A Dissertation On

EFFECT OF MUD BATH ON AUTONOMIC VARIABLES AND PSYCHOLOGICAL STATE IN TECHNOSTRESS PEOPLE -A RANDOMIZED CONTROL TRIAL

Submitted by

DR. A.J. RATHNA PRAKASH, B.N.Y.S (Reg. No. 461811002)

Under the guidance of

Prof. Dr. N. MANAVALAN,
N.D. (OSM), M. A (G. T),M.Sc(Y&N), MPhil, P.G.D.Y, P.G.D.H.M,P.G.D.H.H

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Place: Chennai.

Date:

SIGNATURE OF THE GUIDE

Dr. N. MANAVALAN,
N.D. (OSM), M.A. (GT), M.Sc (Y & N), M. Phil, P.G.D.Y, P.G.D.H.M, P.G.D.H.H
Prof & Head,
Department of Naturopathy,
Government Yoga and Naturopathy
Medical College and Hospital,
Chennai – 106

THE TAMIL NADU DR.M.G.R. MEDICAL UNIVERSITY, CHENNAI

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Place: Chennai.

Date :

SIGNATURE OF THE H.O.D

Dr. N. MANAVALAN,
N.D. (OSM), M.A. (GT), M.Sc (Y & N), M. Phil, P.G.D.Y, P.G.D.H.M, P.G.D.H.H
Prof & Head,
Department of Naturopathy,
Government Yoga and Naturopathy
Medical College and Hospital,
Chennai – 106

THE TAMIL NADU DR.M.G.R. MEDICAL UNIVERSITY, CHENNAI

ENDORSEMENT BY THE PRINCIPAL

I certify that the dissertation entitled "**EFFECT OF MUD BATH ON AUTONOMIC VARIABLES AND PSYCHOLOGICAL STATE IN TECHNOSTRESS PEOPLE -A RANDOMIZED CONTROL TRIAL**" is the record of original research work carried out by DR. A.J. RATHNA PRAKASH, Department of Naturopathy, Government Yoga and Naturopathy Medical College and Hospital, Chennai– 600 106 submitted for the award of degree of DOCTOR OF MEDICINE (M.D) Branch – I (Naturopathy) under my guidance and supervision, and that this work has not formed the basis for the award of any degree, diploma, associate ship, fellowship or other titles in this University or any other University or Institution of higher learning.

Place: Chennai.

Date:

SIGNATURE OF THE PRINCIPAL

Dr. N. MANAVALAN,
N.D. (OSM), M.A. (GT), M.Sc (Y & N), M. Phil, P.G.D.Y, P.G.D.H.M, P.G.D.H.H
Prof & Head,
Department of Naturopathy,
Government Yoga and Naturopathy
Medical College and Hospital,
Chennai – 106

THE TAMIL NADU DR.M.G.R. MEDICAL UNIVERSITY, CHENNAI

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I, DR. A.J. RATHNA PRAKASH solemnly declare that this dissertation entitled "**EFFECT OF MUD BATH ON AUTONOMIC VARIABLES AND PSYCHOLOGICAL STATE IN TECHNOSTRESS PEOPLE -A RANDOMIZED CONTROL TRIAL**" is a bonafide and genuine research work carried out by me at Government Yoga and Naturopathy Medical College and Hospital, Chennai from April 2020 - May 2021 under the guidance and supervision of Dr. N. MANAVALAN, N.D.(OSM), M.A (G.T), M.Sc (Y&N), M. Phil, P.G.D.Y, P.G.D.H.M, P.G.D.H.H, Prof & Head - Department of Naturopathy. This dissertation is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai towards partial fulfillment of requirements for the award of M.D. Degree (Branch – I – Naturopathy) in Yoga and Naturopathy.

Place: Chennai

Date:

Signature of the Candidate

(Dr. A.J. Rathna Prakash)

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LIST OF ABBREVIATIONS

ANS	Autonomic Nervous System
AV	Atrioventricular node
BP	Blood pressure
CNS	Central Nervous System
CO	Cardiac Output
CVS	Cardio Vascular System
DBP	Diastolic blood pressure
ECG	Electro Cardio Gram
HR	Heart rate
HRV	Heart rate variability
ICTs	Information and communication technologies
MDMS	Multi-Dimensional Mood State
OA	Osteoarthritis
PNS	Peripheral Nervous System
PR	Pulse rate
PSD	Power Spectral Density
RBC	Red Blood Cell
SA	Sino Atrial
SBP	Systolic blood pressure

ABSTRACT

Background and Objectives: Mud therapy is one among the treatment modalities in Naturopathy system of medicine. Administration of mud in whole body results in giving relaxation. Hence present study aims to evaluate the physiological effects of mud bath on various autonomic functions and psychological state in patients with techno-stress.

Materials and Methodology: 50 Employees of IT industries were screened with Techno stress questionnaire and based on the score, they were participated in the present study. After the inclusion, subjects were randomly divided in to control group (n=25) and mud bath group (n=25) by simple lottery method. The mud group received full mud bath for a duration of 40 minutes per day while exposing to sunlight. The intervention was given for two weeks (once in 3 days, totally 4 applications of mud bath) under the supervision of naturopathy physician. Control group subjects were requested to sit in a relaxation posture for the same duration. HRV Assessments, and MDMS questionnaire were evaluated before and after intervention in both study group and control group.

Results: In the present study among the two evaluations, all HRV parameters in time domain and HF of frequency domain remain increased during the mud pack trial. Whereas LF /HF ratio of frequency domain is found to decrease. There is no such change in the LF (n.u). This is suggestive of improvement in the sympatho-vagal balance reflecting parasympathetic domination produced among the subjects after Mud bath intervention

Conclusions: Mud bath enhances the parasympathetic activity and could have a role in maintaining the cardiac tone and preventing various cardiovascular ailments.

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1. INTRODUCTION

Stress is a state of imbalance between demand and individual's response to the change in the internal or external environment. Less to moderate level of stress is considered to be beneficial and motivating known as eustress. However, chronic and severe stress is identified as distress which has a deteriorating effect on physiological and psychological wellbeing (1, 2). Stress is mainly considered as a significant cause of social and individual problems all over the world. This may be due to the existing evidence on the effect of stress on origin and occurrence of wide range of somatic disorders such as diabetes, cardiovascular diseases, and infections. It is apparent that stress is also related to cause psychosomatic problem such as depression, and anxiety (3).

Information technology has become a significant source of stress in today's workplace. In the past few decades, the globe has seen a huge growth in unfitness and absenteeism at work due to psychiatric diseases related to technostress (4). The recent studies on technostress among Indian population has shown prevalence of work-related stress problems in employees of IT industries and educational sectors (5, 6). Estimates of the socio-economic cost of stress-related unfitness and absenteeism range from $2 to 20 billion/year in IT sector (6, 7). These tendencies have led to increased efforts to enhance the mental and physical health of employees. The technique to induce relaxation, stress reduction. procedure, and the “de-acceleration” of modern life are gaining interest in the recent days.

To counteract the detrimental effects of technostress on physical and mental health, attempts are being made to improve relaxation through alternative treatment methods such as Naturopathy.

Naturopathy

Naturopathy is a traditional therapeutic approach that uses natural components to increase the body's self-healing capacity. It is a therapeutic science that uses the five great elements of nature to help the body's innate potential to cure itself: Earth, Water, Air, Fire, and Ether. Naturopathy offers a cost-effective medicine or practical approach to disease management, but also a robust theoretical foundation that is relevant to all holistic medical care which focuses on health (8). Naturopathy is a type of primary care medicine that combines traditional healing methods with cutting-edge technology and research. It is guided by a set of principles that recognise the body's inherent healing power, place a premium on disease prevention, and encourage individual responsibility in the pursuit of maximum health.

A naturopathic physician's (ND) purpose is to completely comprehend each patient's situation, and symptoms are thought to be the body's method of communicating an underlying imbalance. Treatments focus on the patient's underlying ailment rather than specific presenting symptoms. Some of them include diet and clinical nutrition, behavioural modification, hydrotherapy, herbal medicine, and physical medicine.

Naturopathy has its origins in nineteenth-century European "nature treatment," a technique for treating illness with natural modalities such as water, fresh air, diet, and herbs. Naturopathy emerged in the early twentieth century in the United States and Canada, combining nature cure, homoeopathy, spinal manipulation, and other therapies.

In naturopathic theory, illness is viewed as a process of disruption to health and subsequent healing within the context of natural systems. Poor diet, long-term stress, and hazardous exposure can all have a negative impact on one's health. The goal of the ND is to restore health by recognising and limiting these anomalies. To do so, the ND must first identify the factors that influence the outcome.

In order to restore health, the ND follows a planned, yet adjustable, treatment protocol, starting with simple interventions and escalating to higher level interventions as needed. The procedure begins with reestablishing health conditions, such as developing a healthier eating and living regimen.

Naturopathy is about maintaining balance with oneself, society, and the environment. The Vedas and other ancient scriptures contain several references to Nature Cure as a way of life. The morbid matter theory, Vital force concept, and other principles that underpin Nature Cure can be found in ancient literature, indicating that these procedures were widely used in ancient India (9). Naturopathy treatment method believes that all diseases are caused by a buildup of morbid matter in the body, and that removing it can provide a relief. It focuses on correcting all of the key elements involved in treatment and allowing the body to heal by itself. There are various modalities applied for cure in naturopathy like Water therapy (hydrotherapy), Air therapy, Fire therapy, Space therapy, Mud therapy, Food therapy, Massage therapy, Acupressure, Magneto therapy and Chromo therapy (10-14).

Hydrotherapy, which can enhance blood and lymph circulation, can then help to promote the body's natural healing mechanisms. To treat weakened or damaged systems, the third step involves using homoeopathy, herbal drugs, or specific exercises such as yoga. The fourth phase involves restoring structural integrity, which is commonly done through physical medicine (14).

The fifth phase is to treat pathology using specific natural ingredients, such as dietary supplements. The sixth phase involves treating pathology with pharmacological or synthetic substances (8).

Mud therapy

According to the concepts of 'Panchamahabuta' in Naturopathy system of medicine earth is an integral component of the human body and has a distinct effect on health and wellbeing (15). In Naturopathy, mud is one of the most important therapeutic components as an element of earth. Mud is a mixture of inorganic and organic debris with water that has gone through geological and biological processes under the influence of various physical and chemical factors (16).

The mud contains hydrophilic organic components such as humic acid, fulmic acid, and ulmic acids. It also includes organic compounds such as fatty acids. Because of these qualities and components, the mud has a variety of medicinal benefits, including improving hyperthermia and activating the body's hydropoietic glands. On the other hand the composition of mud varies according to the area of availability (17).

Mud treatment is defined as the administration of processed mud in the form of packs applied either directly or indirectly over the skin, to elicit therapeutic advantages. Skin pathologies, rheumatic problems, musculoskeletal disorders, gynaecological conditions, neurological complaints, and cardiovascular conditions have all been successfully treated using mud treatment. The mud works by diluting and absorbing the body's poisonous substances, eventually removing them from the body. Mud application over the skin has increased electrical conductance across biological membrane, thus improving the absorption phenomena and activation of the underlying glands and its hormonal secretions (18).

Mud therapy is one of the eliminative therapies recommended by naturopathic doctors. Mud has the unusual property of absorbing heat and toxins from the body and eliminating these toxins in a variety of ways. Mud therapy is a low-cost and easy-to-use treatment option. Mud therapy is divided into two types: direct application or packs. The mud used for treatment should be free of contaminants and should be collected from 122cm to 153 cm depth from the surface of the ground. Before employing the mud for treatment, it should be sieved, powered, and then sun-dried. This mud can also be preserved for long periods of time if the required precautions are taken to keep it clean and dry (19). Mud packs are applied to different parts of the body for treating various conditions. It is used in the form of full body packs and compresses on specific body parts. A mud pack is prepared by spreading a thin layer of mud on a cotton cloth with the help of wooden stick. The mud pack measures 22.86 cm in length, 15.25 cm in width, and 1.27 cm in thickness. The pack's size is determined by the size of the bodily portions upon which it must be applied. Fever, diarrhoea, piles, dysentery, constipation, anxiety, conjunctivitis, headache, allergies, and refractive errors in the eyes are all treated with mud packs (20).

Mud baths are used all around the world for relaxation. Mud has a larger effect than other modalities in various illnesses, such as chronic inflammation and sprains, because it can hold moisture and cooling for longer periods of time than water (18). Though mud packs have been utilized for a variety of ailments, the exact process of how a mud bath works is unknown. This research is being carried out to understand the physiological effects of mud bath on IT Employees’ technostress.

2. REVIEW OF LITERATURES

2.1 Stress

Stress is defined as any intrinsic or exogenous stimulus that causes a biological response. Depending on the nature, and severity of the applied stimulus, stress can have a negative impact on the body, ranging from changes in homeostasis to life-threatening effects and death. Many pathophysiological consequences of disease are caused by stress, and people who are exposed to stress. Those who work or live in stressful situations for a prolonged period are more likely to develop a variety of ailments. Many diseases and pathological situations are made worse by stress, which can be a triggering factor (21).

Stress affects primary physiological systems of humans which include cognition, immune system, cardiovascular system, gastrointestinal system and endocrine system. Stress, whether acute or chronic, has a negative impact on the function of cardiovascular system affecting heart rate, vascular endothelial cell function, and blood pressure. It has been established that there is a link between stress and cardiovascular diseases (22, 23).

2.1.1 Stress and Cardiovascular system

Earlier studies suggest that stress activates the autonomic nervous system, which then alters the functions of cardiovascular system. The heart rate will increase or decrease depending on the direction of the sympatho-vagal response change.

When the sympathetic nervous system is activated, it causes an increase in heart rate, contraction strength of heart, vasodilation in the arteries of skeletal muscles and constriction of peripheral veins (24, 25). When parasympathetic nervous system is activated by stress through stimulation of limbic system, it causes a decrease in heart rate and contractility of heart, peripheral vasodilation, and a drop in blood pressure (26)

Finally, stress can alter the function of vascular endothelial cells, raising the risk of thrombosis and ischemia as well as platelet aggregation. Blood pressure is the third major consequence of stress on cardiovascular function. Stress can induce the autonomic sympathetic nervous system to enhance vasoconstriction, which can result in an increase in blood pressure, vascular alterations, and atherogenesis, all of which can lead to cardiac arrhythmias and myocardial infarction. Stress has been linked to an increase in coronary vasoconstriction, which is seen in patients with atherosclerosis. Of course, there are individual disparities in the level of autonomic-based stress reactions, which are dependent on a person's particular traits (22, 25).

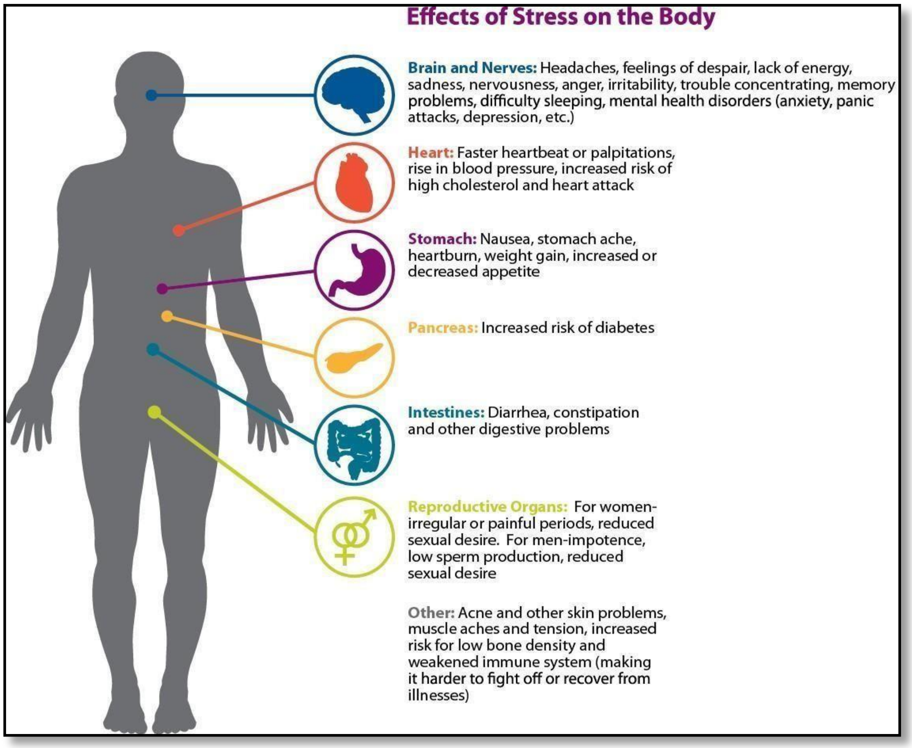
Psychological stress has been demonstrated in studies to promote alpha-adrenergic activation, which increases heart rate and oxygen demand. As a result, coronary vasoconstriction is increased, potentially increasing myocardial infarction. Boltwood et al., reduce the effects of stress and death from heart disease. Furthermore, there are gender-dependent changes in the cardiovascular response to stress, and it has been estimated that female get heart disease 10 years later than males, which has been related to the preventive effects of the oestrogen hormone (27, 28).

2.1.2 Stress and mental health

Stressful experiences are hypothesized to affect the etiology of physical disease by creating negative mental states like anxiety and depression. It has a direct effect on biological processes or behavioral patterns that influence disease risk. Chronic stress exposures are the most dangerous because they are the most likely to create long- term or permanent changes in the emotional, physiological, and behavioral responses that determine susceptibility (29).

Impact of stress on mental health is mainly due to activation of dopaminergic system and the amygdala/hippocampus system. The stress response system is activated when a person's emotional state changes, as well as their behaviour and cognitive skills. During times of stress, people may feel a number of emotions. Anxiety is one of the most commonly felt emotions. Anxiety is defined by Spielberger (1966) as a subjective and consciously felt emotion of uneasiness and tension that is partly based on fear. Feelings of despair, unease rage, indifference, estrangement, or hypochondriasis are examples of further emotional reactions (30-32).

Figure 1: Effects of stress on the body (33)



2.2 Nervous system

The nervous system is in charge of senses, mental activity, and muscle and gland regulation. The brain, spinal cord, nerves, and sensory receptors constitute the nervous system. The nervous system is divided into two parts: the central nervous system and the peripheral nervous system. The brain and spinal cord part of the central nervous system (CNS). The peripheral nervous system (PNS) is a network of nerves that connects the brain to the rest of the body.

There are two divisions in the PNS. The sensory division, also known as the afferent division, sends action potentials from sensory receptors to the CNS, whereas the motor division, also known as the efferent division, sends action potentials from the CNS to effector organs including muscles and glands. The somatic motor nervous system, which transmits action potential, is a subset of the motor division.

2.2.1 Autonomic nervous system

The autonomic nervous system is the part of the nervous system that regulates the body's visceral functions. This system aids in the regulation of blood pressure, perspiration, body temperature, and a variety of other functions, some of which are controlled totally by the autonomic nervous system and others only partially. The autonomic nervous system's ability to change visceral functions quickly and intensely is one of its most noticeable features. For example, it may raise the heart rate to twice normal in 3 to 5 seconds and double the artery pressure in 10 to15 seconds; or, on the other hand, it can lower the arterial pressure to below normal in 10 to 15 seconds.

The sympathetic nervous system and the parasympathetic nervous system transmit efferent autonomic signals to the body's various organs. The sympathetic nervous system is most active during physical activity, whereas the parasympathetic nervous system regulates resting or vegetative functions, such as digesting food or emptying the urinary bladder.

2.2.2 Sympathetic and parasympathetic divisions

The placement of the sympathetic and parasympathetic divisions inside the CNS, as well as the location of their autonomic ganglia, differ anatomically. Between the first thoracic (T1) and second lumbar (L2) segments, sympathetic preganglionic neurons have their cell bodies in the lateral horns of the grey matter of the spinal cord.

