Title of the Study

IMMEDIATE EFFECT OF SLEEP SPECIAL TECHNIQUE ON HRV IN YOGA PRACTITIONERS

Dissertation submitted by

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Under the guidance of

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Towards the partial fulfillment of

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SWAMI VIVEKANANDA YOGA ANUSANDHANA SAMSTHANA

(Declared as Deemed-to-be University under Section 3 of the UGC Act, 1956)

Bengaluru-560019

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CERTIFICATE

This is to certify that **Chaitanya Sharma** is submitting this dissertation on **"Immediate Effect of Sleep Special Technique on HRV (Heart Rate Variability) in yoga practitioners"** in partial fulfillment of the requirement for the Master of Science (Yoga Therapy) registered in **Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA University) Bangalore** and this is a record of the work carried out by him in this institution.

Dr.V. Sureshbabu — (Guide)

Dr. Rajesh S.K — (Co-Guide)

Date: 20th April 2019

Place: Bangalore

DE C L A R A T I O N

I, hereby declare that this study was conducted by me at Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA), Bangalore, under the guidance of Dr. Suresh Babu and Dr. Rajesh S.K, S-VYASA University Bangalore.

I also declare that the subject matter of my dissertation entitled **"Immediate Effect of Sleep Special Technique on HRV (Heart Rate Variability) in yoga practitioner"** has not previously formed the basis of the award of any degree, diploma, associate-ship, fellowship or similar titles.

Date: 10th March 2019 Chaitanya Sharma

Place: Bangalore (Candidate)

A C K N O W L E D G E M E N T

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Date: 10th March 2019 Chaitanya Sharma

Place: Bangalore (Candidate)

STANDARD INTERNATIONAL TRANSLITERATION CODEUSED TO TRANSLITERATE SANSKRIT WORDS

a	=	अ	**ì a**	=	ङ	**pa**	=	प
ä	=	आ	**ca**	=	च	**pha**	=	फ
i	=	इ	**cha**	=	छ	**ba**	=	ब
é	=	ई	**ja**	=	ज	**bha**	=	भ
u	=	उ	**jha**	=	झ	**ma**	=	म
ü	=	ऊ	**ï**	=	ञ	**ya**	=	य
å	=	ऋ	**öa**	=	ट	**ra**	=	र
è	=	ॠ	**öha**	=	ठ	**la**	=	ल
e	=	ए	**òa**	=	ड	**va**	=	व
ai	=	ऐ	**òha**	=	ढ	**ça**	=	श
o	=	ओ	**ëa**	=	ण	**ña**	=	ष
au	=	औ	**ta**	=	त	**sa**	=	स
à	=	अ	**tha**	=	थ	**ha**	=	ह
ù	=	अः	**da**	=	द	**kña**	=	क्ष
ka	=	क	**dha**	=	ध	**tr**	=	त्र
kha	=	ख	**na**	=	न	**jï a**	=	ज्ञ
ga	=	ग	**gha**	=	घ			

ABBREVIATIONS

HRV – Heart Rate Variability

SST – Sleep Special Technique

BP- Blood Pressure

RR- Respiration Rate

FSS- Fatigue Severity Scale

PSS- Perceived Stress Scale

DRT- Deep relaxation technique

EXP- EXPERIMENTAL GROUP

CON –CONTROL GROUP

SS- SILENT SITTING

ABSTRACT

Title: Immediate Effect of Sleep Special Technique on HRV (Heart Rate Variability) in yoga practitioners.

Background: Sleep is an indicator of health. Sleep determines many aspects of our life like mood, Cognitive functions such as attention and working memory, homeostasis, learning, concentration etc. Sleep is very essential for the academic progress in college students; whereas most of the sleep related problems are found in college students.

Aim: To find the Immediate Effect of Sleep Special Technique on HRV (Heart Rate Variability) in yoga practitioners.

Methods and Material: This is a two-group self as control study, with 36 volunteers from a Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA) Yoga Institure Msc & Bsc students. To some we have given SST first and then Silent Sitting after two days of washout period. Main outcome measures were overall HRV, Blood Pressure and Respiration Rate along with Fatigue. Assessments were done at the base line, and after the intervention.

Results: Significant changes have been observed in Blood Pressure and Respiration Rate, it also shows great reduction in Fatigue, as such no significant changes have been observed in HRV

Conclusion: Sleep Special Technique show significant change in Blood Pressure and Respiration Rate, it also shows great reduction in Fatigue. There is not significant change in HRV. Future similar studies should focus on larger sample size and randomized controlled design.

Key words: Sleep, Yoga, College Students, HRV.

Contents

1. INTRODUCTION

1.1. WHAT IS SLEEP?

Sleep is a naturally recurring state of mind and body, characterized by altered consciousness, relatively inhibited sensory activity, inhibition of nearly all voluntary muscles, and reduced interaction with surroundings (Tan et al., 2016).It is a reversible condition of reduced responsiveness usually associated with immobility (Cirelli & Tononi, 2008).According to W.H.O, we spend almost a third of our life in sleeping (Aminoff, Boller, & Swaab, 2011).Most of the adults take 7 hours of sleep during night time.Adequate hours of sleeping are required for all the levels of well-being such as physical, mental, social and emotional levels (Maity,2018.).

1.2. SLEEP AND WELL-BEING

Good sleep is essential to good health (Levendowski, Popovic, Berka, & Westbrook, 2012).Every individual spends around one third of his survives in the state of sleep (Rechtschaffen, 2015).Sleep determine many aspects of our life like mood, cognitive functions such as attention and working memory, homeostasis, learning, concentration etc(Alhola & Polo-Kantola, 2007) .It is one of the basic human needs that is essential for maintaining good health, good quality of life and performing well throughout the day (Regional, 2004).

1.3.SLEEP DEPRIVATION

Sleep Deprivation is a condition of not having enough sleep:it can be chronic and acute. Sleep deprivation increases the risk of human error related accidents, sleep deprivation degrades aspects of neuro- cognitive performance, increased compensatory effort is required to remain behaviorally effective and growing neglect of activities judged to be non-essential (Durmer, Ph, Dinges, & Ph, 2005).The causes of sleep deprivation include modern lifestyle and working factors (Beccuti & Pannain, 2011).There are larger impacts of sleep deprivation on worry in adolescents and there is an increased vulnerability to elevated anxiety. Also, high school students with lower sleep times (7.5 hours) shows higher levels of perceived stress, mood disturbance, suicidal ideation, unhappiness, interpersonal problems, poor perceived health, school absence due to illness and fatigue (Pilcher & Huffcutt, 2018).

It was found that sleep deprivation for 24 hours reduces cognitive functions of right hemisphere of brain relating to motor, rhythm, receptive and expressive speech, memory and complex verbal arithmetic function (Orzeł-Gryglewska, 2010).Lack of sleep leads to many cardiac disorders such as (CHD, HTN) and metabolic disorders such as diabetes, obesity, hypothyroidism (Toth, Meier-Ewert, Haack, Serrador, & Mullington, 2008).

1.4.SLEEP QUALITY

There are two types of sleep quality, subjective sleep quality defines as "one's perception that they fall asleep easily, get sufficient duration so as to wake up feeling rested, and can make it through their day without experiencing excessive day time sleepiness," Objective sleep quality is defined by "sufficient duration, (>7hrs), high efficiency (>85%), and low fragmentation (<25). Using PSG allow us to add sleep architecture to the equation, whereby good objective sleep quality is defined not only by sufficient duration, high efficiency, and low fragmentation, but also by proper staging of sleep" (Landry, Best, & Liu-Ambrose, 2015) (Landry et al., 2015) .

Medical studies show that about 50% elderly individuals complaint about poor sleep (Vitiello, Larsen, & Moe, 2004) (Vitiello & Borson, 2001). When male's sleep duration and female's sleep duration was compared females reported shorter sleep duration, as a result male subject reported better sleep quality as compared to females (Campbell, Gillin, & Kripke, 2017).

1.5.YOGA AND SLEEP

Yoga, a meditative discipline, is a way of gaining insight into the nature of the mind and reality, Yoga is a Sanskrit word that means union, to connect, or to join; the merging of the microcosm of our existence in our body with the macrocosm. For the westerns, yoga is generally referred to as a mind-body technique from Asia, usually categorized as meditation which includes seated practices and yoga which refers practices that include movement and the active participation of the body (Alejandro Chaoul & Cohen, 2010).

The practice of yoga heals and strengthens the body, sharpens the mind, and calms the spirit.By practicing yoga one's body and mind is challenged in way of experiencing Stretching and Relaxation , Which might be the possible reason for enhancing sleep quality(Lin et al., 2011).Para

sympathetic nervous system is responsible for sleep.Yogic relaxation technique stimulates the parasympathetic nervous system and helps to calm down the mind (Colás et al., 2012).

Yoga is an ancient tradition that has been westernized and often practiced for its proposed health benefits (Garfinkel & Schumacher, 2000). Yoga is the spiritual practices originated from the orthodox school of Hindu tradition. The practices were codified by Patanjali generally known as Ashtanga Yoga. Although Yoga was traditionally a practice meant for achieving self-realization, in recent years there has been significant attention given to the effects of yoga practices physiological and psychological health (Satchidananda, 2012).

Slow paced breathing enhance sleep quality and improves vagal activity, Sleep onset latency, number of awakenings, and awakening time during sleep were reduced by practicing slow, paced breathing exercises for 20 min before going to sleep (Pramanik et al., 2009).

One month Of Sleep Special Technique results showed significant reduction in the score of PSQI, Perceived Stress Scale and positive effect on over all Sleep quality(Maity, 2018).

1.6.SLEEP, HRV AND YOGA

HRV is the change in the time interval between heartbeats, from beat to beat. It is controlled by the autonomic nervous system including the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS).Generally, the SNS activity increases heart rate, and the PNS activity decreases heart rate (Terathongkum & Pickler, 2004).Heart rate variability is an index of beat-to-beat changes in the heart rate and is a non-invasive assessment of autonomic control of cardiac functions (Sztajzel, 2004). Reduced Heart rate variability has been associated with negative consequences to health (Alvares et al., 2013).Practicing yoga based relaxations (CM) reduced the heart rate and breath rates during sleep and also influenced time and frequency domain measures of the heart rate variability recorded during sleep (Patra & Telles, 2010a).

Yoga based guided relaxation technique reduces sympathetic activity, the high frequency component increased, suggesting reduced sympathetic activity (Vempati & Telles, 2002). Yogic practices reduces perceived stress & improves adaptive autonomic response to stress (Satyapriya, Nagendra, Nagarathna, & Padmalatha, 2009).

The practice of Bhramari pranayama influences the parasympathetic dominance on cardiovascular system due to its effect in reducing systolic blood pressure (SBP), diastolic BP (DBP), and mean arterial pressure (Pramanik et al., 2009).

Loosening practices, Asana followed by Relaxation show significant decrease in heart rate, blood pressure in yoga group, also, LFnu and LF-HF ratio decreased significantly and HFnu increased significantly in yoga group which means it has improved the parasympathetic activity and decreased the sympathetic activity in heart failure patients (Hari Krishna et al., 2014).

Slow abdominal breathing reduces sympathetic activity and enhances para-sympathetic activity (Wang et al., 2010).

2. LITERATURE RESEARCH FROM ANCIENT TEXT

2.1.AIM

Aim of this ancient literature review is to gather the references and details of the practices involved in the sleep special technique.

2.2.METHODOLOGY

A literature survey of ancient yogic texts in association with Sleep, Stages of sleep, Pranayama techniques was done. The ancient texts used are; **Patanjali Yoga Sutra**, **Hatha Yoga Pradipika**, **Gheranda Samhita**, **Mandukya Upanishad**, **Charaka Samhita Hatha Ratnawali** as those yogic texts reflects the light of Yoga.

2.3.YOGA

Yoga is one of the ancient science one among the shad darshan that deals with the systematic study of mind and potential energies hidden within the mind. In ancient time this science was used to achieve higher goal of life such as gaining the spiritual power called siddhis and self realization .

Definitions of yoga.

2.3.1. MAHARSHI PATANJALI

योगश्चित्तवृत्तिनिरोधः ॥ २॥

yogaçcittavåttinirodhaù ||P.Y.S 1.2 ||

Yoga is process of gaining mastery over the modification of the mind. Then in the next sutra he described the result of such mastery

तदा द्रष्टुः स्वरुपेऽवस्थानम्॥ ३॥

tadä dra¤öuù svarupe'vasthänam ||P.Y.S 1.3 ||

Then seer established himself in his own causal true state

2.3.2. YOGA VASISTHA

मनः प्रशमनोपायो योगः॥

manaù praçamanopäyo yogaù||

Yoga is a skillful trick to calm down the mind. It is a subtle process and not a brutal, mechanical gross effort to stop thought in the mind.

2.3.3. BHAGAVAD GITA

योगस्थः कुरु कर्माणि सङ्गं त्यक्त्वा धनञ्जय।

सिद्ध्यसिद्ध्योः समो भूत्वा समत्वं योग उच्यते॥ ४८॥

yogasthaù kuru karmäëi saìgaà tyaktvä dhanaïjaya|

siddhyasiddhyoù samo bhütvä samatvaà yoga ucyate||B.G 2.48||

Performing the duties with non attachment and maintaining the equiliberiam of mind in success and failure is called Yoga.

बुद्धियुक्तो जहातीह उभे सुकृतदुष्कृते।

तस्माद् योगाय युज्यस्व योगः कर्मसु कौशलम्॥ ५०॥

buddhiyukto jahätéha ubhe sukåtaduñkåte|

tasmäd yogäya yujyasva yogaù karmasu kauçalam||B.G 2.50||

Maintain the equanimity in this life both good and evil. Therefore one must do the practice of yoga to maintain the equanimity. Yoga is dexterity in action. It is refers to maintaining awareness and relaxation during work. Action in relaxation is the skill. Efficiency in action is an out come.

2.3.4. KATHOPANISAT

तम योगमिति मन्यते स्थिरं इन्द्रिय धारणं ॥

tama yogamiti manyate sthiram indriya dhäraëaà|| kaöhopaniñat 2.54||

Yoga is the state in which all our senses are behind steadily or under control.

Thus, the real yoga is subtler state of mind featured by stadiness. Yoga is a state of steadiness in all the levels such as physical, mental, emotional, intellectual, spiritual.

2.4 SLEEP

2.4.1 MANDUKYA UPANISHAD

Upanishads are the treasure of knowledge. Mandukya Upanishad is the most difficult and smallest Upanishad among all the hundred and eight Upanishads, which comprises only twelve passages. It talks about entire range of human consciousness beginning from the walking state and ending with the super conscious state.

सर्वं ह्येतद् ब्रह्म, अयमात्मा ब्रह्म, सोऽयमात्मा चतुष्पात् ॥२॥

sarvaà hyetad brahma, ayamätmä brahma, so'yamätmä catuñpät ||2||

Every object in this creation is nothing but Brahman. It is not only objective existence but the subjective self within (Atman) is also Brahman. Objective existence is nothing but an emanation of the Reality, which is present behind the subject. This Reality manifest in the subject

in four conditions – walking state (jagrit), dreaming state (swapna), deep sleep (supta), super – consciousness / transcendent state (turiya).

2.4.2 JAGRIT

जागरितस्थानो बहिःप्रज्ञः सप्ताङ्ग एकोनविंशतिमुखः स्थुलभुग्वैश्वानरः प्रथमः पादः ॥३॥

jägaritasthäsno bahiùprajïaù saptäìga ekonaviàçatimukhaù sthulabhugvaiçvänaraù prathamaù pädaù||3||

The first quarter is *vaisvanara*, which is common to all men or the material condition. Its field is the walking state, where consciousness is outward turned. It is seven limbed, nineteen mouthed and it is enjoying gross objects.

2.4.3 SWAPNA

स्वप्नःस्थानोऽन्तः प्रज्ञः सप्ताङ्ग एकोनविंशतिमुखः प्रिविविक्तभुक् तैजसो द्वितीयः पादः ॥४॥

svapnaùsthäno'ntaù prajïaù saptäìga ekonaviàçatimukhaù priviviktabhuk taijaso dvitéyaù pädaù||4||

The second quarter is *taijasa* "state of brahman". Its field is the dream state, in which consciousness is inward turned. In this trans state brahman has seven limbs, nineteen mouths and is enjoying subtle objects.

2.4.4 SUSHUPTI

यत्र सुप्तो न कंचन कामं कामयते, न कंचन स्वप्नं पश्यति, तत् सुषुप्तम्।

सुषुप्तस्थान एकीभुतः प्रज्ञानघन एवानन्दमयो ह्यानन्दभुक् चेतोमुखः प्राज्ञस्तृतीयः पादः॥ ५॥

yatra supto na kaïcana kämaà kämayate, na kaïcana svapnaà paçyati, tat suñuptam|

suñuptasthäna ekébhutaù prajïänaghana evänandamayo hyänandabhuk cetomukhaù präjïaståtéyaù pädaù|| 5||

The third quarter is *prajna*, where there is no desire and no dreams. That is the state of deep sleep. In this state one becomes unified with cognition, a differentiated mass of consciousness, full of bliss and forming the gateway to all definite cognitions.

एष सर्वेश्वर एष सर्वज्ञ एषऽन्तर्याम्येष योनिः सर्वस्य प्रभवाप्ययौ हि भुतानाम्॥६॥

eña sarveçvara eña sarvajïa eña'ntaryämyeña yoniù sarvasya prabhaväpyayau hi bhutänäm||6||

This is the Lord of All; the Omniscient, the inner controller, source of everything, this is the beginning and end of the all.

2.4.5 TURIYA

नान्तःप्रज्ञं न वहिःप्रज्ञं नोभयतःप्रज्ञं न प्रज्ञानघनं न प्रज्ञं नाप्रज्ञम्।

अदृष्टमव्यवहार्यमग्राह्यमलक्षणमचिन्त्यमव्यपदेश्यमेकात्मप्रत्ययसारं प्रपञ्चोपशमं शान्तं शिवमद्वैतं चतुर्थं मन्यन्ते स

आत्मा स विज्ञेयः॥७॥

näntaùprajïaà na vahiùprajïaà nobhayataùprajïaà na prajïänaghanaà na prajïaà näprajïam|

adåñöamavyavahäryamagrähyamalakñaëamacintyamavyapadeçyamekätmapratyayasäraà prapaïcopaçamaà çäntaà çivamadvaitaà caturthaà manyante sa ätmä sa vijïeyaù||7||

The fourth quarter is the turiyä, where consciousness is neither inward turned, nor outward turned, nor both side cognitive, neither is it an indefinite mass of cognition, nor collective cognition, nor non cognition. It is non-perceptible, unrelated, inconceivable, un inferable,

unimaginable, indescribable. It is basic of the self. Here all states of consciousness have common cognition. All phenomena cease in it. There is no duality in this state. This is the state of total peace and bliss.

2.4.6 CHARAKA SAMHITA

Physiology of sleep

यदा तु मनसि क्लान्ते कर्मात्मानः क्लमान्विताः।

विषयेभ्यो निवर्तन्ते तदा स्वपिति मानवः॥ च सं २७।३५॥

yadä tu manasi kläntе karmätmänaù klamänvitäù|

viñayebhyo nivartante tadä svapiti mänavaù|| ca saà 27|35||

When body and mind is fed up with the action, then the mind become incapable to focus on action and sense organs also getting fatigue because of too much work load. Which results in body going into state of sleep.

Types of sleep

तमोभवा श्लेष्म समुद्भवा च मनः शरीर श्रमसंभवा च।

आगंतुकी व्याध्यानुवर्तिनी च रात्रिस्वभाव प्रभवा च निद्रा॥ च सू।२१॥

tamobhavä çleñma samudbhavä ca manaù çaréra çramasambhavä ca|

ägantuké vyädhyänuvartiné ca rätrisvabhäva prabhavä ca nidrä|| ca sü|21||

Charaka Samhita explained about the six types of sleep, they are as follows

1. *Tamobhava nidra* - the sleep happening due to predominant of tamoguna in mind.

2. *Clenmasamudbhava nidra* – the sleep happening due to excess kapha dosha in the body.
3. *Cramasambhava nidra* – state of sleep due to tiredness in both mind and body.
4. Agantuki nidra – sleep due to injury of the body.
5. Vyadhyanuvartine nidra – sleep due to particular diseases.
6. Ratrisvabhavaprabhava nidra – the sleep which we are getting daily at night.
7. Effects of sleep
8. In Charaka Samhita acharya Charaka mentioned merits and demerits of sleep.

निद्रायन्तं सुखं दुःखं पुष्टिः काश्र्यं बलाबलम्।

वृषता कलीवता ज्ञानमज्ञानं जीवितं न च॥ च सं २७।३६॥

अकालेऽतिप्रसङ्गाच्च न च निद्रा निषेविता।

सुखायुषी पराकुर्यात् कालरात्रिरिवापरा॥ च सं २७।३७॥

सैव युक्ता पुनर्युक्ते निद्रा देहं सुखायुषा।

पुरुषं योगिनं सिद्ध्या सत्या बुद्धिरिवागता॥ च सं २७।३८॥

nidräyantaà sukhaà duùkhaà puñöiù kärçyaà baläbalam|

våñatä kalévatä jïänamajïänaà jévitaà na ca|| ca saà 27|36||

akäle'tiprasaìgäïca na ca nidrä niñevitä|

sukhäyuñé paräkuryät kälarätririväparä|| ca saà 27|37||

saiva yuktä punaryukte nidrä dehaà sukhäyuñä|

puruñaà yoginaà siddhyä satyä buddhirivägatä|| ca saà 27|38||

Sukha (happiness), dukha (misery), pushti (nourishment), karshya (emaciation), vala (strength), avala (weakness), vrushta (sexual power) , klivata (importance), gyan (knowledge), agyan (ignorence), jivita (long life), ajivita (death) all this factors are depend on nidra (sleep). Samyak nidra gives us happiness, nourishment, strength, sexual power, knowledge, long life. Asamyak nidra causes misery, emaciation, weakness, impotence, ignorence,death.

