Effectiveness Of Sensory Re-Training For Stroke Survivors: A Pilot Randomized Control Trial Study

By

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Submitted in Partial Fulfillment of the Requirements for the Degree of

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Supervisor's Statement

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Declaration Form

- This work has not previously been accepted in substance for any degree and is not concurrently submitted in candidature for any degree.

- This dissertation is being submitted in partial fulfillment of the requirements for the degree of M. Sc in Rehabilitation Science.

- This dissertation is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADL's: Activities of Daily Living

BHPI: Bangladesh Health Professions Institute

BAMSE: Bangla Adapted Mini-Mental State Examination

CRP: Centre for the Rehabilitation of the Paralysed

CRPEC: CRP-Ethics Committee

CNS: Central Nervous System

CVA: Cerebral Vascular Accident

CVD: Cardio Vascular Accident

FIM: Functional Independence Measure

FMA-UE: Fugl-Meyer Assessment Upper Extremity

IRB: Institutional Review Board

NINS: National Institute of Neuroscience

NSA: Nottingham Sensory Assessment

RCT: Randomized Control Trial

Abstract

Introduction: The somatosensory system is the means in which we communicate and interact with our surroundings. It is required for many activities of daily living. The system has a negative effect on many areas, including leisure, sexual activities and safety. Sensory impairments significantly limit the ability to use the upper limb. **Objective:** To investigate the effectiveness of sensory re-training that target sensory impairment after stroke.

Methodology: A pilot randomized controlled design was applied. After screening and signing consent forms, participants was randomly allocated to either the sensory retraining group or control group by means of a random numbers table from the baseline screening assessment which was done to identify how many patient have sensory impairment and not. There are 50 participants have considered sufficient to include in the pilot RCT. Among 50 participants, 25 in experimental group and 25 in control group within a reasonable time frame.

Results: In all regions of the upper body's tactile sensation is significantly improved in experimental group after five weeks treatment. In Light touch, Temperature and Pinpric sensation the sig values are Face (.000<0.05), Trunk (.000<0.05), Shoulder (.000<0.05), Elbow (.000<0.05), Wrist (.000<0.05) and Hand (.000<0.05). In the experimental group sensory performance in pressure, tactile localization and bilateral simultaneous touch also significantly change that are Face (.000<0.05), Trunk (.000<0.05), Shoulder (.000<0.05), Elbow (.000<0.05), Wrist (.000<0.05) and Hand (.000<0.05). The upper limb function has improved significantly in experimental group and the value is .000<0.05. In participation of daily living the control group has less change (-1.445, .161>0.05) and (-1.445, .161>0.05) and the experimental group highly improved (-10.733 and .000<0.05) and (-12.2886 and .000<0.05).

Conclusion: Sensory impairment is a common problem after stroke. Due to sensory loss the patient is unable to perform activities of daily living properly. Recovery of stroke depends on different factors among of them sensory impairment is one that is highly related to occupational performance.

Key words: Stroke Survivors, Sensory Impairment, Sensory re-training and Functional Status or ADL's.

CHAPTER- I INTRODUCTION

1.1.Background

Stroke is a neurological disease which occurred due to damage to the central nervous system (CNS) that is occurred by the thrombus or embolism in the cerebral artery or through the haemorrhage of the artery and ruptured it. When the oxygen is reduced or lack of oxygen in the brain cell the nervous tissue is frequently become necrosis. (Sherwood, 1997). In neurology brain is a very exciting area and complex in both anatomically and functionally.

With the advancement of age in addition to decay, the brain becomes more prone to get many complicated life threatening disease, these will need appropriate attention in time, Stroke is one of such condition which is burning topic in this new millennium since it is not only a major killer but a cause of disability in the world as well as in Bangladesh (Mohammad, 2001)

Stroke becomes a major cause of mortality, morbidity and continues to be one of the foremost causes of disability (Lima et al., 2015; Islam et al., 2013). According to the estimation of 2010, there are 17 million people in the world experienced stroke for first time in their life (Stroke Association, 2015). In Bangladesh the stroke is also a third leading cause of death and the percentage of it is 0.30% (Islam et al., 2013). It limits participation in activities of daily living and upper extremity impairment is common (Pang, Ashe and Eng, 2007).

The clinical features of stroke may vary due to the area of lesion. When the lesion of brain is large then the impairments will be gross. The common impairments of the stroke are reducing motor control, sensory impairment, cognitive impairment, communication problem, decrease functional ability. When the sensory is impaired severely then the recovery of motor control is delayed (Connel, L.A., 2007). The function of upper limb is significantly loses the ability due to sensory impairment and for this reason the interventions would be used (Susan et.al, 2010).

The somatosensory system is to connect or interact each other among the surroundings (Gaubert and Mockett, 2000). When this system neither is nor work properly then it effects the daily living activities, leisure and sexual activities and safety (Carey et al., 1997).

It is very difficult to understand the recovery after stroke. There are many factors influence the recovery of stroke such as the size of infarction, age, pre-stroke status, early treatment etc. The recovery of stroke may vary person to person and some of the recovery occurs spontaneously. Sometimes the recovery occurs within two to three months. Within six months the intrinsic and functional recovery also occurs. The patients with stroke who are initially severely impaired they need more time for recovery (Connel, L. A., 2007).

The recovery after stroke seems to be related with the sensory function. After stroke sensory problems are most common. First of all it is required to measure the sensory impairment to implement the sensory treatment for a better recovery after stroke. Every time we are aware about the sensory function in a normal life of human being and this sensation is a active process. The sensory stimulations are received by the human being those are related to them. Sometime they are not aware about this sensory process until they are not giving concentration on sensation like during dressing activity it is not felt the skin sensation as usual but when he gives attention on this. So when the recovery of stroke is expecting then it is required to give attention about the sensory processing (Sherwood, 1997).

The stroke survivors suffered from reduced upper limb function. The upper limb function remains impaired a long period of time rather than recovery of lower extremity. Most of the stroke survivors have to lead a life with the impaired upper limb function. In a study it is shown that about 32% stroke survivors had severe upper limb impairment after stroke that required a long period of time or lead a permanent life with the non-functional upper limb. When the sensory is impaired then it required more time to recover the upper limb function and decrease the level of participation in the activities of daily living. It is also delayed due to limited rehabilitation process. (Andreea et al., 2018)

1.2. Justification

The recovery of stroke is different in every individual as because they are different. The recovery of stroke depends on the type of stroke, the severity of stroke and the lesion area. There are many physical and sensory factors responsible to delay the outcome or recovery after stroke. If the stroke survivors start treatment early then they are able to regain the certain function. However, regarding this study is useful or helps to know the sensory impairment and the effects of sensory treatment and the expected outcome after stroke.

According to World Health ranks Bangladesh is 84 numbers in the world for mortality rate (Islam et al., 2013).

The percentage of sensory impairment of stroke survivors is 60% and they are suffered from this impairment (Daniela et al., 2010). The patient with Cerebral vascular Accident (CVA) suffered in impairment of tactile and proprioceptive discrimination mostly (Carey, L. M., 1998). In recent some studies have shown that up to 85% have sensory impairment at the upper limb after stroke (Carlsson et al., 2018).

In the acute stage of hemi paretic patients have pain and tactile sensitivity and sensory dysfunctions. These dysfunctions decrease the functional performance. The normal sensory function is responsible for the higher functions and decreases the length of staying in hospital (Sommerfield and Von, 2004).

Sensory impairment is most common among the stroke patient and sensory re training treatment is very much effective for the stroke survivors as well. But we have no research about the effectiveness of sensory re-training for stroke survivors in Bangladesh otherwise when the patient come to us they only focus their Physical and functional problem. The clinical therapists know about the sensory re-training but they don't follow any standard treatment protocol which is evidence based or research based according to the country context. Actually maximum stroke patients have sensory impairment and the recovery also depends on sensory impairment. When the clinical therapists provide therapy to the patients and home advice they just focus on physical activity not about sensory. So the recovery is delayed. Sometimes the

practitioners also focused on physical activity and not focused the sensory impairment.

In Bangladesh the occupational therapists are often engaged in sensory treatment but there is a limited resource to expand this practice. It is very much difficult to advancement of sensory rehabilitation due to lack of experimental study regarding sensory rehabilitation and lack of literature and certified training program for the responsible therapists. Sensory impairment is affects the functional performance of Activities of Daily Living (ADL's). For example sensory impairment may affect a patients' ability in dressing, grooming, eating and also has the effects on motor recovery. However, there is a standard scale of Nottinghum Sensory Assessment which is a indicator to measure the sensory impairment after stroke. This will be useful for the members of multidisciplinary team to assess the sensory impairments and outcome of the sensory re-training program. For this reason the study that is the effectiveness of sensory re-training for the stroke survivors is very much essential.

Sensory impairment and re-education are negatively associated with motor recovery. The therapies are provided to the stroke patients for improving motor recovery. Sensation is an important parts of the stroke rehabilitation. It should to assess the sensory status and give priority for the treatment plan and monitored it continuously. The patient's functional outcome depends on the sensory processing along with the motor control. It needs to apply standardized sensory scale to measure the sensory status of the sensory impaired patient that is reliable and valid. Sensory problems are associated with the outcome after stroke (Connel, L. A., 2007).

The somatosensory system is responsible for coordination of movement as well as the communication and interaction among the surroundings. This system helps to explore the environment, understanding the communication and alertness to danger with others. This somatosensory system is very much important part of the body. The somatosensory impairment can damage the personal care, productivity, leisure activities etc. It influences the ability of performing the activities of daily living. So it requires re-educating the stroke survivors of sensory skill to be independent in activities of daily living. (Carey et al., 1997).

1.3.Research Question

What is the effectiveness of sensory re-training for Stroke Survivors?

1.4. Research Title

Effectiveness of Sensory re-training for stroke survivors: A Pilot Randomized Control Trial Study.

1.5.Operational definition

Stroke

Stroke is a neurological disease that is occurred by the blocked or ruptured in the blood vessels and arteries. When the blood flow of an area of brain is cut off or blocked by a clot then the brain tissue unable to work properly due to lack of oxygen and the body function of that area is paralyzed. After cell deaths the ability of body functions is decreased gradually and lost the muscle control.

Sensory Impairment

Sensory impairment means the dysfunctions in any sense of the body like sight, hearing, smell, touch, taste etc. In this study sensory impairment means when a patient with stroke has sensory problems like tactile deficits, proprioception, kinesthetic, stereognosis, temperature, pain etc include in sensory impairment. Sensory impairment is common term to describe the sensory dysfunction.

Sensory re-training

Sensory re-training is a program that consists of both motor and sensory stimulation with different types of texture, shape, objects, stimulation and joint movement by following a standard protocol by a qualified and trained Occupational Therapist. Sensory re-training is a way to help the patient to recover their sensory system and help to recognize different texture, shape, object and joint sense which lost or impaired after stroke.

Activities of Daily Living (ADL's):

In our daily life we are normally engaged in self-care, productivity and leisure activities. The performance in self-care activities like dressing, grooming, eating are called the Activities of Daily Living (ADL's). The stroke survivors face difficulties to perform the activities of daily living.

Key words: Stroke Survivors, Sensory Impairment, Sensory re-training and Functional Status or ADL's function.

CHAPTER- II LITERATURE REVIEW

Stroke is causing the high rate of disability. Stoke is a disease of the cerebral dysfunction and showing the clinical features depends on the severity of the lesion in the brain. When the dysfunction of the cerebral is lasting more than 24 hours then it occurs death. Globally 25-74% people who are suffered from stroke have the dysfunction in activities of daily living. Besides this about 50 million stroke survivors also have the physical, cognitive and emotional problems (Pei et al., 2016).

Stroke is a disease in which the brain cell damage due to lack of oxygen supply to the brain. When the brain cell damage due to any clot in the blood vessel it is called ischemic stroke and when the blood vessels ruptured due to high blood pressure then it is called haemorrhagic stroke. About 80% stroke is ischemic and 20% is ischemic stroke. Stroke is happened due to unhealthy lifestyle, physical inactivity, high blood pressure, diabetes etc. (Gilen, G. & Burkhadt,A., 2004).

In Bangladesh the stroke deaths rate is arrived in 6.72% of total deaths. The number of deaths is 48,951. The age related deaths number is 53.59 per 100,000 of populations. The ranking of age death is 124 where the stroke death is 84 in the world (World Health Ranking, 2014).

At present in low and middle income countries like Bangladesh 75% of death occurring cardiovascular disease. By analyzing the current situation it is to consider that stroke is the leading cause of disability even it occurs death mostly. It is estimate that there are 25 million people will face death due to CVDs mainly for stroke by 2030. The mortality and morbidity are increasing day by day in Bangladesh for Cardiovascular disease (Rahman et al., 2017).

Stroke has severe impact on Bangladesh's economy and there is huge number of disability occurred due to stroke. There are many organizations work in disability sector but in prevention of this very few. To develop primary stroke prevention strategies there are two non government organizations, BRAC and Centre for the Rehabilitation of the Paralysed working actively.

There are many predisposing factors which is related to occur stroke that become a burden of the society. The risk factors can be divided into modifiable and non modifiable. The modifiable risk factors are hypertension, diabetes mellitus, smoking, obesity, alcohol intake, physical inactivity etc. These factors are preventable by following some strategies like lead a structure healthy life though build an effective exercise program. The other non modifiable risk factors are age, gender, ethnicity and genetics which are not preventable.

The treatment of stroke is very costly and it becomes burden for the poor and middle income family. To manage the situation it should taken effective steps for the person with stroke as they can lead a independent life like others.

Bangladesh is a middle income country and it is the third largest country in the South Asian context. The population is 160 million which is just after the India and Pakistan. In the South Asian countries there are more 40% is global stroke death (Bhowmik et. al., 2016). Mainly there are two types of stroke affect the people like ischemic and hemorrhagic. The maximum number of stroke is ischemic and had a better recovery than the hemorrhagic stroke. (Mohammad, 2013).

There is a vast gap of knowledge in between the South Asian and Western countries regarding the acute and long term care of stroke patients. In the Asian context there is no step for preventing stroke by the government authorities (Wasay et. al., 2014).

Stroke is not only affecting the elderly but also in increases among the young generations day by day. Recently it is found that 15 people per 1000 affected by stroke and causes a major disability which is the burden of the society (National Institute of Neuro Science (NINS) , 2016).

In the world wide the percentage of stroke survivors who need assistance in the activities of daily living that 25% to 74% of the 50 million stroke survivors. The outcome of stroke is heterogeneous process. After stroke the survivors are dependent on the family members or the caregivers for activities of daily living (ADL's). If the medical management of stroke is better then it can be prevent the cerebral damage and the rehabilitation can start earlier. The recovery of stroke is significantly seen in the first month of stroke. The early treatment also reduces the disability and increase the demand of effectiveness of any treatment protocol. The outcome of stroke depends

also the realistic goal setting regarding the physical status, cognitive, sensory and functional like dressing, mobility and bathing etc (Janne et al., 2012).

The right and left sided hemi paretic lesion stroke survivors are both more affected by sensory problem but among of them the right sided hemi paretic lesion is more vulnerable with sensory problems. When the brain area like damage to the thalamus where the somatosensory cortex is located and brainstem which relay sensory information to the cortex then the sensory dysfunction can be located. The sensory impairment after stroke is most common in tactile and proprioception and it can vary from person to person (Connel, L. A., 2007).

The normal sensory function can be affected after stroke and it may be impaired or absent. The sensations like the touch, temperature, hypersensitivity to sensation, the loss of bowl and bladder sensation, proprioception (Admin et al., 2017).