Due to the obvious position of its preganglionic neurons, the parasympathetic nervous system is also known as the craniosacral division of the autonomic nervous system. The oculomotor, facial, and glossopharyngeal nerves nourish the visceral structures in the head, while the vagus nerves supply those in the thorax and upper abdomen. The pelvic viscera is supplied by the sacral outflow through branches of the second to fourth sacral spinal neurons. Preganglionic fibres of the parasympathetic system synapse with ganglia cells concentrated within the walls of visceral organs, making parasympathetic postganglionic fibres exceedingly short.

Through the spinal, sympathetic, and splanchnic nerves, sympathetic axons travel from the sympathetic chain ganglia to their target tissues. Smooth muscle and glands in the skin and skeletal muscles of much of the body are supplied by spinal nerves. The portions of the head and neck not served by spinal nerves aresupplied by sympathetic nerves.

The superior cervical sympathetic chain ganglion supplies the majority of the sympathetic nerve supply to the head and neck. Sympathetic axons connect to cranial nerves and travel to effector organs. Thoracic organs, such as the lungs and heart, are also supplied by sympathetic nerves. The abdominopelvic organs are mostly supplied by splanchnic nerves.

2.2.3 Autonomic Nervous System and its neurotransmitters

Two important neurotransmitters are secreted by sympathetic and parasympathetic nerve terminals. It's a cholinergic neuron if it secretes acetylcholine; it's an adrenergic neuron if it secretes norepinephrine (or epinephrine). The sympathetic division's postganglionic neurons are almost all adrenergic, with the exception of a few cholinergic postganglionic neurons that innervate thermoregulatory sweat glands (34).

2.2.4 Receptors of autonomic neurotransmitters

Certain cells have acetylcholine and norepinephrine receptors in their plasma membrane. The neurotransmitter and receptor combination sends a signal to cells, causing them to react. The reaction is either excitatory or inhibitory, depending on the cell type.

Acetylcholine binds to cholinergic receptors, which are the receptors to which acetylcholine binds. They are divided into two major structural types. Nicotine binds to nicotine receptors, while muscarine binds to muscarinic receptors.

Because acetylcholine binds to and activates both types of receptors, nicotinic and muscarinic receptors are remarkably similar.

Nicotinic receptors are found on the membranes of all postganglionic neurons in the autonomic ganglia, as well as the membranes of skeletal muscle cells. Muscarinic receptors are found on the membranes of effector cells that respond to acetylcholine produced by postganglionic neurons.

Norepinephrine and epinephrine bind to receptors called adrenergic receptors. They are found in the plasma membranes of sympathetically innervated target tissues. G proteins mediate the response of cells to norepinephrine or epinephrine binding to adrenergic receptors.

G protein activation can result in either excitatory or inhibitory responses depending on the target tissue. Alpha (á) and beta (â) receptors are the two types of adrenergic receptors. On most á and â receptors, epinephrine has a stronger impact than norepinephrine. The major subtypes of alpha receptors are a1- and a2-adrenergic receptors, and beta receptors are a1- and a2-adrenergic receptors. The neurological system and epinephrine and norepinephrine secreted by the adrenal gland can both trigger adrenergic receptors. Norepinephrine is released by sympathetic postganglionic neurons, which triggers adrenergic receptors within synapses. The release of norepinephrine at synapses, for example, causes bloodvessels to contract.

Epinephrine and norepinephrine, which are generated by the adrenal glands and delivered by the blood to effector organs, can bind to adrenergic receptors in the plasma membrane, which are positioned away from synapses. Epinephrine and norepinephrine, for example, bind to â2 receptors in skeletal muscles and trigger blood vessel dilatation.

2.3 Cardiovascular system

The circulatory system, also known as the cardiovascular or vascular system, aids in blood circulation, gaseous exchange with other organs, and the supply of essential nutrients such as electrolytes, amino acids, minerals, and other nutrients to the entire body, as well as protecting the body from disease. Homeostasis is the collective term for all of these processes. One of the major body systems that maintains homeostasis is the circulatory system (35).

The lymphatic system, which circulates lymphatic fluid, is part of the circulatory system. Unlike lymph, blood is a critical physiological fluid that consists of plasma, white blood cells, red blood cells, and platelets and is circulated by the heart (36). This is the basic systemic function of the vertebrate circulatory system, which aids in the circulation of oxygen and nutrients to the bodily tissues as well as the elimination of waste items created by them. A systemic circulation and a pulmonary circulation are the two major components of the circulatory system of the blood.

2.3.1. Functions of CVS

CVS plays an important role in leading a healthy life. They are responsible for a variety of essential functions, including:

- Gases, nutrients, and waste materials generated as toxins from the metabolic functioning of tissues/cells are transported throughout the body. Aids in the
- protection of the body against microbial infections and blood loss.
- Assists in the regulation of body temperature, often known as ‘thermoregulation.'
- Assists in the maintenance of our body's fluid equilibrium (37).

CVS serves as the internal network of veins, arteries, arterioles, venules, and capillaries which connects all bodily parts. The system works in a continuous loop, transporting needed nutrients for growth and development and then eliminating toxins and wastes from the body.

Hormones created by the endocrine glands are efficiently carried to the target organs via the cardiovascular system (CVS), whereas waste products are released/expelled through the urine system. The heart and lungs, like the gaseous exchange, are principally involved in the exchange of carbon dioxide and oxygen. Through the pulmonary veins and arteries, oxygen and carbon dioxide are exchanged. The heart pumps deoxygenated blood, which contains carbon dioxide, to the lungs, where it is evacuated through exhalation. The oxygen inhaled is exchanged with that of the lungs at the same time, which then releases/transports the oxygenated (oxygen rich) blood to other parts of the body that are deficient.

2.3.2 Blood pressure and Pulse rate

CVS's normal operation is largely attributed to two fundamental characteristics, notably

- Blood pressure
- Pulse rate

These are two different indicators/measurements that show CVS health. The heartrate is obtained by determining the number of times an individual's heart beats occur within a minute, whereas blood pressure is determined by determining the force of the individual's blood flow going through the blood vessels (38).

These are two independent health signs that help determine whether the heart's functioning is within normal limits. The shift in normal blood pressure and pulse rate is a direct reflection of the individual's CVS abnormalities or problems.

The subsections that follow provide a full understanding of the differences between pulse rate and blood pressure. This could be discovered by determining the underlying link between these two parameters. The next subsection is concerned with determining the general differences and relationship.

Pulse rate

Pulse refers to the arterial palpation of a heartbeat using fingertips. The pulse can be felt in any region of the body that facilitates the artery that is squeezed or present on the surface.

Blood pressure

The lateral exertion of pressure by blood against the artery walls is known as arterial blood pressure (BP). During a cardiac cycle, the systolic pressure reaches its highest point, while the diastolic pressure reaches its lowest point.

The geometric mean of the mean blood pressure (MBP) is computed by integrating the pressure pulse. The following formulas are used to compute the MBP of systolic and diastolic pressure.

MBP = [systolic pressure + 2 (diastolic pressure)]/3.

The difference between the systolic and diastolic pressures determines blood pressure. The systolic pressure is determined by:

- Stroke
- Volume
- Peak-systolic cardiac ejection rate
- Arterial compliance

The diastolic pressure, on the other hand, is determined by

- Total Peripheral Resistance
- Heart Rate

- Systolic Pressure and
- Arterial Elastic Recoil (39).

2.4. Technostress

For a long time, work stress research did not focus on technology as a source of stress. With the digital shift, this has changed. Digital technologies have grown ubiquitous in almost all fields and occupations, and their widespread adoption has had a significant impact on organisational structures, communication, business models, work organisation, and labour relations.

It is practically unavoidable that such changes have an impact on individual employees. From the standpoint of occupational health and safety, it's critical to pinpoint specific components of digitalization processes that cause work stress and, as a result, have the potential to harm mental health (40).

2.4.1 Technostress & its impact on health

Technostress is defined as an individual's incapacity to handle or deal with Information and communication technologies (ICTs) in a healthy way. It was stated as "any negative impact on attitudes, thoughts, behaviours, or body psychology caused directly or indirectly by technology" (41, 42). In the twenty- first century, information and communication technologies (ICTs)

have become a necessity in everyone's life, including cell phones, laptops, the Internet, voicemails, WhatsApp messaging, videoconferencing, teleconferencing, and other work-related technologies. The majority of early encounters with ICTs took place within the organization. However, with the advancement of ICTs, interactions are now pervasive in both the corporate and personal life. Information and communication technology-induced stress (ICTs), has a negative impact on users and forces the individual to adjust to the use of ICTs (43). The IT sector is among the key companies all over the world where ICTs are being employed on a huge scale to boost productivity. While the advantages of ICT adoption and its use are undeniable in the IT industry, it is also true that ICTs has resulted in a variety of demands and issues in the workplace, such as technostress and job burnout. Organizations must address technostress since it has a negative influence on employee health and productivity (44). Technology affords us incredible flexibility in doing business globally, because individuals may potentially be contacted anywhere and at anytime and feel pushed to stay connected at all situations. The standard workday is stretched, office work is done at all hours, and it is practically difficult to "cut away." While constant accessibility via new technologies may help some, it also blurs the boundaries between work and home by allowing more access to both work and persons. Constant communication offered by information communication technologies encroaches on people's personal space, making it difficult to maintain a work-life balance. The outcome of technostress in an individual is known as strain which can be psychological or behavioral. The psychological strains are emotional responses to stressful situations, such as work discontent, depression, and negative self- evaluation. The behavioural stress included reduced productivity, absenteeism, and poor task performance (45).

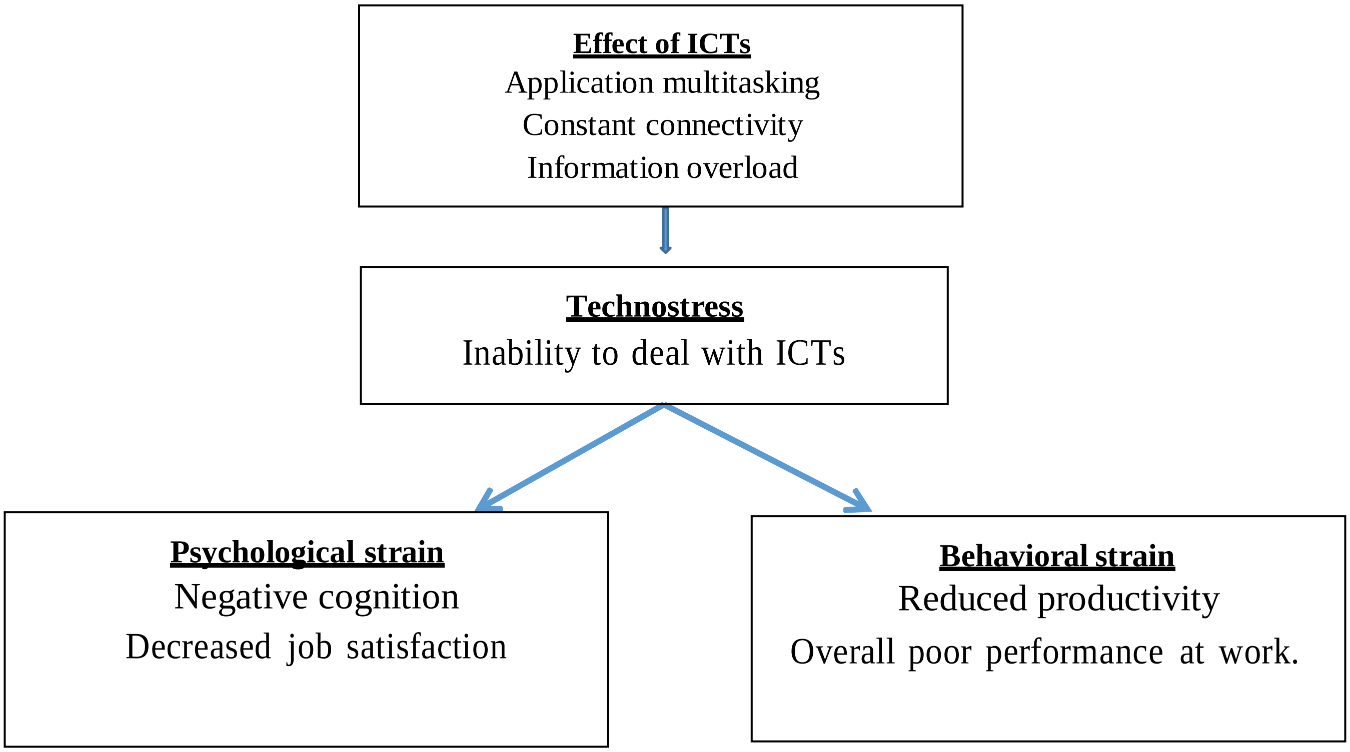


Figure 2: Effect of Information and communication technologies (ICTs) on an individual (46)

Previous studies on technostress have primarily focused on its negative implications. The impact of information overload and task-technology was investigated over 664 working people and found that information overload contributes to technostress. It was also stated about technostress as a sensation of anxiety that has a detrimental impact on a person's thoughts, behaviours, attitudes, and physique when they are required to cope with technology (47, 48). Many research has been conducted on “technostress” and the factors that contribute to it. according to Monideepa Tarafdar et al, professional users are impacted by evolving information systems (IS) at work. They looked at data from IS users (N = 233) from two U.S. companies for the negative repercussions of “technostress” and how it varies across individuals. Approximately 80% of the respondents in this research study believed that increased technology use in the office has made their jobs more stressful. Users feel "technostress" as a result of information overload, IS invasion of personal life, incapacity to deal with the ambiguity and complexity of IS, and a sense of insecurity as a result of rapid improvements in IS. Accordingto the researchers Job commitment, creativity, and productivity may all suffer as a result of “technostress.” Users may access information quickly and simply, work from anywhere, and share information and ideas with coworkers in real time. However, these technologies can make individuals feel compelled to stay connected, forcing them to respond to work-related information in real time, trapping them in almost habitual multitasking, and leaving them with little time for sustained thought and creative analysis (49). A research work was carried out on technological communications by Barley, Meyerson and Grobal (2010) which reviewed the increasing volume ofemail and other communications that are considered as an upcoming sourceof stress in people’s lives. According to this study, it gives people more flexibility and control by allowing them to interact almost anywhere at anytime. On the other hand, people become overwhelmed and unable to cope with the stress caused by email communication (50).

Park and Jex (2011) describe how advancements in CITs like usage of smart phones and mobile Internet access have enabled workers to be connected to work and family regardless of their physical locations, blurring the boundaries between work and home in their study Work Home Boundary Management Using Communication and Information Technology.

The widespread use of CIT, on the other hand, has been commended and criticised for blurring these work-family lines. Employees' enhanced capacity to combine their work and family obligations, such as a working parent caring for a sick child at home while also working, is one advantage of CIT use (51).

According to a study by van Steenbergen, Ellemers, and Mooijaart, frequent psychological work-family interference has been linked to a variety of stressors, including emotional exhaustion, depressive symptoms, and low job satisfaction (52).

2.4.2. Measurement of “technostress”

Techno-stress instrument developed by Tarafdar et al.(2007) which includes 23 items designed to assess the characteristics of the respondents and their organizations. The items were written in the form of statements with which the respondent was to agree or disagree on a 5-point Likert scale (49).

The questionnaire has five sections namely, Techno-overload, Techno-invasion, Techno-complexity, Techno-insecurity and Techno-uncertainty (Figure 3).

"Techno-overload" is a term used to describe situations in which the usage of information technology (IT) encourages professionals to work harder and faster, causing tension and worry. The second is "Techno-invasion," which depicts scenarios in which professionals can possibly be reached anywhere and at any time, and they feel compelled to stay connected at all times. Workdays are extended into family hours, including vacations. Individuals become attracted to these technologies as a result of their constant connectivity, and they feel as if they are intruding on their time and space. As a result, they encounter frustration and stress.

Thirdly, "Techno-complexity" characterizes instances in which the complexity of information systems causes experts to devote time and effort to learning andcomprehending new applications. Users may find the wide range of applications and functionalities frightening and difficult to comprehend, resulting in stress. The fourth type is "techno-insecurity," which occurs when users fear losingtheir jobs to others who have a better knowledge of modern information systems. As a result, current professionals may feel uneasy about IS, causingtension and stress. Finally, "Techno-uncertainty" refers to situations in whichcontinuous changes and updates to IS do not allow experts to build a foundationof experience for a certain application or system.

They are disturbed by this since their knowledge is soon becoming obsolete. Although they may be excited at first about learning new apps and technologies, they must constantly meet certain requirements and the incessant need to refresh and update eventually leads to dissatisfaction and worry. Structured interviews and surveys were used to get these findings. In the context of computer use, survey questions highlighted potentially stressful circumstances. On a five-point Likert scale, all of the items were evaluated.

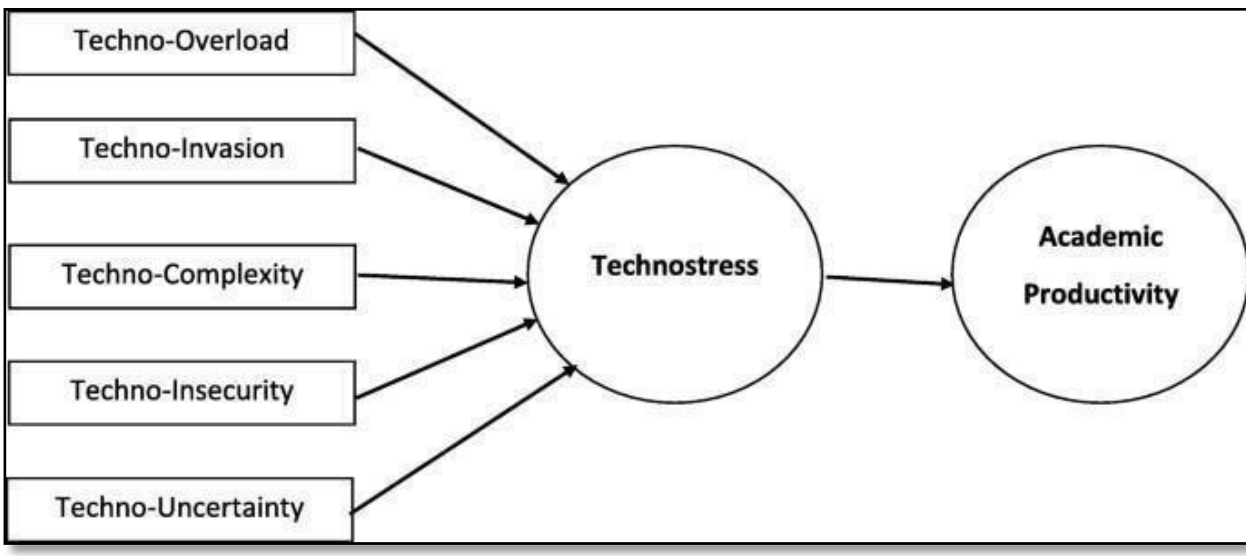


Figure 3: Technostress questionnaire and its sections (53)

2.5 Management of "technostress"

Numerous studies on technostress have been conducted; however, none of them consider the concept of coping in order to explain techniques for avoiding these detrimental effects.

Previous research has confirmed that "technostress" exists and has opened up new research pathways by highlighting the prevalence of "technostress" in organisations and potential methods to alleviate it.

According to Ayyagari, Grover, and Purvis (2011), more research(54) is needed to acquire a better understanding of the effects of technology use, as the topic of stress caused by ICTs has gained inadequate attention (55).

Naturopathic medicine provides natural treatment methods such as Botanical medicine, Clinical nutrition, Hydrotherapy, Homeopathy, Naturopathic manipulation, Traditional Chinese medicine/Acupuncture, Prevention, and lifestyle counselling for prevention of stress in humans. One of the unique and cost effective method used to relieve stress is mud therapy. The unique property of mud helps to eliminate toxins from body thus providing relaxation (54) .