Like the night of distruction, untimely, excessive sleep and prolonged vigil take away both happiness and longevity.

The nidra (sleep) which was taken at proper time period (saivayukta nidra), it brings about happiness (sukha) and longevity (ayusha) in human beings as the real knowledge brings about siddhi (spiritual power) in a yogi.

2.4.7 STRESS

विन्जाय निर्विद्य गतं पतिं प्रजाः पुरोहितामात्यसुहृद्गणादयः ।

विचिक्युरुर्व्यामतिशोककातरा यथा निगूढं पुरुषं कुयोगिनः ॥श्री भा ४ ।१३ ।४८ ॥

vinjäya nirvidya gataà patià prajäù purohitämätyasuhådgaëädayaù|

vicikyururvyämatiçokakätarä yathä nigüòhaà puruñaà kuyoginaù||çré bhä 4|13|48||

No intelligent man would wellcome that embodiment of delution called a son who is the cause of untold infamy, unrighteousness, antagonism and mental worries. The householder's life is plagued with sorrow if there is such son.

अन्यदा भ्रशमुद्विग्रमना नष्टद्रविण इव व्रपणः सकरुणमतितर्षेण

हरिणकुणकविरहविह्वलहृदयसन्तापस्तमेवानुशोचन् किल कश्मलं

महद्भिरम्भित इति होवाच ॥श्री भा ५।८।१५॥

anyadä bhraçamudvigramanä nañöadraviëa iva vrapaëaù sakaruëamatitarñeëa

hariëakuëakavirahavihvalahådayasantäpastamevänuçocan kila kaçmalaà

mahadabhirambhita iti hoväca||çré bhä 5|8|15||

Whenever person unable to see that what he needs then, he would feel extremely perturbed like a miser who had lost his fortune and sorrowing for it along with heart full of agony and overwhelmed with grief at his seperation, like Bharata Maharaja seperated from his young deer and infatuated by an inordinate longing to see it, pitifully exclaimed. With great anxiety in his heart, agitated from being separated from the deer-calf, and then he was started constantly thinking of it only and was thus certain of running into the greatest illusion while saying.

अर्थस्य साधने सिद्धे उत्कर्षे रक्षणे व्यये।

नाशोपभोग आयाशस्त्रासश्चिन्ता भ्रमो नुणाम्॥श्री भा ११।२३।१७॥

arthasya sädhane sidve uktarñe rakñaëe vyaye|

näçopabhoga äyäçasträsaçcintä bhramo nuëäm||çré bhä 11|23|17||

Bodily exertion, apprehension, anxiety and delusion fall to the lot of men engaged in the accumulation of wealth, in augmenting and preserving it once it has been acquired and anxiety is involved in its expenditure, loss and enjoyment.

Effect of attachment and desire are beautifully explained by Sri Krishna in second chapter of Bhagvad gita.

ध्यायतो विषयान्पुंसः सङ्गस्तेषूपजायते।

सङ्गात्सञ्जायते कामः कामात्क्रोधोऽभिजायते ॥भ गी २।६२॥

क्रोधाद्भवति सम्मोहः सम्मोहात्स्मृतिविभ्रमः।

स्मृतिभ्रंशाद् बुद्धिनाशो बुद्धिनाशात्प्रणश्यति ॥भ गी २।६३॥

dhyäyato viñayänpuàsaù saìgasteñüpajäyate|

saìgätsaïjäyate kämaù kämätkrodho'bhijäyate||bha gé 2|62||

krodhädbhavati sammohaù sammohätsmåtivibhramaù|

småtibhraàçäd buddhinäço buddhinäçätpraëaçyati||bha gé 2|63||

The man dwells towards the sense objects and develop attachment for them; from attachment comes desire and from desire sprouts anger. From anger arises delusion; from delusion, confusion of memory; confusion of memory brings destruction of discriminative intelligence and loss of discrimination leads to complete ruin.

चिन्तामपरिमेयां च प्रलयान्तामुपाश्रिताः।

कामोपभोगपरमा एतावदिति निश्चिताः ॥भ गी १६।११॥

cintämaparimeyää ca pralayäntämupäçritäù|

kämopabhogaparamä etäavaditi niçcitäù||bha gé 16|11||

Gratify the senses upto the end of life is the prime necessity of human civilization. Thuse there is no end of desire and anxiety. Being bound by hundreds and thousands of desire, lust and anger, they secure money by illegal means for sense gratification.

2.4.8 SYMPTOMS OF STRESS

Patanjali describe the symptoms of mental distraction:

दुःखदौर्मनस्यांगमेजयत्वश्वासप्रश्वासा विक्षेपसहभुवः ॥ प यो सु १।३१ ॥

duùkhadaurmanasyäìgamejayatvaçväsapraçväsä vikñepasahabhuvaù||
pa yo su 1|31||

Mental distraction leads to pain or unhappiness; unhappiness leads to depression, because of depression shaking of the body comes and due to the shaking of the body unrhythmic breathing or breathlessness comes.

2.4.9 CAUSES OF PAIN

In Patanjali Yoga Sutra maharshi Patanjali described about five kleshas or causes of pain:

अविद्यास्मितारागद्वेषाभिनिवेशाः क्लेशाः ॥ प यो सु २।३ ॥

avidyäsmitäragadveñäbhiniveçäù kleçäù|| pa yo su 2|3||

Stresses are originates from different mental and emotional hindrances like ignorance of our true nature, i-ness or egoism, liking, disliking and fear of death. But this is not our original state, our original state is totally stress free and blisful, which is the source of knowledge, creativity and freedom. Eventhough we are getting stress due to lack of awareness, misconception, ego, desire, anger, greed, jealous, attachment etc. Maharshi Patanjali beautifully descrive the basis of pain:

व्याधिस्त्यानसंशयप्रमादालस्याविरतिभ्रान्तिदर्शनालब्धभूमिकत्वानवस्थितत्वानि

चित्तविक्षेपास्तेऽन्तरायाः ॥प यो सु १।३० ॥

vyädhistyänasaàçayapramädälasyäviratibhräntidarçanälabdhabhümika tvänavasthitatväni

cittavikñepäste'ntaräyäù|pa yo su 1|30||

Disease, dullness, doubt, carelessness, laziness, craving for worldly pleasure, delusion, inability to achieve the final stages and instability are the nine obstracles for the mental peace which leads to stress or pain.

Maharshi patanjali gave the solution to remove from obstracles:

स्वप्ननिद्राज्ञानालम्बनं वा ॥ प यो सु १ ।३८ ॥

svapnanidräjïänälambanaà vä|| pa yo su 1|38||

Mind can be made stable by the knowledge of dream and sleep for support.

People are getting stress by performing different types of actions. Sri Krishna gave the trick how one should do the action without getting stress:

कर्मणो ह्यपि बोद्धव्यं बोद्धव्यं च विकर्मणः ।

अकर्मणश्च बोद्धव्यं गहना कर्मणो गतिः ॥भ गी ४ ।१७ ॥

karmaëo hyapi boddhavyaà booddhavyaà ca vikarmaëaù|

akarmaëaçca boddhavyaà gahanä karmaëo gatiù||bha gé 4|17||

One must know the truth about the action to discriminate the action, inaction and prohibited action.

कर्मण्यकर्म यः पश्येदकर्मणि च कर्म यः ।

स बुद्धिमान्मनुष्येषु स युक्तः कृत्स्नकर्मकृत् ॥भ गी ४ ।१८ ॥

karmaëyakarma yaù paçyedakarmaëi ca karma yaù|

sa buddhimänmanuñyeñu sa yuktaù kåtsnakarmakåt||bha gé 4|18||

One who sees inaction in action and action in inaction, is wise among the men, he is a yogi, who perform all actions without getting stress.

2.4.10 PRANAYAMA

तस्मिन् सति श्वासप्राश्वासयोर्गतिविच्छेदः प्राणायामः ।प यो सु २-४९।

tasmin sati çväsapräçväsayorgativicchedaù präëäyämaùpa yo su 2-49|

This having been (accomplished) Pranayama which is cessation of inspiration and expiration (follows).

The reason why Pranayama plays such an important part in the technique of Yoga lies in the close relation existing between Prana and Mind. Prana which exists on all the planes of manifestation in the connecting link between matter and energy on the one hand and consciousness and mind on the other. Consciousness expressing itself though the mind cannot come into touch with matter and function, though it without the intermediate presence of Prana. Matter in association with energy cannot affect consciousness except through the agency of Prana. That is why Prana is found on all the planes. It is necessary for the vitalization and functioning of all vehicles of consciousness, physical or super physical. This capacity to act as intermediary depends upon its peculiar constitution. It combines in itself in some mysterious manner the essential qualities of both matter and consciousness and is thus able to serve as an instrument for their actions and reactions on each other.

This intimate relation existing between prana and mind is utilized in different schools of Yoga in different ways. In Hatha Yoga Pradipika manipulation of Prana current is utilized for bringing about the control of Citta-Vrttis and changes in consciousness. In Raja Yoga Citta-Vrttis are controlled by consciousness through the will and Prana thus comes under the control of the

mind. Patanjali has included both the technique in his system in order to make it has comprehensive and effective as possible. Thus Pranayama is utilized for preparing the mind for Dharana , Dhayana and Samadhai on the one hand, and Samyama on various objects or principles used for acquiring Siddhis on the other.

Although students of Yogic philosophy are generally familiar with the theory of Pranayama an fairly extensive literature exists on the subject it would be worth while discussing here very briefly some fundamental facts in this connection. This will clear the ground for understanding the inner significance of the five sutras in which Patanjali has dealt with the subject.

2.4.11 UJJAYI PRANAYAMA

Ujjayi means 'victorious'. Ujjayi is derived from the Samskrit root 'ujji' which means 'to conquer' or 'acquire by conquest'. Ujjiyi effect on the mind so that in English it is also called as 'psychic breath'.

मुखं संयम्य नाडीभ्यामाकृष्य पवनं शनैः।

यथा लगति कंठात्तु हृदयावधि सस्वनम्॥२।५१॥

पूर्ववत्कुंभयेत्प्राणं रेचयेदिडया तथा।

श्लेष्मदोषहरं कंठे देहानलविवर्धनम्॥२।५२॥

नाडीजलोदराधातुगतदोषविनाशनम्।

गच्छता तिष्ठता कार्यमुज्जाय्याख्यं तु कुंभकम्॥२।५३॥

mukhaà saàyamya näòébhyämäkåñya pavanaà çanaiù|

yathä lagati kaëöhättu hådayävadhi sasvanam||H.Y.P 2, 51||

pürvavatkumbhayetpräëaà recayediòayä tathä|

çleñmadoñaharaà kaëöhe dehänalavivardhanam||H.Y.P 2, 52||

näòéjalodarädhätugatadoñavinäçanam|

gacchatä tiñöhatä käryamujjäyyäkhyaà tu kumbhakam||H.Y.P 2, 53||

Close the mouth, and then inhale through both the nostrils (ida and pingala) with control and full concentration, so that the breath is felt from the throat region to the heart region and produces a sonorous sound.

Then hold the breath until the breath diffuses to the roots of the hair and tips of the nnails. Then exhale through left nostril (ida). This helps to removes phlegm from the throat and stimulates the digestive fire.

Ujjayi pranayama can be done while moving, standing, sitting or walking. It helps to removes dropsy and disorders related to nadis and dhatu.

2.4.12 BHRAMARI PRANAYAMA

Bhramari pranayama is one of the most important kumbhaka pranayama come under astha kumbhaka in Hatha Yoga Pradipika. It is also called as humming bee breath because during this pranayama we are making sound like black bee.

वेगादघोषं पूरकं भृंगनादं भृंगीनादं रेचकं मंदमंदम्।

योगींद्राणामेवमभ्यासयोगाच्चित्ते जाता काचिदानंदलीला ॥२।६८॥

vegädaghoñaà pürakaà bhåìganädaà bhåìgénädaà recakaà mandamandam|

yogéndräëämevamabhyäsayogäccitte jätä käcidänandalélä||H.Y.P 2, 68||

Quickly inhale by making a reverberating sound like the male black bee, and then exhale slowly by making the soft sound like the female black bee. By practicing Bhramari pranayama one can become lord of yogis and one can enjoy the calmness of the mind and bliss.

3. SCIENTIFIC LITERATURE REVIEW

3.1SLEEP IN COLLEGE STUDENTS

Sleep is the most basic human need & most important for good health, good quality of life and for good performance throughout the day. Good quality of sleep is important for good health and well-being. The duration of sleep moderately decreases as the age the age increases. In young adults sleep duration is reduced to 7-9 hours (Regional, 2004).

College students have some sleep related issues. A recent study in two independent groups of college students at different times in the semester, health, affect balance, satisfaction with life, and feelings of tension, depression, anger, fatigue, and confusion were more closely related to average sleep quality than to the average amount of sleep (Pilcher & Ott, 1998). Over the period it has been observed that sleeping hours in college students get reduced as compared to 10 years before (Robert A, 1991).

Perpetual lack of sleep, considered as a model of perpetual exhaustion, compounds different neurohumoral conditions, and it hinders work out limit even in evidently sound individuals. Autonomic imbalance, represented by Heart rate variability (HRV), is possibly connected with various cardiovascular events (Takase et al., 2004).

Poor sleepers experience more issues with daytime working & daytime difficulties than good sleepers, individuals who complain of trouble in falling or remaining sleeping amid the night frequently complain of being functioning in their capacity to work during the day (Alapin et al., 2000). Insufficient sleep has resulted in various chronic disease states and has been identified as a significant contributor to occupational and road accidents .Lack of sleep has also been linked to behavioral health risk factors(Michael, 2009). Adults aged 18 to 44 who reported sleeping less than 6 hours per night were more prone to smoking and to have more than 5 alcohol congaing drinks in a single day (Schoenborn, Adams, & Peregoy, 2010).

3.2 EFFECT OF SLEEP IN COLLEGE STUDENT'S EDUCATION

College going students faces many sleep problems, which highly affect their academic performance, health and state of mood (Yang, Wu, Hsieh, Liu, & Lu, 2003). One of the study demonstrated that 17% of college students with sleep disturbances who presented symptoms of

Delayed Sleep Phase Syndrome (DSPS) also revealed poorer academic performance (Lack, 1986). High school students who have been surveyed have also shown that a lesser total sleep time, later bedtime, and later weekend sleep schedules were associated with lower school grades (Wheaton, 2016).

Along with the academic performance, sleep-related disturbances were also found to be related to emotional and behavioral problems among college students. In 1999, Verlander and colleagues reported that the emotional response to stress for college students was highly associated with their quality of sleep (VERLANDER, 2007).

The fact of risk for sleep disorders between college students by gender and age, and their associations with grade point average (GPA). A validated sleep disorder questionnaire surveyed sleep data during their 2007–2008 academic years. Results showed Twenty-seven percent of students were at risk for at least one sleep disorder, many college students are at risk for sleep disorders, and those at risk may also be at risk for academic failure (Gaultney, 2010).

3.3 CONTRIBUTION OF YOGA IN SLEEP

Yoga is an ancient Eastern tradition that usually includes regulated breathing, moving through various postures, and meditation (TAIMNI, 1980). Studies show after 6 months of yoga practices , participants, overall sleep quality had significantly improved, over that depression, sleep disturbances, and daytime dysfunction had also reduced significantly (Chen et al., 2011). Studies on yoga-based interventions done on healthy subjects have shown that yoga reduces depression and anxiety (Pilkington, Kirkwood, Rampes, & Richardson, 2005).

Yoga intervention shown significantly fewer sleep disturbances, better subjective sleep quality, faster sleep latency, longer sleep duration, and less use of sleep medications during follow-up compared with participants in the control group (L. Cohen, Warneke, Fouladi, Rodriguez, & Chaoul-Reich, 2004).

Yoga research findings show that yoga improved different aspects of sleep in a geriatric population after 6 months of practice (Manjunath & Telles, 2005b). Yoga intervention with regard to quality of sleep and quality of life showed significant results, the Yoga group showed significant improvements in some of the subjective factors, including overall sleep quality, sleep efficiency,

sleep latency and duration, self-assessed sleep quality, fatigue, general well-being; depression, anxiety, stress, tension, anger, vitality, and function in physical, emotional, and social roles (Kennedy, 2016).

Yoga gives a complete holistic way for mind-body and also addresses physical, mental, and spiritual well-being through diverse psychophysical techniques that may include physical exercises, breathing practices, relaxation practices, and meditation techniques (Mackenzie & Rakel, 2013).

3.4 HOW YOGA DEALS WITH STRESS?

By the practice of yoga in healthy women researchers found significant reduction in heart rate and few hormones which are responsible for stress, Yoga has been taken as a tool to cope up with the stress in the west widely (Schell, Allolio, & Schonecke, 1994) . Previous study on the MBBS students, results showed significant changes in yoga group their concentration improved, they were more relaxed, self-confidence, improved efficiency, good interpersonal relationship, increased attentiveness, lowered Irritability levels and reduction in Stress has been observed (A & A, 1999). By regular practice of yoga for 3 months resulted reduced level of cortisol & cardiovascular reactivity induced by Examination stress, which means that regular practice of yoga for three months reduced the Examination stress possibly by inducing parasympathetic predominance and cortico-hypothalamo-medullary inhibition (Potey, Rahul, Chanda, Sanjeev, & Mahapatra, 2016).

Yoga practices are one of the most honored stress management/health promotion techniques whose health benefits are being proven by modern medical science. Independent research has shown that significantly decreased levels of cortisol decrease the level of stress, relieve anxiety, depression, increase anti – oxidant production, enhance brain function, enhance health well – being and peace of mind (Dpd, 2007). Yoga based intervention on Perceived stress and back pain at work, the results showed that a workplace yoga intervention can reduce perceived stress and back pain and improve psychological well-being (Hartfiel et al., 2012).

3.5 YOGA AND FATIGUE

Yoga and exercise in multiple sclerosis, to determine the effect of yoga and of aerobic exercise on cognitive function, fatigue, mood, and quality of life in multiple sclerosis (MS), as a result subjects with MS participating in either a 6-month yoga class or exercise class showed significant improvement in measures of fatigue compared to a waiting-list control group (Mass et al., 2012). Yoga program was conducted for breast cancer survivors for continuous fatigue; Fatigue severity declined significantly from baseline to post-treatment and over a 3-month follow-up in the yoga group relative to controls (P ¼ .032), results show that a targeted yoga intervention led to significant improvements in fatigue and vigor among breast cancer survivors with persistent fatigue symptoms (Bower et al., 2011). Mindfulness based stress reduction treatment and Yoga showed that the mindfulness - based stress reduction treatment can be effective in improving global and specific life quality and fatigue severity in women with breast cancer (Rahmani & Talepasand, 2015).

3.6 YOGA AND HEART RATE VARIABILITY

Immediate effect of different pranayama on Heart Rate Variability in Health care Students, results showed that Surya Nadi Pranayama increase the sympathetic activity and Chandra Nadi Pranayama increases the parasympathetic activity and these can be appropriately advocated in many chronic cardiovascular diseases where the autonomic imbalance is one of the primary derangements (Rajajeyakumar et al., 2014).

The integrated approach of IAYT in patients with type 2 Diabetes, findings show that IAYT improves autonomic functions in type 2 diabetes patients,LF and Lf/HF normalized units improved significantly and HF decreased (Vinutha, Raghavendra, & Manjunath, 2015). LF power is co-related with the activity of sympathetic and parasympathetic nervous system where as HF power with parasympathetic activity (Reed, Robertson, & Addison, 2005). Relaxation by yoga training have shown significant improvement of cardiac vagal modulation among healthy yoga practitioners, since this method is easy to apply with no side effects, and it gives deep physical and mental relaxation, it could be a suitable intervention during cardiac rehabilitation to shift the

autonomic balance towards an increase of vagal activity and possibly decrease cardiac mortality (Khattab, Khattab, Ortak, Richardt, & Bonnemeier, 2007).

High frequency yogic breathing (HFYB) and breath awareness resulted in reduction in NN50, pNN50 and the mean RR interval during and after HFYB and after breath awareness, the LF power increase and HF power decreased during and after breath awareness and LF/HF ratio increased after breath awareness which says that there was reduced parasympathetic modulation during and after HFYB and increased sympathetic modulation with reduced parasympathetic modulation during and after breath awareness (Telles, Singh, & Balkrishna, 2011). By the practice of Cyclic meditation (CM) twice in a day resulted in decrease in heart rate, LF power (n.u.), LF/HF ratio, this also means that it has positive impact on Para-sympathetic activity (Patra & Telles, 2010b)

Serial No	Author & Year	Sample	Type of intervention & duration	Design	Result	Conclusion
1.	(Booth-LaForce, Thurston, & Taylor, 2007)	Women between the ages of 45 and 60 and in the late pre menopause	10-week yoga program	Pre and post treatment assessments designed	The women reported that hot flashes interfered with their daily lives significantly less (p = .05) following the yoga treatment. Additionally, analysis of the PSQI data indicated significant post treatment improvements in subjective sleep quality (p = .04), habitual sleep efficiency (p = .02), sleep disturbances (p = .08), and global quality (p = .009).	The results provide evidence of potential benefits from yoga practice on key menopausal symptoms and their sequelae, including sleep quality and hot flash-related daily Interference, and suggest the importance of considering underlying mechanisms of action.