Sensory information is a specialized process involving many receptors that are referred to as somatic sensation. The receptors are exteroception and proprioception (Sherwood, 1997). Exteroceptors mean the sensory information regarding the external environment and received the sensation in the skin and subcutaneous tissue (O'ullivan and Schmitz, 1998). This sensory information is responsible for the light touch, temperature, pain and pressure. The sensory information is responsible for proprioception that means position of the body and this sensory work through muscles, ligaments, tendons and fascia (Sherwood, 1997).

There are two separates somatosensory pathways that are tightly localized and poorly localized. The fine touch sensation ascends via the segment of spinal cord white matter called the dorsal columns where the diffuse somatosensory information ascends via spinothalamic tract of the spinal cord. These pathways projects to distinct areas of the thalamus and somatosensory cortex location of parietal lobe.

The dorsal column system that is denoted by green in the figure begins with somatosensory axons entering the spinal cord via the dorsal root and ascending in the dorsal column ipsilaterally. In this pathway the nuclei located in the medulla and the axons of neurons located in crossover ascending via the medial lemnicus to the contra

lateral ventral posterior thalamic nuclei (VPN). It carries information from the contra lateral side of the face and head also synapse in the VPN (National Academy of Science, 1998).

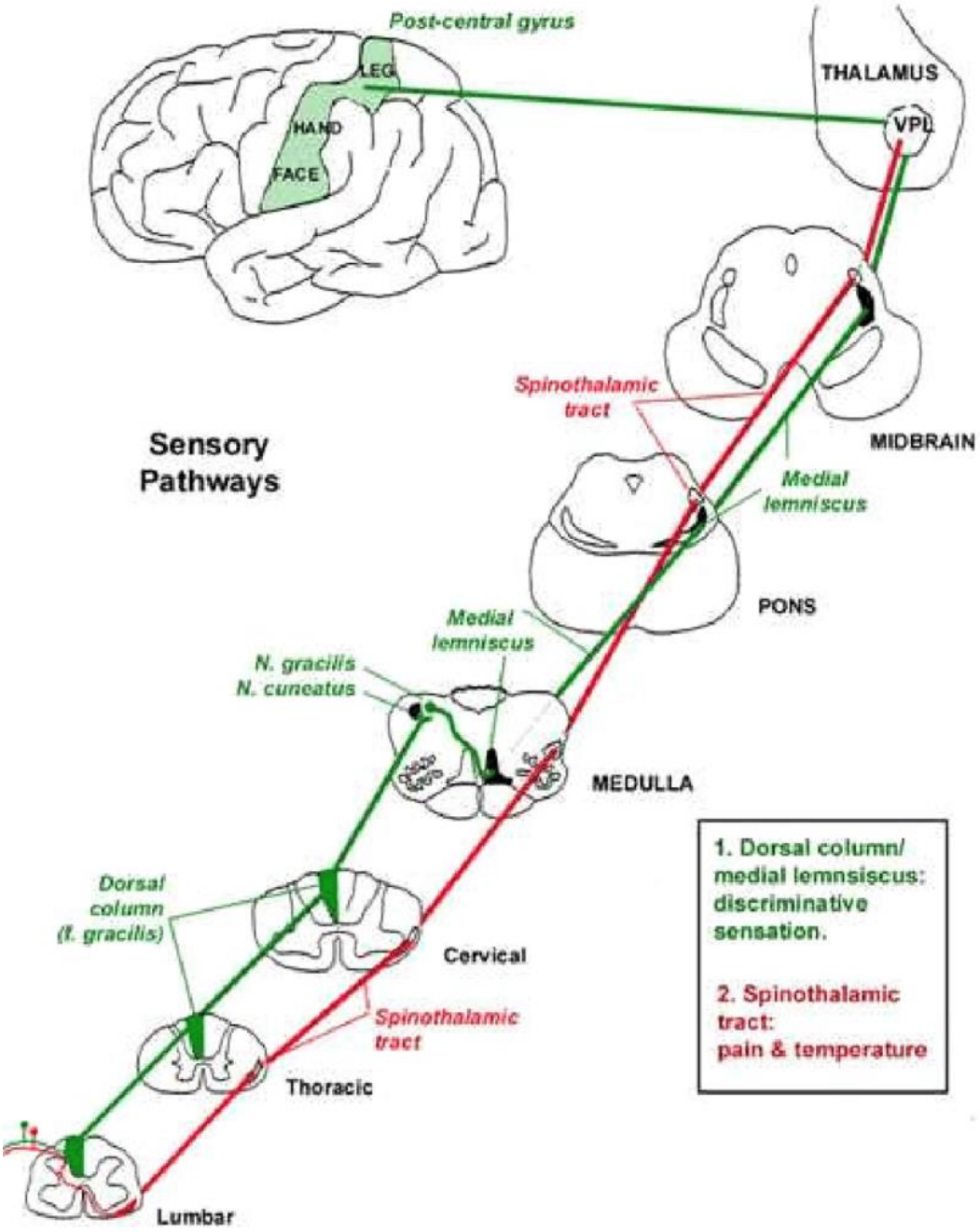

Fig: Somatosensory pathway

The anterolateral system that is denoted in the figure by red pathway starts with somatosensory axons. This is entering into the spinal cord via the dorsal root and synapsing upon entry. Through the anterolateral portion of the spinal cord white matter the second order axons decussate and ascend to the brain. There are three separate tracts, spinothalamic tract and the spinotectal tract and the spinothalamic tract projects to the ventral posterior nucleus of the thalamus. The perception of touch, temperature and sharp pain are involved within this tract (National Academy of Science, 1998).

There are some consequences of sensory impairment after stroke like skin problem, reduced the temperature sensation. Sometimes the stroke survivors become hypersensitive in pain or light touch and they feel discomfort to dressing. They have some altered sensation like numbness, tingling, aching, and burning sensation that causes discomfort and confusion. When the stroke survivors have proprioception problem then they faces default in movement and mobility and control the movement. The sensory dysfunctions cause the impairment in tactile, proprioception, streognosis and loss of visual field. The problems in tactile, proprioception and stereognosis affect the performance of activities of daily living (ADL's) (Gillen,G. & Burkhardt, A., 2004).

Sensation is a body function, a component of the client factors that influences both the motor and processing aspects of performance skills. (Trombly, 2008)

The stroke survivors were assessed their sensory function and most of them have problem in touch, protective and proprioceptive sensation (NSF, 2009). There are also occurred in sensory loss experience of the stroke survivors that is texture discrimination, stereognosis and passive joint movement (Carey et al., 1993). The study explored that the sensory function is relatively significant improvement in a early stage of treatment (Yekutiel and Guttman, 1993).

Loss of sensation impairs a person's ability to explore the immediate environment and execute everyday tasks and therefore affects the quality of life and personal safety. Sensory dysfunction following stroke involves tactile discrimination and proprioception sense more than pain and temperature senses. These losses significantly limit the use of upper limb. A little functional movement sometimes

possible but spontaneous movement is not possible with sensory impairment (Carr and Shepherd, 2010).

Without any sensory training it is not possible to use the extremity and learned further the sensory and motor abilities (Dannnenbaum and Dykes, 1998; Sabari & Lieberman, 2008). Therapists may alter the cortical map by directing the sensory experience of the patient. Increased cerebral blood flow and changed cerebral activation in the somatosensory cortex following proprioceptive stimulation has been demonstrated experimentally (Nelles et al., 1999).

The passive and active training both had shown the improvement the use of the extremity. Appropriate grading of sensory re education activities is important to optimize patient motivation and progress (Trombly, 2008).

The percentage of sensory loss in the affected arm is 80% who have are experienced by stroke and impairment is less than this percentage. The functional level of upper limb affects and reduces the level of participation in Activities of Daily Living (ADL's) due to sensory loss. There is a study shown that the sensory impairment and independence in activities of daily living has significant association with a long term relation (Doyle et al., 2010).

Generally it is shown that the recovery of upper limb take more time than lower limb. When the sensory impairment exists then there is a long term effect to use the UL in daily life like self care activities, household activities and leisure activities. In this case there is also a less attention to the sensory rehabilitation during stroke rehabilitation. The rehabilitation professionals only focus on the motor recovery, physical exercise for lower limb and mobility. However, there is a knowledge gap between the evidence based sensory interventions among the therapists an lack of use of standard outcome measures (Carlsson, 2018).

Sensory re-training is a treatment technique program by different types of sensory stimulation to the patient with sensory impairment. Through this sensory retraining program it tries to recover the functional sensory ability in the damaged area and learn adaptive functioning.

The somatosensory system handles sensory input from superficial sources such as the musculoskeletal system. Sensation is stimulated by receptors then it travels to the brain by way of the spinal cord. The somatosensory stimulus is conveying the information to the body and its environment or in the two regions of the parietal lobe. Traditionally, the sensory re learning is used to as patient-oriented expression of sensory re-education (Carey et al., 1997).

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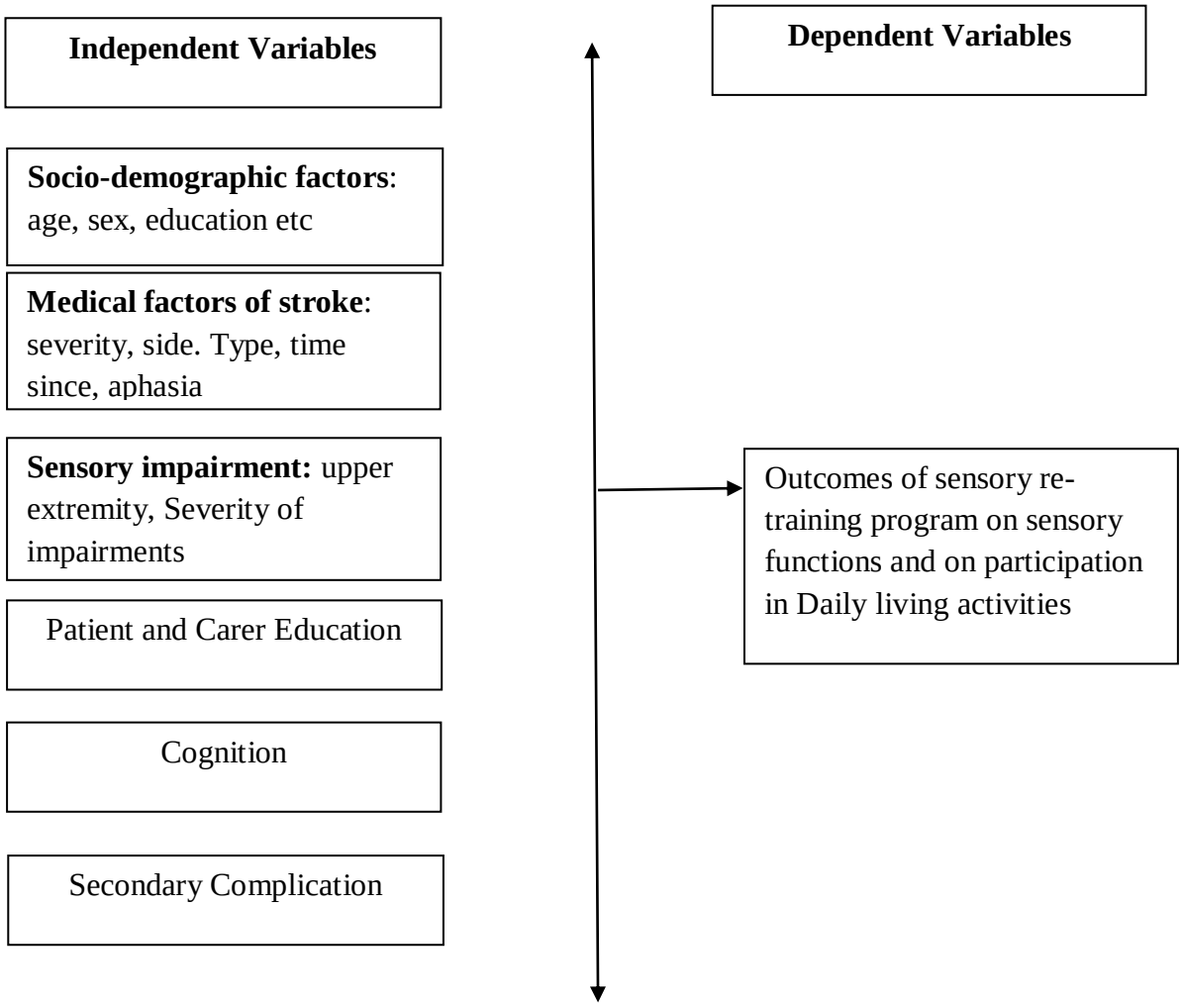
CHAPTER-III METHODOLOGY

3.1.Conceptual Framework



3.2. Study Objectives

3.2.1. General Objective

To investigate the effectiveness of sensory re-training that target sensory impairment after stroke.

3.2.2. Specific Objectives

The purposes of the study are:

1. To study the change of upper limb function after sensory retraining.
2. To identify the changes between experimental group and control group.
3. To find out the associated factors that influences the treatment effectiveness.
4. To identify the level of participation in Activities of Daily Living of the stroke survivors.

3.3.Study Setting:

The study was conducted in the Occupational Therapy Out-patient Unit at Centre for the Rehabilitation of the Paralysed.

3.4.Study Design:

A pilot randomized controlled design was applied in this study. The participants were randomly allocated after screening and signing consent form in the sensory re-training group or in the control group by giving a random numbers table. From the baseline screening assessment it was done to identify how many patient have sensory impairment and not. From the base line screening the participants were selected randomly.

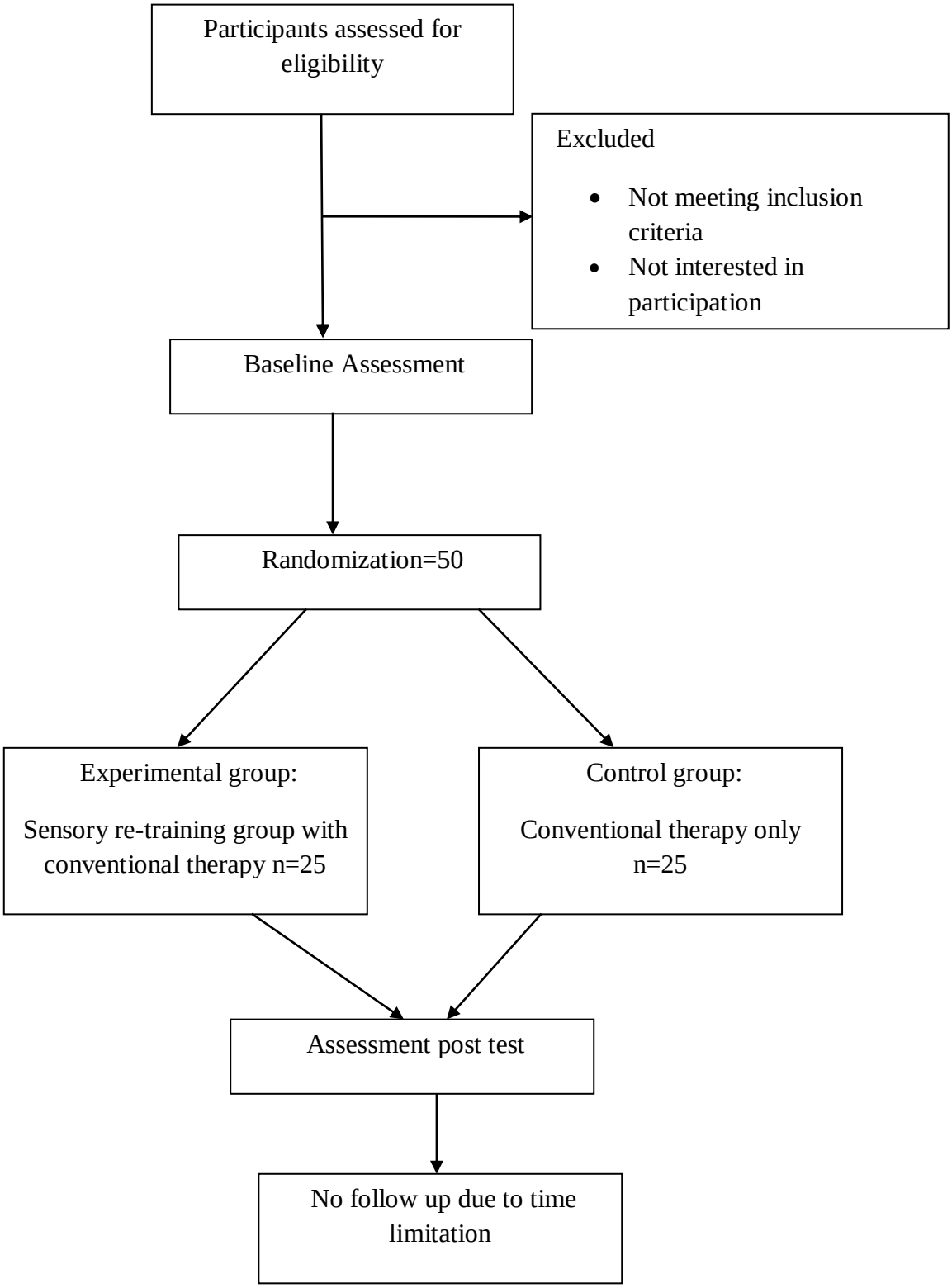
The Pilot Randomized controlled trial is a specific study of experimentation involving the use of a control group. Participants were randomly assigned to an experimental group, which follows the particular intervention or to the control group which is didn't follow any particular any protocol.