2.5 Measurement of Cardiovascular function

The technostress also has a negative impact on autonomic balance thus resulting in cardiovascular dysfunction.

The autonomic nervous system has a significant impact on the heart because of its potential to alter cardiac rate (chronotropy), conduction velocity (dromotropy), contraction (inotropy), and relaxation (lusitropy). Both parasympathetic and sympathetic fibres innervating the sinoatrial (SA) and atrioventricular (AV) nodes mediate the chronotropic and dromotropic effects, while sympathetic fibres innervating atrial and ventricular myocytes mediate the inotropic and lusitropic effects.

The vagus nerve's parasympathetic fibres release acetylcholine, which activates M2 muscarinic acetylcholine receptors, increasing the K conductance of nodal cells. The resulting membrane hyperpolarization lowers the SA node's spontaneous firing rate and reduces AV node conduction, decreasing the intrinsic heart rate. The autonomic nerves provide a key remote mechanism for quickly adjusting cardiac output to meet short-term changes in the body's needs due to their ability to modify both heart rate and stroke volume.

There is a significant amount of tonic vagal discharge and a moderate level of tonic sympathetic discharge in humans. The interaction of these tonic activities causes a 30 percent lower resting heart rate than the intrinsic heart rate of 90–100 beats/min and a 30 percent higher cardiac output than in the absence of sympathetic discharge (56).

The functioning status of autonomic nervous system is revealed by heart rate variability (HRV). It is a non-invasive measure of autonomic input to heart rate that has been used to assess autonomic tone modulation (57).

2.6 Heart rate Variability (HRV)

Heart rate variability (HRV) refers to the variation in time between successive heart beats and represents a non-invasive index of the autonomic nervous system (Figure:4). Analysis of heart rate (HR) variability from electrocardiographic (ECG) recordings has become an important method for assessing cardiovascular autonomic regulation (58).

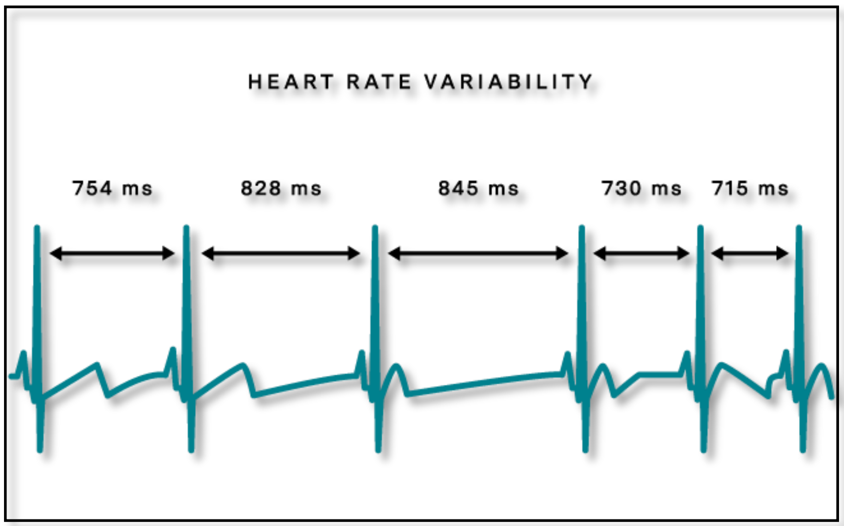


Figure 4: HRV with RR interval

Task Force of the European Society of Cardiology (ESC) and the North American Society of Pacing and Electrophysiology (NASPE) has well-defined and established standards for the measurement, physiological interpretation, and clinical use of HRV variables.

Time-domain and frequency-domain indices are standard clinical parameters. Time- domain analysis measures variation in HR over time or the intervals between successive normal cardiac cycles. Time-domain analysis of recording data involves simple calculations of mean normal-to-normal (NN) intervals and the variance between NN intervals. One of the simplest time-domain analysis variables is the standard deviation of the NN interval (SDNN; i.e., the standard deviation of NN). When HRV is large and irregular, the SDNN value increases. Therefore, SDNN is an index of physiological resilience against stress. In contrast to SDNN, which is computed directly from the NN interval, the root mean square of the successive differences (RMSSD), number of interval differences of successive NN intervals greater than 50 ms (NN50), and proportion derived by dividing NN50 by the total number of NN intervals (pNN50) are derived from the difference between adjacent NN intervals. These variables are impacted by the PNS, as they reflect beat-to-beat changes.

Frequency-domain analysis is preferred for short-term measurements (i.e., 5 min). PSD analysis allows the intensity of the HRV spectral components [i.e., the high- frequency band (HF), low-frequency band (LF), and very low frequency band (VLF)] to be determined. Different HRV spectral components are associated with either the sympathetic or parasympathetic branches of the ANS. The HF is a measure of PNS activity, as it reflects the activity of the vagus nerve, whereas LF reflects the activity of the SNS.

Many software's were available in the market for analysing HRV variables and one of the famous and advanced HRV analysis software is Kubios HRV (version2.0), which was developed at Biosignal Analysis and Medical Imaging Group (BSAMIG), Department of Physics, University of Kuopio, Finland (http://bsamig.uku.fi). This freely distributed software is a considerable upgrade to the previous version of the software which has been distributed to over 2700 users around the world so far. The developed software includes all the commonly used time- and frequency-domain parameters as described above. In addition, the software includes a selection of popular nonlinear analysis methods .

The autonomic nervous system's functioning status is revealed by heart rate variability (HRV). Heart rate variability (HRV) is a non-invasive measure of autonomic input to heart rate that has been used to accurately assess autonomic tone modulation (59).

Hon and Lee demonstrated the clinical importance of HRV in 1965, noting that fetal distress was preceded by changes in inter beat intervals before any significant change in heart rate. In 1070, Ewing et al., devised a series of simple bedside tests for detecting autonomic neuropathy in diabetic patients using short term RR interval (60,61).

Wolf et al., published a study in 1977 that linked lower HRV to an increased risk of post-infraction mortality. Akselrod et al., presented power spectrum analysis of heart rate fluctuations to objectively measure beat-to-beat cardiovascular regulation in 1981 (62, 63).

Pomeranz M et al. shown in 1985 the importance of frequency domain analysis in comprehending the autonomic background of RR interval changes in the heart rate record (64, 65).

When it was established that HRV was a strong and independent predictor of mortality following an acute myocardial infarction in the late 1980s, the clinical value of HRV was recognised. HRV has the potential to provide extra valuable insight into physiological and pathological situations, as well as improve risk stratification, now that new digital, high-frequency, 24-hour, multichannel Electrocardiogram (ECG) recorders are available (66).

Although cardiac automaticity is intrinsic to various pacemaker tissues, heart rate and rhythm are mostly under the control of the autonomic nervous system, according to a study by Jalife J and colleagues (67).

Muscarinic acetylcholine receptors respond to an increase in cell membrane K+ conductance, which causes the vagus nerve to release acetylcholine. As a result, the parasympathetic system influences our body's heart rate (68).

The release of epinephrine and nor epinephrine mediates the sympathetic influence on heart rate. The sympathetic influence on heart rate is mediated by epinephrine and nor epinephrine. The activation of â-adrenergic receptors causes cAMP-mediated phosphorylation of membrane proteins and rises in ICaL, which causes the gradual diastolic depolarization to accelerate (69).

The vagal and sympathetic nervous systems are continually interacting. Because the sinus node contains a lot of acetyl cholinesterase, every vagal impulse has a short effect because the acetylcholine is quickly hydrolyzed.

Parasympathetic influences outnumber sympathetic effects, most likely due to two separate mechanisms: (1) a cholinergically induced reduction in the release of nor epinephrine in response to sympathetic activity, and (2) a cholinergic attenuation of the response to an adrenergic stimulation. When our bodies are at rest, vagal tone takes precedence73, and fluctuations in cardiac period are mostly dependent on vagal modulation (70).

The beat-to-beat regulatory mechanisms are fine-tuned during resting conditions, as seen by the RR interval fluctuations. 75 and 76 Vagal afferent stimulation causes vagal efferent activity to be reflexively stimulated while sympathetic efferent activity is inhibited. The activation of sympathetic afferent activity mediates the opposite reflex consequences. Efferent vagal activity appears to be active as well (71).

The discharge of efferent sympathetic and vagal activity directed to the sinus node is mainly synchronised with each cardiac cycle, and it can be controlled by central (vasomotor and respiratory centres) and peripheral (oscillation in arterial pressure and respiratory movements) oscillators. These oscillators cause short- and long-term oscillations in the cardiac period by causing rhythmic changes in efferent neuronal discharge. The status and function of (a) the central oscillators, (b) sympathetic and vagal efferent activity, (c) humoral variables, and (d) the sinus node can all be determined from these rhythms (72). ECG curves are used to determine the normal-to-normal (NN) intervals. By omitting ventricular extra systoles, which are induced by separate processes, NN intervals are distinguished from common RR intervals (time distance between two R points in ECG). A statistical analysis of heart rate variability is carried out. For example, standard deviation (SDNN) and other defined parameters can be calculated (73).

Table 1: HRV: Description of Time Domain measures

Variable	Description
SDNN	Standard deviation of all NN interval
SDANN	Standard deviation of the averages of NN intervals in all 5-minute segments of the entire recording
RMSSD	The square root of the mean of the sum of the squares of differences between adjacent NN intervals
SDNN index	Mean of the standard deviation of all NN intervals for all 5-minute segments of the entire recording
SDSD	Standard deviation of differences between adjacent NN intervals

NN50	Number of pairs of adjacent NN intervals differing by more than 50 ms in the entire recording; three variants are possible counting all such NN intervals pairs or only pairs in which the first or the second interval is longer
pNN50	NN50 count divided by the total number of all NN intervals

The frequency domain analysis is performed using a fast Fourier transform of the NN intervals as a function of time. This results in power spectral density (PSD), which is a distribution of variance (SDNN2) on variability frequencies, i.e. integrating PSD throughout the entire frequency range of outcomes (SDNN2). The frequency range less than 0.5 Hz is of importance since variability frequencies are described as small-scale changes in heart rate. At least there are specific frequency domains, which are affected differently by parasympathetic and sympathetic activities of the autonomic nervous system.

Table 2: HRV: Description of frequency Domain measures

Variable	Description
LF	Power in LF ranges
HF	Power in HF range
LF/HF	Ratio LF (ms2)/HF(ms2)

The autonomic nerve system regulates a variety of physiological functions, including blood pressure and respiratory rate, which can have a significant impact on autonomic "balance." As a result, HRV analysis offers a non-invasive way to investigate the dynamic effects of changing physiological factors on heart regulation. This "heart rate variability (HRV) study" adds a lot of information about the cardiovascular system and allows for assessment of cardiac regulatory influences on the autonomic nervous system (73).

2.7. Mud therapy

Since prehistoric times, muds have been used for therapeutic purposes. A mud or peloid, according to the International Society of Medical Hydrology, is a natural product consisting of a mixture of sea–salt lake–or minero-medicinal water (liquid phase) and organic and inorganic material (solid phase) produced by biological (humus) and geological (clay minerals) action. They are considered as therapeutic agents, topically applied as cataplasms or baths. The maturation process can alter mud properties like its plasticity, absorption capacity, cooling index, and biological content. Mud treatment is defined as a balneological intervention, and the available scientific evidence supports its effects on a variety of health disorders when used alone or in combination with hot mineral water baths. It is found effective in patients with rheumatic and dermatologic illnesses (74).

In an in-vitro study conducted by F. Tateo et al. on thermal mud, it was found

That mud treatments involve the percutaneous transfer of chemical compounds such as Lithium (Li), Strontium (Sr), Boron (B), Iodine (I), Rubidium (Rb), Bromine (Br), Sodium (Na), Chlorine (Cl), Selenium (Se), and Calcium (Ca) from the mud to the human body happened (75).

According to a study, the used procedure with hyper or isothermic mud caused a transitory elevation in progesterone and estradiol concentrations in blood serum of women with normal and deficient corpus luteum hormonal activity. Adrenaline and noradrenaline excretion in urine also increased significantly, especially after hyperthermic mud application (76).

A study on effects of Mud Therapy over Perceived Pain and Quality of Life related to health in patients with knee osteoarthritis, found that mud therapy provided immediate pain relief, improved health-related quality of life, and reduced drug usage (77).

In other study, treating knee osteoarthritis with intra-articular hyaluronic acid injections or mud-pack therapy produced equivalent functional and pain reduction benefits in the very short term. Mud-pack was considered to be the best alternative technique for treating knee osteoarthritis in a noninvasive way (78).

According to a study on mud packs in osteoarthrosis patients, mature thermal mud modulates chondrocytic activity by modifying serum cytokine production, increasing insulin growth factor and decreasing TNF alpha in the serum.

Another research of mud packs in healthy volunteers found that they dramatically reduced IL-6 and IL-1 beta levels 2 (79).

According to a study, mud therapy boosts bone mineral density in women over time. They looked at over 250 females who received mud bath treatment twice a year, for a total of 15 full mud baths over the course of a year, lasting 45-60 minutes each. They used calcaneus ultrasonometry to assess bone mineral density, which revealed an improvement in the bone mineral density (80).

3. AIMS & OBJECTIVES

AIM

The aim of the study is to evaluate the effect of full mud bath on autonomic functions and psychological state in people with techno-stress.

OBJ ECTIVES

- To study the effect of mud baths on autonomic functions using heart rate variability, in IT employees with techno-stress.
- To study the effect of mud baths on blood pressure in IT employees with techno-stress.
- To assess the effect of mud bath on psychological state using Multi-Dimensional Mood State (MDMS) questionnaire in IT employees with techno-stress.

4. METHODOLOGY

4.1 Study design:

The study is a randomized control trial conducted on 60 IT employees who were under technostress.

4.2 Subject Selection:

Employees of IT industries were screened with Techno stress questionnaire and based on the score they were participated in the present study (81). Subjects with the age of 20 to 40 years with both genders were included aftergetting the informed consent.

Inclusion criteria:

- IT employees who were willing to participate in the study
- Subjects who had technostress
- Subjects in age group 20-40 years

Exclusion criteria:

- Subjects with acute & chronic Respiratory disease
- Patients taking drugs influencing Autonomic functions.
- Those who are consuming alcohol and nicotine.
- Women with pregnancy& Lactation were excluded.

4.2 Sample size:

Present study includes 60 participants those who are working in the IT sector.

4.3 Randomization:

After the recruitment, all the subjects randomly divided in to control group (n=25) and mud bath group (n=25) by simple lottery method. The mud bath group received full mud bath for a duration of 40 minutes per day while exposing to sunlight. The intervention was given for two weeks (once in 3 days, totally 4 applications of mud bath) under the supervision of naturopathy physician. Control group subjects were requested to sit in a relaxation posture for the same duration.

4.4 Intervention Procedure:

The subjects were instructed to take early breakfast and suggested to come in the morning 10.00 – 11.00 am on the days of experiment. The mud was applied all over the body and left for 40 minutes. It was followed by cold water shower for 10 minutes. Full Mud bath was given for 40 min a day for a period of two weeks (once in 3 days, totally 4 applications of mud bath).

Figure 5: Mud bath application in subjects

4.5 Outcome measurement:

4.5.1 Heart Rate Variability (HRV):

For the recording of short-term HRV, the recommendation of the task force on HRV was followed. After 10 minutes of rest, Lead II ECG was recordedusing the Analogue ECG amplifier with A to D (Analogue to Digital) conversion using the sound card inside the computer. From that, the RR interval was extracted and was analyzed using KUBIOS 1.1 software, Finland, which was used to measure the different variables such as the time or frequency domain.

Time-domain analysis calculated directly from the raw RR-interval. The frequency-domain shows the variability of the RR-signal over time by looking at the proportion of the spectra relative to the original RR- signal. Frequently used time-domain parameters are mean and standard deviation (SD) of RR, NN50 (number of consecutive RR intervals that differ more than 50 ms), and pNN50 (proportion of NN50). Frequently used spectral measures are peak frequency and power of very low-frequency bands (VLF), low-frequency bands (LF), high- frequency bands (HF), and LF/HF ratio (14).

Figure 6: HRV recording in subjects

4.5.2 Blood Pressure:

BP measurement was standardized in a sitting position, right arm, two readings and was carried out using a validated BP monitor. BP was measured after 5–10 minutes of rest.

Figure 7: Measurement of Blood pressure

4.5.3 Multi-Dimensional Mood State (MDMS) questionnaire:

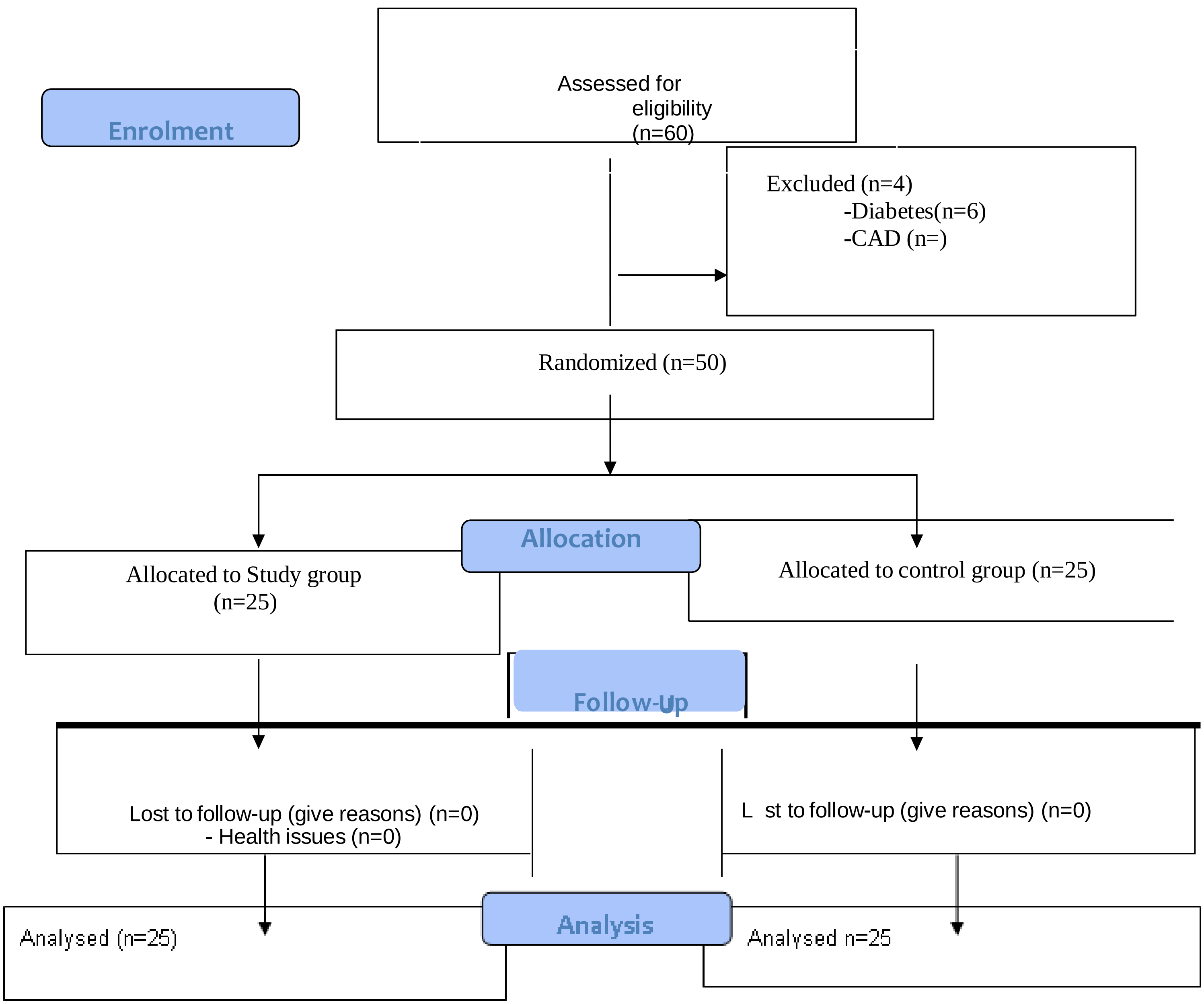
MDMS questionnaire was used to access the mood and calmness of the participants. It includes 30 items designed to assess current mood on three dimensions ranging from good to bad (GB), awake to tired (AT), and calm to nervous (CN). The items were written in the form of statements with which the respondent was to agree or disagree on a 6-point Likert scale.