2.	(“Joshi 1992 yoga mimam.pdf,” n.d.)	20 persons in which 16 male and 4 female of age group 36 to 70.	yoga postures 20 min, guided relaxation 15 min, deep breathing through alternate nostrils 10 min, Meditation 10 min.	Pre and post treatment assessments designed	Pre data - 8 to 14 erasers left in the bowl after 1 month of treatment the range was 12 to 16	Yoga helps improve the quality of sleep.
3.	(Vera et al., 2009)	Twenty-six subjects (16 experimental and 10 controls) were recruited to be part of the study. Experimental subjects were regular yoga	Yoga training in the experimental group typically consisted of two sessions a week, with a duration of 1 hour each, and subjects	The Pittsburgh Sleep Quality Index (PSQI) was employed to assess SSQ. As statistical analysis, Mann–Whitney U-	The yoga group displayed lower PSQI scores and higher blood cortisol levels than control subjects	Therefore, it can be concluded that long-term yoga practice is associated with significant psycho-biological Differences, including better sleep quality as well as a modulatory action on the levels of cortisol.

		practitioners with a minimum of 3 years of practice.	had been following this routine for at least3 years	test was performed.		
4.	(Khalsa, 2004)	The 20 participants completing the protocol with evaluable data consisted of 2 men and 18 women with an average age of 48.1 years (• }10.0 *SD*) and an age range of 30–64 years.	2-week interval of the baseline and for each of the four consecutive 2-week intervals in the treatment phase	A two-way repeated measures analysis of variance (ANOVA) was conducted on each of the following outcome measures: TWT, TST, SE, sleep quality, SOL,	A repeated measures ANOVA on all 19 participants showed a significant main effect for time, $F(3, 54) = 3.06$; $p < .04$, with the overall average of all 19 participants decreasing from 28.6 to 27.4 to 24.8 to 25.8 min in the 2-week intervals During the treatment. The slope of a linear regression analysis correlating average daily	The results of this preliminary study indicate that the yoga treatment generated statistically significant improvements in most of the important subjective sleep measures.

				number of awakenings, WASO and quality of rest at wake time.	Treatment time with the improvement in sleep efficiency from pre- to end-treatment did not reach statistical significance (r = .37, slope = .35, p = .12).	
5,	(C S, 2013)	175 diabetic patients (75 females and 100 males) from diabetic hospital and clinic in Bangalore.	Na	Sleep questionnaire and perceived stress scale	The bivariate correlation analysis showed that there was a positive correlation in age and duration of sleep (p>0.001) and negative correlation with total sleep scores (p>0.001)	The data survey and analysis carried out suggests that chronic partial sleep loss may increase the risk of diabetes.
6	(Kim et al., 2009)	Nineteen patients with anxiety disorder were assigned	8-week MBCT clinical trial	Pittsburgh Sleep Quality Index, Penn State Worry Questionnaire, Ruminative Response	Participants showed significant improvement in Pittsburgh Sleep Quality Index (Z__3.46, p _ 0.00), Penn State Worry	Thus study conclude that MBCT might be a useful intervention for relieving insomnia, worry, anxiety symptoms, depressive

				Scale, Hamilton Anxiety Rating Scale, and Hamilton Depression Rating Scale scores.	Questionnaire (*Z* _ _3.83, *p* _ 0.00), Ruminative Response Scale (*Z*__3.83, *p* _ 0.00), Hamilton Anxiety Rating Scale (*Z*__3.73, *p* _ 0.00), and Hamilton Depression Rating Scale scores (*Z* _ _3.06, *p* _ 0.00) at the end of the 8-week program as compared with baseline.	symptoms, and rumination in patients with anxiety disorders
7	(Carlson & Garland, 2005)	Heterogeneous sample of 63 cancer patients 49 women and 14 men.	Mindfulness, meditation, cancer, sleep, stress, fatigue	In the evaluation sessions participants were given an envelope containing four	The results also confirmed the second hypothesis: reductions in sleep disturbance were significantly correlated with reductions in symptoms of stress. It is of note	Suggest that mindfulness meditation and participation in the MBSR program may have positive influences on the sleep quality of practitioner. The heterogeneity of the present sample strengthens

				measures: (1) PSQI, (2) SOSI, (3) POMS, and (4) a brief demographics questionnaire to collect information regarding age, education, marital status, cancer diagnosis, duration of illness, treatment, and prior experience with meditation.	that improvements in sleep were more related to a reduction in somatic stress symptoms than psychological stress symptoms. This may be a result of activating the physiological relaxation response in meditation participants. The MBSR program may also have improved sleep by reducing the amount of recurrent cognitive distortions and negative or ruminative thoughts.	the MBSR program's applicability to both genders, a diversity of cancer types and stages, and to a range of ages. The present study rein forces previous research suggesting that sleep disturbance in cancer patients is a serious problem and presents mindfulness meditation as a potential no pharmacological treatment for sleep disturbance in this population.

8.	(Manjunath & Telles, 2005a)	Persons of both sexes, over the age of 60 yr. in a residential home for the aged in Bangalore city, south India.	Ayurveda - geriatric population - self-rated sleep - yoga	Yoga (physical postures, relaxation techniques, voluntarily regulated breathing and lectures on yoga philosophy), Ayurveda (a herbal preparation), and Wait-list control (no intervention). The groups were evaluated for self-assessment of	The Yoga group showed a significant decrease in the time taken to fall asleep (approximate group average decrease: 10 min, $P<0.05$), an increase in the total number of hours slept (approximate group average increase: 60 min, $P< 0.05$) and in the feeling of being rested in the morning based on a rating scale ($P<0.05$) after six months. The other groups showed no significant change.	Yoga practice improved different aspects of sleep in a geriatric population.

				sleep over a one week period at baseline, and after three and six months of the respective interventions.		

4. AIM AND OBJECTIVES

4.1AIM

To evaluate the immediate effect of SST on Autonomic variables on HRV in Yoga practitioners.

4.2OBJECTIVES

- ✓ To evaluate immediate effect of SST on Autonomic variables on HRV in Yoga practitioners.
- ✓ To evaluate the Immediate effect of SST on Blood pressure & Co-relation of Immediate effect of SST with Fatigue.

4.3RESEARCH QUESTION

- ✓ Does SST has positive effect on Autonomic variables?
- ✓ Does SST has positive effect on Respiration Rate?
- ✓ Does SST has positive effect on Blood Pressure?

4.4HYPOTHESIS AND NULL HYPOTHESIS

4.4.1 HYPOTHESIS

- ✓ Does SST has positive effect on Heart Rate Variability.
- ✓ Does SST has positive effect on Blood Pressure.
- ✓ Does SST has positive effect on Respiration Rate.

4.4.2 NULL HYPOTHESIS

- ✓ SST has no effect on Heart Rate Variability.
- ✓ SST has no effect on Blood Pressure.
- ✓ SST has no effect on Respiration Rate.

5.METHODOLOGY

5.1SUBJECTS

Normal healthy yoga practitioners were taken.

Gender: both male and female were taken.

5.2AGE:

18 to 47

5.3SAMPLE SIZE CALCULATION

Previous studies accomplished in the field of yoga and life science fields were analyzed to calculate sample size. A previous study done on Heart Rate Variability During Sleep Following the Practice of Cyclic Meditation and Supine Rest (Patra & Telles, 2010a) arrived at sample size of 36 using 'G*Power.

Sample size obtained from calculation n = 36

G*Power is software that provides effect size calculators and graphics options. It contains also a calculator that supports many central and non-central probability distributions. Sample size N is computed a function of power level and significance level (Alpha). To ensure to get dependable results based on previous study which used G*Power Analysis, a sample size of 36 (SST group n = 36, SS group n = 36) chosen.

5.4SOURCE

M.sc and B.sc' Course, S-VYASA University, Bangalore

5.5INFORMED CONSENT

Written informed consent was taken from all the subjects. Approval was taken from Institutional Ethical Committee. Kindly refer **Appendix A**

5.6DESIGN

All the participants recruited in the research trail were assessed with the variables FSS,PSS, HRV,BP, RR. An orientation of 10 days was conducted to make them familiar with SST. After the baseline readings subject followed the SST or else Silent Sitting after that post recordings were taken, a washout period of 2 days was kept as we are looking for immediate effect. The design opted for the research was SELF AS CONTROL.

Table 4; Design

Pre	Intervention	Post
HRV, BP, RR	SST	HRV, BP, RR
HRV, BP, RR	SILENT SITTING.	HRV, BP, RR

5.7INCLUSION CRITERIA

- Male and female**.**
- Yoga practitioners more than six months
- Received Sleep Special Technique orientation program (10 days)
- Age; 21 years to 50 years
- Subjects willing to participate in the study fluent in English language are recruited

5.8EXCLUSION CRITERIA

- Those who have any chronic disease,
- Under any kind of psychiatric or cardiac medication.
- History of hospitalization within the past 6 months.

5.9ETHICAL CONSIDERATION AND INFORMED CONSENT

All data collecting procedures reviewed and to be accepted by Institutional Ethical Committee (IEC) appointed by SVYASA University.

Signed informed consent obtained from the participants before the beginning of study period, after they read the proposal that involves non-invasive data collection methods and risks free intervention. Participants explained in detail about the nature of study and the voluntary nature of participation and participants did not provided with any incentives for their participation.

For information on written informed consent, refer the **Appendix** A section.

5.10 DURATION OF THE INTERVENTION

For SST group participants received SST practice of 30 minutes, and it was administrated from date 25.01.2019 from 4:00 pm to 7:00 pm till data 25.02.2019 SVYASA University, Bangalore campus.

For Silent Sitting group participant were sitting for 30 minutes and it was administrated from date 25.01.2019 from 4:00 pm to 7:00 pm till data 28.08.2018 SVYASA University, Bangalore campus.

A two day of washout period was kept after the intervention. Half of them did SST first and half of them were asked to sit silently for 30 min.

5.11ASSESSMENTS

1. Fatigue Severity Scale.
2. Perceived Stress Scale.
3. Blood Pressure
4. Respiration Rate.
5. Heart Rate Variability.

5.12FATIGUE SEVERITY SCALE (FSS)

Purpose

The FSS is a nine-item instrument designed to assess fatigue as a symptom of a variety of different chronic conditions and disorders. The scale addresses fatigue's effects on daily functioning, querying its relationship to motivation, physical activity, work, family, and social life, and asking respondents to rate the ease with which they are fatigued and the degree to which the symptom poses a problem for them.

Reliability and Validity

Developers Krupp and colleagues conducted an initial psychometric evaluation of the FSS and found an internal consistency of.88 and a test–retest reliability of .84. Scores on the FSS were significantly higher for individuals with multiple sclerosis and systemic lupus erythematosus than they were for healthy control participants; additionally, results on the FSS were found to be significantly correlated with scores obtained using a previously established measure of fatigue.

Scoring

Respondents use a scale ranging from 1 ("completely disagree") to 7 ("completely agree") to indicate their agreement with nine statements about fatigue. A visual analogue scale is also

included with the scale; respondents are asked to denote the severity of their fatigue over the past 2 weeks by placing a mark on a line extending from "no fatigue" to "fatigue as bad as could be."

Higher scores on the scale are indicative of more severe fatigue (Shahid, Wilkinson, Marcu, & Shapiro, 2012).

Please refer to **Appendix A**

5.13PERCEIVED STRESS SCALE (PSS)

Purpose

The Perceived Stress Scale (PSS) is the most widely used psychological instrument for measuring the perception of stress. It is a measure of the degree to which situations in one's life are appraised as stressful. Items were designed to tap how unpredictable, uncontrollable, and overloaded respondents find their lives. The scale also includes a number of direct queries about current levels of experienced stress. The PSS was designed for use in community samples with at least a junior high school education. The items are easy to understand, and the response alternatives are simple to grasp. Moreover, the questions are of a general nature and hence are relatively free of content specific to any subpopulation group. The questions in the PSS ask about feelings and thoughts during the last month. In each case, respondents are asked how often they felt a certain way (S. Cohen, n.d.).

Evidence for Validity:

Higher PSS scores were associated with (for example):

- ✓ failure to quit smoking
- ✓ failure among diabetics to control blood sugar levels
- ✓ greater vulnerability to stressful life-event-elicited depressive symptoms
- ✓ more colds

.

Scoring

PSS scores are obtained by reversing responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1 & 4 = 0) to the four positively

stated items (items 4, 5, 7, & 8) and then summing across all scale items. A short 4 item scale can be made from

questions 2, 4, 5 and 10 of the PSS 10 item scale.

Please refer **Appendix B**

5.14RESPIRATION RATE

Respiration Rate was measured manually by the researcher per minute by observing the up and down movement of the belly/chest.

5.15SPHYGMOMANOMETER

Sphygmomanometer was used to measure Blood Pressure for both the groups.

5.16HEART RATE VARIABILITY

Heart rate variability (HRV) describes the variations between consecutive inter-beat-intervals or IBIs. Both sympathetic and parasympathetic branches of the ANS are involved in the regulation of heart rate (HR). Sympathetic nervous system (SNS) activity increases HR and decreases HRV, whereas parasympathetic nervous system (PNS) activity decreases HR and increases HRV (Berntson et al., 1997).

The control of the autonomic output involves several interconnected areas of central nervous system, which form the so-called central autonomic network. In addition to this central control, arterial baroreceptor reflex as well as respiration is known to induce quick changes in heart rate. The baroreflex is based on baroreceptors which are located on the walls of some large vessels and can sense the stretching of vessel walls caused by pressure increase. Both sympathetic and parasympathetic activity is influenced by baroreceptor stimulation trough a specific baroreflex arc.

Typically, the most conspicuous oscillatory component of HRV is the respiratory sinus arrhythmia (RSA), where the vagus nerve stimulation is being cut-off during inhalation, and thus, HR increases during inhalation and decreases during exhalation. This high frequency (HF) component of HRV is thus centered at respiratory frequency and is considered to range from 0.15

to 0.4 Hz. Another conspicuous component of HRV is the low frequency (LF) component ranging from 0.04 to 0.15 Hz. The HF component is mediated almost solely by the PNS activity, whereas the LF component is mediated by both SNS and PNS activities and is also affected by baroreflex activity (Schlosser, 1999) .

5.17INTERVENTION

Intervention details.

SLEEP SPECIAL TECHNIQUE

Steps to be performed before going to bed **Total duration - 30 min**

1. **Standing position:**
   a. Walking - 5 min
   b. Centering - 2 min
2. **Sitting position:**
   a. Deep abdominal breathing - 3 mins
   b. NadisuddhiPranyama - 3 mins
   c. Ujjayi Pranayama - 2 mins
3. **Supine position:**

Reverse DRT from head to toes - 10 min

"M" Kara - 3 rounds
"U" Kara - 3 rounds
"A" Kara - 3 rounds
"M-U-A" Kara- 3 rounds
"OM" Kara - 3 rounds

4. **"OM" japa** (mental chanting) followed by silence.

6. DATA EXTRACTION AND ANALYSISDATA EXTRACTION

Recordings of Heart Rate Variability were taken before and after for both the groups. The recorded data were visually inspected off-line and noise free data were taken. A software named *Kubios* was used to extract the HRV data. Blood pressure was measured manually by *Sphygmomanometer,* Respiration Rate was also measured manually. Questionnaires were obtained on Google Forms.

6.1DATA ANALYSIS

Data analysis was done using excel and **statistical analysis** done using software called "R" and "SPSS". The quantitative data analyzed by using statistical test, descriptive statistics (Mean, SD).

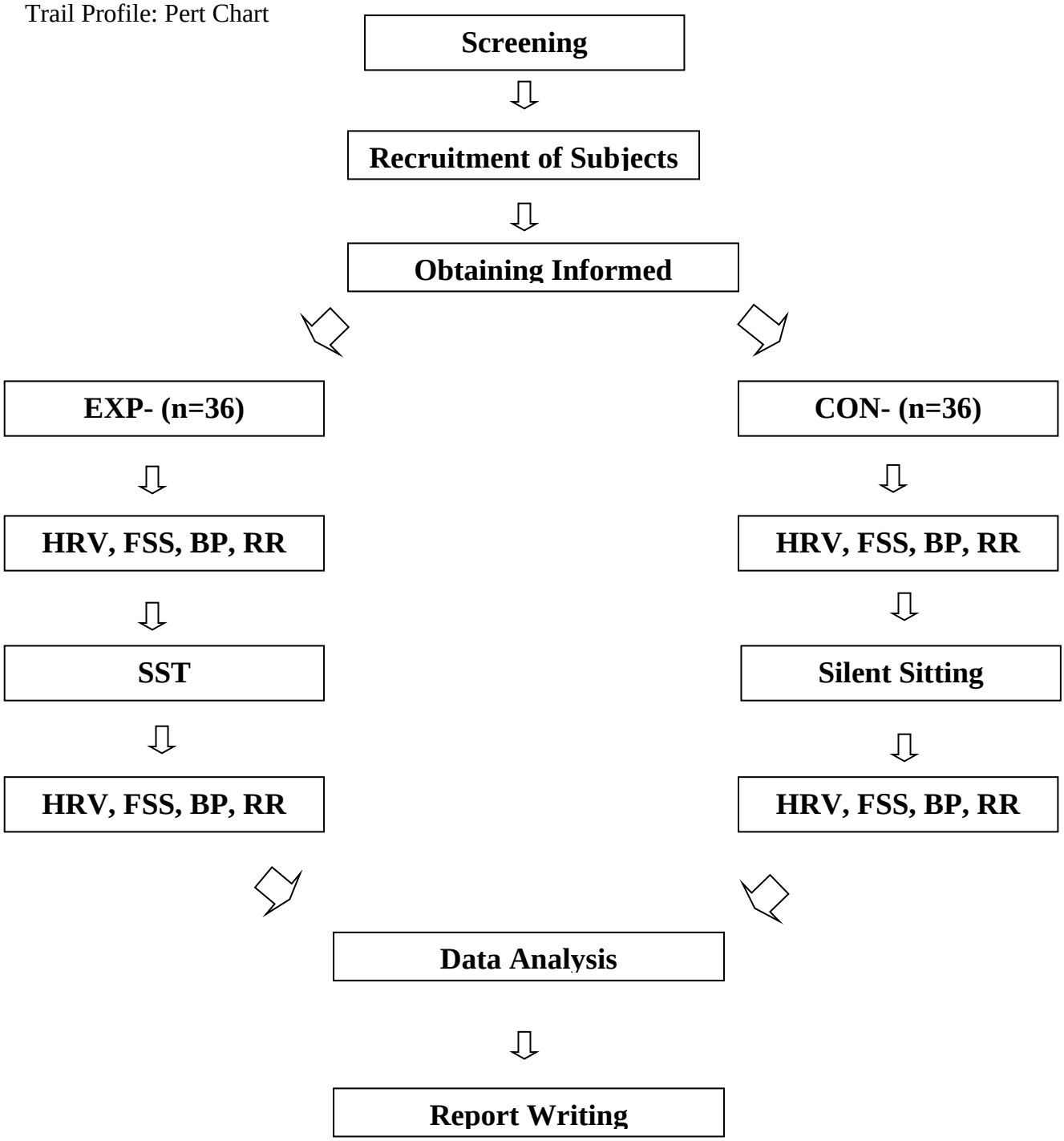
Missing value, outlier's were analyzed and handled. Reverse scoring was done for the positive items (4, 5, 7, and 8) of PSS.