A pilot Randomized controlled trial could be done for a definitive intervention trial. The pilot trial has the target to do the main RCT's and pilot randomized controlled trial is the small versions of the main trial, undertaken to test trial methods and procedures. The main aim of the pilot randomized controlled trial is to demonstrate the future trial can be undertaken. To design a future definitive trial a pilot study can be an step in the assessment of an intervention. The number of participants was small as because the study is pilot and it would be a true RCT's depend on the effective results. In the pilot RCT there was a sensitivity analyses for the main trial's sample size calculations should be undertaken. (Bell, M. L., Whitehead, A. L & Julious, S. A., 2018).

The sensory re-training group or experimental group was consisted for 2 hour with three to five participants per session and twice a week for 5 weeks. The control group has continued as usual conventional treatment not the sensory treatment protocol.

The training session was supervised by the occupational therapists that have experience in stroke rehabilitation.

3.5. Flow chart of the phases of Pilot randomized controlled trial



3.6.Randomization

The participants were assigned by simple random sampling through lottery after the baseline assessment when it has been confirmed and they fulfill the inclusion criteria. The baseline assessed participants were given number and the numbers of one is for experimental group and two for control group. Then the both numbers of all participants were kept in a box and taken those numbers randomly. The number one was for experimental group (n=25) and two for control group (n=25) was involved in the training.

3.7.Blinding

This study will follow the single blinding. There were four qualified Occupational Therapist who are experienced in stroke rehabilitation were assigned and two for assessing the experimental group and control group. The other two Occupational Therapists were responsible for running the group of sensory re-training of stroke survivors. The one of two is only responsible for assessing the experimental group both pre and post assessment and another one is only responsible for assessing the control group both pre and post assessment. The responsible therapists don't know who is for experimental participant and who is for control participants. There are six therapists involved in the study period. Among of six therapists two were trained about the sensory re-training protocol and the local materials which were used for running the group by the researcher. The rest of two therapists were continued the group session with taking help also an Occupational Therapy Assistant and volunteers.

3.8.Study Population

The study populations were the client who was diagnosed as strictly one-sided cerebro-vascular accident (CVA) and will take rehabilitation services from CRP.

3.9.Study area

Data was collected from the out-patient unit of Occupational Therapy department in Centre for the Rehabilitation of the Paralysed (CRP).

3.10. Study Sample size

In the experimental study, the sample size calculation is a important phase during planning the study. The sample size should be standard it not be too small or too big. In case of very small sample size it is very difficult to explore the results of the study. Otherwise, a big number of sample sizes can make the study complex and it would be costly, not feasible.

Sample size has tremendous effects in the study design. In the descriptive study, there are need more sample size like hundreds or more subjects to find out the acceptable significant level for small effects but in the experimental study need small sample size. In the experimental study, there is a cross-over study where the one-quarter of participants compared to the control group because the experimental group get the experimental treatment (Habib, A., Johargy, A.,Mahmood, K., & Humma, 2014).

The sample size is an important consideration when it seen that there is planning to do a clinical trial that not only the main trial. Under investigation to reply the research question the sample size calculation would be minimum in the clinical trial. But in the main trial the result will be less significant when the number of participants is small. In the pilot study, if taken a large number of sample size then the resources may be wasted and given treatment and proven the effectiveness of treatment will be delayed or slower. To do the study the pilot randomized trial as a trial which can be the mimics of the main trial to prove the superiority of the effectiveness of the treatment. In the setting of sample size in the same way usually it is not necessary using formal power considerations. (Whitehead et al., 2016)

As the study was done in the Centre for the Rehabilitation of the Paralysed (CRP) so that the number of sample was included which patients have come at CRP from 1st November, 2017 to 30th November 2018 to take Occupational Therapy services from the Adult Neuro and Orthopaedic Unit at Out-patient Unit. It is quite difficult to make a sampling frame so that the possible participants were recruited in the study about 50, 25 in experimental group and 25 in control group.

3.11. Inclusion and exclusion criteria

3.11.1. Inclusion criteria

Potential participants were identified and recruited by occupational therapists from the Department of Adult Neuro and Orthopaedic Unit, Centre for the Rehabilitation of the Paralysed (CRP). **Inclusion criteria are as follows**:

- One-side brain lesion only, as seen on MRI or CT scan, otherwise exclusion
- Out-patients only, one month to six months after stroke.
- Both males and females.
- Sensory impairments of the UL after stroke according to the sensory scale
- Ability to grasp and release an object.
- Ability to understand oral and written information and BAMSE score<20.
- 18–80 years of age

3.11.2. Exclusion criteria

- Sensory impairments in the UL due to other diagnoses than stroke.
- Bilateral stroke patients
- Recurrent stroke episodes

3.12. Experimental group

Experimental group set same time as control group. Qualified Occupational therapists have given sensory retraining therapy plus conventional therapy (2 sessions per week, for 5 weeks) 5 patients in 1 group (shifts 1: 15 patients (3 groups of 5 patients) ; shift 2: 5 patients, shift 3: 5 patients) in 3 months/3 shifts total 25 patients. Assessments were done by qualified Occupational therapists who are not involved in this training.

The training session was consisted of one hour sensory re-training program with one hour conventional treatment comprising three 20-min sessions per hour. After one hour there was 15 minutes break. The first one hour followed the sensory re-training treatment protocol like touch detection, touch discrimination, identifying different shapes and sizes objects, textures, temperatures, weight bearing of upper limb and proprioception etc.

After completing the one hour sensory re-training treatment the participants took 15 minutes break and then continue 45 minutes conventional therapy with stretching, hand functional activities, gross motor and fine motor activities, ADL's practice, jar opening, practice cylindrical grasp board, practice spherical grasping etc.

3.13.Control group

Qualified Occupational therapists have given conventional therapy (2 sessions per week, for 5 weeks) 25 patients in 3 months in groups. Assessments were done by qualified Occupational therapists who are not involved in this training/ assessors are different from the experimental group assessors. The participants have not get the sensory re training treatment and they were participated in conventional treatment group. The activities or treatment of the control includes the hand function exercise program, hand functional activities including conventional treatment (ADL's practice, mobility practice, manual exercises, strength training, reaching and stretching of UL etc.). The participants were done the conventional therapy for two hours with 15 minutes break after one hour.

In quantitative study the data was collected by using some types of numerical scale to explore the quantitative data and find out the outcome of variables (Robson, C., 2002).

3.14.Sampling technique

The participants of the study were selected through simple random sampling technique from the baseline screening assessment by numbering and make a lottery system by numbering one by one to identify who will be in the experimental group and who will be in the control group at outpatient unit of occupational therapy department at CRP because they were easily accessible for the researcher. Researcher was taken data from the patients who were diagnosed by Stroke and will come at CRP to take occupational therapy or continuing their treatment. Simple random sampling technique was selected because it helps to reduce the biasness and giving chance to the participants to attend in the study have meeting the criteria of inclusion as compared to any other sampling method involved and getting of those samples whose

criteria was concerned with the study purpose. Here another factor is resource limitation to get the sample in bigger aspect as well as the limitation of time.

As this is an academic research and limited time frame so that simple random sampling was used. This method contains some inclusion criteria to select the baseline screening participant as to find out the actual snapshot of the situation. Simple random sampling is a fair method that considers the sampling units of the population number and they have equal chance of being chosen.

3.15.Data collection Instruments/ Tools

- **Socio-demographic Questionnaire**

This questionnaire was developed by the researcher and includes the items related to the socio-demographic information such as age, sex, education, occupation, marital status, duration of illness and types of stroke.

- **Revised Nottingham Sensory Assessment**

The Revised Nottinghum Sensory Assessment is used to assess to find out the sensory impairment. It assesses the senses like light touch, temperature, pinprick, pressure, tactile localization, bilateral simultaneous touch, proprioception and stereognosis. The score of the assessment is 0 (loss of sensation) to 8(intact sensation). In this scale shortly o score is used for absent, 1 score is used for impaired and 2 is used for normal sensation. It has good to excellent intra-rater and inter rater reliability.

The NSA is an established standardized multimodal assessment used with patients post-stroke in other countries. It includes the following test items: Light touch, Temperature, Pinprick, Pressure, Tactile Localization, Bilateral Simultaneous Touch, Stereognosis, Proprioception and two-point discrimination. The Cohen's Kappa (K) coefficient was found a wide range of inter-rater reliability (K=.01 to K=.86) (Lincoln et al., 1991). Through NSA scale it was found out the sensory outcome and by FIM the ADL's participation was found out.

- **Functional Independence Measure**

The Functional Independence Measure (FIM) scale was used to assess the physical and cognitive status of the stroke survivors. To find out the outcome of rehabilitation treatment this scale is used. It is a validated scale to find out the functional outcome of person with disability. This scale mainly focuses on the performance of Activities of Daily Living (ADL's), mobility, transferring, cognition etc. This scale also focuses on the burden care or needs of assistant from other care givers. It makes clear that how much assistance need for the individual to perform the Activities of Daily Living (ADL's). It can measure the level of participation in the ADL's.

It consists of 18 items of 13 motor tasks and 5 cognitive tasks by considering the basic activities of daily living. The tasks are rated by 7 point scale that ranges from 1 is for total assistance, 2 for maximum contact assistance 3 for moderate contact assistance, 4 for minimum contact assistance , 5 for supervision or set up, 6 for modified independent and for 7 for complete independence.

- **Bangla Adapted Mini-mental State Examination (BAMSE)**

The Mini-Mental State Examination (BAMSE) is a commonly used brief global instrument that taps a range of cognitive abilities. It focuses on the memory, time, place, attention, language skill and visual-spatial abilities (Kabir & Herlitz, 2000).

- **Fugl –Meyer Assessment Upper Extremity(FMA-UE)**

Fugl-Meyer Assessment (FMA) scale is an instrument that is used to assess the sensory motor function of the upper extremity. This scale is evaluated into three different parts like motor function and balance, sensation qualities and passive joint of motion and joint pain. This FMA-UE scale is used for evaluating the upper limb function including the sensory status for grading. This scale consists of 0 is minimum or none, 1 is partial and 2 is full or normal (Fugl-Meyer, A.R., 1975).

3.16. Intervention

3.16.1. Conventional occupational therapy

A common intervention program has provided to the stroke survivors with sensory impairment that is conventional occupational therapy in both groups. The conventional therapy means which therapeutic technique are used by the qualified occupational therapists such as guided movement, stretching, strengthening, hand functional activity, ADL's re-training and reaching practice etc. In this study, the researcher is not able to found the significant level of conventional occupational therapy for the control group. These therapies were used in both experimental group and control group for the sensory impaired stroke patients.

3.16.2. Sensory re-training along with conventional occupational therapy

The sensory re-training program was used only for the experimental group. The experimental group was taken this sensory re-training program along with the conventional occupational therapy. This training program followed a protocol that was prepared by the researcher and used the local resources like brush, ball, towel, cereale, velcro, sting, different shapes objects, colored cloth, marbel, safety pin, ADL board, hand functional activities etc. This protocol was used in ten steps. This protocol was introduced to patients and the patients also involved actively.

Step 1: At first the patient takes a wash cloth and rubs it over their affected hand in a circular motion. Repeat it for 10 minutes. They try to feel on their skin.

Step 2: Lightly tap the affected hand with less affected hand from forearm to fingertips. Repeat for 10 minutes.

Step 3: Trace the affected fingertips over a texture amaze like Velcro, sting, cotton balls with eyes open and closed. Repeat for 10 minutes.

Step 4: Clap the hands together at shoulder level. Make sure patient can hear loudly "clap". Repeat for 10 times.

Step 5: Place a butter knife on the table in front of patient. Pick it up using the affected hand. Get the butter knife in a good position to cut and then tap with tip of it as patient are cutting something and using theraputty as sample. Put the knife down on the table. Repeat 10 times and making sure the correct grip each time.

Step 6: Place a pen, pencil, toothbrush or straw in affected hand, holding it at the bottom. Then manipulate it to the top by using only the fingertips. Repeat it up and down 10 times.

Step 7: Put 5 coins in different shape in patients pocket or on the table under a cloth. Use the affected hand to pull them out in order from smallest to largest. Repeat 2 times.

Step 8: Get a dark cloth bag. Place various items of objects inside of it (comb, brush, paste, marbel, spoon, safety pin, coins, scissor, pen, lock, key etc), with a list of each item written out. Then choose one item and find out from the bag. Keep track of how many items can find out correctly.

Step 9: Place a variety of items in a bowl of rice, macaroni, beans or cereal and remove them one at a time with eyes closed and opened. Repeat 10 minutes.

Step 10: Engage the patient in different hand functional activities such as opening jar, manipulation practice, cylindrical grasp board, ADL panel practice after the sensory stimulation. Try to feel the object in affected hand. Repeat 10 minutes (Semenko et al., 2015).

3.17. Data Management and Analysis

The data have represented through statistical analysis by using SPSS 16th version and Microsoft Excel 2010 package. Although the study is a Pilot Randomized Control Trial but there is no power calculation have done as because the treatment approach is new. However, there are 50 participants have considered sufficient to include in the pilot RCT. Among 50 participants, 25 in experimental group and 25 in control group within a reasonable time frame. The independent sample t test has used to analyze the potential differences between the groups through pre test and post test. The Paired sample t test has used to analyze within-group differences of experimental and control group. Another test is one way ANOVA have used to find out have any influencing factors of treatment effectiveness. The data was analyzed through an inductive content analysis approach. These results have represented through table including all the findings that comes from using SPSS software. In addition the statistical expert has given consultation for data analysis.