The MDMQ is the English version of the German *Mehrdimensionale Befindlichkeitsfragebogen* (MDBF), which is a well-established tool for the assessment of current mood, with very good psychometric properties, especially suited for repeated measures within short intervals (82).

A score is assigned to each dimension, ranging from 4 to 24. High scores indicate positive affectivity, alertness, and relaxation, depending on the dimension. We applied the MDMQ before and after mud bath in study group and also in the control group.

Figure 8: Collection of MDMS data

Figure 9. Subjects' recruitment flow diagram



4.6 Statistical Analysis

Data expressed as mean and SD. Normality of data was tested using Kolmogrov- Smirnov test. A p value of > 0.05 indicated normal Gaussian distribution. As the datasets of HRV were skewed and not normally distributed, Wilcoxon signed rank test and Mann Whitney U test was performed and for the data set of blood pressure variables, paired and unpaired t test was done using Statistical Package for the Social Sciences (SPSS), Version-16.

5. Results

This interventional study was conducted among 60 IT professionals between the age group 20-40 years at a tertiary care hospital, Chennai. Among the 60participants, 50 were apparently healthy and the rest 10 participants were excluded from the study based on the selection criteria. 50 participants who had Techno score high were recruited for the intervention study. They were grouped into the Mud bath group (n- 25) and control group (n-25). There were no differences (p>0.05) between the two groups as regards for age (Figure 10).

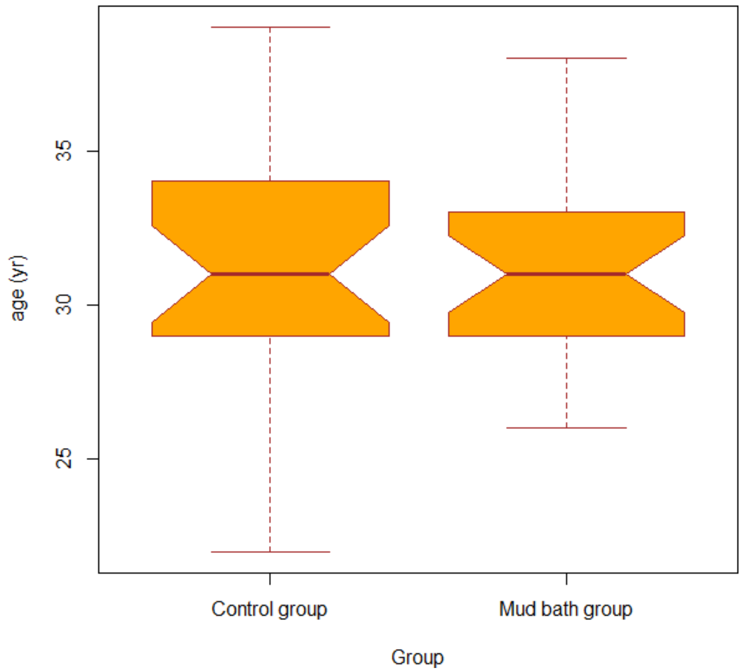


Figure: 10 Comparison of Age between the groups

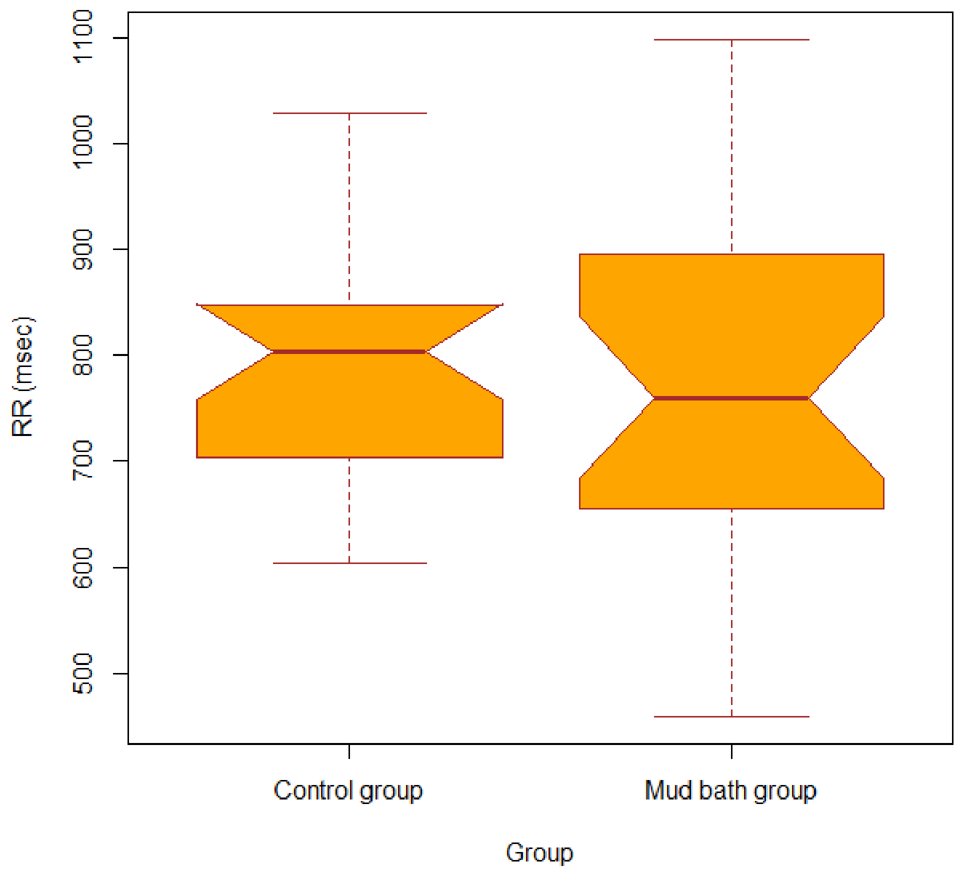


Figure: 11 Comparison of RR intervals before the intervention between the groups

The time domain short term HRV parameters of RR interval in baseline (Figure: 11) showed similar values (Mean R-R – 785.84 (103.88) vs 779.80 (156.77) between the groups. There is no statistical difference (P=0.87).

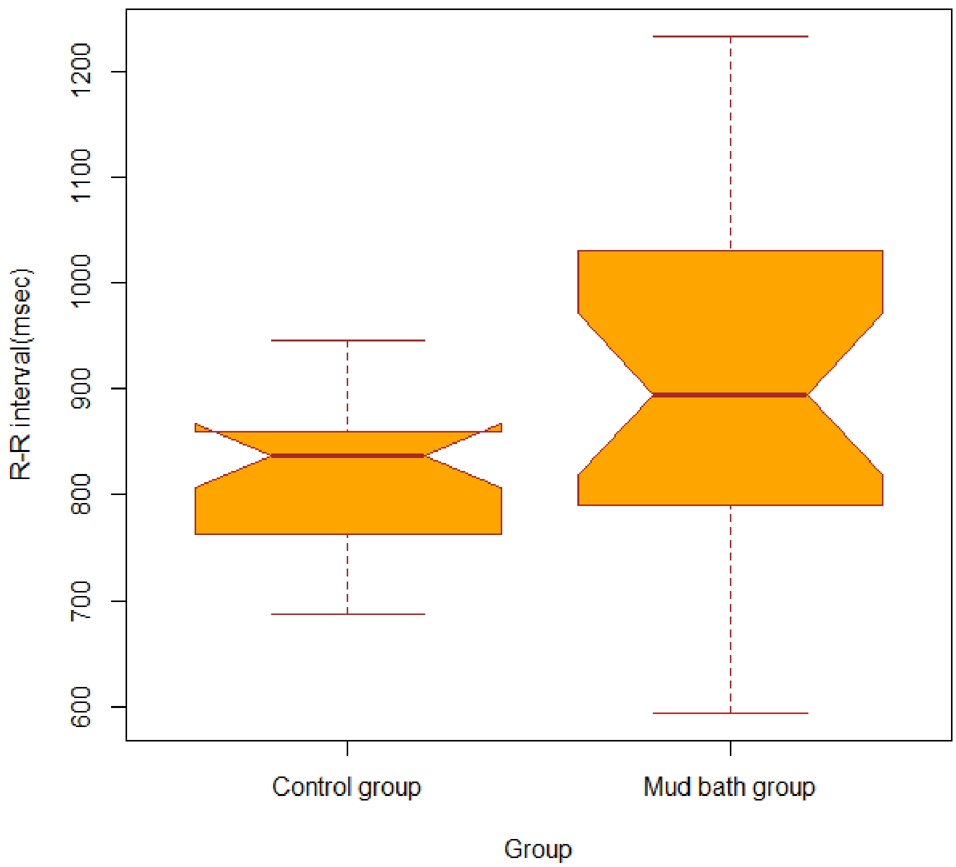


Figure: 12 Comparison of RR intervals After the intervention between the groups

The time domain short term HRV parameters of RR interval after the intervention (Figure:12) showed significant improvement (Mean R-R – 820.79 (65.74) vs 914.80 (156.77) in the mud bath group between the groups. There is no statistical difference (P=0.09).

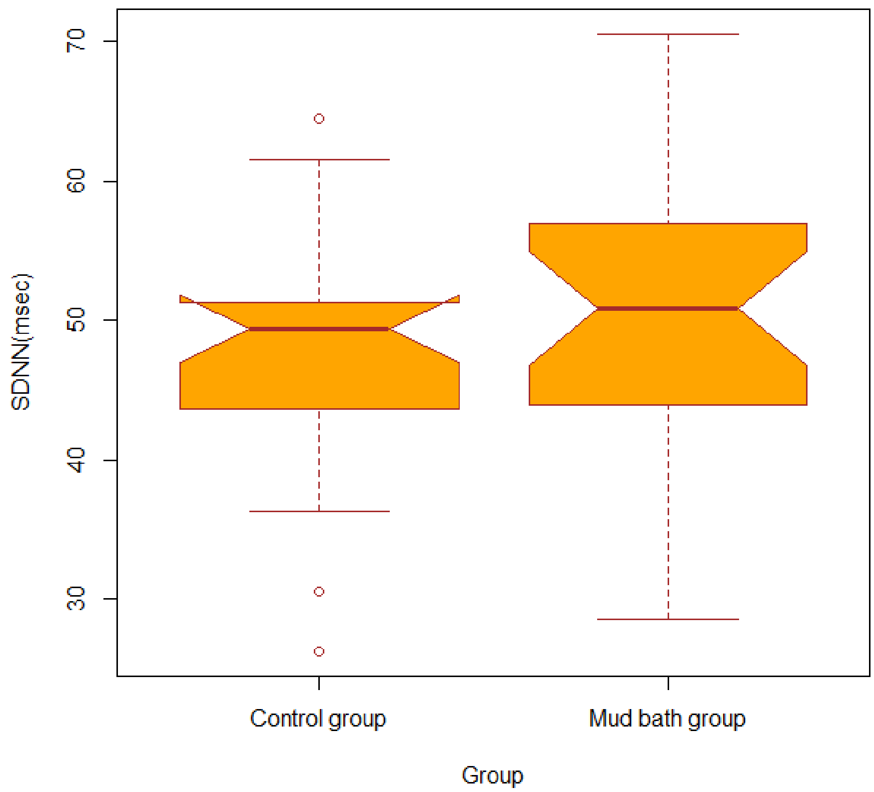


Figure: 13 Comparison of SDNN before the intervention between the groups

The time domain short term HRV parameters of SDNN in baseline (Figure: 13) showed similar values (47.75(8.73 vs 49.81(10.66) between the groups. There is no statistical difference (P=0.45).

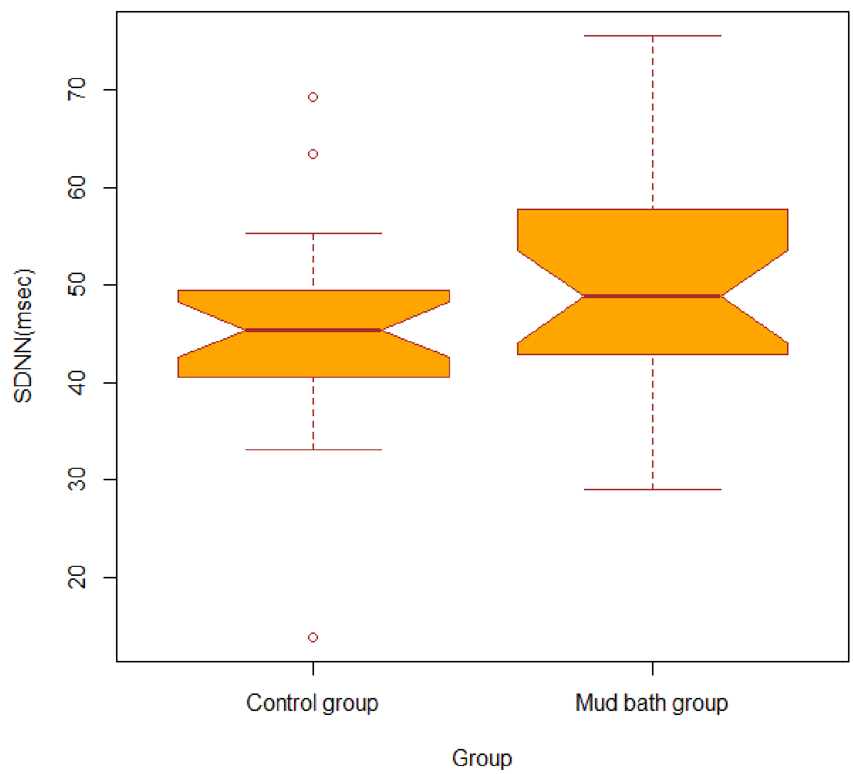


Figure: 14 Comparison of SDNN After the intervention between the groups

The time domain short term HRV parameters of SDNN after the intervention (Figure: 14) showed significant improvement (SDNN: 44.80(10.70) vs 50.78(12.41)) in the mud bath group between the groups. There is no statistical difference (P=0.07).

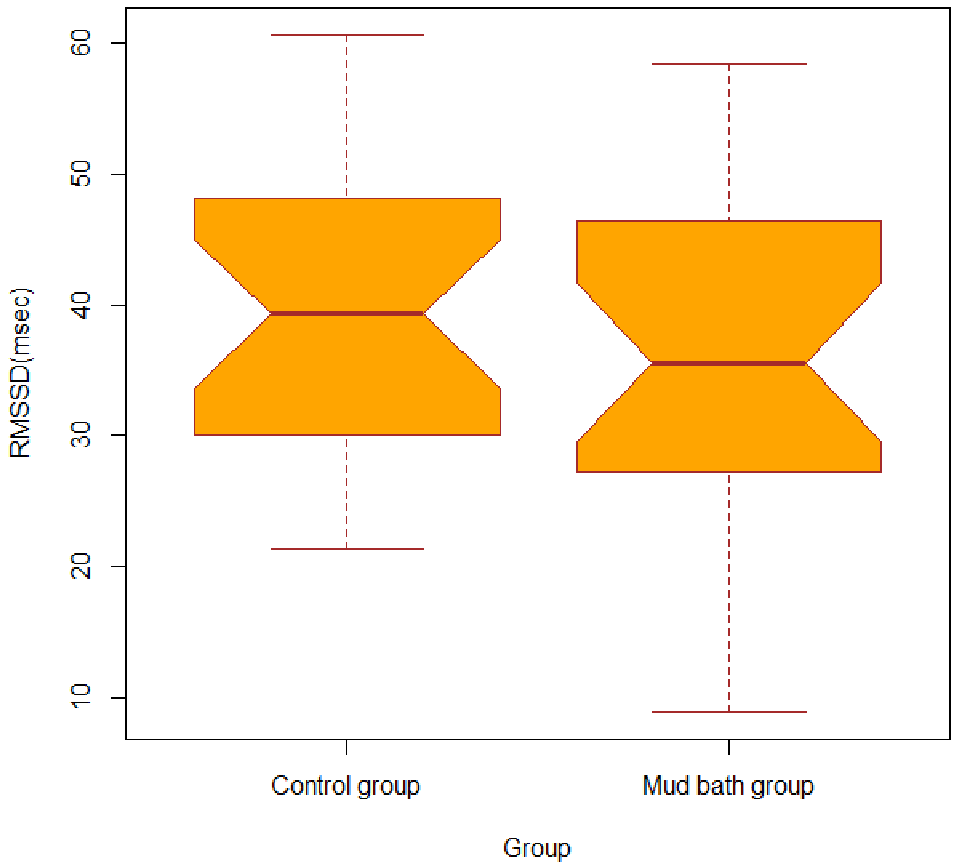


Figure: 15 Comparison of RMSSD before the intervention between the groups

The time domain short term HRV parameters of RMSSD in baseline (Figure: 15) showed similar values (Mean RMSSD 40.00(12.21) vs 36.88(13.20) between the groups. There is no statistical difference (P=0.38).

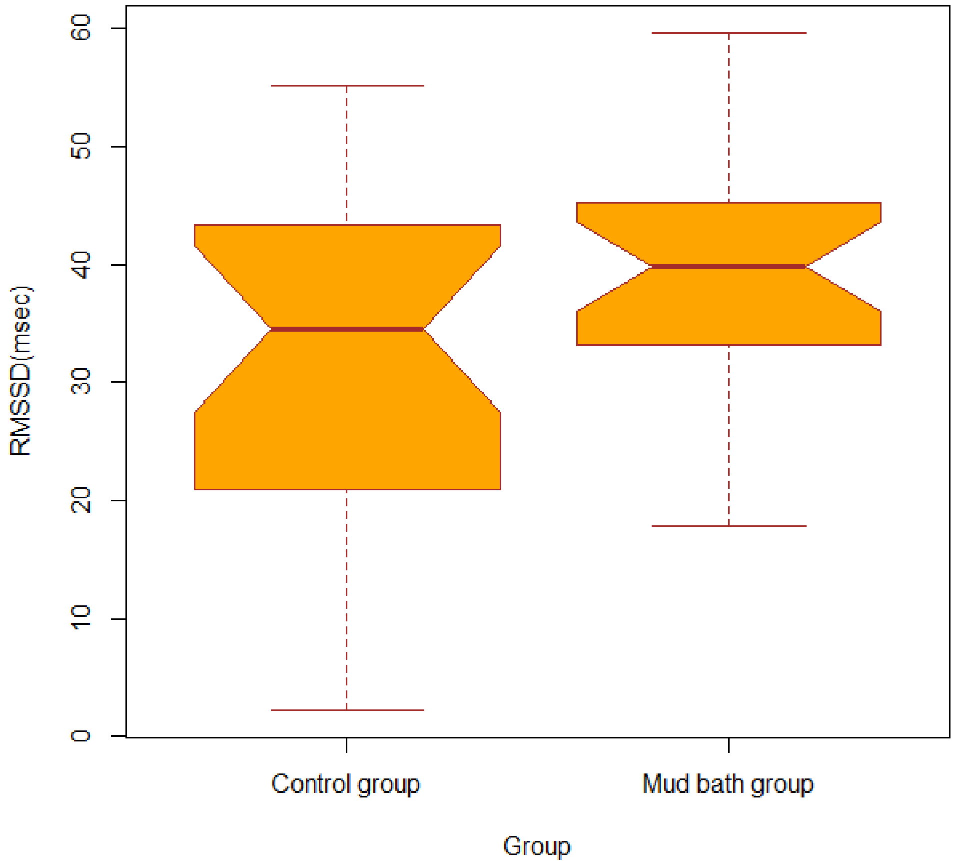


Figure: 16 Comparison of RMSSD after the intervention between the groups

The time domain short term HRV parameters of RMSSD after the intervention (Figure:16) showed significant improvement (RMSSD: 32.26(14.16) vs 39.54(9.77) in the mud bath group between the groups. There is a statistical difference (P=0.04).