Table 1 Reliability and validity of Fatigue Severity and Perceived stress scales

Questionnaire	Cronbach alpha
PSS	0.82, Pre-0.75, Post-0.79
FSS	0.90, Pre-0.81, Post-0.86

7. RESULTS

Trail Profile: Pert Chart



DEMOGRAPHIC DATA

Volunteers from different places of South India and North India were chosen to involve in our study. The details are given below;

Table-6: Demographic data (Raw)

S. No	Demography	Details
1	Age (in years) Mean ± SD	21 – 47 25.19 ± 5.80
2	Male	17
3	Female	19

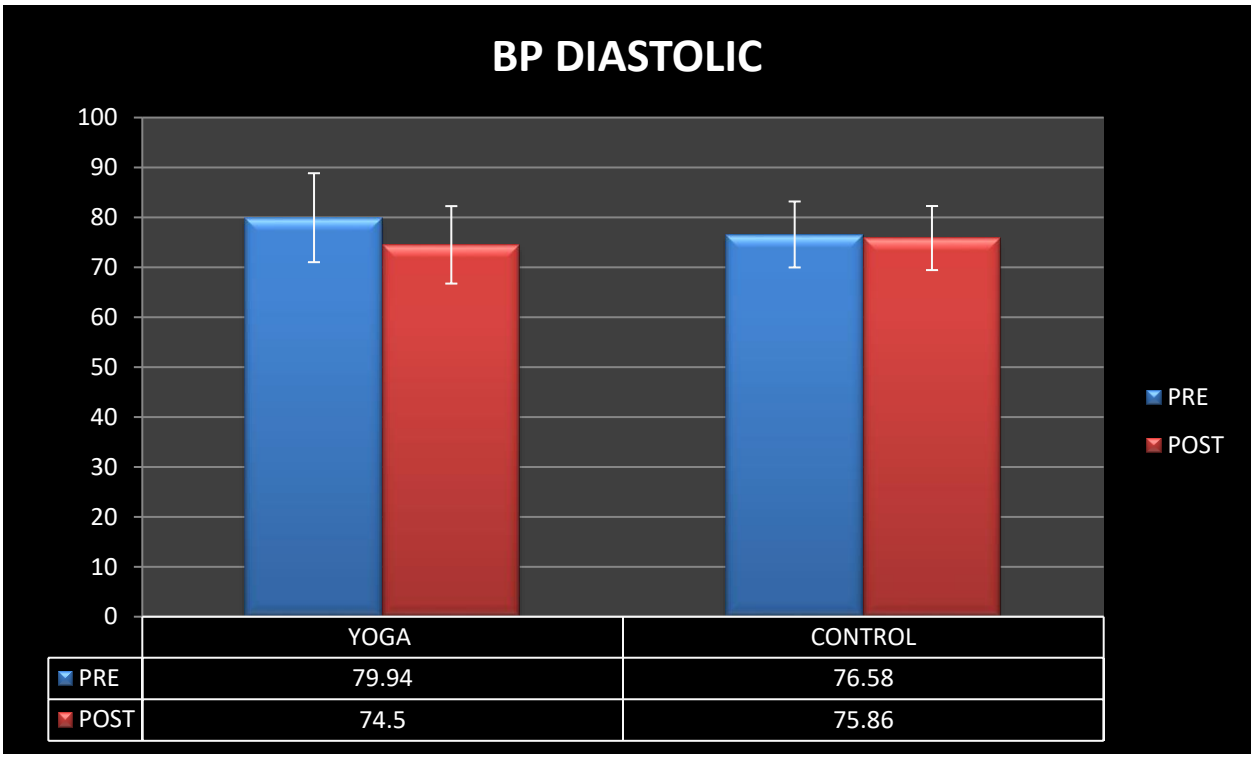
Table - 1 (Within Group & Between Groups)

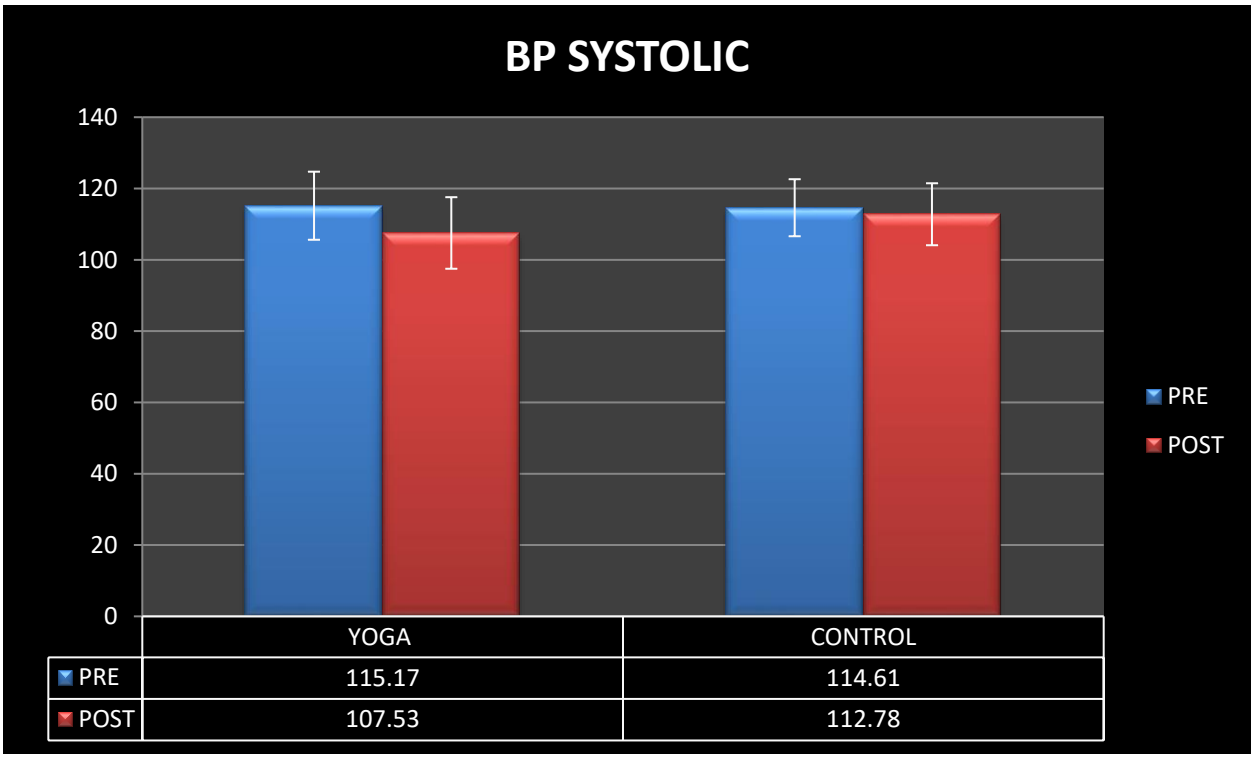
Sl.no.	Variables	Experimental group			Control Group			Between Group
		Pre	Post	P-value	Pre	Post	P-value	P-value
1	BP DIA	79.94 ± 8.91	74.50 ± 7.76	0.0002873***	76.58 ±6.61	75.86 ±6.42	0.1516	0.4204
2	BP SYS	115.17 ±9.55	107.53 ±10.04	$3.252^{e-05***}$	114.61 ±8.00	112.78 ±8.69	0.0488*	0.02049*
3	RR	19.61 ± 3.20	16.00 ± 2.56	$8.977^{e-07***}$	19.11 ±3.28	18.61 ±3.05	0.0139*	0.00020***
4	FSS	31.78 ± 8.47	31.03 ±10.51	0.3421	32.42 ±8.86	32.72 ±9.15	0.3146	0.4681
5	VAFS	4.78 ± 1.69	±8.11 ±1.19	$1.359^{e-12***}$	5.36 ±1.74	5.53 ±1.66	0.3917	$2.375^{e-09***}$
6	HR	70.38 ± 7.69	66.76 ± 7.72	$5.818^{e-08***}$	72.37 ± 8.73	69.25 ± 7.37	0.0001***	0.1667
7	RMSSD	52.67 ± 21.35	59.59 ± 24.94	0.00607**	50.66 ± 24.99	54.88 ± 24.53	0.0379*	0.4213
8	NN50 Beats	105.19 ± 67.40	122.89 ± 73.23	0.00935**	99.31 ±68.30	112.19 ± 67.11	0.0579	0.5204
9	NNXX %	31.79 ± 20.01	38.42 ± 23.00	0.00162**	29.91± 20.62	33.34 ± 20.39	0.0561*	0.3081
10	LF	42.38 ± 19.02	43.66 ± 21.47	0.6734	45.01 ± 18.84	48.39 ± 17.31	0.247	0.3067

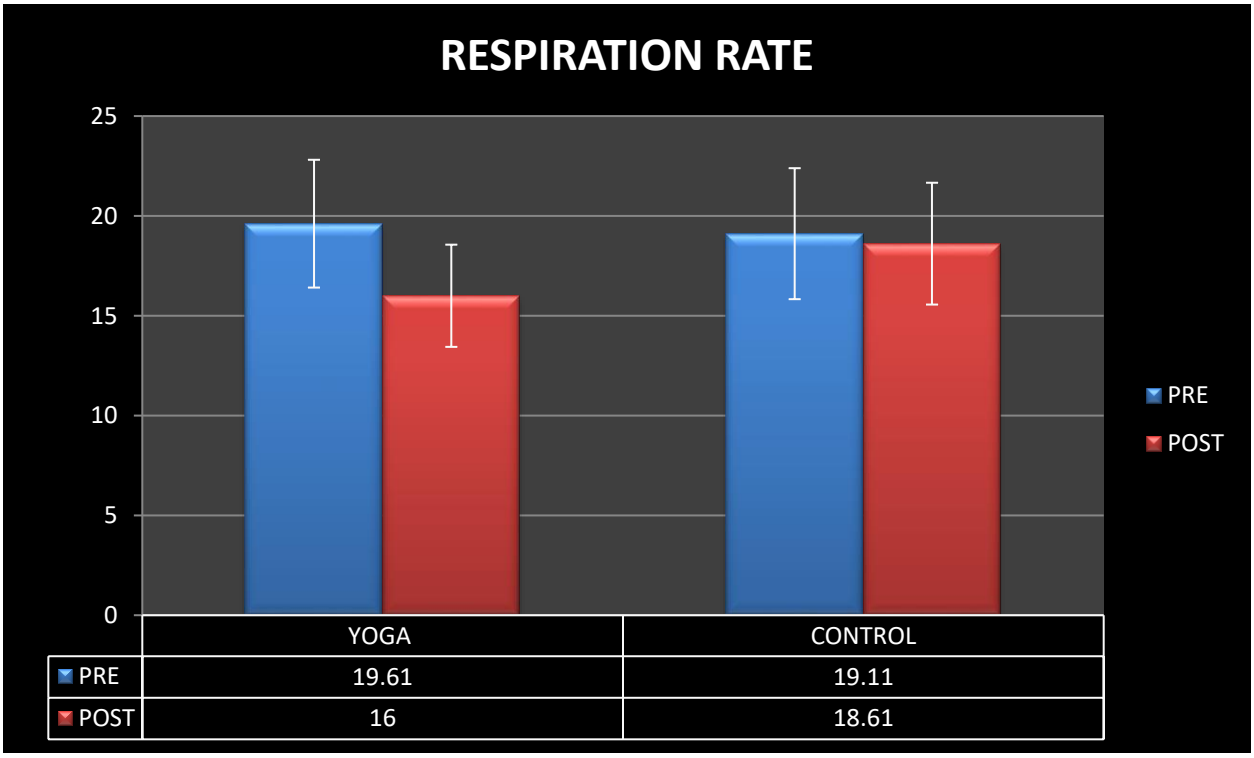
11	HF	57.37 ± 18.86	56.20 ± 21.42	0.6994	54.75 ± 18.79	51.43 ± 17.28	0.257	0.3021
12	LF/HF	1.17 ± 1.65	1.41 ± 2.18	0.5071	1.11 ± 0.94	1.30 ± 1.34	0.3898	0.7902
13	SAMPEN	1.78 ± 0.20	1.76 ± 0.20	0.4895	1.80 ± 0.22	1.82 ± 0.27	0.7985	0.2934