3.18. Significance level

A p value is the significance level of a research. In order to find out the significance level p value have set and the p value is $p<0.05$ was set for the study. The p value refers to the probability results of an experimental study. The p value of >0.05 accepted for the significance of experimental health research. If the p value is equal or smaller then it called the experiment is significant.

3.19. Elimination of confounding variables

The confounding variables have an effect on the result of the study. There are some confounding variables such as age, history, type of condition, affected brain area, sex, others intervention etc. Researcher has taken both types of conditions in both groups. The patients who are not taking treatment before are selected in experimental and control group. The sensory impaired patient did not get any sensory treatment from the other department like physiotherapy and speech and language therapy in CRP. Both male and female are recruited in both groups.

3.20. Quality control and quality assurance

The questionnaires were pre tested before data collection. Before data collection all the team members were trained. After that each interview questionnaire was checked for possible error. The questionnaire was piloted and amended accordingly before going to the final data collection. Data was entered very carefully first and then again was checked by the researcher and matched for possible error.

3.21. Informed Consent

The researcher was described her own role in the study. There was a written consent form given to the all participants before taking the information from them. In the written consent form the participants have given signature before participating in the study. The participant was known as a voluntary basis and this study may effective or not effective for them. The information of the participant was kept by maintaining confidentiality. The information was delivered to the participants that this study was not harmful effects on them. It was also informed to the participants that he or she can withdraw himself or herself in any time as because they have the right of this without feeling any hesitation. They also can discontinue the services if they think it is useful for them or have the more priority to receive other treatment. The information was stored by providing a code number differently to the experimental group and the control group. Finally it was also known to them when the results of the study will published it keep confidential and no explore their identity.

3.22. Ethical Consideration

The research proposal was submitted to the research Institutional Review Board (IRB) of Bangladesh Health Professions Institute (BHPI) and CRP-Ethics Committee (CRPEC) of the Centre for the Rehabilitation of the Paralysed (CRP), Savar, Dhaka. The ethical consideration was making sure by an informed consent letter to the participant. Consent was obtained by providing each respondent a clear description of the study purpose; the procedures involve in the study and also inform them that if they wish they can withdraw themselves any time from the study. Respondents also be assured that the study was not involve any physical, social or psychological harm, discomfort or invasion of their privacy. Response was recorded anonymously and by identification number and confidentiality was maintained. Data and relevant document was stored in a secured file cabinet.

CHAPTER- IV RESULTS

There were fifty patients taken for the study. Among of 50 participants the 25 in experimental group and 25 in control group. The socio-demographic scale, Revised Nottingham sensory assessment scale, Functional Independence Measure (FIM) scale and Fugle-Meyer Upper extremity scale were used for measuring the results of the study. The scores of these scales showed the effectiveness of the study before and after the assessment.

Table 1: Socio demographic Details of Stroke survivors with Sensory Impairment

		n	%
Age group	15-40 years	8	16.00
	41-50 years	18	36.00
	50+ years	24	48.00
Sex	Male	29	58.00
	Female	21	42.00
Place of Residence	Rural	19	38.00
	Urban	28	56.00
	Semi-Urban	3	6.00
Geographical Location	Dhaka	32	64.00
	Chittagong	5	10.00
	Rangpur	2	4.00
	Barisal	1	2.00
	Rajshahi	1	2.00
	Sylhet	3	6.00
	Mymensingh	2	4.00
	Khulna	3	6.00
Marital Status	Married	49	98.00
	Unmarried	1	2.00
Education Level	Illiterate	6	12.00
	Primary	7	14.00
	Secondary	21	42.00
	HSC	5	10.00
	Graduate and above	11	22.00
Previous Occupation	Govt employee	4	8.00
	NGO	5	10.00
	Self business	11	22.00
	Farmer	4	8.00
	No formal activities	4	8.00
	Household activities	17	34.00
	Others	5	10.00

Live with	Family members	47	94.00
	Paid Caregivers	3	6.00
Dominant hand	Right	47	94.00
	Left	3	6.00
Duration of stroke in months	1-2	15	30.00
	2.1-4	14	28.00
	4+	21	42.00
Affected body	Right	28	56.00
	Left	22	44.00
Affected brain	Right	22	46.00
	Left	28	54.00
Type of stroke	Ischemic	42	84.00
	Haemorrhagic	8	16.00
Other Disease	HTN	39	78.00
	DM	29	58.00
	Heart Disease	1	2.00
	Arthritis	1	2.00
	GBS	0	0.00
	Head Injury	0	0.00
	Others	3	6.00
Personal Habits	Smoking	12	24.00
	Alcohol	0	0.00
	Drug Abuse	0	0.00
	Betel leaf	8	16.00
	Others	0	0.00
Complications	Pain	24	48.00
	Hearing	2	4.00
	Vision	8	16.00
	Subluxation	18	36.00
	Urinary in continence	1	2.00
	Others	1	2.00

The characteristics of baseline socio-demographic and clinical of the two groups are similar (Table 1). The age group of suffering sensory impairment after stroke is 50+ most and 48% are in this 50+ age group and the number of participant is 24. The less number of participant's age group is 15-40 years, the number 8 and the percentage is 16% and the rest of the participants are in 40-50 years , the number is 18 and the percentage 36%. There were 29 are male and 21 are female participants. Most of the participants are living in urban area that 56% and the geographical area is Dhaka 64%. Among of 50 participants 49 are married and only 1 participant was unmarried. The increased number of participants lives with their family members about 94% and only 6 % participants live with paid caregivers.

The participants were included 1-6 months post stroke and it is shown that 42% are above 4 months and 30% within 1-2 months and 28% within 2-4 months post stroke. Both sided hemiplegic participants were included in experimental and control group. The right sided participants are 28 and left sided are 22. In all, 23 had right and 27 had left hemispheric lesions. There is no difference between groups in side of lesion. In case of type stroke 84% are ischemic stroke and 16% are haemorrhagic. The stroke patients have some other diseases like HTN, DM, Heart Disease, Arthritis etc. Among of all participants 78% participants has HTN, 58% DM, 2% heart disease, 2% Arthritis and 3% has other diseases. Smoking is the main risk factor of stroke and 12 participants has the habit of smoking. After stroke there are some complications may arise and 36% participants has Subluxation, 48% has pain and also vision problem about 16%.

Results for Inferential Statistical Analysis:

Hypothesis 1: Sensory re training with conventional therapy is more effective than conventional therapy alone for the stroke survivors with sensory impairment in tactile sensation.

Null Hypothesis 1: Sensory re training with conventional therapy has no effectiveness than conventional therapy alone for the stroke survivors with sensory impairment in tactile sensation.

Table 2(A): Results of Independent t-test for different regions of the body with TACTILE SENSATION by Pre and Post test

Regions of the body	**Light Touch**				**Temperature**				**Pinpric**			
	Pre		Post		Pre		Post		Pre		Post	
	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value
Face	-1.47	.072	3.871	.001	-1.812	.077	1.44	.166	-1.427	.160	2.711	.011
Trunk	-1.165	.250	7.250	.000	-1.272	.210	2.946	.006	-1.063	.293	5.716	.000
Shoulder	-.620	.538	15.879	.000	-1.242	.220	4.027	.000	.000	1.000	9.449	.000
Elbow	-.620	.538	13.861	.000	.859	.394	4.583	.000	.000	1.000	14.053	.000
Wrist	-.620	.538	10.675	.000	-1.120	.268	5.199	.000	-.283	.779	7.273	.000
Hand	-.620	.538	11.154	.000	-1.043	.302	4.977	.000	.000	1.000	8.839	.000

The results of independent t test shows that tactile sensation is significantly improved after taking sensory retraining treatment for the stroke survivors with sensory impairment (Table 7). The independent t test indicates the pre test and post test results that the significance of post test is shown in this table. The light touch, temperature and pinpric sensation are changed in all regions of body like Face, Trunk, Shoulder, Elbow, Wrist and Hand and their t value and sig value are (-3.871, .001<0.05) of face in light touch, .000<0.05 in trunk, shoulder, elbow , wrist and hand in light touch. The

sig value of pre test are from .072>0.05 to 1.000>0.05 that indicate not significant so the hypothesis is accepted and the null hypothesis is rejected.

Table 2 (B): Results of Independent t-test for different regions of the body with TACTILE SENSATION by Pre and Post test

Regions of the body	Pressure				Tactile sensation				Bilateral simultaneous touch			
	Pre		Post		Pre		Post		Pre		Post	
	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value
Face	-1.912	.062	2.585	.016	-2.029	.049	3.939	.000	.000	1.000	2.711	.011
Trunk	-1.736	.089	5.628	.000	-.814	.420	7.558	.000	.422	.675	5.628	.000
Shoulder	-1.225	.227	7.056	.000	.000	1.000	11.700	.000	.225	.823	5.124	.000
Elbow	-.891	.378	6.431	.000	.000	1.000	10.182	.000	.463	.646	7.184	.000
Wrist	-.790	.433	6.299	.000	.000	1.000	8.744	.000	.717	.477	6.710	.000
Hand	-1.225	.227	5.168	.000	.000	1.000	7.612	.000	.717	.477	7.927	.000

The independent t test showed that before and after significance of the sensory re training treatment. There is highly changes in post test and no significance in the pre test (Table 8). The t value of Face, Trunk, Shoulder, Elbow, Wrist and Hand in Pressure are 2.585, 5.628,7.056,6.431, 6.431, 6.299 and 5.168 and sig value .01 and .000<0.05 at post test which indicate that sensory retraining in pressure is highly significant. The t value in pre test is from .062 to 1.000 in pressure, tactile localization and bilateral simultaneous touch in all regions of the body that means less significant. In tactile localization and bilateral simultaneous touch the sig value of post test .000<0.05 to 0.01<0.05 that means post test results is significant. As a result it can be said that the hypothesis regarding sensory re training with conventional therapy is more effective than conventional therapy alone for the stroke survivors with sensory impairment in tactile sensation is accepted and the null hypothesis is rejected.

Hypothesis 2: Sensory re training with conventional therapy is more effective than conventional therapy alone for the stroke survivors with sensory impairment in Proprioception.

Null Hypothesis 2: Sensory re training with conventional therapy has no effectiveness than conventional therapy alone for the stroke survivors with sensory impairment in Proprioception.

Table 3: Results of Independent t-test for different regions of the body with Proprioception sensation by Pre and Post test

Regions of the body	PROPRIOCEPTION					
	Pre			Post		
	Mean difference	t value	Sig value	Mean difference	t value	Sig value
Face	N/A	N/A	N/A	N/A	N/A	N/A
Trunk	N/A	N/A	N/A	N/A	N/A	N/A
Shoulder	-.20	-1.145	.258	.88	6.559	.000
Elbow	-.16	-.934	.355	.76	6.111	.000
Wrist	-.16	-.891	.378	.84	6.041	.000
Hand	-.20	-1.145	.258	.76	5.563	.000

Sensory re training has seen significant recovery in post test. The t value and sig value indicate the significance of pre test and post test. The t value of post test are 6.559, 6.111, 6.041 and 5.563 >2 which indicate the effectiveness of sensory retraining (Table 9). The mean difference of post test in shoulder is (.88), elbow (.76), wrist (.84) and hand (.76). The sig value of shoulder, elbow, wrist and hand is .000<0.05 at post test that means sensory re training is effective for the stroke survivors to improved proprioception. On the other hand, in pre test the t value between -.891 to -1.145<2 and sig value between from .258 to .378 >0.05 which indicate that the pre test is not significant. The mean difference of the pre test are in shoulder (-.200), elbow (-.160), wrist (-.160) and hand (-.200). Before sensory re training the stroke survivors has no change in proprioception and no significant recovery. So the hypothesis accepted and the null hypothesis is rejected.

Hypothesis 3: Sensory re training with conventional therapy has significant recovery in stereognosis than conventional therapy alone for the stroke survivors with sensory impairment.

Null Hypothesis 3: Sensory re training with conventional therapy has no significant recovery in stereognosis than conventional therapy alone for the stroke survivors with sensory impairment.

Table 4: Results of Independent t-test for Stereognosis sensation by Pre and Post test

STEREOGNOSIS SENSATION					
Pre			**Post**		
Mean difference	**t value**	**Sig value**	**Mean difference**	**t value**	**Sig value**
-2.12	-1.496	.141	13.52	11.470	.000

There is highly a change in post test after taking the sensory re training treatment as base on that statistical analysis (Table 10). The Mean difference in pre test -2.12 and the mean difference in post test is 13.52. The t value of pre test is -1.496 <2 and the sig value of pre test is .141>0.05 which indicate that the pre test of sensory re training is not significant. Here, it shows that the t value after sensory re training is 11.470>2 and the sig value is .000<0.05 which indicate that there is highly significant in recovery of stereognosis after taking the treatment. So it is proved that the sensory re training with conventional therapy has significant recovery in stereognosis than conventional therapy alone for the stroke survivors with sensory impairment and this hypothesis is accepted and the null hypothesis is rejected.

Hypothesis 4: Sensory re training with conventional therapy has significant recovery in upper limb function than conventional therapy alone for the stroke survivors with sensory impairment.

Null Hypothesis 4: Sensory re training with conventional therapy has no significant recovery in upper limb function than conventional therapy alone for the stroke survivors with sensory impairment.

Table 5: Results of Independent t-test for Upper Limb Function according to Fugl meyer assessment Upper extremity scale by Pre and Post test

Regions of Upper Limb	Pre			Post		
	Mean difference	t value	Sig value	Mean difference	t value	Sig value
Upper Extremity	6.76	4.214	.000	18.76	14.309	.000
Wrist	2.60	4.428	.000	6.40	9.628	.000
Hand	2.92	4.454	.000	8.76	19.523	.000
Coordination	1.32	3.125	.003	7.16	6.968	.000
Sensation	-.56	-.738	.464	2.84	11.631	.000
Passive joint motion	.64	.926	.359	.84	12.665	.013
Joint pain	.88	1.062	.294	2.84	4.948	.000

The results of independent t test show the highly significant level of upper limb function after sensory re-training treatment for stroke survivors with sensory impairment (Table 11). In post test the mean difference of upper extremity is 18.76 that is greater than the score of pre test is 6.76. In pre test the mean differences of wrist, hand, coordination, sensation, passive joint motion and joint pain are 2.60, 2.92, 1.32, -.56, .64 and .88. In post test the mean difference of wrist, hand, coordination, sensation, passive joint motion and joint pain are 6.40, 8.76, 7.16, 2.84, .84 and 2.84 which are larger than pre test that means the treatment is significant. The sig value of upper extremity, wrist, hand, coordination, sensation and joint pain is .000<0.05 and the sig value of passive joint motion is .013<0.05 in post test. It indicates that the sensory retraining has significant recovery. But in pre test the upper extremity, wrist, hand and coordination has also significant level in.000<0.05 to 0.03<0.05 and other point like sensation .464>0.05, Passive joint motion .359>0.05 and joint pain .294>0.05 means no significance recovery. So the hypothesis is accepted and the null hypothesis is rejected.

Hypothesis 5: Sensory re training with conventional therapy has significant impact in Activities of Daily Living (ADL's) than conventional therapy alone for the stroke survivors with sensory impairment.

Null Hypothesis 5: Sensory re training with conventional therapy has no significant impact in Activities of Daily Living (ADL's) than conventional therapy alone for the stroke survivors with sensory impairment.