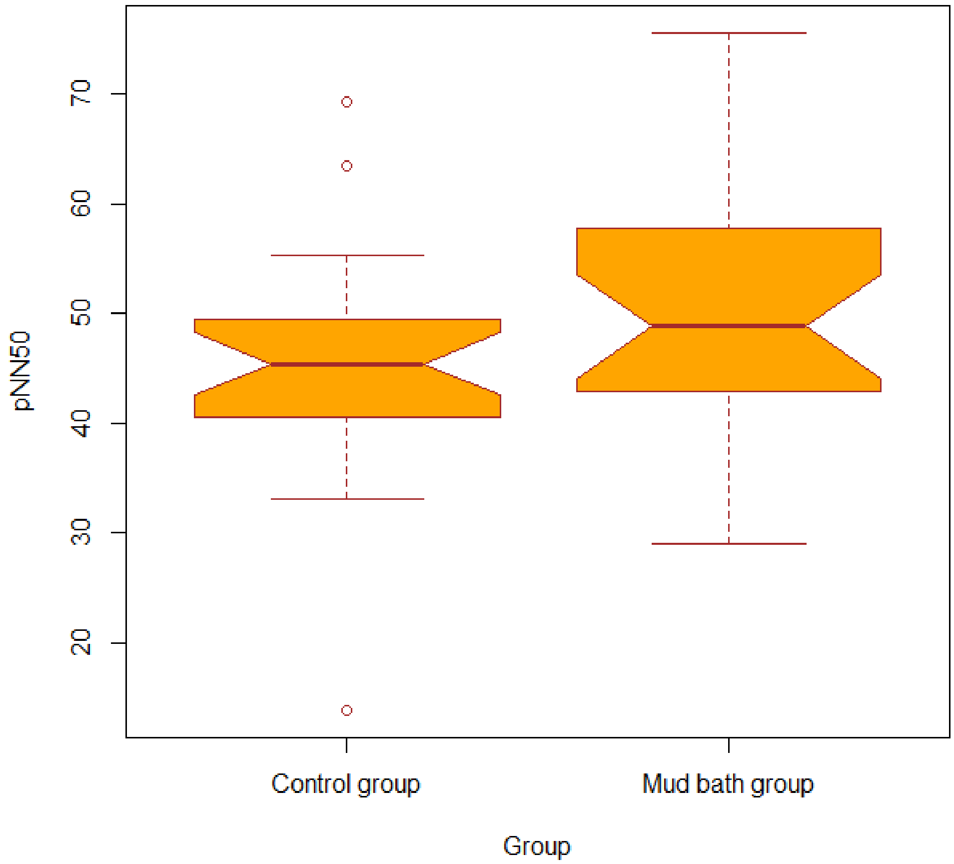


Figure: 17 Comparison of pNN50 before the intervention between the groups

The time domain short term HRV parameters of pNN50 in baseline (Figure: 17) showed similar values (Mean pNN50 14.89(3.13 vs 15.82(3.64)) between the groups. There is no statistical difference (P=0.33).

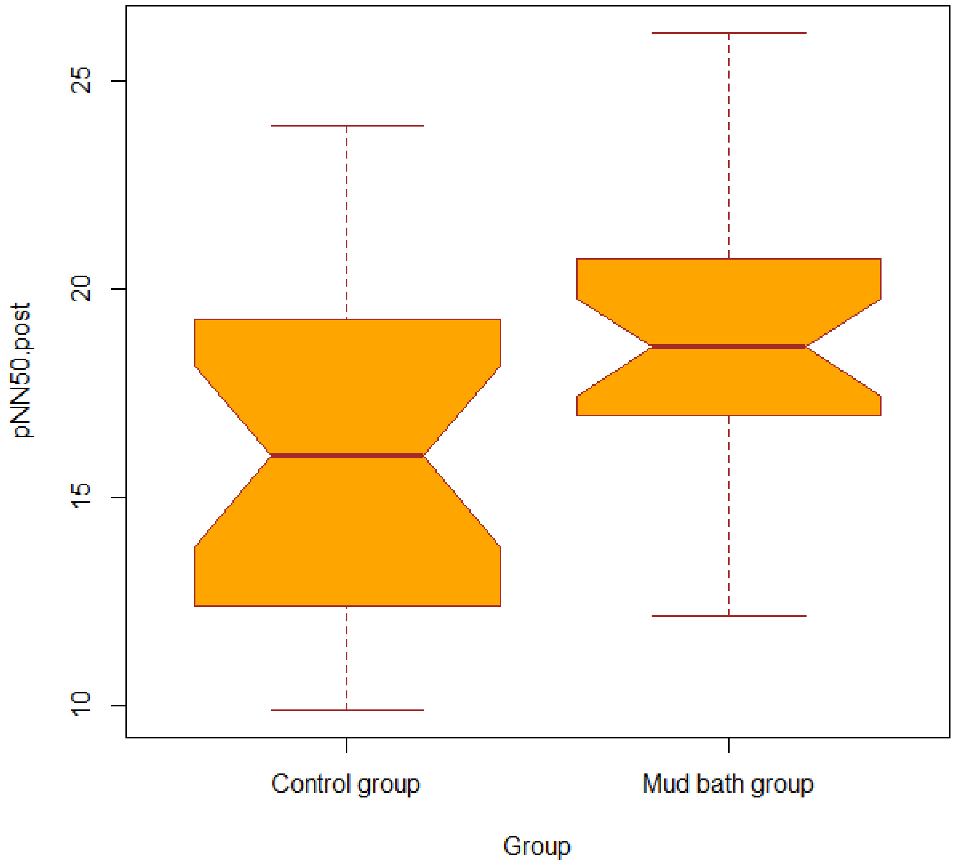


Figure: 18 Comparison of pNN50 after the intervention between the groups

The time domain short term HRV parameters of pNN50 after the intervention (Figure:18) showed significant improvement (pNN50: 16.97(4.20) vs 18.65(3.22) in the mud bath group between the groups. There is a statistical difference (P=0.03).

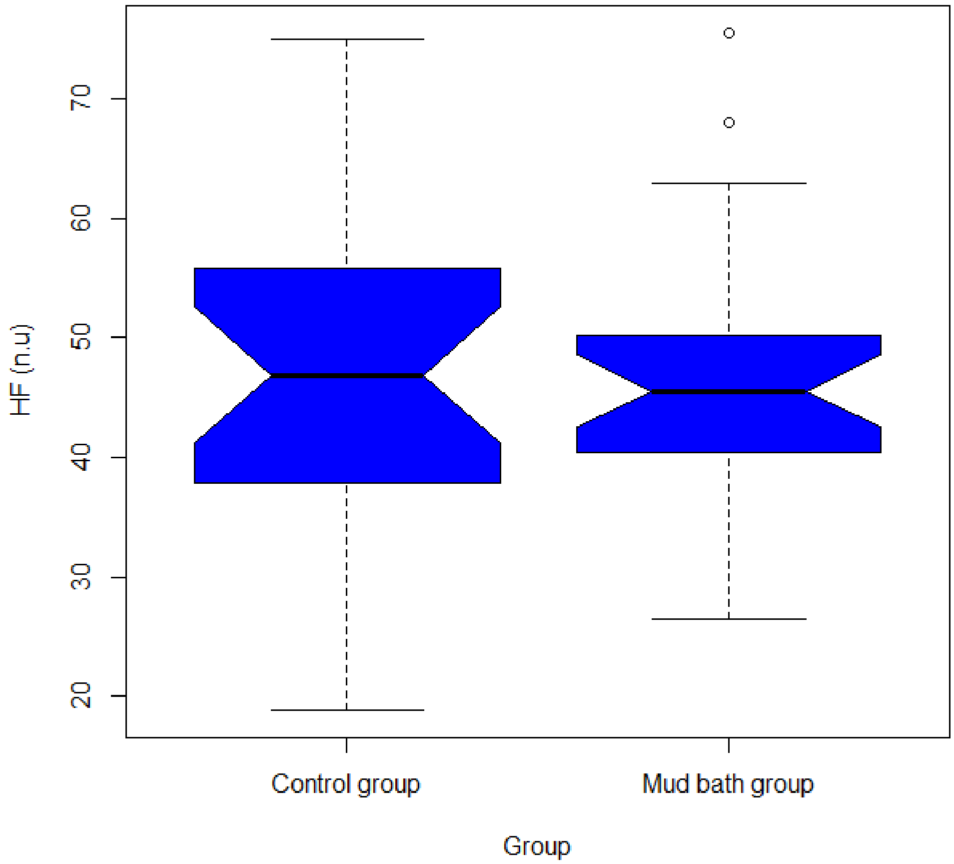


Figure: 19 Comparison of HF(n.u) before the intervention between the groups

The frequency domain short term HRV parameters of HF (n.u) in baseline (Figure: 19) showed similar values (Mean HF (n.u) 46.34(14.20) vs 46.37(12.03)) between the groups. There is no statistical difference (P=0.99).

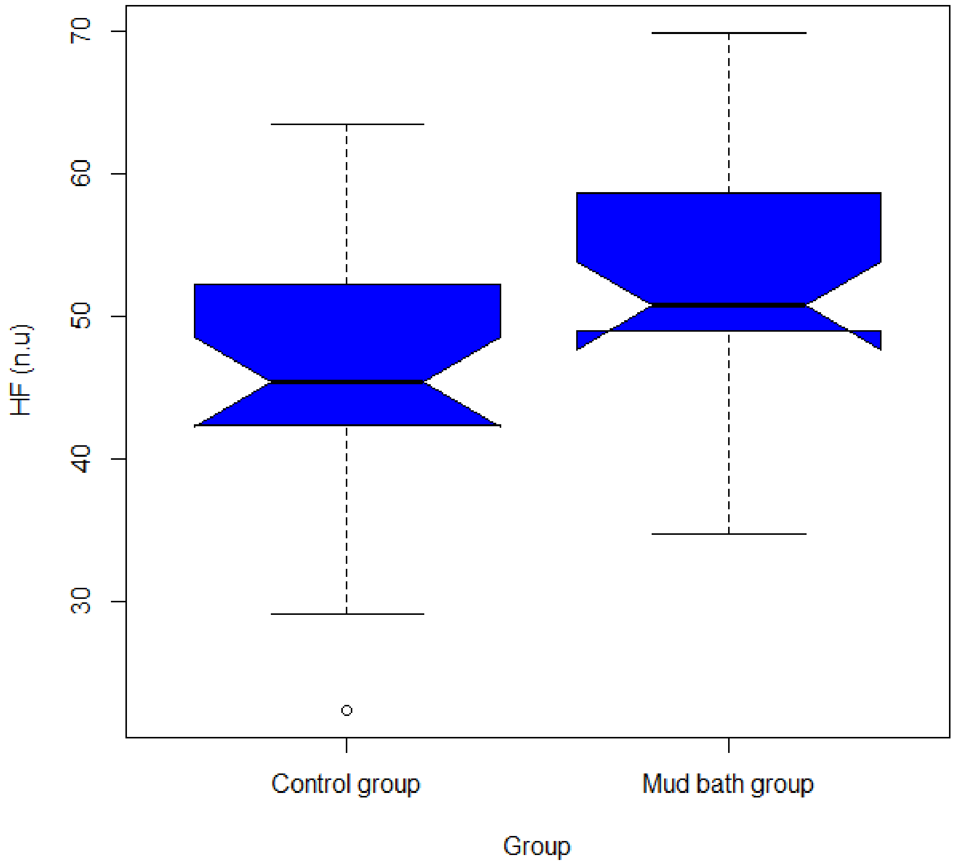


Figure: 20 Comparison of HF (n.u) after the intervention between the groups

The frequency domain short term HRV parameters of HF (n.u) after the intervention (Figure: 20) showed significant improvement (HF (n.u) : 46.35(9.71 vs 52.94(9.27)) in the mud bath group between the groups. There is a statistical difference (P=0.01).

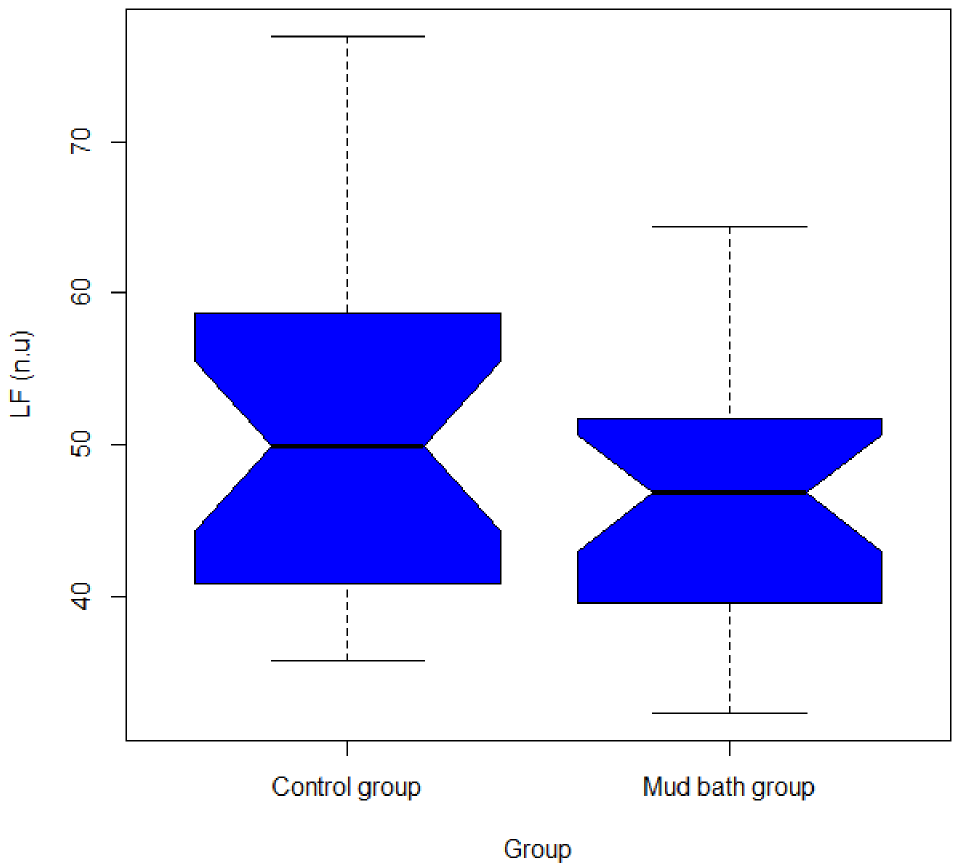


Figure: 21 Comparison of LF (n.u) before the intervention between the groups

The frequency domain short term HRV parameters of LF (n.u) in baseline (Figure: 21) showed similar values (Mean LF (n.u): 50.29 (10.92) vs 46.38(7.99) between the groups. There is no statistical difference (P=0.15).

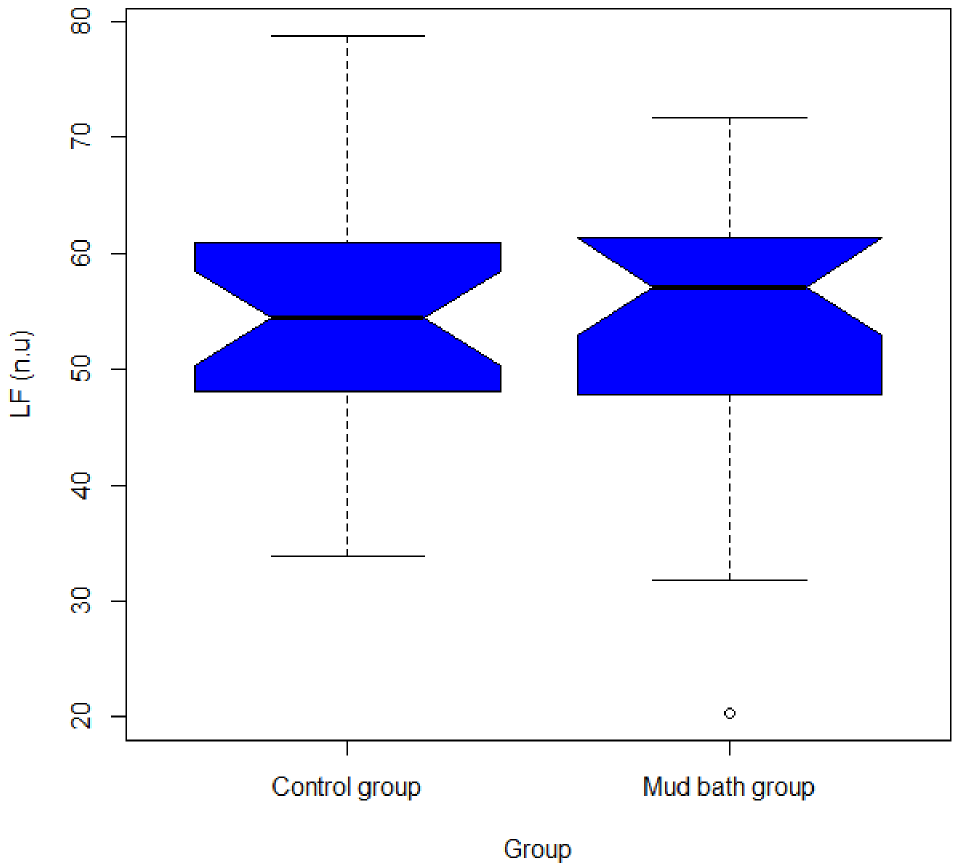


Figure: 22 Comparison of LF (n.u) after the intervention between the groups

The frequency domain short term HRV parameters of LF (n.u) after the intervention (Figure: 22) showed significant improvement (LF (n.u) : 54.10 (10.61) vs 53.04 (11.65)) in the mud bath group between the groups. There is no statistical difference (P=0.73).