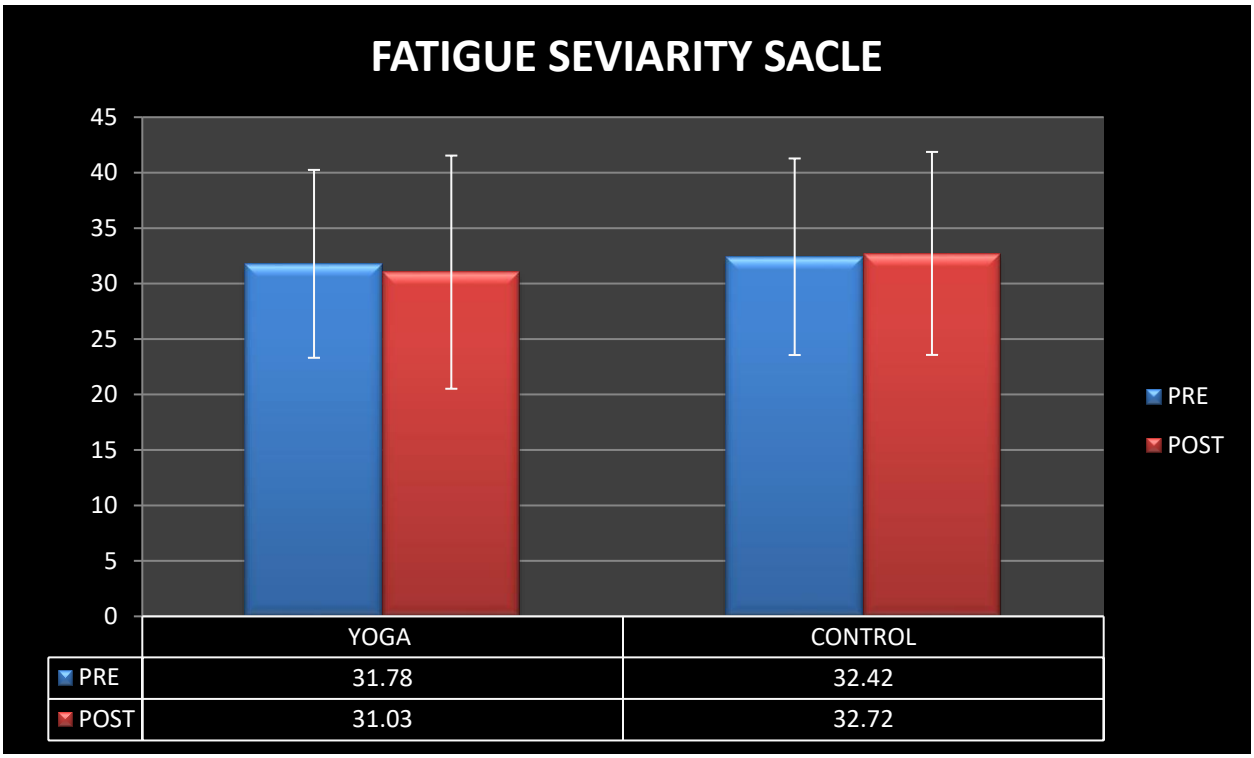
* P<0.05, ** P<0.001

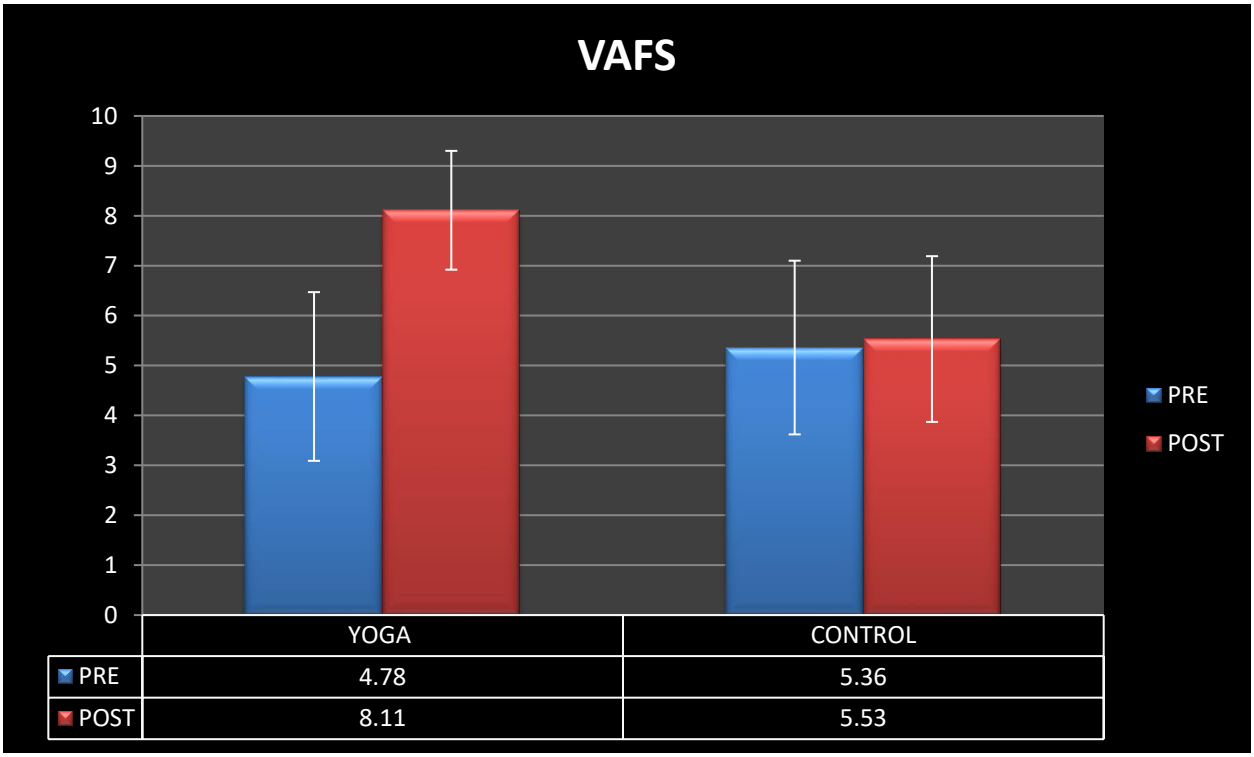
7.2LIST OF GRAPHS

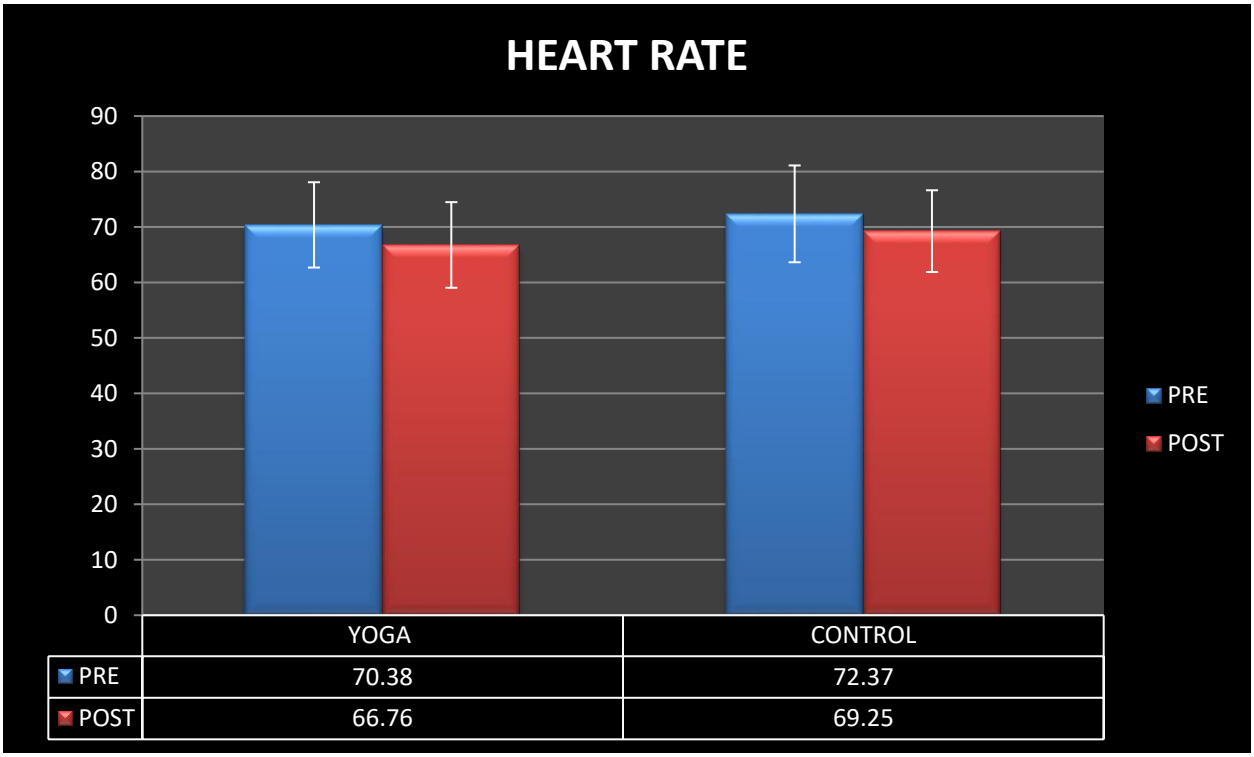



BP SYSTOLIC
140
120
100
80
60
40
20
0
PRE
POST
YOGA
CONTROL
PRE 115.17 114.61
POST 107.53 112.78

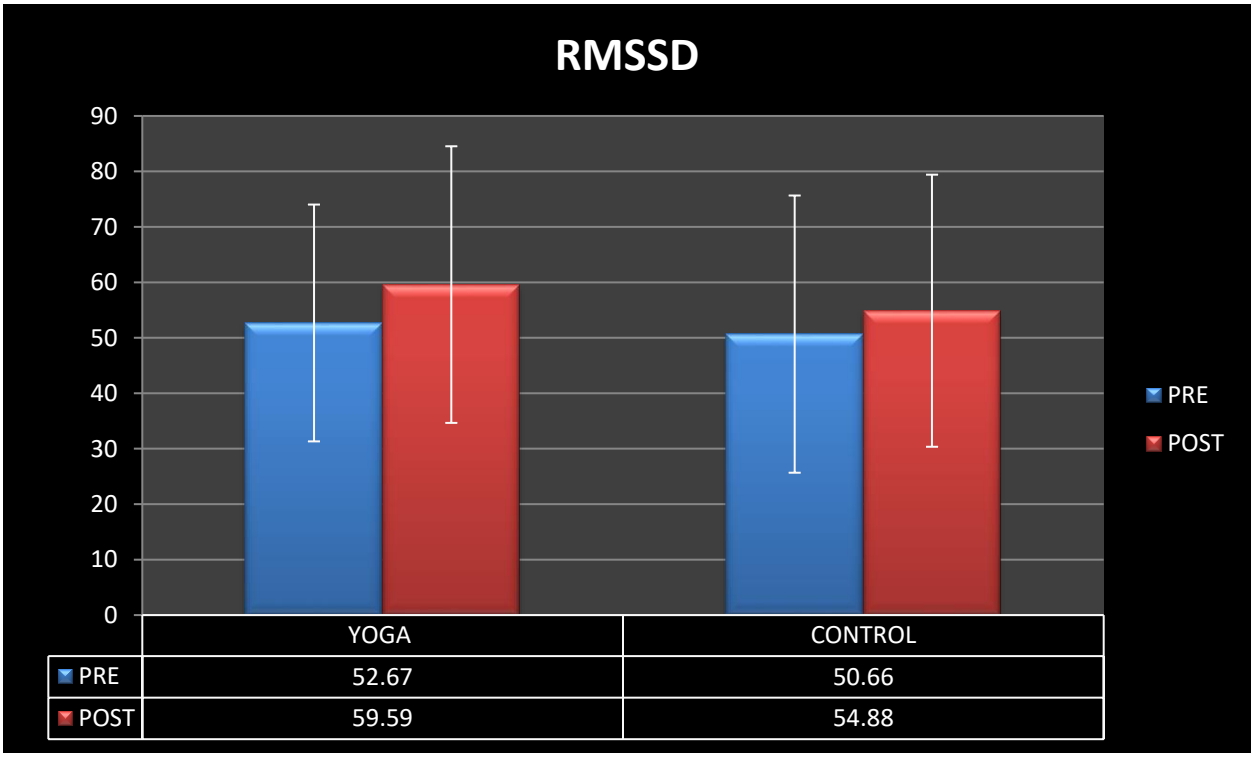

RESPIRATION RATE
25
20
15
10
5
0
PRE
POST
YOGA
CONTROL
PRE 19.61 19.11
POST 16 18.61


FATIGUE SEVIARITY SACLE
45
40
35
30
25
20
15
10
5
0
PRE
POST
YOGA
CONTROL
PRE 31.78 32.42
POST 31.03 32.72

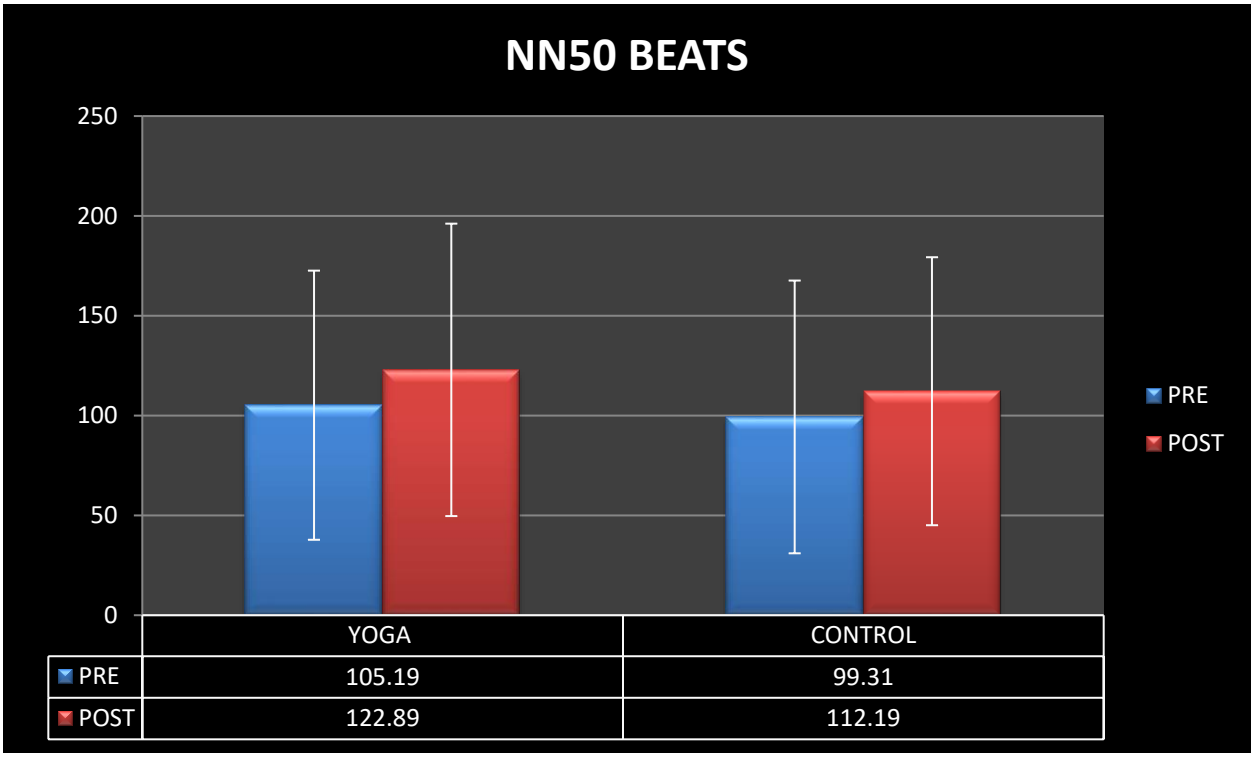

VAFS
10
9
8
7
6
5
4
3
2
1
0
PRE
POST
YOGA
CONTROL
PRE 4.78 5.36
POST 8.11 5.53

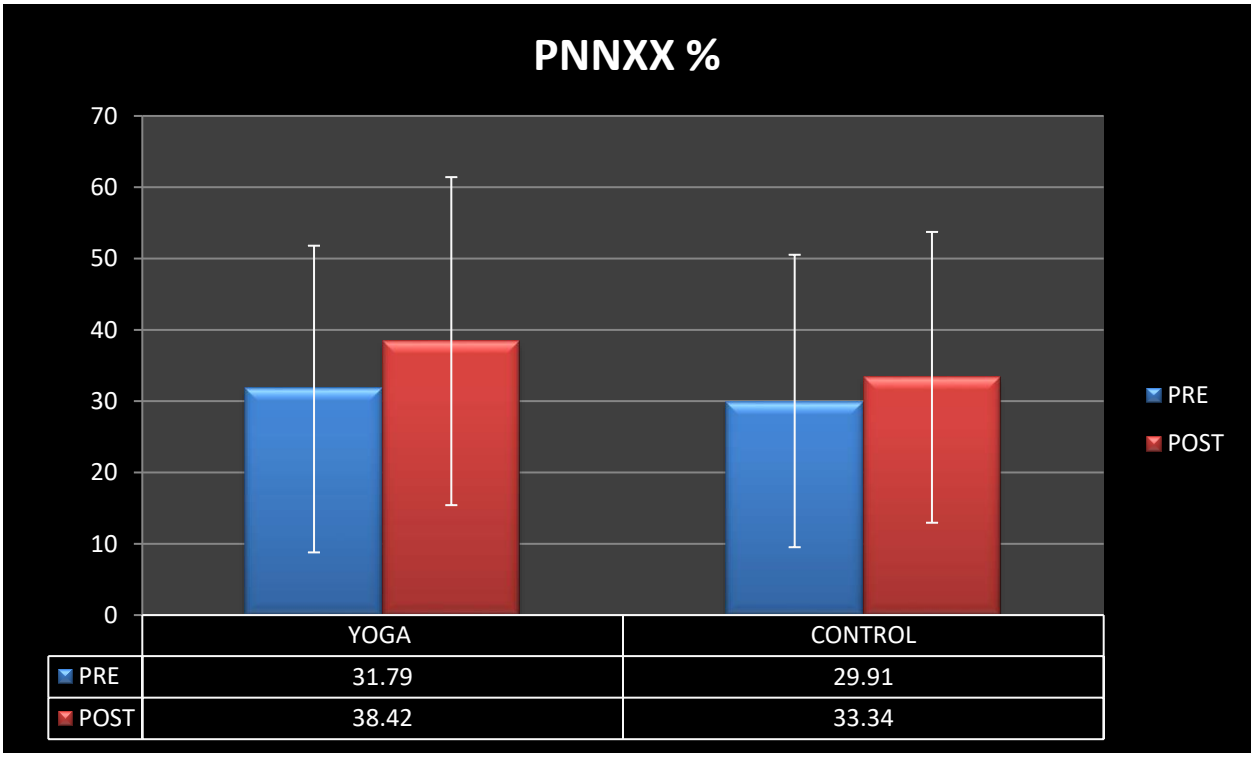


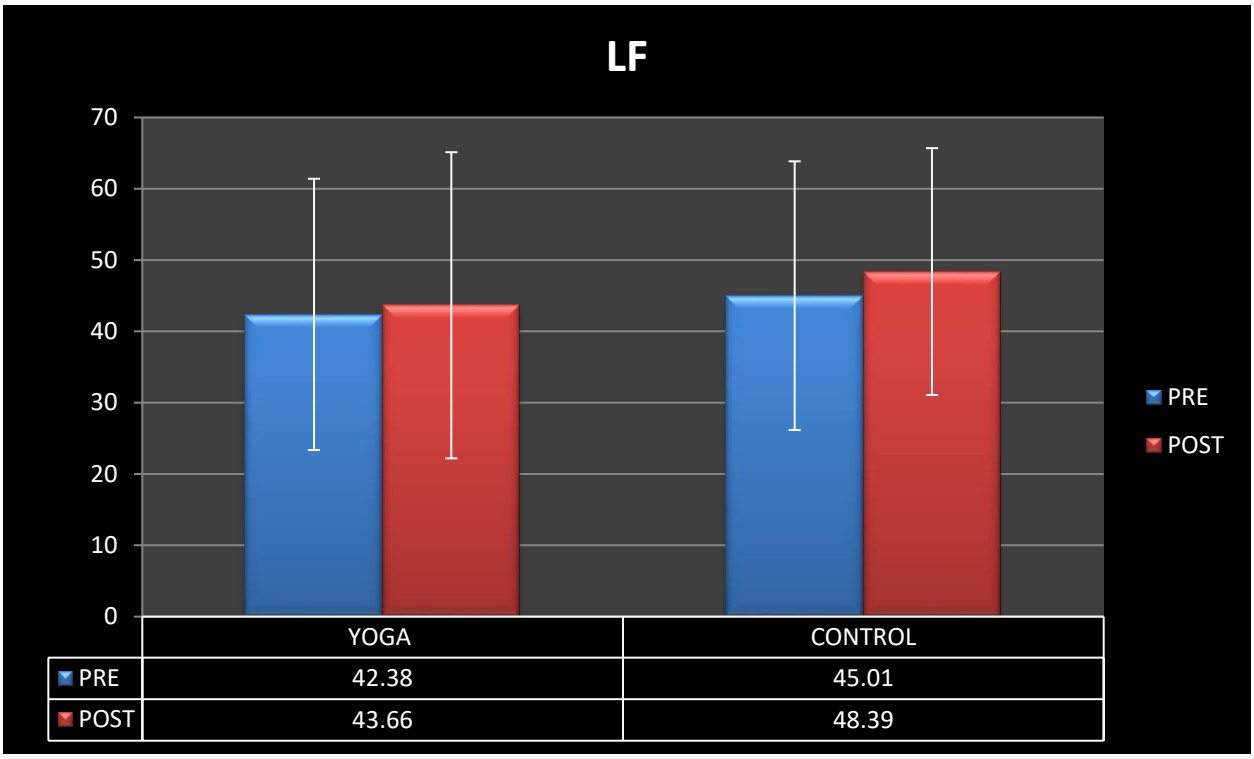
	YOGA	CONTROL
PRE	70.38	72.37
POST	66.76	69.25



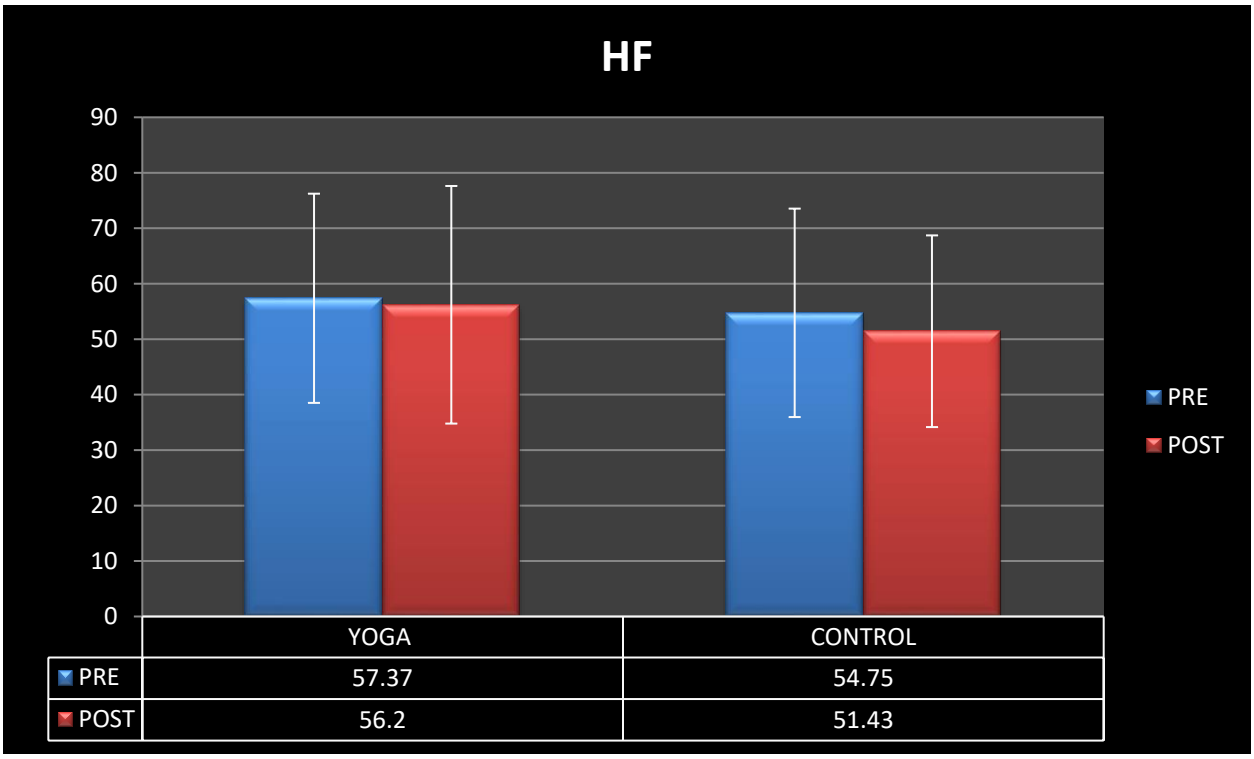
	YOGA	CONTROL
PRE	52.67	50.66
POST	59.59	54.88


NN50 BEATS
250
200
150
100
50
0
PRE
POST
YOGA
CONTROL
PRE 105.19 99.31
POST 122.89 112.19

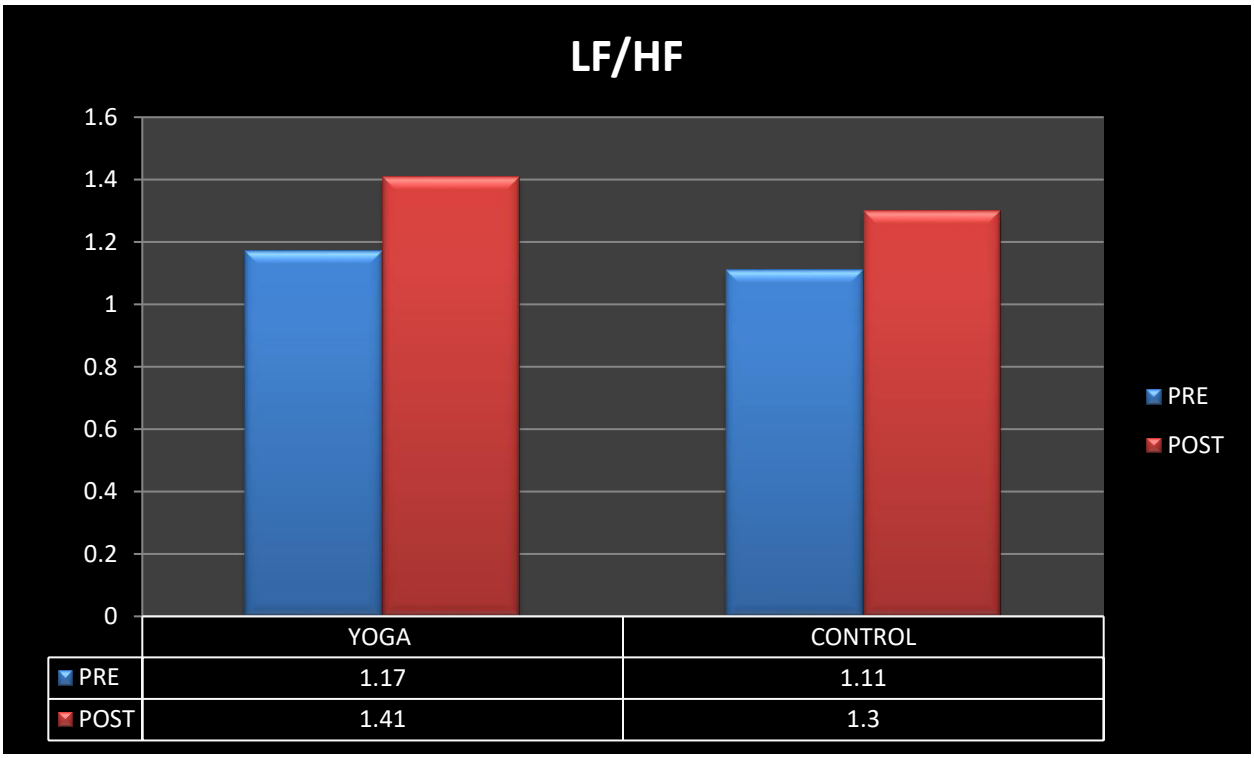

PNNXX %
70
60
50
40
30
20
10
0
PRE
POST
YOGA
CONTROL
PRE 31.79 29.91
POST 38.42 33.34

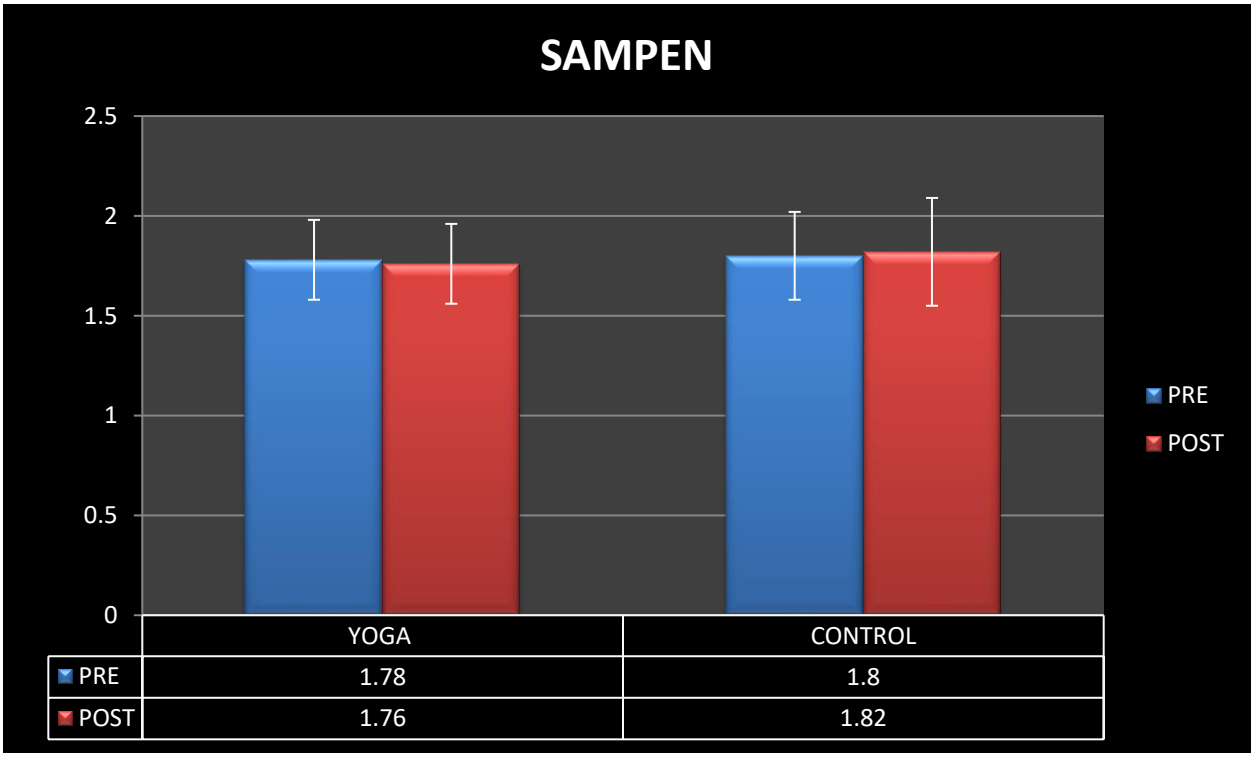


	YOGA	CONTROL
PRE	42.38	45.01
POST	43.66	48.39



	YOGA	CONTROL
PRE	57.37	54.75
POST	56.2	51.43


LF/HF
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
PRE
POST
YOGA
CONTROL
PRE 1.17 1.11
POST 1.41 1.3


SAMPEN
2.5
2
1.5
1
0.5
0
PRE
POST
YOGA
CONTROL
PRE 1.78 1.8
POST 1.76 1.82

8. DISCUSSIONS

8.1 INTRODUCTION

The present study was conducted with an aim to see the immediate effect of Sleep Special Technique on Heart Rate Variability, Fatigue, changes in Respiration Rate and Blood Pressure.