Table 6: Results of Independent t-test for ADL's participation according to FIM scale by Pre and Post test

Perception	Pre			Post		
	Mean difference	t value	Sig value	Mean difference	t value	Sig value
Participant's mentioned	.44	.309	.759	7.56	5.482	.000
Therapist's mentioned	3.36	2.542	.014	12.80	10.693	.000

The above result shows that the level of participation is improved after sensory re training treatment (Table 12) as the mean difference of participants mentioned and therapist's mentioned in post test are 7.56 and 12.80 which is more than pre test mean difference .44 and 3.36. The t value of participant's mentioned according to scale is 5.482 in post test and the therapist's mentioned t value is 10.693 which indicate that this is significant. The sig value of participant's mentioned is .000<0.05 and sig value as therapist's mentioned is .000<0.05 in post test which indicate that the sensory re training has an significant impact on the level of participation in Activities of Daily Living of the stroke survivors. On the other hand, the t value of participant's mentioned is .309>0.05 and sig value is .759>0.05 which indicate that in pre test there is no significant level in participation in activities of Daily Living. But in therapist's mentioned score shows less significant in pre test that is .014<0.05. So that it can be said that the hypothesis is accepted and the null hypothesis rejected.

Hypothesis 6: There will be significant changes in experimental group in improving tactile sensation (Light touch, Temperature, Pinpric, Pressure, Tactile sensation and Bilateral simultaneous touch) compared to control group.

Null Hypothesis 6: There is no change in experimental group in tactile sensation improving compared to control group.

Table 7 (A): Results of Paired – Sample t-test for different regions of the body with TACTILE SENSATION by experimental group and control group

Regions of the body	Light Touch				Temperature				Pinpric			
	Ex		Cont		Ex		Cont		Ex		Cont	
	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value
Face	-13.856	.000	-4.243	.000	-5.308	.000	-3.055	.005	-10.000	.000	-4.707	.000
Trunk	-14.421	.000	-2.74	.008	-5.657	.000	-2.449	.022	-10.947	.000	-2.000	.057
Shoulder	-18.767	.000	-1.00	.327	-6.197	.000	-1.000	.327	-12.247	.000	.000	1.000
Elbow	-17.644	.000	-1.000	.327	-5.657	.000	-1.000	.327	-11.438	.000	-1.445	.161
Wrist	-14.905	.000	-1.000	.327	-6.197	.000	-1.000	.327	-11.438	.000	-1.445	.161
Hand	-14.905	.000	-1.445	.161	-6.105	.000	-1.000	.327	-9.656	.000	-1.000	.327

In the statistical analysis the paired sample t test has shown the largely significance in experimental group (Table 2). In all regions of the upper body's tactile sensation is significantly improved in experimental group after five weeks treatment. In Light touch, Temperature and Pinpric sensation the sig values are Face (.000<0.05), Trunk (.000<0.05), Shoulder (.000<0.05), Elbow (.000<0.05), Wrist (.000<0.05) and Hand (.000<0.05). These scores showed the large gains with a high level of statistical significance. The control group showed negligible changes in sensory scores in Shoulder, Elbow, Wrist and Hand after five weeks. The sensory performance changes in the experimental group compared to the control group. So that it can be said that the hypothesis is accepted and the null hypothesis is rejected.

Table 7 (B): Results of Paired – Sample t-test for different regions of the body with TACTILE SENSATION by experimental group and control group

Regions of the body	Pressure				Tactile sensation				Bilateral simultaneous touch			
	Ex		Cont		Ex		Cont		Ex		Cont	
	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value	t value	Sig value
Face	-7.333	.000	-3.055	.000	-14.905	.000	-4.303	.000	-5.253	.000	-4.096	.000
Trunk	-8.048	.000	___	___	-15.396	.000	-1.445	.161	-5.634	.000	-2.874	.008
Shoulder	-7.856	.000	-1.000	.327	-14.905	.000	-1.000	.327	-8.000	.000	-1.445	.161
Elbow	-7.103	.000	-1.445	.161	-14.905	.000	-1.445	.161	-7.333	.000	-1.000	.327
Wrist	-6.725	.000	-1.445	.161	-12.273	.000	-1.000	.327	-8.000	.000	-1.000	.327
Hand	-7.333	.000	-1.000	.327	-16.885	.000	-1.445	.161	-7.333	.000	-1.000	.327

There is significant change in the experimental group as like shown the scores of test the sig values shown high level of sensory performance in pressure, tactile localization and bilateral simultaneous touch (Table 3). The sig values are Face (.000<0.05), Trunk (.000<0.05), Shoulder (.000<0.05), Elbow (.000<0.05), Wrist (.000<0.05) and Hand (.000<0.05) in the experimental group that means the tactile sensations are significantly changes in this group. On the other hand, the control group showed very less changes only in Face the control group has shown the significance level. In control group, at trunk the t value and sig value are not shown as because there is no change in the pre and post test in case of pressure sensation. In here, the hypothesis is accepted and the null hypothesis is rejected.

Hypothesis 7: There will be significant changes in experimental group in improving Proprioception compared to control group.

Null Hypothesis 7: There is no change in experimental group in proprioception improving compared to control group.

Table 8: Results of Paired – Sample t-test for different regions of the body with Proprioception sensation by experimental group and control group

Regions of the body	PROPRIOCEPTION					
	Ex			Cont		
	Mean difference	t value	Sig value	Mean difference	t value	Sig value
Face	N/A	N/A	N/A	N/A	N/A	N/A
Trunk	N/A	N/A	N/A	N/A	N/A	N/A
Shoulder	-1.08	-9.448	.000	-.04	-1.000	.327
Elbow	-1.00	-10.000	.000	-.08	-1.445	.161
Wrist	-1.04	-9.656	.000	-.04	-1.000	.327
Hand	-1.00	-8.660	.000	-.04	-1.000	.327

The proprioception is not applicable for Face and Trunk. The paired sample t test shown the significance of the experimental group compared to the control group (Table 4). In proprioception improvement is significant in all regions of upper limb. The mean difference of experimental group are -1.08, -1.00, -1.04 and -1.00 which are greater than control group -.04, -08, -.04 and -.04 that means the experimental group's score is significant. The t values and sig values are Shoulder (-9.448, .000<0.05), Elbow (-10.000, .000<0.05), Wrist (-9.656, .000<0.05) and Hand (-8.660, .000<0.05) of experimental group that is significant compared to the control group. The t value of control group from -1.000 to -1.445 and sig value .161 to .327 that is not significant. So the hypothesis 2 is accepted and the null hypothesis is rejected.

Hypothesis 8: There will be significant changes in experimental group in improving Stereognosis compared to control group.

Null Hypothesis 8: There is no change in experimental group in stereognosis improving compared to control group.

Table 9: Results of Paired – Sample t-test for stereognosis by experimental group and control group

STEREOGNOSIS SENSATION					
Experimental			**Control**		
Mean difference	**T value**	**Sig value**	**Mean difference**	**t value**	**Sig value**
-1.57	-19.990	.000	-.08	-1.445	.161

There is highly a change of stereognosis in the experimental group that is shown in the Table 4. The mean difference of stereognosis in experimental group is -1.57 which is greater than control group -.08 that means the treatment is significant. The t value and sig value of experimental group is -19.990 and .000<0.05 that is highly significant and a great change after five week sensory re- training treatment. The t value and sig value of control group is -1.445 and .161>0.05 that means it is not significant. So that it can be said that there is significant change in experimental group in improving stereognosis compared to the control group, the hypothesis 3 is accepted and the null hypothesis is rejected.

Hypothesis 9: There will be significant recovery in upper limb function after sensory retraining in experimental group compared to control group.

Null Hypothesis 9: There will be no significant recovery in upper limb function after sensory retraining in experimental group compared to control group.

Table 10: Results of Paired – Sample t-test for affected side of Upper Limb Function according to Fugl meyer assessment Upper extremity scale by experimental group and control group

Regions of Upper Limb	Experimental			Control		
	Mean difference	t value	Sig value	Mean difference	t value	Sig value
Upper Extremity	-1.20	-15.599	.000	-.08	-1.000	.327
Wrist	-3.96	-8.288	.000	-.16	-1.693	.103
Hand	-5.96	-14.981	.000	-.12	-1.365	.185
Coordination	-1.60	-9.238	.000	-.08	-1.445	.161
Sensation	-7.80	-19.500	.000	-.08	-1.000	.327
Passive joint motion	.68	-1.622	.118	-.12	-1.000	.327
Joint pain	-2.88	-5.432	.000	-.92	-3.994	.001

The statistical analysis base on paired sample t test shown that the control group has no significant changes after five weeks (Table 5) as because the mean differences are increased in experimental group than in control group like -1.20>-.08, -3.96>-.16, -5.96>-.12, -1.60>-.08, -7.80>-.08, .68>.-12 and -2.88>-.92. Here, the upper limb function has improved significantly in experimental group as because the sig value of upper extremity, Wrist, Hand, Coordination, sensation and joint pain is .000<0.05. In case of upper extremity, shoulder, wrist, hand and sensation have highly changes but in passive joint motion no significant change and joint pain in both experimental and control has significant changes. It can be said that there is significant recovery in upper limb function after sensory re training so hypothesis is accepted and null hypothesis is rejected.

Hypothesis 10: There will be significant impact on the level of participants in Activities of Daily Living in experimental group compared to control group.

Null Hypothesis 10: There will be no significant impact on the level of participants in Activities of Daily Living in experimental group compared to control group.

Table 11: Results of Paired – Sample t-test for affected side of ADL's participation according to FIM scale by experimental group and control group

Perception	Experimental			Control		
	Mean difference	t value	Sig value	Mean difference	t value	Sig value
Participant's mentioned	-7.20	-10.733	.000	-.08	-1.445	.161
Therapist's mentioned	-9.52	-12.286	.000	-.08	-1.445	.161

According to Functional Independence Measure (FIM), there are two perceptions are accepted to see the functional independence in self-care activities or Activities of daily living one is participant's mentioned and the another one is therapist's mentioned. The both perceptions are significant in the experimental group as because the mean differences of these perceptions are greater than the both perceptions of control group like -7.20>-.08 and -9.52> -.08. However, the t value and sig value of participant's mentioned are -10.733 and .000<0.05 in experimental group that means there is a highly significant impact on the level of participation in activities of daily living (Table 6). The t value and sig value of therapist's mentioned is -12.2886 and .000<0.05 in experimental group that is also highly significant. On the other hand in control group the t value and sig value of participant's mentioned and therapist's mentioned are (-1.445, .161>0.05) and (-1.445, .161>0.05) which indicates that there is no significant in participation of Activities of daily living in control group. As a result, there is a significant impact in experimental group compared to control group and hypothesis is accepted and null hypothesis is rejected.

Hypothesis 11: There will be no associated factors except duration of stroke, affected body part and affected brain that influence the treatment effectiveness for the stroke survivors with sensory impairment.

Null Hypothesis 11: There will be associated factors that significantly influence the treatment effectiveness for the stroke survivors with sensory impairment.

Table 12: Results of One Way ANOVA to find out associate factors that influence treatment effectiveness of Light Touch by experimental group and control group

Light Touch														
Regions of the body	**Age**		**Sex**		**Duration of stroke**		**Affected body part**		**Affected brain**		**Type of stroke**		**Complication**	
	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Shoulder	.536	.549	.430	.426	.513	.361	.007	.387	.007	.426	.121	.043	.672	.585
Elbow	.421	.429	.217	.426	.315	.361	.025	.268	.025	.228	.006	.627	.377	.602
Wrist	.171	.549	.830	.426	.208	.361	.005	.268	.005	.426	.058	.627	.431	.602
Hand	.225	.444	.322	.775	.730	.106	.005	.866	.005	.775	.511	.482	.431	.961

The results of One way ANOVA shows that in light touch the experimental group has significant in affected body part, affected brain and types of stroke (Table 13). The sig value of shoulder, elbow, wrist and hand in affected body part and affected brain are .007<0.05, .025<0.05, .005<0.05 and .005<0.05. The sig value in types of stroke are in elbow .006<0.05 and wrist .058=0.05. The others associated factors like age, sex, duration of stroke and complication has no significance in light touch and no impact on treatment effectiveness. The sig value of other associated factors are within .171>0.05 to .775>0.05 that is not significant so that the hypothesis is accepted and the null hypothesis is rejected.

Table 13: Results of One Way ANOVA to find out associate factors that influence treatment effectiveness of Temperature by experimental group and control group

Temperature														
Regions of the body	**Age**		**Sex**		**Duration of stroke**		**Affected body part**		**Affected brain**		**Type of stroke**		**Complication**	
	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Shoulder	.263	.549	.628	.426	.669	.361	.797	.268	.797	.426	.711	.627	.124	.074
Elbow	.824	.444	.658	.775	.690	.628	.407	.866	.407	.775	.168	.482	.898	.337
Wrist	.792	.549	.270	.228	.972	.429	.797	.387	.797	.426	.130	.627	.888	.602
Hand	.402	.549	.892	.228	.720	.429	.293	.387	.293	.429	.191	.627	.979	.602

Here, the sig value of shoulder, elbow, wrist and hand in experimental group is .130>0.05 to .979>0.05 in temperature and in the control group the sig value is .074>0.05 to .775 (Table 14). There is no associated factors that influence the treatment effectiveness. Age has no significancy in changes of temperature as because the sig value of age in between .263 to .792 in experimental group and also in control group .444 to .549 which is shown that not significancy. The factors has no influence in the treatment effectiveness in temperature sensation recovery.

Table 14: Results of One Way ANOVA to find out associate factors that influence treatment effectiveness of Pinpric by experimental group and control

Pinpric														
Regions of the body	**Age**		**Sex**		**Duration of stroke**		**Affected body part**		**Affected brain**		**Type of stroke**		**Complication**	
	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Shoulder	1.000	1.000	.334	1.000	.146	.251	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Elbow	.794	.776	.208	.775	.365	.628	.770	.866	.770	.775	.875	.288	.811	.961
Wrist	.511	.776	.208	.076	.365	.576	.533	.866	.533	.775	.875	.482	.445	.337
Hand	.438	.135	.067	.228	.492	.429	.599	.268	.599	.228	.894	.627	.520	.602

There is no significance level less than 0.05 (Table 15). In experimental group the sig value between.067>0.05 to 1.000>0.05 that means no significant or associated factors has no influence in treatment effectiveness. In the experimental group there is no influencing factors in shoulder, elbow, wrist and hand recovery of pinpric sensation. The treatment effectiveness is not influenced by any associated factors. On the otherhand, in the control group there is also no influencing factors as because the sig value of control group in between .135 to 1.000<0.05. So it can be said that the hypothesis is accepted and the null hypothesis is rejected.

Table 15: Results of One Way ANOVA to find out associate factors that influence treatment effectiveness of Pressure by experimental group and control group

Pressure														
Regions of the body	**Age**		**Sex**		**Duration of stroke**		**Affected body part**		**Affected brain**		**Type of stroke**		**Complication**	
	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Shoulder	.968	.549	.779	.426	.855	.361	.643	.387	.643	.426	.268	.043	.071	.585
Elbow	.597	.776	.799	.246	.880	.576	.676	.207	.676	.246	.318	.002	.402	.961
Wrist	.328	.275	.634	.246	.670	.576	.631	.207	.631	.246	.148	.288	.145	.337
Hand	.939	.549	.387	.426	.864	.361	.469	.387	.469	.426	.168	.627	.585	.602

In the experimental group there is no significant value are seen in the result of One way ANOVA that means there is no associated factors that influence the treatment effectiveness of pressure sensation except type of stroke. The sig value of shoulder and elbow in type of stroke is .043<0.05 and .002<0.05 which indicate the significance in pressure sensation recovery (Table 16). The sig values of experimental group are between .071>0.05 to .968>0.05 that indicate no significance. On the other hand in control group has no significance. So the hypothesis is accepted and the null hypothesis is rejected.

