	63	40	64	39	20	14	84.81	72.56
2	m	167	80	57	47	50	33	15	14	76.59	67.69
2	f	160	71	45	35	52	32	17	18	96.88	98.66
2	f	158	50	69	52	61	55	21	16	75.28	75.39
2	f	171	77	49	44	50	41	15	12	93.49	88.48
2	f	164	50	56	38	60	41	21	20	96.55	90.42
2	f	164	50	52	45	65	40	14	11	76.79	72.56
2	m	167	60	46	34	42	42	15	12	91.49	88.34
2	f	160	54	57	28	43	31	16	18	82.68	60.36
2	m	172	57	79	38	70	45	10	19	88.96	87.23
2	m	179	70	47	44	50	47	20	21	74.96	67.43

SDNN 1	SDNN 2	RMSSD 1	RMSSD 2	LF 1	LF 2	HF 1	HF 2	LF/HF 1	LF/HF 2
23.47	62.42	18.18	20.77	57.39	28.00	32.89	49.33	1.74	0.56
50.14	88.38	20.91	49.42	55.75	47.04	22.04	55.75	2.52	0.84
60.73	44.20	38.54	52.72	40.16	35.88	36.13	33.29	1.11	1.07
50.43	30.58	52.08	47.42	31.71	23.51	17.73	31.62	1.78	0.74
64.70	52.46	50.76	59.77	70.45	22.73	23.03	64.77	3.05	0.35
28.68	58.32	47.17	52.12	28.54	10.98	30.45	37.50	0.93	0.29
36.76	26.70	15.82	33.47	61.77	45.74	41.01	81.78	1.50	0.55
20.39	73.99	72.41	92.43	46.40	17.56	37.34	68.72	1.24	0.25
58.52	42.32	45.17	77.59	18.54	17.24	30.45	78.18	0.60	0.22
40.18	75.29	40.09	43.91	33.26	27.70	46.27	69.98	0.71	0.39
36.69	58.14	15.02	47.19	59.43	47.94	35.46	41.57	1.67	1.15
60.91	44.87	41.58	36.42	63.22	31.71	22.61	61.69	2.79	0.51
31.00	33.40	18.46	51.14	33.88	26.44	32.71	39.48	1.035	0.66
20.95	25.55	20.17	53.00	37.80	17.52	18.05	46.74	2.09	0.37
34.12	21.22	41.34	20.77	41.02	23.99	40.95	51.66	1.00	0.46
17.57	18.92	32.97	72.89	58.64	26.24	35.64	60.63	1.64	0.43
55.57	61.28	37.91	42.89	72.83	58.64	13.21	35.64	5.51	1.64
42.78	52.18	30.61	53.53	54.03	12.70	29.62	82.32	1.82	0.15
32.51	25.52	75.79	28.39	34.85	34.04	11.49	37.34	3.03	0.91
40.39	37.50	40.67	12.43	25.94	17.56	44.52	68.72	0.58	0.25
20.74	38.86	31.79	15.45	34.13	29.19	51.50	64.80	0.66	0.45
20.68	37.32	42.58	51.47	52.96	18.13	28.99	42.20	1.82	0.42
40.70	85.46	37.50	59.77	70.45	22.73	23.03	64.77	3.05	0.35
23.68	58.32	47.17	42.12	18.54	10.98	30.45	37.50	0.60	0.29
36.76	87.70	15.82	33.47	61.77	45.74	61.01	81.78	1.01	0.55
30.39	73.99	72.41	62.43	46.40	17.56	37.34	68.72	1.24	0.25
58.52	98.32	45.17	30.59	18.54	17.24	30.45	78.18	0.60	0.22
40.18	75.29	50.09	83.91	33.26	27.70	46.27	69.98	0.71	0.39
36.69	88.14	15.02	37.19	59.43	47.94	35.46	41.57	1.67	1.15
30.91	54.87	41.58	26.42	63.22	31.71	22.61	61.69	2.79	0.51

Group 1 –control,2-study, HT-height in cm, WT-weight in kg, HR1,SDNN1, RMSSD1, LF1,HF1,LF/HF 1 are pre interventional values, HR2,SDNN2, RMSSD2, LF2,HF2,LF/HF 2 are post interventional values.