8.2 BLOOD PRESSURE

Current study results showed significant reduction in Blood pressure in both the groups, but significantly more reduction found in experimental group. Experimental group show significant reduction in blood pressure diastolic ($p<.001$**), Significant reduction in blood pressure systolic ($p<.001$**). Also, significant reduction in blood pressure systolic ($p=0.04$) in Silent Sitting group were reported.

Previous study by Hyoung Sook Park on effect of yoga program on reduced blood pressure in elderly's essential hypertension show significant reduction in systolic and diastolic blood pressure it also support our current result of significant reduction in blood pressure systolic & diastolic (Park, Kim, & Kim, 2002).

8.3 FATIGUE

Immediate effect of Sleep Special Technique results showed significant reduction in Visual Analog Fatigue Scale when compared with pre data of experimental group ($p<.001$**). Whereas there was no significant reduction found in Control group.

Previous researches on Mindfulness based stress reduction treatment and Yoga showed that the mindfulness - based stress reduction treatment can be effective in improving global and specific life quality and fatigue severity in women with breast cancer (Rahmani & Talepasand, 2015).

8.4 RESPIRATION-RATE

Current study results showed significant reduction in Respiration rate in both the groups, but great significant change has been observed in the yoga group with a p-value of ($p=8.977e-07$**), also there is reduction in Respiration Rate in control group as well with a p-value of ($p=0.01393$*). Previous study by Eveline Beutler on Effect of Regular Yoga Practice on Respiratory Regulation and Exercise Performance showed higher Tidal volume at rest which

means reduced number of breath with long exhalations and inhalations (Beutler, Beltrami, Boutellier, & Spengler, 2016).

8.5 HEART RATE VARIABILITY

In experimental group, post SST intervention we observed a significant reduction in Heart Rate ($p<.001^{**}$) and the LF power improved ($p=0.67$) and HF power reduced ($p=0.69$). The LF/HF ratio increased ($p=0.50$) after SST which says that there was reduced parasympathetic modulation after SST and increased sympathetic modulation with reduced parasympathetic modulation after SST.

Previous studies have shown high frequency yogic breathing (HFYB) and breath awareness resulted in reduction in NN50, pNN50 and the mean RR interval during and after HFYB and after breath awareness, the LF power improved and HF power reduced during and after breath awareness and LF/HF ratio increased after breath awareness which says that there was reduced parasympathetic modulation during and after HFYB and increased sympathetic modulation with reduced parasympathetic modulation during and after breath awareness (Telles, Singh, & Balkrishna, 2011)

9 CONCLUSION

Sleep Special Technique show significant change in Blood Pressure and Respiration Rate, it also shows great reduction in Fatigue. There is significant change in HRV.

Findings of many researches on various meditation techniques explore the relaxation response as one outcome of meditation. From this we conclude that the reduction in Blood pressure, fatigue and decrease in Breath rate is because of activation of parasympathetic system inducing relaxation and also a reduction of sympathetic activation through SST practice.

10 APPRAISAL

10.1 STRENGTH OF THE STUDY

- So far there is limited study commenced on these techniques to study Fatigue, Blood Pressure, Respiration Rate and HRV.
- This study is having self as control design with both gender's.
- Participants expressed positive response after end of the SST practice session
- No side-effects and negative effects were reported

10.2 LIMITATION OF THE STUDY

- The recruited subjects have come from versatile professions such as job, service, and business for long term courses, for consistent results, all students should belong to student's category.
- Random allocation into SST and SS groups should have been done based on gender and age.
- Though the end result didn't show significant results in in-between group analysis, this may be due to sample selection, since the subjects were regular yoga practitioners in-between group analysis couldn't provide significant change. If the design would have been single group pre-post design then the results are highly convincing .

10.3 SUGGESTIONS FOR THE FUTURE STUDY

- Study should be carried out across higher schools and UG, PGs colleges in different variety of courses, in present study the students were staying in campus for 2 years.
- As per subject's feedback they prefer manual/live instruction instead of recordings

11 APPENDICES

11.1 Appendix A

Informed Consent

Title: Title: Effects of Sleep Special Technique on HRV (Heart Rate Variability), Blood Pressure and Respiration Rate in yoga practitioner.

Information to the participants:

We are conducting a study to find immediate effect of Sleep Special Technique on HRV (Heart Rate Variability in yoga practitioner. This study is a part of the M.Sc. degree. Your consent will have very important role in this study.

If you consent to take part in this study, the investigator will assess your present status by measuring Blood pressure Respiration Rate and HRV before and after the practice of Sleep Special Technique. The information collected from you would be helpful to find immediate effect of Sleep Special Technique on HRV (Heart Rate Variability), Blood Pressure and Respiration Rate in yoga practitioner. The tests & recordings are expected not to cause any serious adverse effect on your physical or mental health. Please note that you have a right to refuse to take part in the study at any time.

Consent:

I have been informed about the procedures and the risks of the study. I have understood that I/We have the right to refuse my consent or withdraw it any time during the study without adversely affecting my treatment. I am aware that by subjecting to this investigation, I will have to give more time to assessments by the investigating team and that these assessments do not interfere with the benefits. I, _____, the undersigned, give my consent to be a participant of this investigation/study program.

Signature of the Participant Signature of the investigator

11.2 Appendix B – Sample Fatigue Severity Questionnaire.

FATIGUE SEVERITY SCALE (FSS)

Date _____ Name _____

Please circle the number between 1 and 7 which you feel best fits the following statements. This refers to your usual way of life within the last week. 1 indicates "strongly disagree" and 7 indicates "strongly agree."

Read and circle a number.	Strongly Disagree → Strongly Agree						
1. My motivation is lower when I am fatigued.	1	2	3	4	5	6	7
2. Exercise brings on my fatigue.	1	2	3	4	5	6	7
3. I am easily fatigued.	1	2	3	4	5	6	7
4. Fatigue interferes with my physical functioning.	1	2	3	4	5	6	7
5. Fatigue causes frequent problems for me.	1	2	3	4	5	6	7
6. My fatigue prevents sustained physical functioning.	1	2	3	4	5	6	7
7. Fatigue interferes with carrying out certain duties and responsibilities.	1	2	3	4	5	6	7
8. Fatigue is among my most disabling symptoms.	1	2	3	4	5	6	7
9. Fatigue interferes with my work, family, or social life.	1	2	3	4	5	6	7

VISUAL ANALOGUE FATIGUE SCALE (VAFS)

Please mark an "X" on the number line which describes your global fatigue with 0 being worst and 10 being normal.

0	1	2	3	4	5	6	7	8	9	10
_____										

11.3 Appendix C – Sample PSS Questionnaire.

PERCEIVED STRESS SCALE

The questions in this scale ask you about your feelings and thoughts during the last month. **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** Other _____

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

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

info@mindgarden.com
www.mindgarden.com

References

The PSS Scale is reprinted with permission of the American Sociological Association, from Cohen, S., Kamarck, T., and Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24,* 386-396.
Cohen, S. and Williamson, G. Perceived Stress in a Probability Sample of the United States. Spacapan, S. and Oskamp, S. (Eds.) *The Social Psychology of Health.* Newbury Park, CA: Sage, 1988.

11.4 Appendix D - Rawdata

Blood Pressure & Respiration Rate.

ID.	NAME.	GENDER.	GROUP.	BP_SYS_PRE.	BP_SYS_POST.	BP_DIA_PRE.	BP_DIA_POST.	RR_PRE.	RR_POST.
1	Indu bala	F	EXP	118	110	80	70	17	14
2	Indu bala	F	CON	114	112	76	78	18	18
3	Shridhar	M	EXP	122	112	90	82	16	13
4	Shridhar	M	CON	100	90	60	62	17	17
5	Pooja K	F	EXP	118	100	76	70	20	14
6	Pooja K	F	CON	112	116	72	76	20	20
7	Jiban	F	EXP	110	106	70	70	21	17
8	Jiban	F	CON	110	114	70	76	17	17
9	Manjula	F	EXP	110	114	80	72	14	12
10	Manjula	F	CON	130	126	70	72	12	12
11	Davendra	M	EXP	112	110	72	80	22	16
12	Davendra	M	CON	120	110	70	70	17	16
13	Fu	F	EXP	92	90	60	60	18	15
14	Fu	F	CON	106	104	70	68	20	19
15	Megha	F	EXP	122	118	92	80	19	13
16	Megha	F	CON	116	100	84	80	18	17
17	Rishu	F	EXP	104	115	68	70	20	16
18	Rishu	F	CON	108	102	70	70	18	20
19	Shubhashree	F	EXP	112	118	82	82	16	20
20	Shubhashree	F	CON	118	110	84	80	17	18
21	Purshothaman	M	EXP	122	114	90	86	22	17
22	Purshothaman	M	CON	118	124	90	94	20	19
23	Chaitanya	M	EXP	110	108	76	68	17	14
24	Chaitanya	M	CON	118	118	82	80	18	17
25	Vandana	F	EXP	116	108	76	70	25	18
26	Vandana	F	CON	108	110	82	78	24	18
27	Krishna	M	EXP	114	100	78	74	16	13
28	Krishna	M	CON	118	116	80	78	14	14
29	KRITIKA	F	EXP	88	98	72	72	14	12
30	KRITIKA	F	CON	110	108	70	65	13	12
31	BHAVYA	F	EXP	112	98	84	72	18	16
32	BHAVYA	F	CON	110	108	70	72	18	18
33	PRAKASH	M	EXP	140	130	90	90	16	13

34	PRAKASH	M	CON	140	138	90	90	15	15
35	SAGAR	M	EXP	128	124	94	80	23	20
36	SAGAR	M	CON	118	114	75	76	22	22
37	PARICHITI	F	EXP	118	108	82	68	24	19
38	PARICHITI	F	CON	116	116	86	84	24	24
39	PRITY	F	EXP	122	112	82	76	21	16
40	PRITY	F	CON	110	112	82	80	21	21
41	POOJA V	F	EXP	118	104	84	70	22	18
42	POOJA V	F	CON	110	110	80	80	22	21
43	KRUPA	F	EXP	118	110	78	76	13	10
44	KRUPA	F	CON	112	110	80	76	13	13
45	ANKIT	M	EXP	110	108	68	74	24	18
46	ANKIT	M	CON	120	118	74	72	23	23
47	hemal	F	EXP	122	112	84	72	22	18
48	hemal	F	CON	118	116	84	86	22	21
49	ARVIND	M	EXP	118	118	72	70	20	16
50	ARVIND	M	CON	100	110	76	74	20	19
51	ROOBA	F	EXP	102	96	74	70	16	13
52	ROOBA	F	CON	98	96	72	72	16	16
53	RIYANA	F	EXP	112	98	80	74	20	17
54	RIYANA	F	CON	112	110	74	72	20	20
55	ANUSHKA	F	EXP	100	90	74	72	22	18
56	ANUSHKA	F	CON	110	110	70	72	22	21
57	Kamal	M	EXP	120	110	82	74	20	16
58	Kamal	M	CON	118	110	80	70	20	19
59	Prahlad	M	EXP	122	110	84	72	24	19
60	Prahlad	M	CON	120	126	70	70	24	23
61	Meet C	M	EXP	120	112	78	72	18	15
62	Meet C	M	CON	122	110	74	72	17	17
63	Anuj P	M	EXP	122	110	74	70	22	18
64	Anuj P	M	CON	118	116	78	76	22	21
65	Dinesh	M	EXP	116	76	110	72	18	16
66	Dinesh	M	CON	120	118	82	80	18	18
67	Sabastian	M	EXP	118	106	82	106	20	17
68	Sabastian	M	CON	122	122	80	78	20	19
69	Sujit	M	EXP	120	112	78	72	24	20
70	Sujit	M	CON	116	118	76	78	24	23
71	Jagjeet	M	EXP	118	106	82	74	22	19
72	Jagjeet	M	CON	110	112	74	74	22	22

ID	NAME	GENDER	GROUP	FSS_PRE_Q1	FSS_PRE_Q2	FSS_PRE_Q3	FSS_PRE_Q4	FSS_PRE_Q5	FSS_PRE_Q6	FSS_PRE_Q7	FSS_PRE_Q8	FSS_PRE_Q9	FSS_PRE_SCORE	VAFS_PRE
1	Indu bala	F	EXP	1	2	2	3	4	5	3	2	2	24	6
2	Indu bala	F	CON	4	4	2	3	2	2	2	2	2	23	7
3	Shridhar	M	EXP	5	4	2	5	4	5	5	5	5	40	1
4	Shridhar	M	CON	5	4	4	5	3	5	5	5	5	41	6
5	Pooja K	F	EXP	3	3	3	4	2	4	3	2	3	27	5
6	Pooja K	F	CON	3	3	3	3	2	3	4	2	3	26	3
7	Jiban	F	EXP	5	2	1	2	2	3	3	1	2	21	2
8	Jiban	F	CON	3	2	1	3	2	3	4	2	2	22	8
9	Manjula	F	EXP	5	5	4	4	6	4	4	3	3	38	9
10	Manjula	F	CON	4	2	2	4	2	2	2	2	1	21	6
11	Davendra	M	EXP	3	2	5	5	4	4	5	3	4	35	4
12	Davendra	M	CON	5	2	4	5	4	3	3	4	2	32	5
13	Fu	F	EXP	1	3	5	3	1	5	2	3	2	25	4
14	Fu	F	CON	1	2	2	2	1	2	1	1	1	13	5
15	Megha	F	EXP	5	1	3	3	1	2	2	2	2	21	6
16	Megha	F	CON	2	2	3	3	3	3	3	3	3	25	5
17	Rishu	F	EXP	4	2	2	2	2	2	2	2	2	20	6
18	Rishu	F	CON	3	2	2	3	2	3	2	2	2	21	4
19	Shubhashree	F	EXP	2	2	2	2	3	3	3	4	2	23	4
20	Shubhashree	F	CON	2	6	6	5	6	6	6	5	6	48	4
21	Purshothaman	M	EXP	5	4	3	5	4	4	4	5	4	38	6
22	Purshothaman	M	CON	3	4	4	6	5	5	5	5	5	42	6
23	Chaitanya	M	EXP	5	4	3	4	3	3	4	2	3	31	4
24	Chaitanya	M	CON	5	4	3	3	3	3	4	2	3	30	5
25	Vandana	F	EXP	5	4	3	3	4	4	5	4	4	36	6
26	Vandana	F	CON	4	5	2	4	4	3	3	3	4	32	7
27	Krishna	M	EXP	6	5	5	6	5	5	5	5	4	46	2
28	Krishna	M	CON	6	5	5	5	5	6	5	4	3	44	3
29	KRITIKA	F	EXP	5	3	4	4	4	3	3	3	4	33	5
30	KRITIKA	F	CON	5	5	3	4	5	4	3	5	5	39	7
31	BHAVYA	F	EXP	3	4	4	3	4	3	4	4	3	32	5
32	BHAVYA	F	CON	3	3	4	4	4	4	3	4	4	33	5
33	PRAKASH	M	EXP	3	3	2	3	3	3	3	3	3	26	5
34	PRAKASH	M	CON	4	3	2	4	3	3	3	3	3	28	7

35	SAGAR	M	EXP	6	6	5	6	6	6	5	5	6	51	4
36	SAGAR	M	CON	5	4	4	5	6	5	5	4	6	44	4
37	PARICHITI	F	EXP	2	5	4	4	5	5	5	3	2	35	5
38	PARICHITI	F	CON	4	4	5	3	3	3	3	5	3	33	6
39	PRITY	F	EXP	4	4	3	5	5	5	6	6	5	43	5
40	PRITY	F	CON	3	4	4	4	4	4	4	5	3	35	6
41	POOJA V	F	EXP	5	5	4	4	4	3	4	2	3	34	2
42	POOJA V	F	CON	4	5	5	6	4	3	3	3	4	37	1
43	KRUPA	F	EXP	5	2	3	6	4	2	5	2	3	32	8
44	KRUPA	F	CON	5	4	3	5	3	5	5	2	4	36	10
45	ANKIT	M	EXP	6	2	3	5	3	4	5	3	4	35	2
46	ANKIT	M	CON	5	2	3	5	4	4	4	3	4	34	5
47	hemal	F	EXP	4	2	3	4	3	3	3	4	2	28	4
48	hemal	F	CON	5	4	2	3	5	4	4	5	3	35	2
49	ARVIND	M	EXP	4	1	2	3	2	3	1	1	2	19	3
50	ARVIND	M	CON	4	1	2	3	2	3	1	1	2	19	4
51	ROOBA	F	EXP	4	3	3	4	3	3	4	3	3	30	6
52	ROOBA	F	CON	4	3	2	4	4	4	5	4	4	34	7
53	RIYANA	F	EXP	3	3	2	3	2	2	2	2	3	22	4
54	RIYANA	F	CON	5	2	3	2	3	4	3	4	4	30	7
55	ANUSHKA	F	EXP	6	4	4	6	4	4	6	5	6	45	7
56	ANUSHKA	F	CON	7	6	5	7	3	6	6	4	5	49	7
57	Kamal	M	EXP	5	3	2	3	6	2	2	1	2	26	6
58	Kamal	M	CON	5	3	2	3	6	2	2	1	2	26	5
59	Prahlad	M	EXP	6	6	5	5	3	4	5	4	5	43	4
60	Prahlad	M	CON	6	6	5	5	3	4	5	4	5	43	4
61	Meet Chitalia	M	EXP	5	5	3	3	3	4	4	3	3	33	5
62	Meet Chitalia	M	CON	5	6	4	5	3	3	5	4	5	40	4
63	Anuj Poonia	M	EXP	1	2	1	2	2	4	6	4	2	24	5
64	Anuj Poonia	M	CON	1	2	1	2	2	4	6	4	2	24	5
65	Dinesh	M	EXP	4	3	1	6	2	2	2	4	1	25	6
66	Dinesh	M	CON	4	3	1	6	2	2	2	4	1	25	5
67	Sabastian B	M	EXP	7	4	4	7	4	7	2	4	7	46	5
68	Sabastian B	M	CON	6	4	4	5	4	4	6	4	6	43	5
69	Sujit	M	EXP	3	3	2	3	3	3	3	1	2	23	6
70	Sujit	M	CON	3	3	2	3	3	3	3	1	2	23	7
71	Jagjeet	M	EXP	6	5	4	3	4	4	4	1	3	34	5

72	Jagjeet	M	CON	6	5	3	4	4	3	5	2	5	37	6

ID	NAME	GENDER	GROUP	FSS_POST_Q1	FSS_POST_Q2	FSS_POST_Q3	FSS_POST_Q4	FSS_POST_Q5	FSS_POST_Q6	FSS_POST_Q7	FSS_POST_Q8	FSS_POST_Q9	FSS_POST_SCORE	VAFS_POST
1	Indu bala	F	EXP	5	4	3	5	4	5	4	5	6	41	8
2	Indu bala	F	CON	1	2	3	3	2	4	4	2	2	23	5
3	Shridhar	M	EXP	5	4	3	5	4	5	5	5	5	41	8
4	Shridhar	M	CON	5	5	4	5	4	5	5	5	5	43	7
5	Pooja K	F	EXP	2	3	2	4	3	4	2	3	3	26	9
6	Pooja K	F	CON	3	3	3	3	3	3	3	3	4	28	4
7	Jiban	F	EXP	3	2	1	2	1	2	2	1	2	16	8
8	Jiban	F	CON	3	2	1	3	1	3	3	2	3	21	8
9	Manjula	F	EXP	5	5	4	4	6	4	4	3	3	38	10
10	Manjula	F	CON	4	2	2	4	2	2	2	2	2	22	6
11	Davendra	M	EXP	2	2	4	2	3	3	2	2	2	22	8
12	Davendra	M	CON	5	2	4	4	5	4	3	4	2	33	5
13	Fu	F	EXP	2	4	4	3	2	3	2	2	2	24	9
14	Fu	F	CON	1	2	2	2	1	2	1	1	1	13	6
15	Megha	F	EXP	1	1	1	1	1	1	1	1	1	9	9
16	Megha	F	CON	3	2	3	3	3	3	3	3	3	26	5
17	Rishu	F	EXP	2	2	2	2	2	2	2	2	2	18	9
18	Rishu	F	CON	3	2	2	2	3	3	3	2	2	22	6
19	Shubhashree	F	EXP	2	2	3	2	1	1	1	2	2	16	8
20	Shubhashree	F	CON	5	5	6	6	6	5	6	6	6	51	4
21	Purshothaman	M	EXP	5	4	4	5	5	5	5	5	5	43	6
22	Purshothaman	M	CON	5	4	4	5	4	5	5	4	5	41	6
23	Chaitanya	M	EXP	5	4	3	4	3	3	4	2	3	31	10
24	Chaitanya	M	CON	5	4	3	4	3	3	3	2	3	30	6
25	Vandana	F	EXP	5	5	3	4	4	4	3	4	4	36	8
26	Vandana	F	CON	4	4	3	4	4	3	4	4	4	34	7
27	Krishna	M	EXP	6	5	5	6	5	5	5	5	4	46	8
28	Krishna	M	CON	5	6	5	5	5	5	5	5	4	45	3
29	KRITIKA	F	EXP	4	4	3	3	4	5	4	3	4	34	5
30	KRITIKA	F	CON	4	4	3	3	3	4	4	3	4	32	6
31	BHAVYA	F	EXP	3	4	4	3	4	3	4	4	3	32	8
32	BHAVYA	F	CON	3	3	4	4	4	4	3	4	4	33	5
33	PRAKASH	M	EXP	3	3	3	4	3	3	3	3	3	28	7