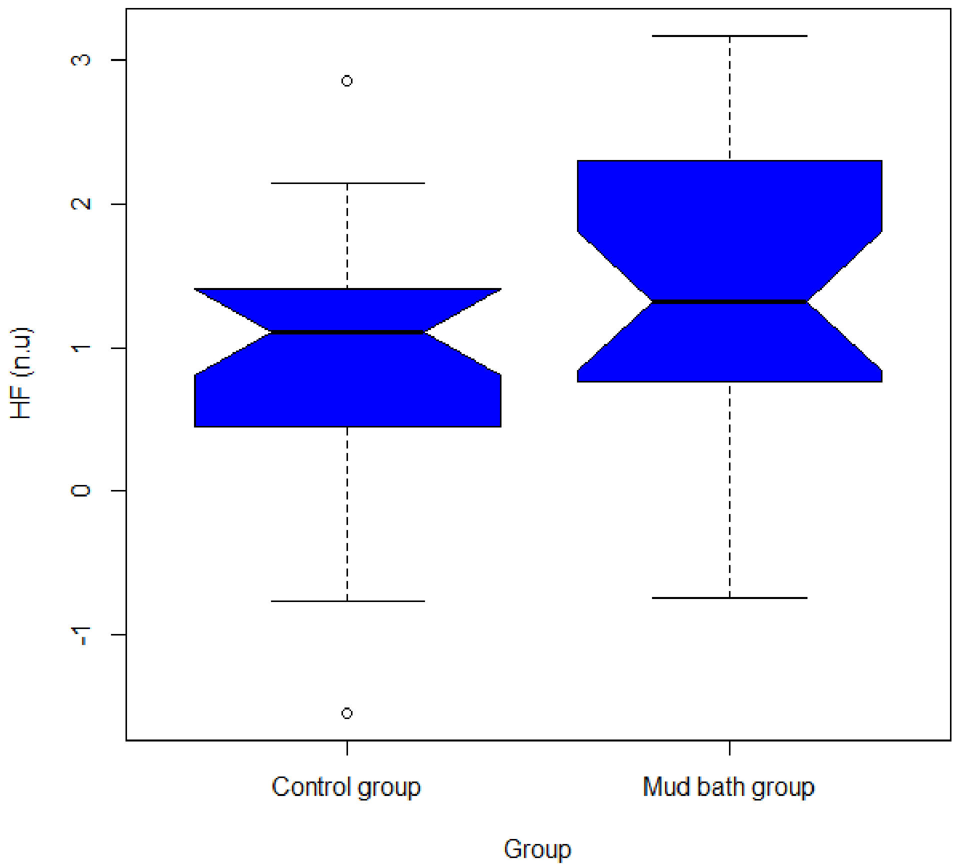


Figure: 23 Comparison of LF/HF ratio before the intervention between the groups

The frequency domain short term HRV parameters of LF/HF ratio in baseline (Figure: 23) showed similar values (Mean LF/HD ratio : 0.99(0.91 vs 1.41(1.06)) between the groups. There is no statistical difference (P=0.09).

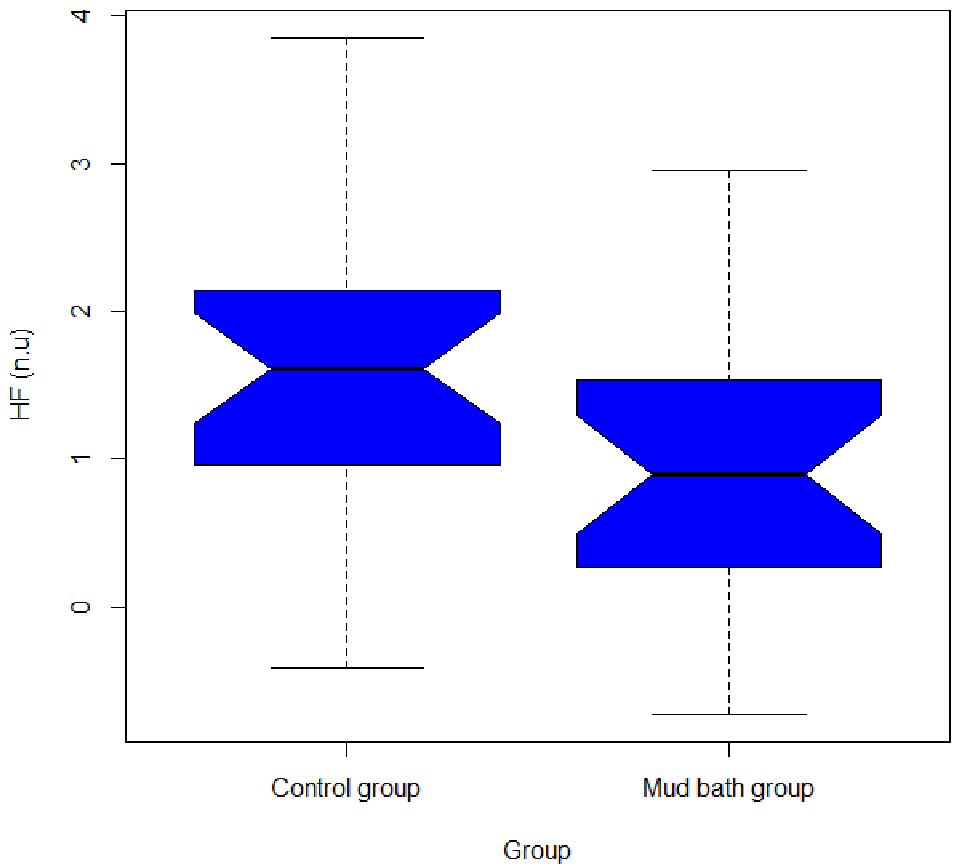


Figure: 24 Comparison of LF/HF ratio after the intervention between the groups

The frequency domain short term HRV parameters of LF/HF ratio after the intervention (Figure: 24) showed significant reduction (LF/HF ratio: 1.62 (1.02) vs 1.02(0.94)) in the mud bath group between the groups. There is a statistical difference (P=0.03).

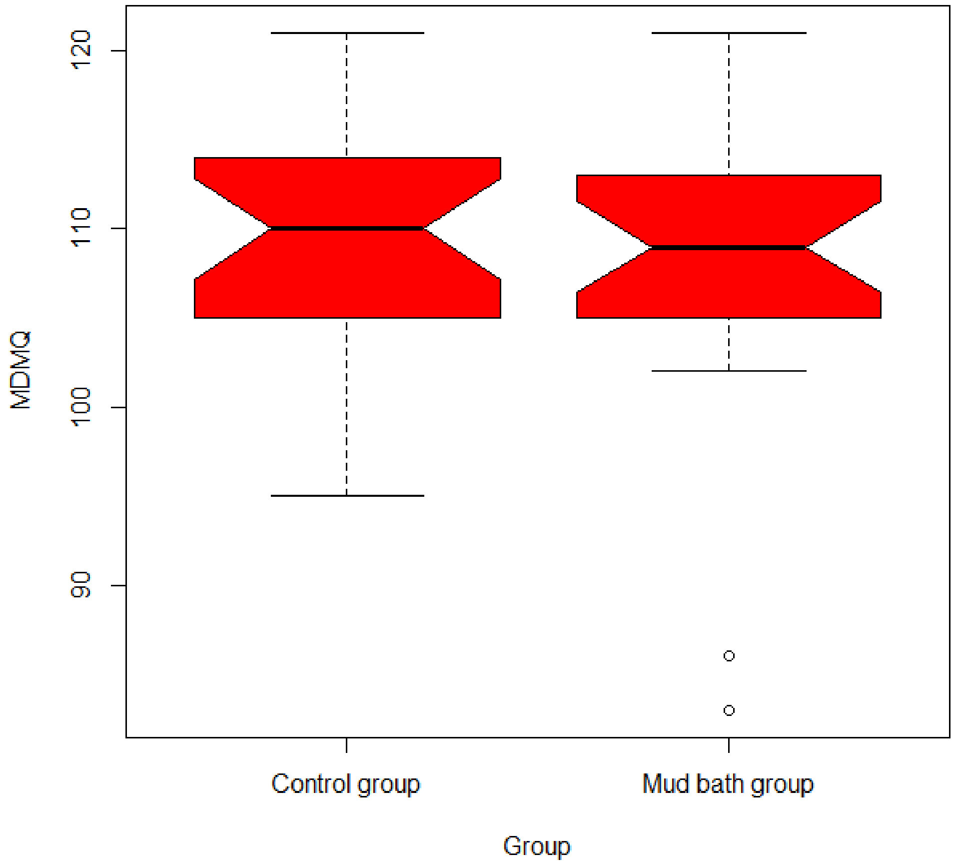


Figure: 25 Comparison of MDMQ scale score before the intervention between the groups

MDMQ scale score in baseline (Figure: 25) showed similar values (Mean MDMQ: 109.36(7.11 vs 108.12(8.79) between the groups. There is no statistical difference (P=0.58).

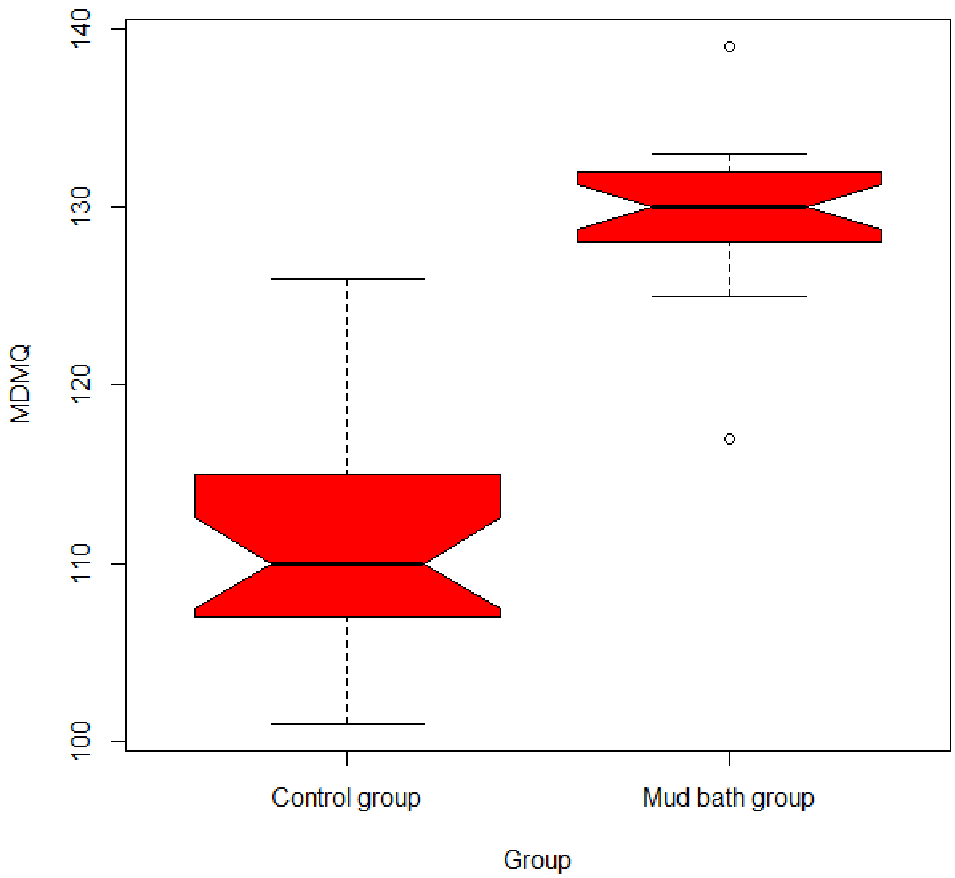


Figure: 26 Comparison of MDMQ scale score after the intervention between the groups

MDMQ scale score after the intervention (Figure: 26) showed significant improvement (Mean MDMQ: 112.12 (6.13) vs 129.52 (3.96)) in the mud bath group between the groups. There is a statistical difference (P=0.000).

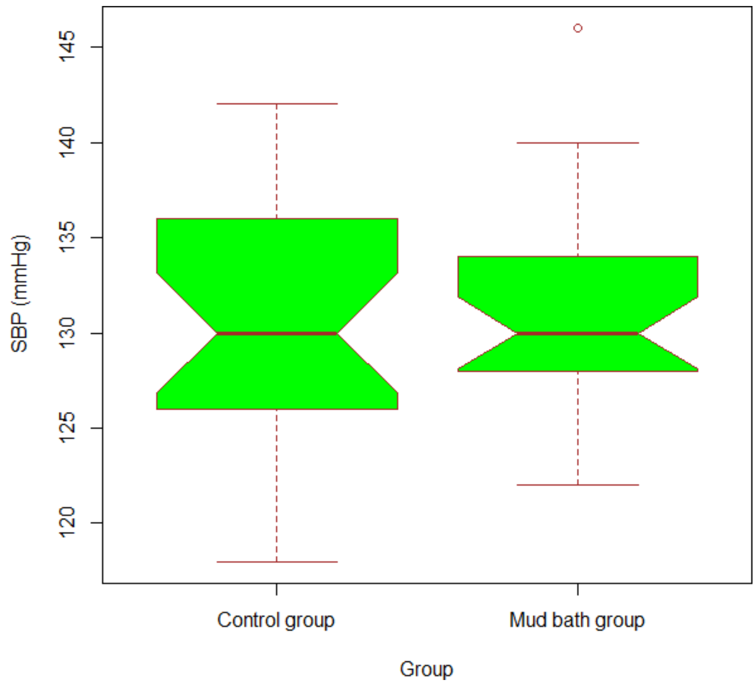


Figure: 27 Comparison of SBP before the intervention between the groups

SBP in baseline (Figure: 27) showed similar values (Mean SBP: 130.72(6.56) vs 130.64(5.58)) between the groups. There is no statistical difference (P=0.96).

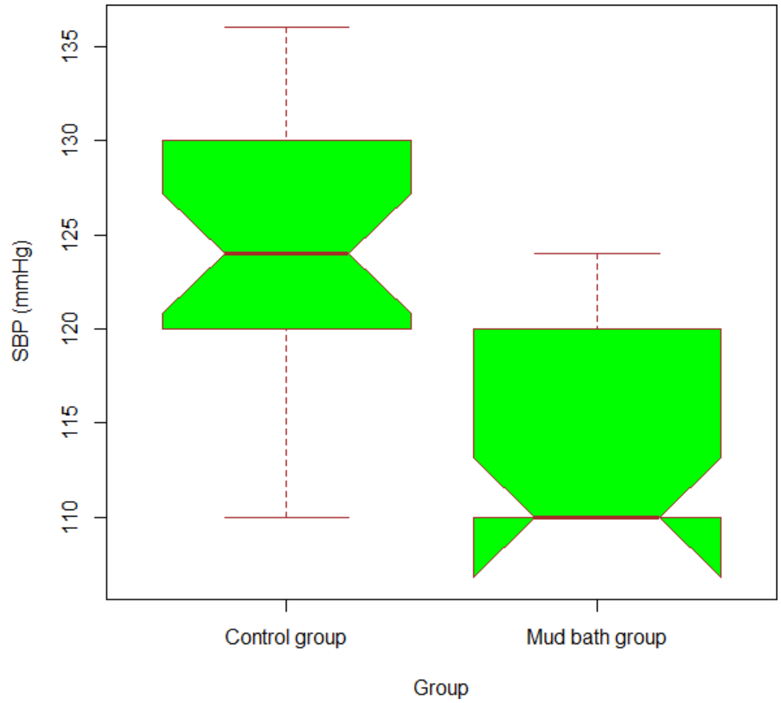


Figure: 28 Comparison of SBP after the intervention between the groups

SBP after the intervention (Figure: 28) showed significant reduction (Mean SBP: 124.56(6.46) vs 114.40(5.00)) in the mud bath group between the groups. There is a statistical difference (P=0.001).

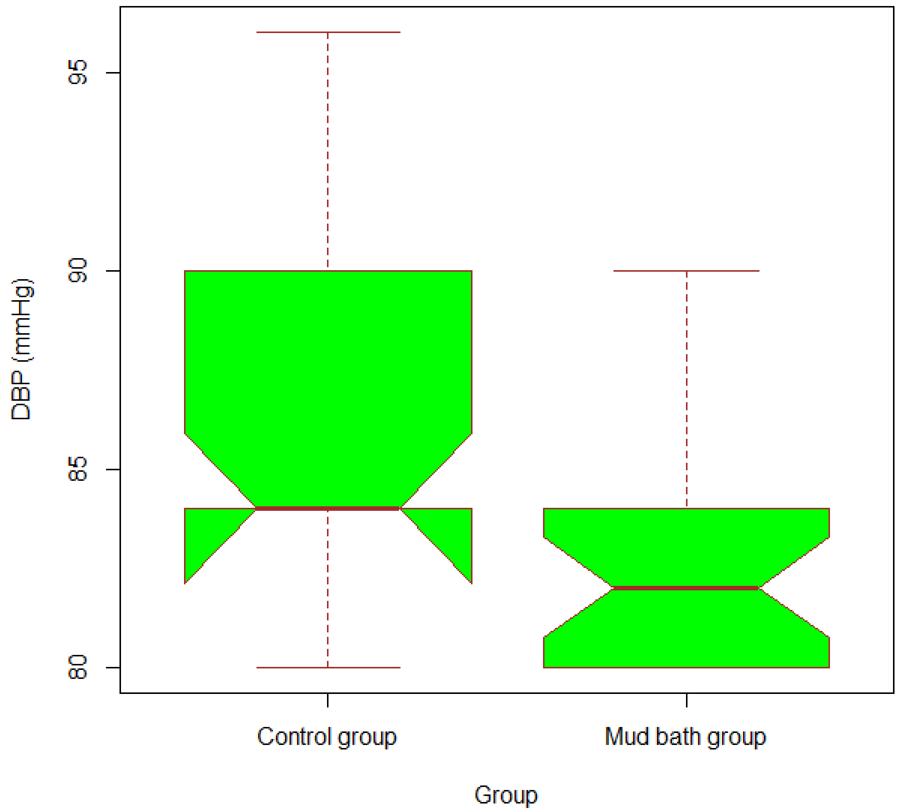


Figure: 29 Comparison of DBP before the intervention between the groups

DBP in baseline (Figure: 29) showed similar values (Mean DBP: 85.79 (4.66) vs 82.64(3.20)) between the groups. There is no statistical difference (P=0.08).

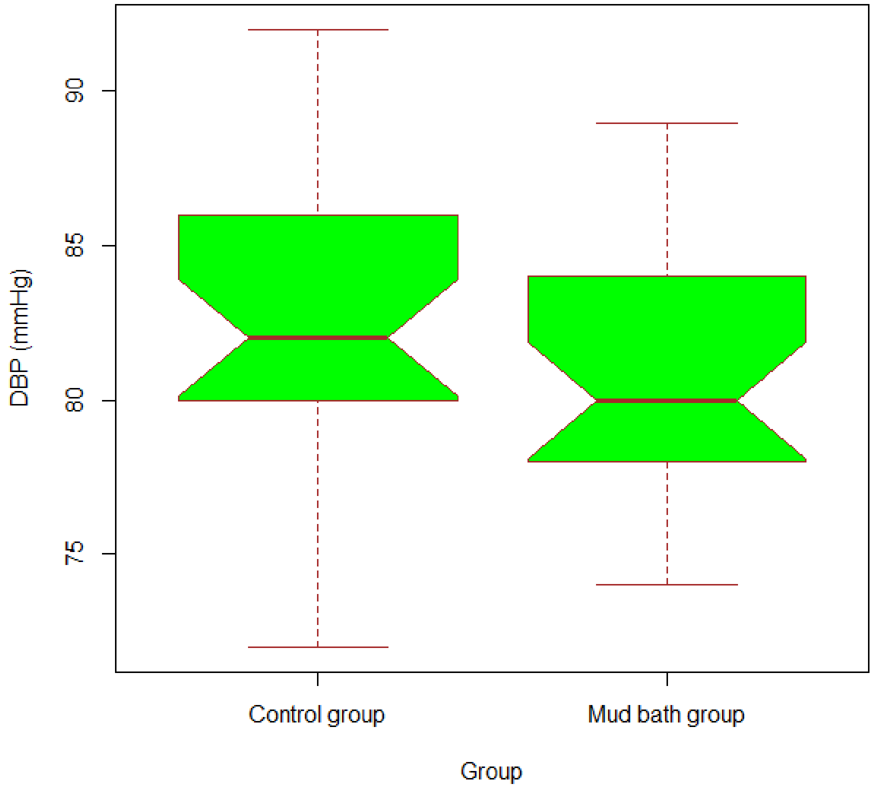


Figure: 30 Comparison of DBP after the intervention between the groups

DBP after the intervention (Figure: 30) showed significant reduction (Mean DBP: 83.32(4.90) vs 80.44 (4.32)) in the mud bath group between the groups. There is a statistical difference (P=0.03).