Table 16: Results of One Way ANOVA to find out associate factors that influence treatment effectiveness of Tactile Localization by experimental group and control group

Tactile Localization														
Regions of the body	**Age**		**Sex**		**Duration of stroke**		**Affected body part**		**Affected brain**		**Type of stroke**		**Complication**	
	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Shoulder	.472	.549	.179	.228	.730	.361	.896	.268	.896	.228	.511	.627	.704	.585
Elbow	.114	.158	.179	.775	.203	.628	.492	.207	.492	.246	.058	.482	.915	.961
Wrist	.208	.549	.843	.426	.096	.361	.254	.268	.254	.426	.543	.627	.352	.602
Hand	.812	.275	.110	.775	.228	.628	.184	.207	.184	.246	.516	.228	.320	.337

In tactile localization, the sig value of experimental group is .058<0.05 at type of stroke which indicate the significancy and others factors sig value in between .110>0.05 to .915<0.05 which indicate that these factors has no influence in the treatment effectiveness. There is no associated factors except type of stroke to influence in the treatment effectiveness of sensory re-training. So the hypothesis is accepted and the null hypothesis is rejected.

Table 17: Results of One Way ANOVA to find out associate factors that influence treatment effectiveness of bilateral simultaneous touch by experimental group and control group

Bilateral simultaneous touch														
Regions of the body	**Age**		**Sex**		**Duration of stroke**		**Affected body part**		**Affected brain**		**Type of stroke**		**Complication**	
	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Shoulder	.676	.275	.531	.246	.954	.576	.002	.207	.002	.246	.633	.288	.328	.429
Elbow	.244	.549	.268	.426	.414	.429	.002	.387	.002	.426	.523	.043	.030	.602
Wrist	.676	.549	.151	.426	.471	.429	.002	.387	.002	.426	.633	.043	.270	.002
Hand	.244	.549	.071	.426	.089	.429	.002	.387	.002	.426	.523	.043	.185	.602

In affected body part and affected brain the sig value is .002<0.05 (Table 18) means that these factors has significant influence on treatment effectiveness of bilateral simultaneous touch changes. The sig values of shoulder, elbow, wrist and hand in affected body part are .002<0.05, .002<0.05, .002<0.05 and .002<0.05 that means the shoulder, elbow, wrist and hand sensation changes influenced by the affected body part. Others factors has no influence on treatment effectiveness as because the sig value in between .071>0.05 to .954>0.05. So the hypothesis is accepted and the null hypothesis is rejected.

Table 18: Results of One Way ANOVA to find out associate factors that influence treatment effectiveness of Proprioception by experimental group and control group

Proprioception														
Regions of the body	**Age**		**Sex**		**Duration of stroke**		**Affected body part**		**Affected brain**		**Type of stroke**		**Complication**	
	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Shoulder	.553	.429	.039	.228	.889	.361	.794	.387	.794	.426	.802	.627	.610	.585
Elbow	1.000	.776	.072	.775	.634	.106	1.000	.207	1.000	.246	1.000	.288	.360	.337
Wrist	.849	.429	.067	.228	.817	.361	.599	.387	.599	.426	.894	.627	.840	.602
Hand	1.000	.429	.083	.228	.626	.361	1.000	.387	1.000	.426	1.000	.627	1.000	.602

In proprioception changes there is no factors influences in treatment effectiveness because there is no sig value less than 0.05 (Table 19). The sig value of experimental group in between .067>0.05 to 1.000>0.05 which indicate that the associated factors not influenced the treatment effectiveness. In the control group the sig value in between .106>0.05 to .889>0.05 which means that the associated factors has no significance in the conventional treatment

Table 19: Results of One Way ANOVA to find out associate factors that influence treatment effectiveness of Stereognosis by experimental group and control group

Stereognosis Sensation														
	Age		**Sex**		**Duration of stroke**		**Affected body part**		**Affected brain**		**Type of stroke**		**Complication**	
	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Stereognosis	.455	.990	.191	.775	.484	.106	.473	.207	.473	.246	.171	.482	.332	.337

In experimental group the sig value of stereognosis in age , sex, duration of stroke, affected body part, affected brain, type of stroke and complication are .455<0.05, .191<0.05, .484<0.05, .473<0.05, .171<0.05and .332<0.05 that indicate there is no significance level (Table 20). So in stereognosis changes the associated factors has no impact. So it can be said that the hypothesis is accepted and the null hypothesis is rejected.

Table 20: Results of One Way ANOVA to find out associate factors that influence treatment effectiveness of Upper Extremity function according to Fugl-Meyer Assessment by experimental group and control group

Light Touch														
Region of Upper limb	**Age**		**Sex**		**Duration of stroke**		**Affected body part**		**Affected brain**		**Type of stroke**		**Complication**	
	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Upper Extremity	.141	.549	.314	.228	.002	.361	.945	.268	.945	.228	.196	.627	.951	.602
Wrist	.933	.821	.454	.035	.396	.273	.413	.054	.413	.035	.065	.409	.473	.668
Hand	.287	.195	.759	.274	.591	.138	.783	.776	.783	.857	.792	.113	.180	.381
Coordination	.121	.444	.094	.246	.688	.628	.701	.207	.701	.246	.207	.288	.461	.961
Sensation	.491	.549	.075	.228	.703	.361	.617	.387	.617	.426	.435	.627	.270	.602
PJM	.811	.361	.396	.119	.646	.557	.931	.152	.931	.119	.560	.533	.192	.795
Joint pain	.115	.074	.251	.897	.897	.412	.264	.704	.264	.447	.886	.801	.416	.942

In both experimental and control group there is no significance level less than 0.05 and indicate no impact of associated factors in treatment effectiveness (Table 21). In experimental group the age has no influence in treatment effectiveness as because the sig value of upper extremity, wrist, hand, coordination, sensation, passive joint of motion and joint are .141, .933, .287, .121, .491, .811 and .115 which shows no significancy and accept the hypothesis and reject the null hypothesis. On the other hand the sig value of duration of stroke in upper extremity, wrist , hand, coordination, sensation, passive joint of motion and joint pain are .002, .396, .591, .688, .703, .646 and .897. Among of these the sig value of upper extremity is .002>0.05 which indicates that the significancy and shows duration of stroke influence the treatment effectiveness of sensory re-training in recovery of upper extremity.

Table 21: Results of One Way ANOVA to find out associate factors that influence treatment effectiveness of ADL's participation according to Functional Independence Measure scale (FIM) by experimental group and control group

	Age		**Sex**		**Duration of stroke**		**Affected body part**		**Affected brain**		**Type of stroke**		**Complication**	
	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont	Ex	Cont
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Participant's mentioned	.629	.390	.834	.775	.005	.158	.766	.207	.766	.246	.049	.482	.398	.961
Therapist mentioned	.876	.390	.401	.246	.204	.576	.680	.207	.680	.246	.065	.288	.826	.961

By following the results of One Way ANOVA in participation of Activities of Daily Living the sig value in duration of stroke is 0.05=0.05 in participant's mentioned and the therapists' mentioned value is .204>0.05 , affected brain is .766>0.05 and .680>0.05. The type of stroke the participant's mentioned sig value is .049<0.05 and therapist's mentioned sig value is .065<0.05. (Table 22). In control group the sig value of participant's mentioned is .158>0.05 in duration of stroke and the therapist mentioned sig value is .576>0.05. There is no influence of other factors like age, sex, complication in treatment effectiveness. So it can be said that there will be no associated factors except duration of stroke, affected body part and affected brain that influence the treatment effectiveness for the stroke survivors with sensory impairment that means the hypothesis is accepted and the null hypothesis is rejected.

CHAPTER- V DISCUSSION

The purpose of the study was to investigate the effectiveness of sensory re-training with conventional occupational therapy compare to only conventional occupational therapy for stroke survivors with sensory impairment. There were 50 patients randomly assigned to the experimental group and to the control group. Among of these 50 patients, 25 patients were included in the experimental group who received sensory re-training with conventional treatment and 25 patients were included in the control group who received conventional occupational therapy only. The outcome was measured by using Revised Nottinghum Sensory Assessment scale for sensory changes, Fugl-Meyer Assessment Upper Extremity (FMA-UE) for upper limb function and Functional Independence Measure (FIM) for measuring functional independence.

The researcher found the significant improvement of sensory in tactile sensation, proprioception and stereognosis in upper limb, improvement in upper limb function and improvement in level of participation in Activities of Daily Living or self care activities. The researcher also found that the associated factors that influence the treatment effectiveness. The score of tactile sensation, proprioception and stereognosis was statistically significant. The upper limb function score and the functional activities score was also statistically significant.

During the first month of stroke it is less opportunity to find the result of any therapeutic treatment so that in this pilot trial the patients were selected from one month to six months. Generally most of the recovery are taking places of neurological impairment in first six months (Yeakutiel & Guttman, 1993).

The results of sensory training have added new experience and idea about the feasibility and effectiveness of sensory re-training in combination with the conventional therapy on upper limb function after stroke. The results also increase the understanding that the way of receiving the sensory re-training intervention by using the local resources and given an idea about sensation and the effects of the training.

Although it is a new treatment approach but it can provide knowledge on how to design a larger RCT in persons with sensory impairments after stroke.

In this study, there was no dropout rate resulting in the small sample size. The baseline measurements in both groups were not statistically significant before taking the sensory re-training treatment. According to the statistical result, the significant improvement was shown in the sensory function of upper limb especially in tactile sensation, stereognosis and proprioception. Thus the instant improvement has shown in a short period of particularly in the sensory function.

There is also a great improvement of functional outcome within a shortest amount of time after stroke. In this study the intervention was given for five weeks and the conventional occupational therapy was ongoing intervention. Although the ongoing improvement after five weeks of sensory function is might be expected through sensory re-training with conventional treatment.

The somatosensory system process consists of several modalities of somatic sensation (e. g. Touch, temperature, proprioception) and represent the sensory information for the motor system (Bolognini et al., 2017). It is not surprising that motor recovery can be enhanced by sensory stimulation. The functional outcome also depends on the sensory function (Farne et al., 2004). Accordingly, re-learning and compensation may be benefited from the sensory treatment. Active sensory training has the effects on function, sensation and proprioception (Schabrun & Hillier, 2009).

After stroke at six months there is a relationship between stroke severity, motor function and ADL ability with sensory function. Significantly sensory outcome is correlated with the sensory impairment. Age did not significantly correlate with performance and changes of sensory function. There are some other categorical factors like type of stroke, affected brain and affected body part has the impact on improvement of sensory function. According to gender sensory outcome did not differ. There is no statistically significant difference in sensory ability between men and women (U values 311.5 to 366.0, $p>0.01$). The sensory impairment in upper limb has a largest impact in upper limb sensory function although it shows significant improvement following an intervention. However, the effectiveness of sensory

rehabilitation needs to address the development of outcome measure first. (Connel, L.A., 2007).

In this study, the duration of stroke, type of stroke and affected brain are significantly related to the sensory outcome like tactile sensation.

There are some factors like the severity of stroke; activities of daily living and the initial sensory impairment were significantly associated to sensory recovery. These factors accounted for 46-71% of the variance. Within six months after stroke significant recovery was shown in upper limb tactile sensations, stereognosis and proprioception but lower limb sensations did not show significant recovery. The sensory motor recovery is most benefited for the patients. The patients who are specific to training sensation show positive effects (Cambier et al., 2003, Carey et al., 1993, Yeakutiel & Guttman, 1993).

Cambier et al. (2003) found that touch sensation improved significantly with motor impairment and somatosensory function the sig value $p<0.001$ in experimental group. There is a relationship between touch pressure and hand function. There are many studies examined that motor impairment and ADL independence consider the impact of sensory impairment (Dannenbaum et al., 2002). Tyson et al.(2008) found that sensory impairment are associated with stroke severity and weakness especially related to ADL independence. Additionally, sensory re – training are relating to upper limb function recovery.

Sensory program enhance somatosensory functioning focusing on tactile localization, proprioception and movement. The affected impaired hand function leads to disability for ADL's. (Gao et al., 2010).

In this study the researcher found that the sig value of experimental group in tactile sensation (Light touch, temperature, Pinpric, pressure, tactile localization and bilateral stimulation) is $0.000<0.05$ where the significance level has set as $p<0.05$. After five weeks sensory re-training program the experimental group has significantly changed. On the other hand, the control group's significance levels are from .161 to $1.000>0.05$ that indicate that the control has not significant changes as because they are not given the sensory re-training treatment with the conventional treatment. In case of proprioception and stereognosis there highly significant changes has shown in

the experimental group. The sig value of experimental group in proprioception and stereognosis is 0.000<0.05 and in the control group Proprioception from .161 to .327>0.05 and the stereognosis .161>0.05 which indicate the control group has negligible changes after five weeks conventional treatment only.

There were two tests are taken one is pre test and another is post test. In both group the pre test score was not significant. In tactile sensation the significant level of pre test was 0.07>0.05 to .538>0.05 that indicate no significant and the post test significant level was in tactile sensation 0.000<0.05 that means higher significant level. In tactile sensation has improved after the sensory re-training treatment.

The pre test score in proprioception was 0.258>0.05 to 0.378>0.05 and not significant but in post the sig value in all regions of upper limb is .000<0.05. In case of stereognosis the sig value in post test is .000<0.05 and the pre test sig value is .161>0.05 so that the sensory re-training has effects on improvement in stereognosis where the pre test has no significant. There was a study show that the somatosensory training has a significant recovery in somatosensory performance and also leads to motor recovery for the stroke patients (Yekutiel and Guttman, 1993). In this study the pre test sig value are .309>0.05 and sig value is .759>0.05 and in the post test sig value .000<0.05 of the participation in Activities of daily living. The interventions of sensory training and motor training both are required and 20% ($p<0.01$) improvement across in both groups in improvement of functional independence and upper extremity function (Connel, L.A., 2007).

In Fugl Meyer Assessment scale have shown the upper limb function improvement that was 000<0.05 to 0.03<0.05 at post test. The upper limb function has significant recovery. The study shown those Fugl-Meyer assessments was significantly higher at 6 and 12 months in the intervention group compared to control group (Connel, L.A., 2007).

5.1. Limitations of the study

As it is a centre based study data was collected only those who came for rehabilitation at occupational therapy department of the Centre for the Rehabilitation of the Paralysed (CRP) and its sub-centers but this research does not reach the people with stroke treat in other hospitals.

The data collection tools that three standardized assessment tools Nottingham Sensory Assessment (NSA), FIM, FMA-UE & BAMSE. Out of them NSA, FIM and FMA-UE are not validated in the context in Bangladesh that will be a limitation of the study.

As it is the academic research and the research got a couple of months only so that the collection of large number of sample was difficult for the researcher. This treatment protocol was not applicable for a large number of people in a group. It is only taken three to five participants in a group so it was not possible to take more samples in the study.

There was no relevant research done in the area of Bangladesh even in south Asian countries so that it was difficult to get available information for the study and literature review. The researcher was unable to find out the result in follow up session due to time limitation.

CHAPTER -VI RECOMMENDATIONS & CONCLUSION

4.1. Recommendation

The purpose of the study is to find out the effectiveness of sensory re training intervention for stroke survivors. The researcher can indentify some further step that may be taken into consideration for the better accomplishment of further research and it can be done with a large sample.

The result of the study will demonstrate the effects between the experimental group and control group can be done by considering proof of hypothesis in term of comparison between experimental group and control group after stroke or same study can be done in true randomized controlled trial study.