34	PRAKASH	M	CON	3	3	3	4	3	3	4	3	3	29	5
35	SAGAR	M	EXP	6	6	5	6	6	6	5	5	6	51	7
36	SAGAR	M	CON	5	4	4	5	6	5	5	4	6	44	4
37	PARICHITI	F	EXP	2	5	4	4	5	5	5	3	2	35	8
38	PARICHITI	F	CON	4	4	5	3	3	3	3	5	3	33	6
39	PRITY	F	EXP	4	5	5	4	4	4	4	4	4	38	5
40	PRITY	F	CON	4	4	5	5	5	5	5	4	4	41	5
41	POOJA V	F	EXP	5	5	4	4	4	3	4	2	3	34	7
42	POOJA V	F	CON	4	4	2	5	3	3	3	4	3	31	1
43	KRUPA	F	EXP	5	6	4	5	4	5	5	2	3	39	9
44	KRUPA	F	CON	5	5	5	5	4	5	5	3	4	41	10
45	ANKIT	M	EXP	5	2	3	5	4	4	4	3	4	34	7
46	ANKIT	M	CON	5	2	3	5	4	4	4	3	4	34	5
47	hemal	F	EXP	4	2	3	4	3	3	3	4	2	28	8
48	hemal	F	CON	5	4	4	4	6	5	6	4	4	42	2
49	ARVIND	M	EXP	1	1	1	1	1	1	1	1	1	9	10
50	ARVIND	M	CON	4	1	2	3	2	3	1	1	2	19	4
51	ROOBA	F	EXP	3	2	2	3	2	3	3	2	3	23	8
52	ROOBA	F	CON	5	4	3	4	3	4	3	3	4	33	7
53	RIYANA	F	EXP	3	3	3	3	2	2	3	2	2	23	8
54	RIYANA	F	CON	3	3	3	3	2	3	3	3	3	26	5
55	ANUSHKA	F	EXP	6	6	4	5	4	5	6	4	5	45	8
56	ANUSHKA	F	CON	6	5	4	6	4	5	6	6	6	48	7
57	Kamal	M	EXP	5	3	2	3	6	2	2	1	2	26	9
58	Kamal	M	CON	5	3	2	3	6	2	2	1	2	26	7
59	Prahlad	M	EXP	6	6	5	5	3	4	5	4	5	43	9
60	Prahlad	M	CON	6	6	5	5	3	4	5	4	5	43	5
61	Meet Chitalia	M	EXP	5	5	3	3	3	4	4	3	3	33	8
62	Meet Chitalia	M	CON	5	6	4	5	3	3	5	4	5	40	5
63	Anuj Poonia	M	EXP	1	2	1	2	2	4	6	4	2	24	9
64	Anuj Poonia	M	CON	1	2	1	2	2	4	6	4	2	24	7
65	Dinesh	M	EXP	4	3	1	6	2	2	2	4	1	25	9
66	Dinesh	M	CON	2	2	6	6	2	1	2	3	2	26	6
67	Sabastian B	M	EXP	7	4	4	7	4	7	2	4	7	46	7
68	Sabastian B	M	CON	6	4	3	4	4	4	6	4	6	41	5
69	Sujit	M	EXP	3	3	1	3	3	3	3	2	2	23	9
70	Sujit	M	CON	3	3	2	3	3	3	3	1	2	23	7

71	Jagjeet	M	EXP	6	5	4	4	3	3	5	2	5	37	9
72	Jagjeet	M	CON	6	5	3	4	4	3	5	2	5	37	7

ID	NAME	GENDER	GROUP	PSS_Q1	PSS_Q2	PSS_Q3	PSS_Q4	PSS_Q5	PSS_Q6	PSS_Q7	PSS_Q8	PSS_Q9	PSS_Q10	PSS_SCORE
1	Indu bala	F	EXP	3	2	1	3	3	2	3	0	1	2	20
2	Indu bala	F	CON											
3	Shridhar	M	EXP	2	3	2	3	3	3	3	3	2	1	25
4	Shridhar	M	CON											
5	Pooja K	F	EXP	1	1	1	3	3	1	2	3	2	1	18
6	Pooja K	F	CON											
7	Jiban	F	EXP	4	2	3	2	1	3	2	0	1	2	20
8	Jiban	F	CON											
9	Manjula	F	EXP	4	3	4	2	4	3	3	3	3	3	32
10	Manjula	F	CON											
11	Davendra	M	EXP	1	1	1	3	3	1	2	2	2	3	19
12	Davendra	M	CON											
13	Fu	F	EXP	0	0	2	4	3	1	3	1	1	1	16
14	Fu	F	CON											
15	Megha	F	EXP	4	0	0	4	2	1	2	1	3	0	17
16	Megha	F	CON											
17	Rishu	F	EXP	3	2	3	2	1	1	1	2	1	1	17
18	Rishu	F	CON											
19	Shubhashree	F	EXP	2	0	1	2	3	1	3	1	1	1	15
20	Shubhashree	F	CON											
21	Purshothaman	M	EXP	2	2	2	2	2	2	2	2	2	2	20
22	Purshothaman	M	CON											
23	Chaitanya	M	EXP	2	2	2	3	2	2	3	2	3	1	22
24	Chaitanya	M	CON											
25	Vandana	F	EXP	4	2	3	3	2	1	3	3	4	2	27
26	Vandana	F	CON											
27	Krishna	M	EXP	2	2	2	3	3	2	3	3	2	2	24
28	Krishna	M	CON											
29	KRITIKA	F	EXP	3	1	2	3	2	2	3	3	2	3	24
30	KRITIKA	F	CON											
31	BHAVYA	F	EXP	2	2	0	2	2	2	1	1	2	2	16
32	BHAVYA	F	CON											
33	PRAKASH	M	EXP	2	1	2	3	2	2	3	1	2	2	20
34	PRAKASH	M	CON											

35	SAGAR	M	EXP	3	3	4	3	3	4	2	3	4	4	33
36	SAGAR	M	CON											
37	PARICHITI	F	EXP	2	3	2	3	2	2	2	2	3	1	22
38	PARICHITI	F	CON											
39	PRITY	F	EXP	4	3	4	2	0	2	4	2	4	3	28
40	PRITY	F	CON											
41	POOJA V	F	EXP	2	3	2	3	2	1	3	1	2	2	21
42	POOJA V	F	CON											
43	KRUPA	F	EXP	2	2	2	4	3	1	3	3	2	0	22
44	KRUPA	F	CON											
45	ANKIT	M	EXP	3	2	2	2	2	2	2	2	2	2	21
46	ANKIT	M	CON											
47	hemal	F	EXP	3	2	3	2	2	2	3	2	4	3	26
48	hemal	F	CON											
49	ARVIND	M	EXP	0	0	1	4	4	1	4	4	1	0	19
50	ARVIND	M	CON											
51	ROOBA	F	EXP	3	2	1	3	1	1	3	2	2	1	19
52	ROOBA	F	CON											
53	RIYANA	F	EXP	1	2	1	3	3	1	3	2	2	2	20
54	RIYANA	F	CON											
55	ANUSHKA	F	EXP	2	2	3	3	1	3	2	1	3	0	20
56	ANUSHKA	F	CON											
57	Kamal	M	EXP	3	2	2	4	2	2	1	1	1	1	19
58	Kamal	M	CON											
59	Prahlad	M	EXP	2	1	2	3	3	1	3	3	2	1	21
60	Prahlad	M	CON											
61	Meet Chitalia	M	EXP	1	2	0	3	2	2	2	2	2	1	17
62	Meet Chitalia	M	CON											
63	Anuj Poonia	M	EXP	0	0	0	4	3	1	3	3	1	0	15
64	Anuj Poonia	M	CON											
65	Dinesh	M	EXP	2	1	0	3	4	2	3	0	1	1	17
66	Dinesh	M	CON											
67	Sabastian B	M	EXP	2	2	2	3	3	1	3	3	3	2	24
68	Sabastian B	M	CON											
69	Sujit	M	EXP	4	4	2	4	2	1	3	2	1	2	25
70	Sujit	M	CON											
71	Jagjeet	M	EXP	3	4	3	3	2	2	2	1	3	3	26

72	Jagjeet	M	CON											

ID	NAME	GENDER	GROUP	PRE_HR	PRE_RMSSD	PRE_NNxx(beats)	PRE_pNNxx(%)	PRE_LF	PRE_HF	PRE_LF/HF	PRE_SampEn
1	Indu bala	F	EXP	66.9035	64.768	158	47.4474	49.9315	50.0056	0.9985	2.0919
2	Indu bala	F	CON	75.4493	44.6474	87	23.1383	51.0082	48.8656	1.0438	1.9424
3	Shridhar	M	EXP	91.902	21.9707	15	3.2751	72.5632	27.3806	2.6502	1.462
4	Shridhar	M	CON	77.5556	42.5631	98	25.3886	42.1356	57.8082	0.7289	1.6996
5	Pooja K	F	EXP	74.7086	48.8509	97	26.0753	34.9731	64.966	0.5383	1.7836
6	Pooja K	F	CON	74.0217	61.3912	163	44.1734	50.195	49.6985	1.01	1.9455
7	Jiban	F	EXP	75.6272	31.543	30	7.9576	53.1754	46.788	1.1365	1.7323
8	Jiban	F	CON	69.1374	46.0349	84	24.4186	78.4886	21.4918	3.652	1.6779
9	Manjula	F	EXP	75.8281	48.0136	123	32.5397	26.558	73.2672	0.3625	1.8221
10	Manjula	F	CON	75.9433	54.9578	127	33.5979	33.6007	66.0912	0.5084	2.0153
11	Davendra	M	EXP	58.1452	91.2042	173	59.8616	21.8179	78.0119	0.2797	1.7819
12	Davendra	M	CON	60.0855	108.5852	218	72.9097	33.442	66.2231	0.505	2.0634
13	Fu	F	EXP	62.662	92.7037	149	47.7564	40.5598	59.4167	0.6826	1.3527
14	Fu	F	CON	73.6306	63.8087	136	37.7778	23.405	76.5222	0.3059	1.4253
15	Megha	F	EXP	77.4883	28.0503	28	7.2539	89.1632	10.8323	8.2312	1.3536
16	Megha	F	CON	64.8956	51.9506	106	32.8173	60.3296	39.5244	1.5264	1.9105
17	Rishu	F	EXP	69.6553	29.1401	26	7.4928	57.9528	42.0363	1.3786	1.8798
18	Rishu	F	CON	71.8625	44.2148	67	18.7151	55.8693	44.1166	1.2664	1.5786
19	Shubhashree	F	EXP	75.9816	70.064	212	56.0847	28.4425	70.8262	0.4016	1.9584
20	Shubhashree	F	CON	75.9816	70.064	212	56.0847	28.4425	70.8262	0.4016	1.9584
21	Purshothaman	M	EXP	68.2842	79.4441	208	61.1765	37.7787	61.9556	0.6098	2.1322
22	Purshothaman	M	CON	68.2842	79.4441	208	61.1765	37.7787	61.9556	0.6098	2.1322
23	Chaitanya	M	EXP	67.3198	28.1727	17	5.0746	54.6391	45.3132	1.2058	1.4159
24	Chaitanya	M	CON	79.8508	24.6648	12	3.0151	69.3031	30.6936	2.2579	1.3835
25	Vandana	F	EXP	67.4499	55.0194	152	45.2381	22.1645	77.7308	0.2851	1.6467
26	Vandana	F	CON	64.683	53.4754	138	42.8571	41.9315	57.5835	0.7282	1.4855
27	Krishna	M	EXP	79.7366	22.5814	18	4.534	52.0066	47.9781	1.084	1.707
28	Krishna	M	CON	85.244	10.2565	0	0	75.0825	24.9141	3.0137	1.6191
29	KRITIKA	F	EXP	74.4223	51.6886	134	36.1186	27.1688	72.6633	0.3739	1.8697
30	KRITIKA	F	CON	74.4223	51.6886	134	36.1186	27.1688	72.6633	0.3739	1.8697
31	BHAVYA	F	EXP	85.2685	34.6616	48	11.2941	34.3892	64.8967	0.5299	1.5649
32	BHAVYA	F	CON	80.1764	53.9475	150	37.594	28.9688	70.8405	0.4089	1.8813
33	PRAKASH	M	EXP	67.4346	83.4505	181	53.869	48.2091	51.1962	0.9417	1.9116

34	PRAKASH	M	CON	59.8413	117.4561	176	66.9202	52.7014	47.2595	1.1151	1.86
35	SAGAR	M	EXP	73.7416	18.9504	7	1.9074	75.1161	24.821	3.0263	1.6937
36	SAGAR	M	CON	72.293	18.0648	3	0.8333	66.3641	33.611	1.9745	1.574
37	PARICHITI	F	EXP	69.0062	57.4305	96	27.907	29.5793	70.3503	0.4205	1.5974
38	PARICHITI	F	CON	79.0398	29.1959	33	8.3756	28.4269	71.4912	0.3976	1.9718
39	PRITY	F	EXP	73.6722	72.0759	234	65.5462	23.5611	75.4643	0.3122	1.9547
40	PRITY	F	CON	73.9343	68.3991	212	57.6087	27.3616	71.8523	0.3808	1.9582
41	POOJA V	F	EXP	74.7288	42.3565	106	28.4946	18.2243	78.9263	0.2309	2.0357
42	POOJA V	F	CON	82.1317	28.7613	29	7.0905	29.9974	69.8015	0.4298	1.9371
43	KRUPA	F	EXP	57.9172	82.7654	158	54.8611	40.7886	59.1838	0.6892	1.8599
44	KRUPA	F	CON	70.3797	48.4168	92	26.2857	57.7156	42.2562	1.3658	1.7199
45	ANKIT	M	EXP	65.6814	62.67	152	46.4832	25.6962	74.176	0.3464	1.7565
46	ANKIT	M	CON	87.7468	26.7823	27	6.1785	27.6859	72.2721	0.3831	1.7969
47	hemal	F	EXP	71.3148	74.7709	186	52.3944	26.8676	72.9589	0.3683	1.7825
48	hemal	F	CON	67.2477	91.43	186	55.5224	8.2713	91.6926	0.0902	1.3483
49	ARVIND	M	EXP	69.7067	45.2276	105	30.2594	21.5515	78.3553	0.275	1.9602
50	ARVIND	M	CON	69.7067	45.2276	105	30.2594	21.5515	78.3553	0.275	1.9602
51	ROOBA	F	EXP	78.6542	56.5541	132	34.0206	43.5493	56.3718	0.7725	1.8342
52	ROOBA	F	CON	79.684	68.3352	164	41.7303	51.6416	48.2714	1.0698	1.6911
53	RIYANA	F	EXP	64.3749	75.5184	188	59.306	9.2016	90.7409	0.1014	1.7096
54	RIYANA	F	CON	91.4616	15.8866	0	0	58.8652	40.9583	1.4372	2.021
55	ANUSHKA	F	EXP	56.198	58.5179	97	34.767	55.5105	44.4327	1.2493	1.8835
56	ANUSHKA	F	CON	61.6747	46.4504	76	25	30.8522	69.0941	0.4465	1.692
57	Kamal	M	EXP	64.0583	62.0683	129	40.4389	36.4799	63.5082	0.5744	1.6968
58	Kamal	M	CON	59.0083	85.1387	177	60.2041	25.1647	74.6611	0.3371	1.7794
59	Prahlad	M	EXP	71.3453	62.0271	110	30.9859	56.8491	43.0274	1.3212	1.8458
60	Prahlad	M	CON	67.4886	42.867	71	21.131	67.9026	31.969	2.124	1.7096
61	Meet Chitalia	M	EXP	75.0523	11.7787	0	0	42.1248	57.868	0.7279	1.8162
62	Meet Chitalia	M	CON	86.9501	9.1717	0	0	68.7953	31.1581	2.2079	1.576
63	Anuj Poonia	M	EXP	65.1259	51.2587	24	29.6296	55.4514	44.3254	1.251	1.9805
64	Anuj Poonia	M	CON	66.4289	60.1122	34	40	28.7818	69.5151	0.414	2.0713
65	Dinesh	M	EXP	65.3835	58.0744	107	32.9231	29.9293	70.0315	0.4274	1.5762
66	Dinesh	M	CON	65.4225	54.664	104	31.9018	30.3889	69.5825	0.4367	1.6343
67	Sabastian B	M	EXP	64.5409	39.5281	57	17.757	37.9036	61.2352	0.619	1.9134
68	Sabastian B	M	CON	58.4082	41.7386	71	24.3986	77.9157	21.7967	3.5747	2.1698
69	Sujit	M	EXP	76.5784	29.8049	17	4.4619	86.4556	13.4643	6.4211	1.5553
70	Sujit	M	CON	77.0437	26.8205	27	7.0313	65.6494	33.0598	1.9858	1.7502

71	Jagjeet	M	EXP	57.8353	53.5363	113	39.2361	59.282	40.683	1.4572	1.9824
72	Jagjeet	M	CON	58.1364	37.212	48	16.609	57.3545	42.5386	1.3483	2.1659

ID	NAME	GENDER	GROUP	POST_HR	POST_RMSSD	POST_NNxx(beats)	POST_pNNxx(%)	POST_LF	POST_HF	POST_LF/HF	POST_SampEn
1	Indu bala	F	EXP	65.2154	83.7645	210	64.6154	41.1715	58.6983	0.7014	1.8716
2	Indu bala	F	CON	74.6391	49.3706	95	25.5376	42.3364	57.5071	0.7362	1.7987
3	Shridhar	M	EXP	83.607	36.9705	56	13.4293	59.4755	40.4946	1.4687	1.603
4	Shridhar	M	CON	73.342	51.1812	117	32.0548	41.2156	58.6969	0.7022	1.9859
5	Pooja K	F	EXP	68.5021	53.1792	131	38.4164	37.8261	62.1535	0.6086	2.037
6	Pooja K	F	CON	62.7781	37.9895	54	17.3077	41.1771	58.7525	0.7009	2.1353
7	Jiban	F	EXP	69.169	44.1783	76	22.093	55.128	44.8459	1.2293	1.8343
8	Jiban	F	CON	70.4167	38.6692	55	15.6695	43.6552	56.1357	0.7777	1.9143
9	Manjula	F	EXP	71.013	80.1342	196	55.3672	41.3668	58.6036	0.7059	1.8542
10	Manjula	F	CON	76.1132	61.9717	147	38.7863	37.5845	62.2338	0.6039	1.807
11	Davendra	M	EXP	53.0741	76.0522	82	36.4444	30.7987	68.958	0.4466	1.8279
12	Davendra	M	CON	71.7691	73.0257	216	60.5042	39.6419	60.2568	0.6579	2.2323
13	Fu	F	EXP	57.8538	83.419	178	61.8056	10.743	89.228	0.1204	1.5964
14	Fu	F	CON	71.2138	67.729	150	42.2535	64.5881	35.3728	1.8259	1.3467
15	Megha	F	EXP	73.8559	27.4818	23	6.25	91.8751	8.111	11.3273	1.2945
16	Megha	F	CON	62.5367	43.9492	68	21.865	88.6153	11.3642	7.7978	1.2497
17	Rishu	F	EXP	76.3787	30.6112	20	5.2632	33.4745	66.15	0.506	1.6654
18	Rishu	F	CON	66.1915	42.6037	71	21.5805	65.8384	34.1313	1.929	1.7002
19	Shubhashree	F	EXP	71.9071	77.4097	237	66.2011	14.3201	85.4634	0.1676	1.75
20	Shubhashree	F	CON	71.9071	77.4097	237	66.2011	14.3201	85.4634	0.1676	1.75
21	Purshothaman	M	EXP	70.252	76.9882	228	65.1429	40.168	59.6606	0.6733	1.933
22	Purshothaman	M	CON	62.5947	95.8133	228	73.3119	41.6751	58.1422	0.7168	2.0684
23	Chaitanya	M	EXP	63.4895	34.4969	24	7.5949	85.6835	14.3131	5.9864	1.19
24	Chaitanya	M	CON	70.0719	27.4913	31	8.8825	44.4398	55.5083	0.8006	1.8661
25	Vandana	F	EXP	65.5674	60.4806	106	32.5153	53.1512	46.7391	1.1372	1.6095
26	Vandana	F	CON	63.7541	55.7374	116	36.5931	48.8303	51.07	0.9561	1.3662
27	Krishna	M	EXP	78.6999	16.1595	1	0.2551	61.165	38.8162	1.5758	1.7117
28	Krishna	M	CON	76.9367	33.2999	61	15.9269	66.9331	32.8958	2.0347	1.5865
29	KRITIKA	F	EXP	67.8362	62.9328	130	38.4615	48.4521	51.4908	0.941	1.9006
30	KRITIKA	F	CON	74.6822	54.3253	140	37.6344	21.853	78.063	0.2799	1.8581
31	BHAVYA	F	EXP	77.6443	44.1808	91	23.5142	38.0267	61.8976	0.6143	1.7279
32	BHAVYA	F	CON	75.9707	67.5257	198	52.381	25.2796	74.4746	0.3394	1.8412