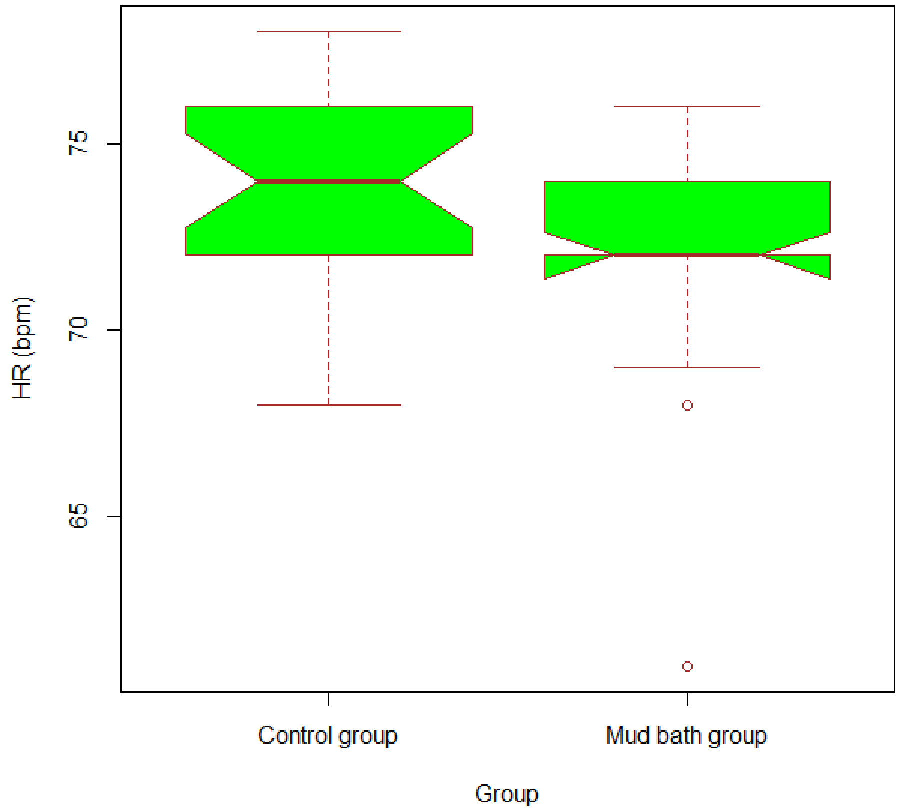


Figure: 31 Comparison of HR before the intervention between the groups

HR in baseline (Figure: 31) showed similar values (Mean HR: 73.92 (2.79) vs 72.28(3.51)) between the groups. There is no statistical difference (P=0.07)

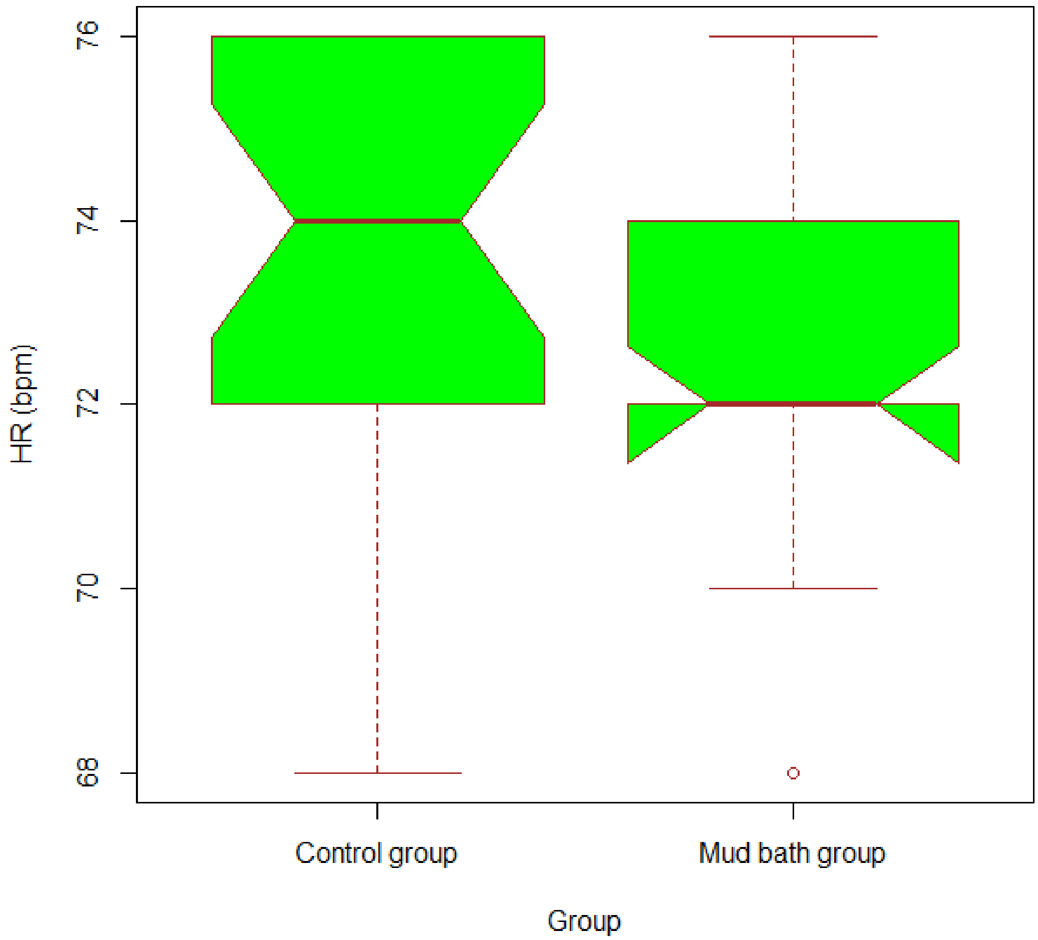


Figure: 32 Comparison of HR after the intervention between the groups

HR after the intervention (Figure: 32) showed not much significant reduction (Mean HR: 73.28 (2.37) vs 72.32 (1.79)) in the mud bath group between the groups. There is no statistical difference (P=0.11).

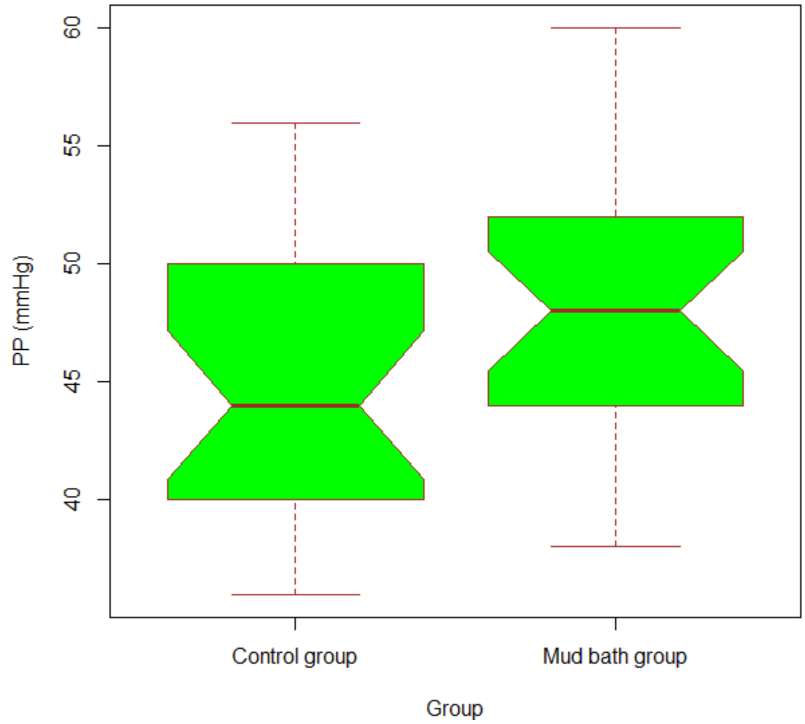


Figure: 33 Comparison of PP before the intervention between the groups

PP in baseline (Figure: 33) showed slightly changed values (Mean PP: 44.96 (5.45) vs 48.32(5.99)) between the groups. There is a statistical difference (P=0.04). But both the values are within the normal range.

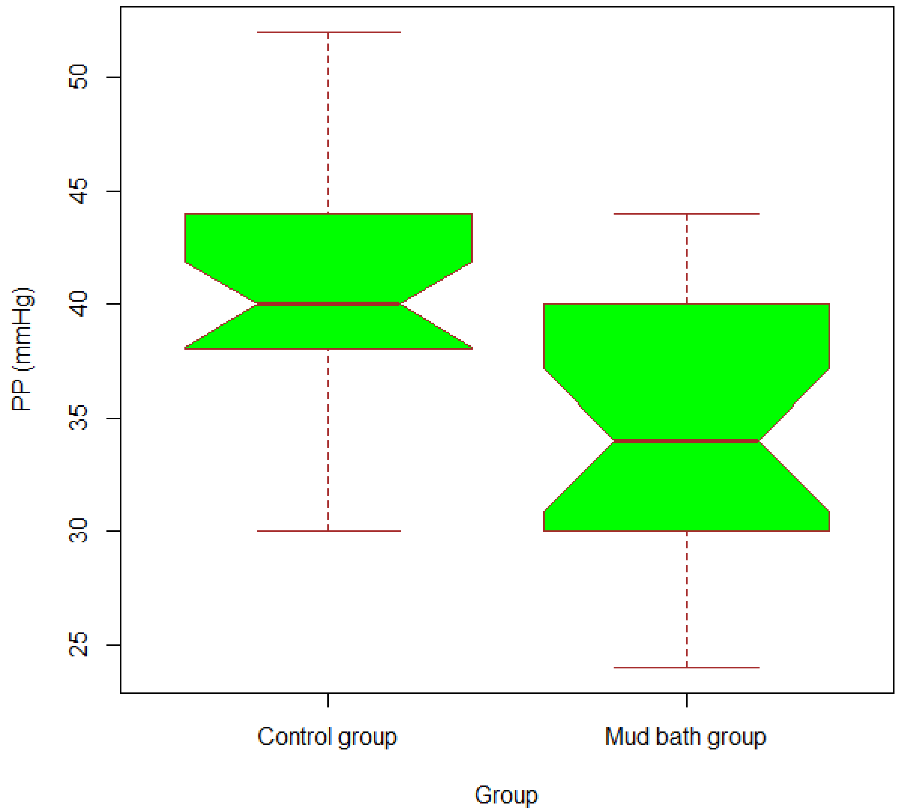


Figure: 34 Comparison of PP after the intervention between the groups

PP after the intervention (Figure: 34) showed significant reduction (Mean PP: 41.44 (6.57) vs 34.64(5.37)) in the mud bath group between the groups. There is a statistical difference (P=0.001).

Table: 3- Comparison of Short term HRV parameters between the groups

HRV variables	Before intervention		P value	After intervention		P value
	Control Group	Mud bath Group		Control Group	Mud bath Group	
RR interval	785.84 (103.88)	779.80 (156.77)	0.87	820.79 (65.74)	914.80 (156.77)	0.09
SDNN	47.75 (8.73)	49.81 (10.66)	0.45	44.80 (10.70)	50.78 (12.41)	0.07
RMSSD	40.00 (12.21)	36.88 (13.20)	0.38	32.26 (14.16)	39.54 (9.77)	**0.04**
pNN50	14.89 (3.13	15.82 (3.64)	0.33	16.97 (4.20)	18.65 (3.22)	**0.03**
HF(n.u)	46.34 (14.20)	46.37 (12.03	0.99	46.35 (9.71)	52.94 (9.27)	**0.01**
LF (n.u	50.29 (10.92	46.38 (7.99)	0.15	54.10 (10.61)	53.04 (11.65)	0.73
LF/HF ratio	0.99 (0.9)	1.41 (1.06)	0.09	1.62 (1.0)	1.02 (0.94)	**0.03**

6. Discussion

This study of a two weeks mud bath intervention showed significant effect on HRV, with a significant increase in SDNN, pNN50%, the NN50, and the HF power component increased, and the LF/HF ratio decreased, but failed to reach statistical significance for LF.

Few other studies have looked into the effects of Mud bath interventions on HRV in healthy individuals. Specifically, previous findings show that acute effects include increased HRV at after having Mud bath. Findings from previous small-scale studies have suggested that Mud bathing significantly increase cardiac vagal modulation which, in turn, suggests a greater parasympathetic control.

HRV is a very sensitive measure and high HRV indicates greater parasympathetic control. In the view of observations of stress-associated variation in HRV and existing neurobiological evidence, HRV may be used as an objective assessment of stress and mental health. Many studies have found an association between mental health and HRV. However, since HRV is associated with various stress factors, physical conditions and lifestyle habits which including physiological factors (e.g., breathing, circadian rhythms, and posture), non-modifiable factors (e.g., age, sex, and genetic factors), modifiable lifestyle factors (e.g., obesity, metabolic syndrome, physical activity, smoking, and drinking), and other factors (e.g., medication).

Findings of the present study showed that parasympathetic domination of vagal

Nerve reflected with increased HRV. Greater cardiac vagal tone may offer a survival benefit. Better vagal influence declines the amount of work and oxygen spent by the heart via a decrease in resting heart rate and myocardial contractility. It seems that stimulation of the vagus nerve directly acts on the sinus node (SA) and the myocardium, and delays sympathetic effects. Cardiac vagal tone might also decrease the threat of commonly lethal ventricular dysrhythmias including ventricular fibrillation.

It's possible that peripheral vasodilation in response to cold temperature with full mud bath is the mechanism of action suggesting parasympathetic dominance.Thermic and chemical effects of a thorough mud bath are also possibilities.According to a study, when mud is applied to the human, considerable mineraland percutaneous cationic exchanges, as well as other chemical changes, occur.Furthermore, taking a mud bath is usually found to be beneficial and relaxing. The relaxing and stress-relieving effect, however, is part of physicians' and patients' knowledge gained from experience but has not been scientifically examined to date. To our knowledge, the present study is the firstto examine the stress-relieving effects of full Mud baths. The findings suggest that Mud baths can have a positive, effect on the stress levels of highly stressed Technostress subjects. Accordingly, Mud baths could be an effective therapeutic intervention for stress reduction as an integral part of multimodal burnout prevention programs for the Technostress subjects for an effective stress management.

Limited research to date suggests that Mud bathing (immediate and long term application) increases cardiac vagal tone and reduces sympathetic cardiac influences. The exact mechanisms underlying the modification of HRV by Mud therapy are not known. However, more research is required to substantiate these claims, particularly with respect to full Mud bathing.

7. Conclusion

- This pilot study has presented preliminary evidence for the stress-relieving effects of two weeks Mud baths, which have been found to reduce the stress level in adults with an above-average level of Techno stress. As a result, Mud baths might be considered a sensible and recommended therapeutic tool to manage the Techno stress.
- In addition to this, mud bath also reduces the blood pressure among the participants, so it can be an effective therapeutic intervention for prevention ofLifestyle disorders in near future.
- There was an improvement in the Mood dimension of the participants after the full mud bath intervention and it would help them to maintain mental health as well.
- Limitation of this study is that the number of subjects participated in the study was relatively small.
- To improve the reliability and generalizability of the results, further research needs to be conducted using a larger sample size with greater control of confounding factors and matching on more socio-demographic variables.

References

1. Baqutayan SMSJMJoSS. Stress and coping mechanisms: A historical overview. 2015;6(2 S1):479-.
2. Selye HJM. What is stress. 1956;5(5):525-30.
3. Nakao MJBm. Work-related stress and psychosomatic medicine. 2010;4(1):1-8.
4. Walz KJMSS. Stress related issues due to too much technology: Effects on working professionals. 2012;11:3-2012.
5. Kortum E, Leka S, Cox TJIjoom, health e. Psychosocial risks and work-related stress in developing countries: health impact, priorities, barriers and solutions. 2010;23(3):225-38.
6. Jena R, Mahanti PJIJoE, Learning. An empirical study of Technostress among Indian academicians. 2014;3(2):1-10.
7. Ossebaard HCJAp, biofeedback. Stress reduction by technology? An experimental study into the effects of brainmachines on burnout and state anxiety. 2000;25(2):93-101.
8. Fleming SA, Gutknecht NCJPCCiOP. Naturopathy and the primary care practice. 2010;37(1):119-36.
9. Alter JSJB, Society. Nature cure and Ayurveda: Nationalism, viscerality and bio-ecology in India. 2015;21(1):3-28.
10. Cayleff SE. Nature's path: a history of naturopathic healing in America: JHU Press; 2016.

11. Pandiaraja M, Vanitha A, Maheshkumar K, Manavalan N, Venugopal VJJoC, Medicine I. Effects of 12 sessions of steam bath intervention on spirometry parameters among healthy adult volunteers. 2021.

12. Pandiaraja M, Vanitha A, Maheshkumar K, Venugopal V, Poonguzhali S, Radhika L, et al. Effect of the steam bath on resting cardiovascular parameters in healthy volunteers. 2020.

13. Maheshkumar K, Pandiaraja M, Venugopal V, Poonguzhali S, Sundareswaran LJTF. Effects of hot foot and arm bath in bronchial asthma: A single case report. 2020;42:101651.

14. Maheshkumar K, Venugopal V, Poonguzhali S, Mangaiarkarasi N, Venkateswaran S, Manavalan NJCE, et al. Trends in the use of Yoga and Naturopathy based lifestyle clinics for the management of Non-communicable diseases (NCDs) in Tamilnadu, South India. 2020;8(2):647-51.

15. Shankar K, Liao LPJPM, Clinics R. Traditional systems of medicine. 2004;15(4):725-47.

16. Nair PM, Nanda AJFoA, Therapies C. Naturopathic medicine in I ndia. 2014;19(3):140-7.

17. Chadzopulu A, Adraniotis J, Theodosopoulou EJPHS. The therapeutic effects ofmud. 2011;1(2):132-6.

18. Rastogi R. Therapeutic uses of Mud therapy in Naturopathy. 2012.

19. Carretero MIJACS. Clay minerals and their beneficial effects upon

Human health. A review. 2002;21(3-4):155-63.

20. Lindlahr H. Practice of natural therapeutics: Lindlahr Publishing Company;1920.

21. Dohms JE, Metz AJVI, Immunopathology. Stress—mechanisms of immunosuppression. 1991;30(1):89-109.

22. Krantz DS, Santiago HT, Kop WJ, Merz CNB, Rozanski A, Gottdiener JSJTAjoc. Prognostic value of mental stress testing in coronary artery disease. 1999;84(11):1292-7.

23. Kario K, Bruce SM, Thomas GPJHR. Disasters and the heart: a review of the effects of earthquake-induced stress on cardiovascular disease. 2003;26(5):355-67.

24. Hall M, Vasko R, Buysse D, Ombao H, Chen Q, Cashmere JD, et al. Acute stress affects heart rate variability during sleep. 2004;66(1):56-62.

25. Vrijkotte TG, Van Doornen LJ, De Geus EJJH. Effects of work stress on ambulatory blood pressure, heart rate, and heart rate variability. 2000;35(4):880-6.

26. Cohen H, Benjamin J, Geva AB, Matar MA, Kaplan Z, Kotler MJPr. Autonomicdysregulation in panic disorder and in post-traumatic stress disorder: application of power spectrum analysis of heart rate variability at rest and in response to recollection of trauma or panic attacks. 2000;96(1):1-13.

27. Boltwood MD, Taylor CB, Burke MB, Grogin H, Giacomini JJTAjoc.

Anger report predicts coronary artery vasomotor response to mental stress in atherosclerotic segments. 1993;72(18):1361-5.

28. Dakak N, Quyyumi AA, Eisenhofer G, Goldstein DS, Cannon III ROJTAjoc. Sympathetically mediated effects of mental stress on the cardiac microcirculation ofpatients with coronary artery disease. 1995;76(3):125-30.

29. Finlay JM, Zigmond MJJNr. The effects of stress on central dopaminergicneurons: possible clinical implications. 1997;22(11):1387-94.