A longer time frame and long time follow up session would provide valuable longer effects of the applied treatment protocol. Double blinding can be reduced the biasness of the study.

4.2. Conclusion

Sensory impairment is a common problem after stroke. Due to sensory loss the patient is unable to perform activities of daily living properly. Recovery of stroke depends on different factors among of them sensory impairment is one that is highly related to occupational performance. Among of the different tactile sensation like light touch, temperature, pinpric, pressure, tactile localization , bilateral simultaneous touch etc light touch was the most frequently impaired sensation. The stereognosis also frequently impaired in stroke survivors. But the significance in recovery of stereognosis is very high. There was a significance recovery in the tactile sensation of upper limb after the sensory re education.

There was a significant difference in the pre test and post test of the sensory impaired participants.

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APPENDIX I

CONSENT FORM

INFORMED DECISION MAKING CONSENT FORM

Code: ---------- Date: ----/----/ -----

Name of the respondent----------

I am **Mansura Akter**, student of MRS program, Bangladesh Health Professions Institute (BHPI). As a course requirement I am doing a research on **"Effectiveness of Sensory re-training for stroke survivors: A Pilot randomized controlled trial study".** I am inviting you to participate in this research study.

I need some valuable information from you as a part of my academic purpose. Your co-operation will be highly appreciable. You can refuse to answer any questions or may leave any time you feel like. If you refuse to leave you will not face any problem.

All the information given by you will be kept confidential. Your identity will not be disclosed. Only study-related personnel will be allowed to see the information.

I would appreciate your cooperation. If you agree to join the study please sign at the space indicated below.

Investigator's signature & Date **Volunteer signature & Date**

Witness signature/Thumb impression & Date

APPENDIX II

INFORMED CONSENT

I have read the for-going information. All of my quarries were answered satisfactorily. I have understood that it is a research for **"Effectiveness of Sensory re-training for stroke survivors: A Pilot randomized controlled trial study"**. I have fully understood the purpose and duration of this research's. I have got a clear idea of this research including the procedures to be followed. I have understood that my personal identifies and other social information was kept highly confidential and the records connected with the participation in this research were safeguarded. My name was revealed in any publication that may arise from the study. I was haven't any risk and discomfort of participating into this research. I have understood that I have right to leave this research any time for any reason so ever I have undersigned certify that I signed this document willingly to participate in the same time research of following witness.

……..	……
Volunteer's Signature	Witness's Signature
Name:	Name:
Father's Name:	Father's Name:
Address:	Address:
Date:	Date:

……

Principal investigator's Signature

Date:

APPENDIX III
Consent form in Bangla
তথ্যপত্র

আমি **মানসুরা আক্তার**, সিনিয়র ক্লিনিক্যাল অকুপেশনাল থেরাপিস্ট হিসাবে অকুপেশনাল থেরাপী বিভাগে **সি. আর. পি** সাভারে কর্মরত আছি । বর্তমানে আমি ঢাকা বিশ্ববিদ্যালয়ের অধিনে বাংলাদেশে হেল্‌থ প্রফেশন্স ইন্সটিটিউট (বি এইচ পি আই) থেকে রিহ্যাবিলিটেশন বিজ্ঞান (Rehabilitation Science) এর উপর মাষ্টার্স করছি। মাষ্টার্স কোর্সটি সম্পূর্ণ করার জন্য একটি গবেষণা করা বাধ্যতামূলক।

তাই, আমি আপনাকে এই গবেষণা বিষয়ে অংশগ্রহণ করার জন্য অনুরোধ করছি । আমার গবেষণার বিষয় হল; **" মস্তিস্কের পক্ষাঘাত (**Stroke/CVA**) আক্রান্ত ব্যক্তিদের ক্ষেত্রে সংবেদনশীলতার পুনঃপ্রশিক্ষনের কার্যকারীতাঃ একটি পাইলট রেন্ডোমাইজড কন্ট্রোল ট্রায়েল স্টাডি।"** এই গবেষনার মূল লক্ষ্য হচ্ছে, মস্তিস্কের আক্রান্ত ব্যক্তিদের পক্ষাঘাত সংবেদনশীলতার পুনঃপ্রশিক্ষনের কার্যকারীতার ব্যাপকতা এবং কর্মক্ষমতার অবস্থা নির্ণয় করা।

এই গবেষণায় আপনার অংশগ্রহণ হবে স্বেচ্ছামূলক। যদি আপনি মোটেই অংশগ্রহণ করতে না চান তাহলে যে কোন সময় আপনি আপনার সহযোগীতা বাতিল করতে পারবেন। এতে আপনার কোন সমস্যা হবে না।

আপনাকে প্রশ্নগুলোর উত্তর করতে হবে, যাতে প্রায় ৩০ মিনিটের মত সময় লাগতে পারে এবং প্রশ্নের উত্তর সম্পূর্ণরূপে গোপন রাখা হবে। আপনার অংশগ্রহণের জন্য কোন সম্মানি ভাতা প্রদান করা হবে না। এই অংশগ্রহণ আপনার কোন উপকারে নাও আসতে পারে। এ গবেষণা আপনার জন্য কোন ক্ষতিকরও হবে না। গোপনীয়তার সাথে সব ধরনের প্রশ্নের উত্তর সংরক্ষন করা হবে। কখনও এই তথ্যগুলো ব্যবহার করা হলে, আপনার পরিচিতি গোপন রাখা হবে এবং আপনার অনুমতি ছাড়া এ তথ্যগুলো ব্যবহার করা হবে না।

বর্তমানে ও পরবর্তীতে যদি এই গবেষণা সম্পর্কে কোন প্রশ্ন থাকে তাহলে নিচে বর্নিত ব্যক্তির সাথে যোগাযোগ করবেন।

মানসুরা আক্তার

সিনিয়র ক্লিনিক্যাল অকুপেশনাল থেরাপিস্ট

অকুপেশনাল থেরাপী বিভাগ

সিআরপি, চাপাইন, সাভার , ঢাকা-১৩৪৩

মোবাইল নম্বর: ০১৬৭৬৯৯৯০৪১

APPENDIX IV

Informed consent in Bangla

অনুমতি পত্র

আমি তথ্য পত্রটি পড়েছি এবং গবেষণার বিষয়বস্তু সম্পর্কে অবগত হয়েছি। যেখানে আমার বুঝতে সমস্যা হয়েছিল আমি প্রশ্ন করার সুযোগ পেয়েছিলাম এবং সন্তোষজনক উত্তর পেয়েছি। এই গবেষণার খারাপ এবং ভাল দিকগুলো সম্পর্কে জানতে পেরেছি। আমি যে কোন সময় কোন রকম অনুমতি নেয়া ছাড়াই আমার অংশগ্রহণ বাতিল করতে পারব এবং এটা আমার চিকিৎসা ক্ষেত্রে কোন রকম প্রভাব ফেলবে না। তথ্যপত্রে আমার সকল তথ্যসমূহ গোপন রাখা হবে। এজন্য আমি এই গবেষণায় অংশগ্রহণ করতে ইচ্ছুক।

অংশগ্রহণকারীর স্বাক্ষর... তারিখ...

তথ্যগ্রহণকারীর স্বাক্ষর... তারিখ...

APPENDIX V
Sensory Re-training Protocol

Sensory Stimulation and Re-training

An occupational therapist involved in sensory retraining should:

- Educate client / caregiver regarding the purpose of sensation, safety concerns, and upper extremity protection.
- Modify the environment for safety (e.g. adjust water temperature).
- Introduce varied textures and sensations (e.g. wash cloth, rice, and macaroni).
- Use different weights, sizes, and shapes of objects to promote discrimination.
- Use vision as a compensatory strategy, progressing to occluding vision if able and if safety permits.

Sensation Re-training Intervention

Step 1: At first the patient takes a washcloth and rubs it over their affected hand in a circular motion. Repeat it for 10 minutes. They try to feel on their skin.

Step 2: Lightly tap the affected hand with less affected hand from forearm to fingertips. Repeat for 10 minutes.

Step 3: Trace the affected fingertips over a texture amaze like Velcro, sting, cotton balls with eyes open and closed. Repeat for 10 minutes.

Step 4: Clap the hands together at shoulder level. Make sure patient can hear loudly "clap". Repeats for 10 times.

Step 5: Place a butter knife on the table in front of patient. Pick it up using the affected hand. Get the butter knife in a good position to cut and then tap with tip of it as patient are cutting something and using theraputty as sample. Put the knife down on the table. Repeat 10 times and making sure the correct grip each time.

Step 6: Place a pen, pencil, toothbrush or straw in affected hand, holding it at the bottom. Then manipulate it to the top by using only the fingertips. Repeat it up and down 10 times.

Step 7: Put 5 coins in different shape in patients pocket or on the table under a cloth. Use the affected hand to pull them out in order from smallest to largest. Repeat 2 times.

Step 8: Get a dark cloth bag. Place various items of objects inside of it (comb, brush, paste, marbel, spoon, safety pin, coins, scissor, pen, lock, key etc), with a list of each item written out. Then choose one item and find out from the bag. Keep track of how many items can find out correctly.

Step 9: Place a variety of items in a bowl of rice, macaroni, beans or cereal and remove them one at a time with eyes closed and opened. Repeat 10 minutes.

Step 10: Engage the patient in different hand functional activities such as opening jar, manipulation practice, cylindrical grasp board, ADL panel practice after the sensory stimulation.Try to feel the object in affected hand. Repeat 10 minutes.

Experimental group set same time as control group. Qualified Occupational therapists have given sensory retraining therapy plus conventional therapy (2 sessions per week, for 5 weeks) 5 patients in 1 group (shifts 1: 15 patients (3 groups of 5 patients) ; shift 2: 5 patients, shift 3: 5 patients) in 3 months/3 shifts total 25 patients
Assessments were done by qualified Occupational therapists who are not involved in this training.

The training session was consisted of one hour sensory re-training program with one hour conventional treatment comprising three 20-min sessions per hour. After one hour there was 15 minutes break. The first one hour followed the sensory re-training treatment protocol like touch detection, touch discrimination, identifying different shapes and sizes objects, textures, temperatures, weight bearing of upper limb and proprioception etc.

After completing the one hour sensory re-training treatment the participants took 15 minutes break and then continue 45 minutes conventional therapy with stretching, hand functional activities, gross motor and fine motor activities, ADL's practice, jar opening, practice cylindrical grasp board, practice spherical grasping etc.

APPENDIX VI

Baseline screening Assessment

Therapist's Name: **Date:** **Signature:**

Patient's Name, ID Number & contact number	Diagnosis CVA (LSH /RSH)	Date of onset	Ability to grasp and release (Yes/No)	Sensory Impairment (Yes/No)

SMMSE score: 20-30

APPENDIX VII

Data Collection Form

A. Socio-Demographic questions:

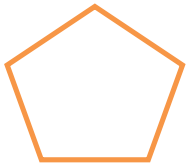
Patient's Name:	Patient's ID No.:
01	Age (in years)…….
02	Sex: 1.Male 2. Female 3. Hermaphrodite
03	Place of residence: 1. Rural 2. Urban 3. Semi/Sub-urban
04	Geographical location of the patient: 1=Dhaka 2=Chittagong 3= Dinajpur 4=Barisal 5=Noakhali 6=Mymensingh 7=Khulna 8= Sylhet 9=Jessore
05	Marital Status: 1. Married 2. Unmarried 3. Never married 4. Widow (a woman lost her husband) 5. Widower (a husband lost his wife) 6. Separated from spouse 7. others
06	Educational Level: 1. Illiterate 2. Primary 3. Secondary 4. HSC 5. Graduate and above
07	What is your previous occupation? 1. Govt. employee 2. NGO 3. Self-business 4. Student 5. Day Labour 6. Land owner/Farmer 7. No Formal activities 8. Household activities 9. others
08	Who live with you? 1. Family members 2. Paid Caregivers
09	Dominant hand: 1. Right 2. Left
11	Duration of stroke: 1. Two weeks to- ……. weeks (acute phase) 2. ……. weeks to 24 weeks/6 months (chronic phase)

B. Medical Observation:

12	Affected body part: **1.** Right side of the body 2. Left side of the body 3. Both side affected
13	Affected brain side: 1. Right side of the brain 2. Left side of the brain 3. Both side involved
14	What type of stroke? 1. Ischemic 2. Haemorrhagic
15	Do you have any other disease or injuries before stroke? a. No b. Yes; if yes please select from the list below- 1=HTN 2=DM 3=Heart Disease 4=Arthritis 5= GBS 6=Head Injury 6=others
16	Do you have any personal habits? a. No b. Yes; if yes please select from the list below- 1=Smoking 2=Alcohol 3=Drug Abuse 4=Betel leaf 5=others
17	Is there any stroke related complications present? a. No b. Yes; if yes please select from the list below- 1=Pain 2= Hearing 3= Vision 4=Subluxation 5=Urinary in continence 6=others

APPENDIX VIII

Bangla Adapted Mini-mental State Examination (BAMSE)

	Items	BAMSE Total score = 30	Participation Score
Orientation	1.Orientation to time	Season; month; day; date;time of day. (5)	
	2.Orientation to place	Country; district; village/city; area/street/ neighborhood; house/place (asked in the reverse order). (5)	
Registration	3.Three objects registration	Mango; Flower; Fish. (3)	
Attention & Calculation *	*4.A Calculation*	"A man has 20 taka for rickshaw fare. Every day, he spends 3 taka for rickshaw fare. After spending the first day's rickshaw fare, he will be left with 17 taka. How much money will be left after the next day's rickshaw fare, and the next day's fare . . .' and so on, five times. (5)	
	4 B.Attention/ Days backward	Name the days of the week backwards (eg before Sunday comes Saturday, and before Saturday comes . . .?). (5)	
Recall	6.Recall	Name the three objects learned earlier. (3)	
Language	7.Naming	Glass and spoon. (2)	
	8.Repetition	`Neither this nor that' in Bangla. (1)	
	9.Language/ comprehension	The individual is asked to follow the interviewer who will raise his/her right hand. (1)	
	10.Three-step task	The individual is asked to follow the interviewer's instruction: `Take the paper in your right or left hand. Fold the paper in half. Put the paper on the floor'. (3)	
	11.Sentence construction	The individual is asked the question: `If you did not know my name how would you find out my name?' (1)	
Copying	12.Copying a figure 	The individual is asked to construct a figure with sticks following a laid out construction of overlapping pentagons. (1)	
	* *(Alternatively)*	**Total Score:**	

APPENDIX IX
Functional Independence Measure (FIM)

FIM Scoring Criteria		
	Score	**Description**
No Helper Required	**7**	Complete Independence
	6	Modified Independence (patient requires use of a device, but no physical assistance)
Helper (Modified Dependence)	**5**	Supervision or Setup
	4	Minimal Contact Assistance (patient can perform 75% or more of task)
	3	Moderate Assistance (patient can perform 50% to 74% of task)
Helper (Complete Dependence)	**2**	Maximal Assistance (patient can perform 25% to 49% of task)
	1	Total assistance (patient can perform less than 25% of the task or requires more than one person to assist)

Dimensions of Assessment :		Participants mentioned FIM Score	Therapist's Observation FIM Score
1.	Eating		
2.	Grooming		
3.	Bathing		
4.	Upper body dressing		
5.	Lower body dressing		
6.	Toileting		
Self-care sub-total			
7.	Bladder management		
8.	Bowel management		
Sphincter control sub-total			
9.	Bed to chair transfer		
10.	Toilet transfer		
11.	Shower transfer		
12.	Locomotion (ambulatory or wheelchair level)		
13.	Stairs		
Mobility and locomotion sub-total			
14.	Comprehension –Audio/Visual (circle)		
15.	Expression-Verbal, Non-verbal (circle)		
16.	Social interaction		
17.	Problem solving		
18.	Memory		
Cognitive & communication sub-total			
	Grand Total FIM Score		