33	PRAKASH	M	EXP	63.1925	100.2039	195	62.1019	49.3547	50.4709	0.9779	1.9644
34	PRAKASH	M	CON	59.8413	117.4561	176	66.9202	52.7014	47.2595	1.1151	1.86
35	SAGAR	M	EXP	67.6792	22.9757	12	3.5608	85.8351	14.1548	6.064	1.6534
36	SAGAR	M	CON	69.8142	17.4776	2	0.5747	73.1598	26.7881	2.7311	1.8547
37	PARICHITI	F	EXP	63.9131	37.4894	57	17.9245	27.7806	71.1527	0.3904	1.8399
38	PARICHITI	F	CON	69.9836	43.6512	87	25	60.1481	39.3385	1.529	1.866
39	PRITY	F	EXP	69.5175	107.7795	227	67.3591	48.0292	51.2404	0.9373	2.0424
40	PRITY	F	CON	71.7691	73.0257	216	60.5042	39.6419	60.2568	0.6579	2.2323
41	POOJA V	F	EXP	73.6459	42.1761	98	26.703	28.4556	71.5197	0.3979	1.7798
42	POOJA V	F	CON	76.8156	42.8457	90	23.4987	54.6564	43.4633	1.2575	1.7738
43	KRUPA	F	EXP	55.0035	91.8917	188	68.6131	24.4824	75.4942	0.3243	1.924
44	KRUPA	F	CON	69.1725	49.3326	95	27.6163	50.7778	49.1736	1.0326	1.6666
45	ANKIT	M	EXP	59.3218	65.8581	165	55.9322	18.5816	81.2374	0.2287	1.6756
46	ANKIT	M	CON	82.1761	44.3095	99	24.2054	21.7868	78.2049	0.2786	1.4215
47	hemal	F	EXP	66.1186	112.114	247	75.076	18.2301	81.4987	0.2237	1.891
48	hemal	F	CON	63.1552	116.8645	235	74.8408	35.3223	63.9861	0.552	2.0379
49	ARVIND	M	EXP	60.8347	54.5225	127	41.9142	44.1865	55.7436	0.7927	1.9506
50	ARVIND	M	CON	69.8319	43.7946	88	25.2874	33.5907	66.3083	0.5066	2.0819
51	ROOBA	F	EXP	78.6542	56.5541	132	34.0206	43.5493	56.3718	0.7725	1.8342
52	ROOBA	F	CON	77.1437	67.7942	157	41.3158	23.7072	76.0061	0.3119	1.7635
53	RIYANA	F	EXP	62.8003	67.5035	181	58.5761	7.3007	92.6217	0.0788	1.5697
54	RIYANA	F	CON	84.1623	28.1988	28	6.747	39.4723	60.4466	0.653	1.7627
55	ANUSHKA	F	EXP	55.1325	56.1479	129	47.0803	15.7263	84.2699	0.1866	1.627
56	ANUSHKA	F	CON	62.7781	37.9895	54	17.3077	41.1771	58.7525	0.7009	2.1353
57	Kamal	M	EXP	56.2593	66.956	154	55	22.917	77.0775	0.2973	1.8158
58	Kamal	M	CON	60.1554	94.4233	145	48.495	60.8249	39.121	1.5548	1.2012
59	Prahlad	M	EXP	69.2023	66.2266	138	40	46.3706	53.3571	0.8691	1.9218
60	Prahlad	M	CON	55.5879	54.1836	102	36.9565	70.3717	29.5747	2.3795	2.1265
61	Meet Chitalia	M	EXP	72.4732	16.6308	0	0	75.2698	24.7179	3.0451	1.6821
62	Meet Chitalia	M	CON	80.336	10.6358	0	0	65.9125	34.0842	1.9338	1.6425
63	Anuj Poonia	M	EXP	66.598	82.0532	191	57.7039	33.7205	66.0694	0.5104	2.1378
64	Anuj Poonia	M	CON	70.1155	63.0526	162	46.4183	39.448	60.3082	0.6541	2.128
65	Dinesh	M	EXP	61.5592	62.8797	125	40.8497	52.3997	47.5106	1.1029	1.5469
66	Dinesh	M	CON	62.2926	72.1326	149	48.0645	44.4696	55.3488	0.8034	1.6638
67	Sabastian B	M	EXP	58.4733	72.3251	161	55.3265	64.8992	34.973	1.8557	1.7733
68	Sabastian B	M	CON	55.5879	54.1836	102	36.9565	70.3717	29.5747	2.3795	2.1265
69	Sujit	M	EXP	74.5068	27.1311	18	4.8518	71.354	28.5154	2.5023	1.4486

70	**Sujit**	**M**	**CON**	**71.082**	**27.5567**	**17**	**4.8023**	**75.2277**	**24.7701**	**3.037**	**1.6504**
71	**Jagjeet**	**M**	**EXP**	**54.5382**	**47.4759**	**90**	**33.2103**	**50.36**	**49.6287**	**1.0147**	**1.7884**
72	**Jagjeet**	**M**	**CON**	**56.2835**	**38.55**	**51**	**18.2143**	**61.2853**	**38.6529**	**1.5855**	**1.9028**

11.5 R Codes

BLOOD PRESSURE

```
########within group##########

describe(RS)

describeBy(RS,RS$GENDER)

describeBy(RS,RS$GROUP)

male <- subset(RS,RS$GENDER=="M")

female <- subset(RS,RS$GENDER=="F")

con <- subset(RS,RS$GROUP=="CON")

exp <- subset(RS,RS$GROUP=="EXP")

######WITHIN GROUP#########

exp$diffsysbp<-exp$BP_SYS_POST-exp$BP_SYS_PRE

shapiro.test(exp$diffsysbp) ####Nnd#

exp$diffdiabp<-exp$BP_DIA_POST-exp$BP_DIA_PRE

shapiro.test(exp$diffdiabp)#nnd#

con$diffsysbp<-con$BP_SYS_POST-con$BP_SYS_PRE

con$diffDIAbp<-con$BP_DIA_POST-con$BP_DIA_PRE

shapiro.test(con$diffsysbp)#ND

shapiro.test(con$diffDIAbp)#NND

wilcox.test(exp$BP_SYS_POST,exp$BP_SYS_PRE,paired = TRUE) #  s change

wilcox.test(exp$BP_DIA_POST,exp$BP_DIA_PRE,paired = TRUE) # s change

wilcox.test(con$BP_SYS_POST,con$BP_SYS_PRE,paired = TRUE) # change
```

wilcox.test(conBP_DIA_POST,conBP_DIA_PRE,paired = TRUE) # no change

########between group#################

shapiro.test(con$BP_SYS_PRE) #NND

shapiro.test(exp$BP_SYS_PRE)#NND wil

leveneTest(RSBP_SYS_PRE,RSGROUP)#ND

wilcox.test(RS$BP_SYS_PRE~RS$GROUP)# baseline same

shapiro.test(con$BP_SYS_POST) #ND

shapiro.test(exp$BP_SYS_POST) #ND tt

leveneTest(RSBP_SYS_POST,RSGROUP)#ND tt

t.test(RS$BP_SYS_POST~RS$GROUP,var.equal = FALSE) # S change

shapiro.test(con$BP_DIA_PRE) #ND

shapiro.test(exp$BP_DIA_PRE) #ND

leveneTest(RSBP_DIA_PRE,RSGROUP)#ND

t.test(RS$BP_DIA_PRE~RS$GROUP,var.equal = FALSE)# no change

shapiro.test(con$BP_DIA_POST) #ND

shapiro.test(exp$BP_DIA_POST) #NND

leveneTest(RSBP_DIA_POST,RSGROUP)# ND

wilcox.test(RS$BP_DIA_POST~RS$GROUP)# No change

RESPIRATION RATE

######WITHIN GROUP#########

exp$diffRR<-exp$RR_POST-exp$RR_PRE

shapiro.test(exp$diffsysbp) ####Nnd#

wilcox.test(expRR_POST,expRR_PRE,paired = TRUE)# s change p-value = 8.977e-07

con$diffRR<-con$RR_POST-con$RR_PRE

shapiro.test(con$diffsysbp) ####Nd#

t.test(conRR_POST,conRR_PRE,paired = TRUE) # S change p-value = 0.01393

#####BETWEEN GROUP##############

shapiro.test(con$RR_PRE) #ND

shapiro.test(exp$RR_PRE)#ND

leveneTest(RSRR_PRE,RSGROUP)#ND

t.test(RS$RR_PRE~RS$GROUP,var.equal = FALSE) #p-value = 0.5152

shapiro.test(con$RR_POST) #ND

shapiro.test(exp$RR_POST)#ND

leveneTest(RSRR_POST,RSGROUP)# ND

t.test(RS$RR_POST~RS$GROUP,var.equal = FALSE) #p-value = 0.0002023

FATIGUE SEVIARITY SCALE

######WITHIN GROUP#########

exp$diffFSS<-exp$FSS_POST_SCORE-exp$FSS_PRE_SCORE

shapiro.test(exp$diffFSS) #NND

wilcox.test(expFSS_POST_SCORE,expFSS_PRE_SCORE,paired = TRUE) #p-value = 0.3421

con$diffFSS<-con$FSS_POST_SCORE-con$FSS_PRE_SCORE

shapiro.test(con$diffFSS) #NND

wilcox.test(conFSS_POST_SCORE,conFSS_PRE_SCORE,paired = TRUE) ## p-value = 0.3146

#####BETWEEN GROUP##############

shapiro.test(con$FSS_PRE_SCORE) #ND

shapiro.test(exp$FSS_PRE_SCORE) #ND

leveneTest(RSFSS_PRE_SCORE,RSGROUP) #ND

t.test(RS$FSS_PRE_SCORE~RS$GROUP,var.equal = FALSE) # p-value = 0.7555

shapiro.test(con$FSS_POST_SCORE) #ND

shapiro.test(exp$FSS_POST_SCORE)#ND

leveneTest(RSFSS_POST_SCORE,RSGROUP)

t.test(RS$FSS_POST_SCORE~RS$GROUP,var.equal = FALSE) # p-value = 0.4681

VISUAL ANALOG FATIGUE SCALE

######WITHIN GROUP#########

exp$diffvafs<-exp$VAFS_POST-exp$VAFS_PRE

shapiro.test(exp$diffvafs) #NND

wilcox.test(exp$VAFS_POST,exp$VAFS_PRE,paired = TRUE) # p-value = 5.045e-07

con$diffvafs<-con$VAFS_POST-con$VAFS_PRE #NND

shapiro.test(con$diffvafs) ####NNd#

wilcox.test(con$VAFS_POST,con$VAFS_PRE,paired = TRUE) ## p-value = 0.3917

#####BETWEEN GROUP##############

shapiro.test(con$VAFS_PRE) #ND

shapiro.test(exp$VAFS_PRE)#ND

leveneTest(RS$VAFS_PRE,RS$GROUP) #ND

t.test(RS$VAFS_PRE~RS$GROUP,var.equal = FALSE) # p-value = 0.1541

shapiro.test(con$VAFS_POST) #ND

shapiro.test(exp$VAFS_POST) #NND

leveneTest(RS$VAFS_POST,RS$GROUP) #ND

wilcox.test(RS$VAFS_POST~RS$GROUP,var.equal = FALSE) # p-value = 2.375e-09

HEART RATE

######WITHIN GROUP#########

exp$diffhr<-exp$POST_HR-exp$PRE_HR

shapiro.test(exp$diffhr) #ND

t.test(exp$POST_HR,exp$PRE_HR,paired = TRUE) #p-value = 5.818e-08

con$diffhr<-con$POST_HR-con$PRE_HR

shapiro.test(con$diffhr) ####Nd# # p-value = 0.1039

t.test(exp$POST_HR,exp$PRE_HR,paired = TRUE) p-value = 5.818e-08

#####BETWEEN GROUP##############

shapiro.test(con$PRE_HR) #ND p-value = 0.6096

shapiro.test(exp$PRE_HR) #ND

leveneTest(RSPRE_HR,RSGROUP) #ND

t.test(RS$PRE_HR~RS$GROUP,var.equal = FALSE) = p-value = 0.3094

shapiro.test(con$POST_HR)

shapiro.test(exp$POST_HR) #ND

leveneTest(RS$POST_HR,RS$GROUP) #ND

t.test(RS$POST_HR~RS$GROUP,var.equal = FALSE) ##p-value = 0.1667

RMMSD

######WITHIN GROUP#########

exp$diffRmssd<-exp$POST_RMSSD-exp$PRE_RMSSD

shapiro.test(exp$diffRmssd) ####Nnd#

wilcox.test(exp$POST_RMSSD,exp$PRE_RMSSD,paired = TRUE) # p-value = 0.006079

con$diffRmssd<-con$POST_RMSSD-con$PRE_RMSSD

shapiro.test(con$diffRmssd) ####NNd#

wilcox.test(con$POST_RMSSD,con$PRE_RMSSD,paired = TRUE) ##p-value = 0.004722

#####BETWEEN GROUP##############

shapiro.test(con$PRE_RMSSD) #ND

shapiro.test(exp$PRE_RMSSD)#ND

leveneTest(RSPRE_RMSSD,RSGROUP)#ND

t.test(RS$PRE_RMSSD~RS$GROUP,var.equal = FALSE) # p-value = 0.7146

shapiro.test(con$POST_RMSSD) #ND

shapiro.test(exp$POST_RMSSD)#ND

leveneTest(RS$POST_RMSSD,RS$GROUP)# ND

t.test(RS$POST_RMSSD~RS$GROUP,var.equal = FALSE) #p-value = 0.4213

NNXX BEATS

######WITHIN GROUP#########

exp$diffnnxx<-exp$`POST_NNxx(beats)`-exp$`PRE_NNxx(beats)`

shapiro.test(exp$diffnnxx) ####Nnd#

wilcox.test(exp$`POST_NNxx(beats)`,exp$`PRE_NNxx(beats)`,paired = TRUE) # p-value = 0.00935

con$diffnnxx<-con$`POST_NNxx(beats)`-con$`PRE_NNxx(beats)`

shapiro.test(con$diffnnxx) ####Nd#

t.test(con$`POST_NNxx(beats)`,con$`PRE_NNxx(beats)`,paired = TRUE) # p-value = 0.05797

#####BETWEEN GROUP##############

shapiro.test(con$`PRE_NNxx(beats)`) #ND

shapiro.test(exp$`PRE_NNxx(beats)`)#ND

leveneTest(RS$`PRE_NNxx(beats)`,RS$GROUP)#ND

t.test(RS$`PRE_NNxx(beats)`~RS$GROUP,var.equal = FALSE) # p-value = 0.7138

shapiro.test(con$`POST_NNxx(beats)`) #ND

shapiro.test(exp$`POST_NNxx(beats)`)#ND

leveneTest(RS$`POST_NNxx(beats)`,RS$GROUP)# ND

t.test(RS$`POST_NNxx(beats)`~RS$GROUP,var.equal = FALSE) # p-value = 0.5204

PNXX %

######WITHIN GROUP#########

exp$diffpnnxx<-exp$`POST_pNNxx(%)`-exp$`PRE_pNNxx(%)`

shapiro.test(exp$diffpnnxx) ####Nd#

t.test(exp$`POST_pNNxx(%)`,exp$`PRE_pNNxx(%)`,paired = TRUE) # p-value = 0.001624

con$diffpnnxx<-con$`POST_pNNxx(%)`-con$`PRE_pNNxx(%)`

shapiro.test(con$diffpnnxx) ####Nd#

t.test(con$`POST_pNNxx(%)`,con$`PRE_pNNxx(%)`,paired = TRUE) # p-value = 0.05617

#####BETWEEN GROUP##############

shapiro.test(con$`PRE_pNNxx(%)`) #ND

shapiro.test(exp$`PRE_pNNxx(%)`) #NND

leveneTest(RS$`PRE_pNNxx(%)`,RS$GROUP) #ND

wilcox.test(RS$`PRE_pNNxx(%)`~RS$GROUP,var.equal = FALSE) #p-value = 0.5581

shapiro.test(con$`POST_pNNxx(%)`) #ND

shapiro.test(exp$`POST_pNNxx(%)`) #NND

leveneTest(RS$`POST_pNNxx(%)`,RS$GROUP) # ND

wilcox.test(RS$`POST_pNNxx(%)`~RS$GROUP,var.equal = FALSE) #p-value = 0.3081

LOW FREQUENCY

######WITHIN GROUP#########

exp$difflf<-exp$POST_LF-exp$PRE_LF

shapiro.test(exp$difflf) ####Nd#

t.test(exp$POST_LF,exp$PRE_LF,paired = TRUE) # p-value = 0.6734

con$difflf<-con$POST_LF-con$PRE_LF

shapiro.test(con$difflf) ####Nd#

t.test(con$POST_LF,con$PRE_LF,paired = TRUE) # p-value = 0.2479

#####BETWEEN GROUP##############

shapiro.test(con$PRE_LF) #NnD

shapiro.test(exp$PRE_LF) #ND

leveneTest(RSPRE_LF,RSGROUP) #ND

wilcox.test(RS$PRE_LF~RS$GROUP,var.equal = FALSE) # p-value = 0.4338

shapiro.test(con$POST_LF) #ND

shapiro.test(exp$POST_LF) #ND

leveneTest(RS$POST_LF,RS$GROUP) # ND

t.test(RS$POST_LF~RS$GROUP,var.equal = FALSE) #p-value = 0.3067

HIGH FREQUENCY

######WITHIN GROUP#########

exp$diffHF<-exp$POST_HF-exp$PRE_HF

shapiro.test(exp$diffHF) ####Nd#

t.test(exp$POST_HF,exp$PRE_HF,paired = TRUE) # p-value = 0.6994

con$diffHF<-con$POST_HF-con$PRE_HF

shapiro.test(con$diffHF) ####Nd#

t.test(con$POST_HF,con$PRE_HF,paired = TRUE) #p-value = 0.257

#####BETWEEN GROUP##############

shapiro.test(con$PRE_HF) #NnD

shapiro.test(exp$PRE_HF) #ND

leveneTest(RSPRE_HF,RSGROUP) #ND

wilcox.test(RS$PRE_HF~RS$GROUP,var.equal = FALSE) #p-value = 0.4207

shapiro.test(con$POST_HF) #ND

shapiro.test(exp$POST_HF) #ND

leveneTest(RS$POST_HF,RS$GROUP) # ND

t.test(RS$POST_HF~RS$GROUP,var.equal = FALSE) #p-value = 0.3021

LOW AND HIGH FREQUENCY

######WITHIN GROUP#########

exp$diffLFHF<-exp$`POST_LF/HF`-exp$`PRE_LF/HF`

shapiro.test(exp$diffLFHF) ####Nnd#

wilcox.test(exp$`POST_LF/HF`,exp$`PRE_LF/HF`,paired = TRUE) #p-value = 0.5071

con$diffLFHF<-con$`POST_LF/HF`-con$`PRE_LF/HF`

shapiro.test(con$diffLFHF) ####Nnd#

wilcox.test(con$`POST_LF/HF`,con$`PRE_LF/HF`,paired = TRUE) #p-value = 0.3898

#####BETWEEN GROUP##############

shapiro.test(con$`PRE_LF/HF`) #NnD

shapiro.test(exp$`PRE_LF/HF`) #ND

leveneTest(RS$`PRE_LF/HF`,RS$GROUP) #ND

wilcox.test(RS$`PRE_LF/HF`~RS$GROUP,var.equal = FALSE) #p-value = 0.4272

shapiro.test(con$`POST_LF/HF`) #NnD

shapiro.test(exp$`POST_LF/HF`) #ND

leveneTest(RS$`POST_LF/HF`,RS$GROUP) # ND

wilcox.test(RS$`POST_LF/HF`~RS$GROUP,var.equal = FALSE) #p-value = 0.2746

SAMPEN

######WITHIN GROUP#########

exp$diffsampEn<-exp$POST_SampEn-exp$PRE_SampEn

shapiro.test(exp$diffsampEn) ####Nd#

t.test(exp$POST_SampEn,exp$PRE_SampEn,paired = TRUE) #p-value = 0.4895

con$diffLFHF<-con$POST_SampEn-con$PRE_SampEn

shapiro.test(con$diffLFHF) ####Nd#

```
t.test(con$POST_SampEn,con$PRE_SampEn,paired = TRUE) #p-value = 0.7985

#####BETWEEN GROUP##############

shapiro.test(con$PRE_SampEn) #ND

shapiro.test(exp$PRE_SampEn) #ND

leveneTest(RS$PRE_SampEn,RS$GROUP) #ND

t.test(RS$PRE_SampEn~RS$GROUP,var.equal = FALSE) #p-value = 0.5469

shapiro.test(con$POST_SampEn) #ND

shapiro.test(exp$POST_SampEn) #ND

leveneTest(RS$POST_SampEn,RS$GROUP) # ND

wilcox.test(RS$POST_SampEn~RS$GROUP,var.equal = FALSE) #p-value = 0.2238
```

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