30. Horger BA, Roth RHJCRiN. The role of mesoprefrontal dopamine neurons in stress. 1996;10(3-4).

31. Spielberger CD, Smith LHJJoEP. Anxiety (drive), stress, and serial-positioneffects in serial-verbal learning. 1966;72(4):589.

32. Dooley D, Fielding J, Levi LJAroph. Health and unemployment. 1996;17(1):449-65.

33. Avison W, Gotlib IH. Stress and mental health: Contemporary issues andprospects for the future: Springer Science & Business Media; 1994.

34. Thomas GDJAipe. Neural control of the circulation. 2011;35(1):28-32.

35. Goldberger AL, Rigney DR, West BJJSA. Chaos and fractals in humanphysiology. 1990;262(2):42-9.

36. Saladin K, Miller L. Anatomy & Physiology. New York: WCB. McGraw-Hill;1998.

37. Koeppen BM, Stanton BA. Renal Physiology E-Book: Mosby

PhysiologyMonograph Series: Elsevier Health Sciences; 2012.

38. Mancia G, Grassi G, Pomidossi G, Gregorini L, Bertinieri G, Parati G, et al. Effects of blood-pressure measurement by the doctor on patient's blood pressure andheart rate. 1983;322(8352):695-8.

39. Ogedegbe G, Pickering TJCc. Principles and techniques of blood pressuremeasurement. 2010;28(4):571-86.

40. Dragano N, Lunau TJCoip. Technostress at work and mental health: conceptsand research results. 2020;33(4):407-13.

41. Brod C. Technostress: The human cost of the computer revolution: Reading,Mass.: Addison-Wesley; 1984.

42. Weil MM, Rosen LD. Technostress: Coping with technology@ work@ home@ play: J. Wiley New York; 1997.

43. Spielberger CD, Reheiser ECJAPH, Well-Being. Assessment of emotions: Anxiety, anger, depression, and curiosity. 2009;1(3):271-302.

44. Leong FT, Bonz MH, Zachar PJCPQ. Coping styles as predictors of college adjustment among freshmen. 1997;10(2):211-20.

45. Tarafdar M, Tu Q, Ragu-Nathan TJJomis. Impact of technostress on end-user satisfaction and performance. 2010;27(3):303-34.

46. Chen LJJoIT, Management I. Validating the technostress instrument using a sample of Chinese knowledge workers. 2015;24(1):5.

47. Burke MSJNet. The incidence of technological stress among baccalaureate

nurse educators using technology during course preparation and delivery. 2009;29(1):57-64.

48. Yavuz SJTOJoET-T. Developing a technology attitude scale for pre-service chemistry teachers. 2005;4(1):17-25.

49. Tarafdar M, Tu Q, Ragu-Nathan BS, Ragu-Nathan TJJomis. The impact of technostress on role stress and productivity. 2007;24(1):301-28.

50. Barley SR, Meyerson DE, Grodal SJOS. E-mail as a source and symbol of stress. 2011;22(4):887-906.

51. Raišienė AG, Jonušauskas SJE, issues s. Silent issues of ICT era: impact of techno-stress to the work and life balance of employees. 2013;1:108-15.

52. Ghislieri C, Emanuel F, Molino M, Cortese CG, Colombo LJFip. New technologies smart, or harm work-family boundaries management? Gender differences in conflict and enrichment using the JD-R theory. 2017;8:1070.

53. Meinlschmidt G, Lee J-H, Stalujanis E, Belardi A, Oh M, Jung EK, et al. Smartphone-based psychotherapeutic micro-interventions to improve mood in a real-world setting. 2016;7:1112.

54. Hechtman L. Clinical naturopathic medicine: Elsevier Health Sciences; 2018.

55. Ayyagari R, Grover V, Purvis RJMq. Technostress: Technological antecedentsand implications. 2011:831-58.

56. Park SB, Lee BC, Jeong KSJIJoN. Standardized tests of heart rate variability forautonomic function tests in healthy Koreans. 2007;117(12):1707-17.

57. Bilchick KC, Berger RDJJoce. Heart rate variability. 2006;17(6):691.

58. Maheshkumar K, Dilara K, Maruthy K, Sundareswaren LJNAjoms. Validation of PC-based sound card with biopac for digitalization of ECG recording in short-term HRV analysis. 2016;8(7):307.

59. Longin E, Gerstner T, Schaible T, Lenz T, König S. Maturation of the autonomic nervous system: differences in heart rate variability in premature vs. term infants. 2006.

60. Hon EHJAJOG. Electronic evaluations of the fetal heart rate patterns preceding fetal death, further observations. 1965;87:814-26.

61. Ewing DJ, Martyn CN, Young RJ, Clarke BFJDc. The value of cardiovascular autonomic function tests: 10 years experience in diabetes. 1985;8(5):491-8.

62. Wolf M, Varigos G, Hunt D, Sloman JJMJoA. Sinus arrhythmia in acute myocardial infarction. 1978;2(2):52-3.

63. Akselrod S, Gordon D, Ubel FA, Shannon DC, Berger A, Cohen RJJs. Power spectrum analysis of heart rate fluctuation: a quantitative probe of beat- to-beat

cardiovascular control. 1981;213(4504):220-2.

64. Pomeranz B, Macaulay R, Caudill MA, Kutz I, Adam D, Gordon D, et al. Assessment of autonomic function in humans by heart rate spectral analysis. 1985;248(1):H151-H3.

65. Pagani M, Lombardi F, Guzzetti S, Rimoldi O, Furlan R, Pizzinelli P, et al. Power spectral analysis of heart rate and arterial pressure variabilities as a marker of sympatho-vagal interaction in man and conscious dog. 1986;59(2):178-93.

66. Cook JR, Bigger Jr JT, Kleiger RE, Fleiss JL, Steinman RC, Rolnitzky LMJJotACoC. Effect of atenolol and diltiazem on heart period variability in normal persons. 1991;17(2):480-4.

67. Jalife JJVcothEb, implications c. Neural control of sinoatrial pacemaker activity. 1994:173-205.

68. Osterrieder W, Noma A, Trautwein WJPAEjop. On the kinetics of the potassiumchannel activated by acetylcholine in the SA node of the rabbit heart. 1980;386(2):101- 9.

69. Trautwein W, Kameyama MJJhj. Intracellular control of calcium and potassium currents in cardiac cells. 1986;27:31-50.

70. Chess G, Tam R, Calaresu FJAJoP-LC. Influence of cardiac neural inputs on rhythmic variations of heart period in the cat. 1975;228(3):775-80.

71. Schwartz PJ, Pagani M, Lombardi F, MALLIANI A, BROWN AMJCr. A cardiocardiac sympathovagal reflex in the cat. 1973;32(2):215-20.

72. Malliani A, Pagani M, Lombardi F, Cerutti SJC. Cardiovascular neural regulation explored in the frequency domain. 1991;84(2):482-92.

73. Lewis MJJCC, Informatics, Nursing. Heart rate variability analysis: a tool to assess cardiac autonomic function. 2005;23(6):335-41.

74. Ciani O, Pascarelli NA, Giannitti C, Galeazzi M, Meregaglia M, Fattore G, et al. Mud-Bath Therapy in Addition to Usual Care in Bilateral Knee Osteoarthritis: An Economic Evaluation Alongside a Randomized Controlled Trial. 2017;69(7):966-72.

75. Tateo F, Ravaglioli A, Andreoli C, Bonina F, Coiro V, Degetto S, et al. The in- vitro percutaneous migration of chemical elements from a thermal mud for healing use. 2009;44(1-2):83-94.

76. Bromirska D, editor Effect of hyperthermic and isothermic mud application on hormonal function of normal and insufficient corpus luteum in women. Annales Academiae Medicae Stetinensis; 1993.

77. Antúnez LE, Puértolas BC, Burgos BI, Payán JMP, Piles STTJRC. Effects of mud therapy on perceived pain and quality of life related to health in patients with knee osteoarthritis. 2013;9(3):156-60.

78. Bostan B, Ufuk S, Gunes T, SAHİN S, Cengiz S, Erdem M, et al. Comparison of intra-articular hyaluronic acid injections and mud-pack therapy in the treatment of knee osteoarthritis. 2010;44(1):42-7.

79. Bellometti S, Cecchettin M, Galzigna LJCCA. Mud pack therapy in

osteoarthrosis: changes in serum levels of chondrocyte markers. 1997;268(1-2):101-6.

80. Loi A, Lisci S, Denotti A, Cauli A. Bone mineral density in women on long-term mud-bath therapy in a Salus per Aquam (SPA) environment. 2013.

81. Nimrod GJA, health m. Technostress: measuring a new threat to well-being in later life. 2018;22(8):1086-93.

82. Steyer R, Schwenkmezger P, Notz P, Eid MJJF-S-UJ, Institut für Psychologie, Lehrstuhl für Methodenlehre und Evaluationsforschung. Available online at: https://www. metheval. uni-jena. de/mdbf. php. MDMQ questionnaire (english version
of MDBF). 2014.

Annexure

INFORMED CONSENT FORM

Title of the study: **EFFECT OF MUD BATH ON AUTONOMIC VARIABLES AND PSYCHOLOGICAL STATE IN TECHNO STRESS PEOPLE -A RANDOMIZED CONTROL TRIAL**

Name of the Participant: _______

Name of the Principal Investigator: DR. A.J. RATHNA PRAKASH Name of the Institution: Government Yoga & Naturopathy Medical College& Hospital, Chennai – 600 106

Documentation of the informed consent

I,________________________have read the information in this form

(or it has been read to me). I was free to ask any questions and they have been answered. I am over 18 years of age and, exercising my free power of choice, hereby give my consent to be included as a participant in the study titled, “Effect of Mud bath on Autonomic variables and psychological state in technostress people -A randomized control trial.”

1. I have read and understood this consent form and the information provided tome.

2. I have had the consent document explained to me.

3. I have been explained about the nature of the study.

4. I have been explained about my rights and responsibilities by the investigator.

5. I have been informed the investigator of all the treatments I am taking or have taken in the past____months including any native (alternative) treatment.

6. I have been advised about the risks associated with my participation in this study.

7. I agree to cooperate with the investigator and I will inform him/her immediately if I suffer unusual symptoms.

8. I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital.

9. I am also aware that the investigator may terminate my participation in the study at any time, for any reason, without my consent.

10. I hereby give permission to the investigators to release the information obtained from me as result of participation in this study to the sponsors, regulatory authorities, Govt. agencies, and IEC. I understand that they are publicly presented.

11. I have understood that my identity will be kept confidential if my dataare publicly presented.

12. I have had my questions answered to my satisfaction.

13. I have decided to be in the research study.

I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this document has been clearly explained to me and understood by me, I will be given a copy of this consent document.

For adult participants:

Name and signature of the participant

Name_______________________________Signature___________________

Date_______________________

Name and Signature of the investigator or his representative

obtaining consent:

Name_______________________________Signature___________________

Date_______________________

<u>Annexure</u>

INFORMATION TO PARTICIPANTS

Investigator: DR. A.J. RATHNA PRAKASH

Name of Participant:

Study title: "Effect of Mud bath on Autonomic variables and psychological state in technostress people **-**A randomized control trial."

You are invited to take part in this research study. The information in this document is meant to help you decide whether or not to take part. Please feel free to ask if you have any queries or concerns. You are being asked to participate in this study being conducted in Government Yoga & Naturopathy Medical College & Hospital, Chennai – 600 106

The purpose of the research study is to examine the Effect of Mud bath on Autonomic variables and psychological state in technostress people.

Study Procedure:

The experimental protocol consists of application of full mud bath for a duration of 40 minutes per day while exposing to sunlight. The study participants will be subjected to mud bath for two weeks. The mud bath will be given once in 3 days, totally 4 applications will be done.

Possible Risks to you: Nil
Possible benefits to you : Nil

You have the right to confidentiality regarding the privacy of your medical information (personal details, results of physical examinations, investigations, and your medical history). By signing this document, you will be allowing the research team investigators, other study personnel, sponsors, IEC and any person or agency required by law to view your data, if required.

The information from this study, if published in scientific journals or presented at scientific meetings, will not reveal your identity.

How will your decision to not participate in the study affect you?

Your decisions to not to participate in this research study will not affect your studies or your relationship with investigator or the institution.

Can you decide to stop participating in the study once you star t?

The participation in this research is purely voluntary and you have the right to withdraw from this study at any time during course of the study without giving any reasons.

However, it is advisable that you talk to the research team prior to stopping the participation.

The results of the study may be intimated to you at the end of the study period.

Signature of investigator　　　　　　　　　　Signature of the participant

Date:

PROFORMA

Govt. Yoga and Naturopathy Medical College & Hospital, Arumbakkam, Chennai-600106

Title of the study: Effect of mud bath on autonomic variables and psychological state in technostress people

Demographic Details:

Subject Code: Name:

Gender: Age (years): Marital status:

Education: Occupation:

Address (PIN): Residing at: Urban/Rural

Height (meter): Weight (kg): BMI (kg/m^2):

Outcome measures:

Parameters	**Baseline Assessment**	**Post-test Assessment**
Heart Rate Variability		
Systolic blood Pressure		
Diastolic blood pressure		
MDMS questionnaire		

MDMS: Multi dimensional mood swing questionnaire

Annexure

Technostress Questionnaire

Items	**strongly disagree**	**disagree**	**neutral**	**strongly agree**	**strongly agree**
Techno-overload					
I1_1—I am forced by this technology to work much faster.*					
I1_2—I am forced by this technology to do more work than I can handle.					
I1_3—I am forced by this technology to work with very tight time schedules.					
I1_4—I am forced to change my work habits to adapt to new technologies.					
I1_5—I have a higher workload because of increased technology complexity					
Techno-invasion					
I1_8—I spend less time with my family due to this technology.*					
I1_9—I have to be in touch with my work even during my vacation due to this technology.					
I1_10—I have to sacrifice my vacation and weekend time to keep current on new technologies.					
I1_11—I feel my personal life is being invaded by this					

Technology					
Techno-complexity					
I1_12—I do not know enough about this technology to handle my job satisfactorily.					
I1_13—I need a long time to understand and use new technologies.					
I1_14—I do not find enough time to study and upgrade my technology skills.					
I1_15—I find new recruits to this organization know more about computer technology than I do.					
I1_16—I often find it too complex for me to understand and use new technologies.					
Techno-insecurity					
I1_17—I feel constant threat to my job security due to new technologies.					
I1_18—I have to constantly update my skills to avoid being replaced.					
I1_19—I am threatened by coworkers with newer technology skills.					
I1_20—I do not share my knowledge with my coworkers for fear of being replaced.*					
I1_21—I feel there is less sharing of knowledge among coworkers for fear of being replaced					
Literacy facilitation					

I2_1—Our organization encourages knowledge sharing to help deal with new technology.*					
I2_2—Our organization emphasizes teamwork in dealing with new technology-related problems.					
I2_3—Our organization provides end-user training before					
the introduction of new technology.					
I2_4—Our organization fosters a good relationship between IT department and end users.					
I2_5—Our organization provides clear documentation to end users on using new technologies					
Technical support provision					
I2_6—Our end-user help desk does a good job of answering questions about technology.*					
I2_7—Our end-user help desk is well staffed by knowledgeable individuals.					
I2_8—Our end-user help desk is easily accessible.					
I2_9—Our end-user help desk is responsive to end-user requests.					
Involvement facilitation					
I2_10—Our end users are encouraged to try out new technologies.*					
I2_11—Our end users are rewarded for using new technologies.					
I2_12—Our end users are consulted before introduction					

of new technology.					
I2_13—Our end users are involved in technology change and/or implementation					
Job satisfaction					
I3_1—I like doing the things I do at work.					
I3_2—I feel a sense of pride in doing my job.					
I3_3—My job is enjoyable					
Organizational commitment					
I4_1—I would be happy to spend the rest of my career in this organization.					
I4_2—I enjoy discussing my organization with people outside it.					
I4_3—I really feel as if this organization's problems are my own.					
I4_4—This organization has great deal of personal meaning for me.					
Continuance commitment					
I5_1—Too much of my life would be disrupted if I decided I want to leave my organization right now.					
I5_2—Right now staying with my organization is a matter of necessity as much as desire.					

I5_3—I believe that I have too few options to consider leaving this organization.					

I5_4—It would be very hard for me to leave my organization right now even if I wanted to					

Annexure

Multi-Dimensional Mood State (MDMS) questionnaire

In the following you find a list of expressions that characterize different moods. Please take a look at the list, word by word, and mark for each word the answer that represents best the actual intensity of your mood status.

Example:

Right now I feel ...

	definitely not	not	not really	a little	very much	extremely
	1	2	3	4	5	6
good	○	○	○	○	○	○

Supposed you feel very good at the moment, you would fill out the circle number 5:

Right now I feel ...

	definitely not	not	not really	a little	very much	extremely
	1	2	3	4	5	6
good	○	○	○	○	●	○

Please pay attention to the following facts:

- Within the list there are some attributes that possibly describe the same or similar moods. Please do not get irritated due to this fact, and judge each attribute irrespective of your answer to another attribute.

- Please judge only how you feel at this moment, and not how you normally or sometimes feel.
- If you have some difficulties in finding an answer, please mark those answer that fits best.

Please judge each word and do not leave out a word.

	1 Definitely not	2 not	3 not really	4. a little	5 very much	6 extremely		1 Definitely not	2 not	3 not really	4 a little	5 very much	6 extremely
1. content (GB+)	☐	☐	☐	☐	☐	☐	16. sleepy (AT-)	☐	☐	☐	☐	☐	☐
2. rested (AT+)	☐	☐	☐	☐	☐	☐	17. good (GB+)	☐	☐	☐	☐	☐	☐
3. restless (CN-)	☐	☐	☐	☐	☐	☐	18. at ease (CN+)	☐	☐	☐	☐	☐	☐
4. bad (GB-)	☐	☐	☐	☐	☐	☐	19. unhappy (GB-)	☐	☐	☐	☐	☐	☐
5. worn-out (AT-)	☐	☐	☐	☐	☐	☐	20. alert (AT+)	☐	☐	☐	☐	☐	☐
6. composed (CN+)	☐	☐	☐	☐	☐	☐	21. discontent (GB-)	☐	☐	☐	☐	☐	☐
7. tired (AT-)	☐	☐	☐	☐	☐	☐	22,tense (CN-)	☐	☐	☐	☐	☐	☐
8. great (GB+)	☐	☐	☐	☐	☐	☐	23. fresh (AT+)	☐	☐	☐	☐	☐	☐
9. uneasy (CN-)	☐	☐	☐	☐	☐	☐	24. happy (GB+)	☐	☐	☐	☐	☐	☐

10. energetic (AT+)	☐ ☐	☐ ☐ ☐ ☐
11. uncomfortable (GB-)	☐ ☐	☐ ☐ ☐ ☐
12. relaxed (CN+)	☐ ☐	☐ ☐ ☐ ☐
13. highly activated (AT++)	☐ ☐	☐ ☐ ☐ ☐
14,superb (GB++)	☐ ☐	☐ ☐ ☐ ☐
15,absolutely calm (CN++)	☐ ☐	☐ ☐ ☐ ☐
	1 2	3 4 5 6

1. definitely not
2. not
3. not really
4. .a little
5. very much
6. extremely

25. nervous (CN-)	☐ ☐	☐ ☐ ☐ ☐
26. .exhausted (AT-)	☐ ☐	☐ ☐ ☐ ☐
27. calm (CN+)	☐ ☐	☐ ☐ ☐ ☐
28. wide awake (AT++)	☐ ☐	☐ ☐ ☐ ☐
29,wonderful (GB++)	☐ ☐	☐ ☐ ☐ ☐
30. deeply relaxed (CN++)	☐ ☐	☐ ☐ ☐ ☐
	1 2	3 4 5

1. definitelynot
2. not
3. not really
4. a little
5. very much
6. extremely