APPENDIX X

FUGL-MEYER ASSESSMENT UPPER EXTRIMITY (FMA-UE)
ASSESSMENT OF sensory motor function

ID: Date: Examiner:

A. UPPER EXTREMITY, sitting position				
I.Reflex activity		none	Can be elicited	
Flexors: biceps and finger flexors (at least one) **Extensors:** triceps				
	Subtotal I (max 4)			
II. Volitional movement within synergies, without gravitional help		none	partial	Full
Flexor synergy: Hand from contralateral knee to ipsilateral ear. From extensor synery (shoulder adduction/internal rotation, elbow extension, forearm pronation) to flexor synergy (shoulder abduction/external rotation, elbowflexion, forearm supination) **Extensor synery:** Hand from ipsilateral ear to contralateral knee	Shoulder retraction elevation abduction(90˚) external rotation Elbow flexion Forearm Supination	0 0 0 0 0 0	1 1 1 1 1 1	2 2 2 2 2 2
	Shoulder abduction internal rotation Elbow extension Forearm pronation	0 0 0	1 1 1	2 2 2
	Subtotal II (max 18)			
III. . Volitional movement mixing synergies, without compensation		none	partial	full
Hand to lumber spine Hand on lap	Can not perform or hand in front of ant-sup iliac spine Hand behind ant-sup iliac spine Hand to lumber spine	0	1	2
Shoulder flexion 0˚-90˚ Elbow at 0˚ Pronation-supination 0˚	Immediate abduction or elbow flexion Abduction or elbow flexion during movement Flexion 90˚, no shoulder abduction or elbow flexion	0	1	2
Pronation-Supination elbow at 90˚ shoulder at 0˚	No pronation/supination, starting position impossible Limited pronation/supination, maintains starting position Full pronation/supination, maintains starting position	0	1	2
	Subtotal III (max 6)			

III. Volitional movement with little or no synery		none	partial	Full
Shoulder abduction 0-90˚ Elbow at 0˚ Forearm pronated	Immediate supination or elbow flexion Supination or elbowflexion during movement Abduction 90˚, maintains starting position Abduction 90˚, maintains starting position	0	1	2
Shoulder flexion 90˚-180˚ Elbow at 0˚ Pronation-supination	Immediate abduction or elbow flexion Abduction or elbow flexion during movement Flexion 180˚, no shoulder abduction or elbow flexion	0	1	2
Pronation/Supination Elbow at 0˚ Shoulder at 30˚-90˚ flexion	no pronation/supination, starting position impossible limited pronation/supination, maintains starting position full pronation/supination, maintains starting position	0	1	2
	Subtotal IV (max 6)			
IV. Normal reflex activity assessed only if full score of 6 points is achieved in part IV, compare with the unaffected side		0(IV), hyper	livel y	normal
Biceps , triceps, finger flexors	2 of reflexes markedly hyperactive or 0 points in part IV 1 reflex markedly hyperactive or at least 2 reflexes lively maximum of 1 reflex lively, none hyperactive	0	1	2
	Subtotal V (max 2)			
B. WRIST support may be provided at the elbow to take or hold the starting position, no support at wrist, check the passive range of motion prior testing		none	partial	full
Stability at 15˚ dorsiflexion Elbow at 90˚, forearm pronated Shoulder at 0˚	Less than 15˚ active dorsiflexion Dorsiflexion 15˚, no resistance tolerated Maintains dorsiflexion against resistance	0	1	2
Repeated dorsiflexion Elbow at 90˚, forearm pronated Shoulder at 0˚, slight finger flexion	Can not perform volitionally Limited active range of motion Full active range of motion, smoothly	0	1	2
Stability at 15˚ dorsiflexion Elbow at 0˚, forearm pronated Slight shoulder flexion/extension	Less than 15˚ active dorsiflexion Dorsiflexion 15˚, no resistance tolerated Maintains dorsiflexion against resistance	0	1	2
Repeated dorsiflexion Elbow at 0˚, forearm pronated Slight shoulder flexion/extension	Can not perform volitionally Jerky movement or incomplete Complete and smooth circumduction	0	1	2
	Total B (max 10)			

C. HAND support may be provided at the elbow to keep 90˚ flexion, no support at the wrist, compare with unaffected hand, the objects are interposed, active grasp		none	partial	full
Mass flexion From full active or passive extension		0	1	2
Mass extension From full active or passive flexion		0	1	2
GRASP				
a. Hookgrasp Flexion in PIP and DIP (digits II-V) Extension in MCP II-V	Can not be performed Can hold position but weak Maintains position against resistance	0	1	2
b. Thumb adduction 1-st CMC, MCP, IP at 0˚, scrap of paper Between thumb and 2-nd MCP joint	Can not be performed Can hold paper but not against tug Can hold paper against a tug	0	1	2
c. Pincer grasp, opposition Pulpa of the thumb against the pulpa of 2-nd finger, pencil, tug upward	Can not be performed Can hold pencil but not against tug Can hold pencil against a tug	0	1	2
d. Cylindrical grasp Cylindrical shaped object (small can) Tug upward, opposition of the thumb and fingers	Can not be performed Can hold cylindrical but not against tug Can hold cylindrical against a tug	0	1	2
e. Spherical grasp Fingers in abduction/flexion, thumb opposed, tennis ball, tug away	Can not be performed Can hold spherical but not against tug Can hold spherical against a tug	0	1	2
	Total C (max 14)			

COORDINATION/SPEED, sitting, after one trial with both arms, eyes closed, tip of the index finger from knee to nose, 5 times as fast as possible		marked	slight	none
Tremor	At least 1 completed movement	0	1	2
Dysmetria At least 1 completed movement	Pronoinced or unsystematic Slight and systematic No dysmetria	0	1	2
		≥ 6s	2-5s	< 2s
Time Start and end with the hand on the knee	At least 6 sec. Slower than unaffected side 2-5 sec. Slower than unaffected side Less than 2 sec. difference	0	1	2
	Total D (max 6)			

		Total A-D (max 66)		
H. SENSATION, upper extremity, eyes closed, compared with the unaffected side		anesthesia	Hypoesthesia	normal
Light Touch	Upper arm, forearm Palmary surface of the hand	0 0	1 1	2 2
		Less than ¾ correct or absence	¾ correct or considerable difference	Correct 100%, no difference
Position Small alterations in the position	Shoulder Elbow Wrist Thumb (IP-joint)	0 0 0 0	1 1 1 1	2 2 2 2
		Total H (max 12)		

J. PASSIVE JOINT MOTION, upper extremity, sitting position, compaire with the unaffected side				**J. JOINT PAIN** during passive motion, upper extremity		
	Only few degrees (less than 10˚ in shoulder)	decreased	normal	Pronounced pain during movement	Some pain	No pain
Shoulder Flexion (0˚-180˚)	0	1	2	0	1	2
Abduction (0˚-90˚)	0	1	2	0	1	2
External rotation	0	1	2	0	1	2
Internal roration	0	1	2	0	1	2
Elbow Flexion Extension	0 0	1 1	2 2	0 0	1 1	2 2
Forearm Pronation Supination	0 0	1 1	2 2	0 0	1 1	2 2
Wrist Flexion Extension	0 0	1 1	2 2	0 0	1 1	2 2
Fingers Flexion Extension	0 0	1 1	2 2	0 0	1 1	2 2
Total (max 24)				**Total** (max 24)		

A. UPPER EXTREMITY	/36
B. WRIST	/10
C. HAND	/14
D. COORDINATION/SPEED	/6
TOTAL A-D (motor function)	/66
H. SENSATION	/12
J. PASSIVE JOINT MOTION	/24
J. JOINT PAIN	/24

APPENDIX XI

REVISED NOTTINGHAM SENSORY ASSESSMENT

Name..... Examiner.....

Patient code..... Side of body affected: Right/Left/ Both

Date of stroke..... Date of Assessment.....

TACTILE SENSATION												PROPRIO-CEPTION
Regions of the body	Light touch		Temperature		Pinpric		Pressure		Tactile Localization		Bilateral Simultaneous touch	
	L	R	L	R	L	R	L	R	L	R		
Face												
Trunk												
Shoulder												
Elbow												
Wrist												
Hand												
Hip												
Knee												
Ankle												
Foot												

STEREOGNOSI

10p ☐ Biro ☐ Comb ☐ Sponge ☐ Cup ☐

2p ☐ Pencil ☐ Scissors ☐ Flannel ☐ Glass ☐

50p ☐

KEY	
0 Absent	2 Normal
1 Impaired	9 Unable to test

COMMENTS: e.g. oedema or brushing present, TEDS, presence of reflexes

KEY Proprioception
0 Absent
1 Appreciation of movement
2 Direction of movement (>10 degree)
3 Joint Position sense
9 Unable to test

APPENDIX XII

APPLICATION FOR REVIEW AND ETHICAL APPROVAL

Date: 16th October, 2018

The Chairman
Institutional Review Board (IRB)
Bangladesh Health Professions Institute (BHPI)
CRP-Savar, Dhaka-1343, Bangladesh

Subject: **Application for review and ethical approval.**

Sir,

With due respect I would like to draw your kind attention that I am a student of M.Sc. in Rehabilitation Science program at Bangladesh Health Professions Institute (BHPI)- an academic institute of CRP under Faculty of Medicine of University of Dhaka (DU). This is a 2-year full-time course under the project of "Regional Inter-professional Master's program in Rehabilitation Science" funded by SAARC Development Fund (SDF). I have to conduct a thesis entitled, **"Effectiveness of Sensory re-training for stroke survivors: A Pilot randomized controlled trial study"** under honorable supervisor Md. Julker Nayan, Associate Professor & Head of Occupational Therapy Department. The purpose of the study is to investigate the effectiveness of sensory re-training that target sensory impairment after stroke..

The study involves use of a socio-demographic questionnaire, Nottingham Sensory Assessment (NSA), Functional Independence Measure (FIM), Fugl Meyer Assessment Upper Extremity (FMA-UE) and Bangla Adapted Mini-Mental State Examination (BAMSE) to investigate the effectiveness of sensory re-training that target sensory impairment after stroke that may take 20 to 25 minutes to answer in the questionnaire or participate in the test. There is no likelihood of any harm to the participants. Related information will be collected from the patients' guide books. Data collectors will receive informed consents from all participants. Any data collected will be kept confidential.

Therefore I look forward to having your kind approval for the thesis proposal and to start data collection. I can also assure you that I will maintain all the requirements for study.

Sincerely,

Mansura Akter
Student of M.Sc. in Rehabilitation Science (MRS)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Recommendation from the thesis supervisor:

Md. Julker Nayan
Associate Professor and Head of Occupational Therapy Department
Centre for the Rehabilitation of the Paralysed (CRP),
Savar, Dhaka-1343

Attachment: Thesis Proposal including measurement tools and process and procedure for maintaining confidentiality, Questionnaire (English and Bengali version), Information sheet & consent.

APPENDIX XIII

APPROVAL OF THESIS PROPOSAL BY ETHICS COMMITTEE OF BHPI

বাংলাদেশ হেল্‌থ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)
Bangladesh Health Professions Institute (BHPI)
(The Academic Institute of CRP)

Ref.

Date: 11/03/2019

CRP-BHPI/IRB/03/19/1297

To,
Mansura Akter
M.Sc. in Rehabilitation Science (MRS)
Session: 2017-2018
BHPI, CRP-Savar, Dhaka-1343, Bangladesh

Subject: Approval of revised thesis proposal **"Effectiveness of Sensory re-training for stroke survivors: A Pilot randomized controlled trial study"** by ethics committee.

Dear Mansura Akter

Congratulations,

The Institutional Review Board (IRB) of BHPI has reviewed and discussed your reapplication to conduct the above mentioned thesis with revised research design and above title, with yourself, as the Principal Investigator" The Following documents have been reviewed and approved:

S.N.	Name of Documents
1.	Thesis Proposal
2.	Questionnaire (English and / or Bangla version)
3.	Information sheet & consent form.

Since the study involves use of a socio-demographic questionnaire, Nottingham Sensory Assessment (NSA), Functional Independence Measure (FIM), Fugl –Meyer Assessment Upper Extremity (FMA-UE) Assessment of sensorimotor function and Bangla Adapted Mini-mental State Examination (BAMSE) to find out the effectiveness of sensory retraining interventions for stroke survivors that may take 20 to 25 minutes to answer in the questionnaire or participate in the test. Since, there is no likelihood of any harm to the participants; the members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 9:00 AM on 22nd April, 2018 at BHPI.

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring in the course of the study, any revision in the protocol and patient information or informed consent and ask to be provided a copy of the final report. This Ethics committee is working accordance to Nuremberg Code 1947, World Medical Association Declaration of Helsinki, 1964 - 2013 and other applicable regulation.

Best regards,

Muhammad Millat Hossain
Assistant Professor, Dept. of Rehabilitation Science
Member Secretary, Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

সিআরপি-চাপাইন, সাভার, ঢাকা-১৩৪৩, বাংলাদেশ, ফোন ঃ ৭৭৪৫৪৬৪-৫, ৭৭৪১৪০৪ ফ্যাক্স ঃ ৭৭৪৫০৬৯
CRP-Chapain, Savar, Dhaka-1343, Tel : 7745464-5, 7741404, Fax : 7745069, E-mail : contact@crp-bangladesh.org, www.crp-bangladesh.org

APPENDIX XIV

APPLICATION FOR DATA COLLECTION

9th October 2018
To
The Head of Department
Occupational Therapy Department
Centre for the Rehabilitation of the Paralysed (CRP)
Savar, Dhaka-1343, Bangladesh

Subject: **Application for data collection.**

Sir,

With due respect I would like to draw your kind attention that I am a student of M.Sc. in Rehabilitation Science program at Bangladesh Health Professions Institute (BHPI)- an academic institute of CRP under Faculty of Medicine of University of Dhaka (DU). This is a 2-year full-time course under the project of "Regional Inter-professional Master's program in Rehabilitation Science" funded by SAARC Development Fund (SDF). I have to conduct a thesis entitled, **"Effectiveness of Sensory re-training for stroke survivors: A Pilot randomized controlled trial study"** under honorable supervisor Md. Julker Nayan, Associate Professor & Head of Occupational Therapy Department. The purpose of the study is to investigate the effectiveness of sensory re-training that target sensory impairment after stroke..

The study involves use of a socio-demographic questionnaire, Nottingham Sensory Assessment (NSA), Functional Independence Measure (FIM), Fugl Meyer Assessment Upper Extrimity (FMA-UE) and Bangla Adapted Mini-Mental State Examination (BAMSE) to investigate the effectiveness of sensory re-training that target sensory impairment after stroke that may take 20 to 25 minutes to answer in the questionnaire or participate in the test. There is no likelihood of any harm to the participants. Related information will be collected from the patients' guide books. Data collectors will receive informed consents from all participants. Any data collected will be kept confidential. I would like to use the space and table & chair of the out-patient unit at Occupational Therapy department.

Therefore I look forward to having your kind approval for the thesis proposal and to start data collection. I can also assure you that I will maintain all the requirements for study.

Sincerely,

Mansura Akter
Student of M.Sc. in Rehabilitation Science (MRS)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Approved
Md. Julker Nayan
MS(Rehab), MPH, BSc(HM)
Associate Professor & Head
Occupational Therapy Department
CRP, Savar, Dhaka-1343