EFFECTIVENESS OF GLOSSOPHARYNGEAL BREATHING ALONG WITH CONVENTIONAL PHYSIOTHERAPY IN PATIENTS WITH TETRAPLEGIC SPINAL CORD INJURY

Nishitha Nandy

Bachelor of Science in Physiotherapy (B. Sc. In PT)

Roll no: 135

Registration no: 6252

Session: 2013-2014

BHPI, CRP, Savar, Dhaka-1343

Bangladesh Health Professions Institute (BHPI)

Department of Physiotherapy

CRP, Savar, Dhaka-1343

Bangladesh

August, 2018

We the undersigned certify that we have carefully read and recommended to the Faculty of Medicine, University of Dhaka, for the acceptance of this dissertation entitled

EFFECTIVENESS OF GLOSSOPHARYNGEAL BREATHING ALONG WITH CONVENTIONAL PHYSIOTHERAPY IN PATIENTS WITH TETRAPLEGIC SPINAL CORD INJURY

Submitted by **Nishitha Nandy** for partial fulfillment of the requirements for the degree of Bachelor of Science in Physiotherapy (B. Sc. In PT)

.....Habib.....
Mohammad Habibur Rahman
Associate Professor,
Department of Physiotherapy,
BHPI, CRP, Savar, Dhaka

.....
Mohammad Anwar Hossain
Associate Professor, BHPI &
Head of Department of Physiotherapy,
CRP, Savar, Dhaka

E.Rah
.....
Ehsanur Rahman
Assistant Professor
Department of Physiotherapy
BHPI, CRP, Savar, Dhaka

Shofiq
.....
Md. Shofiqul Islam
Assistant Professor
Department of Physiotherapy
BHPI, CRP, Savar, Dhaka

.....
Prof. Md. Obaidul Haque
Head of Physiotherapy
Department &
Vice Principal
BHPI, CRP, Savar, Dhaka

DECLERATION

DECLERATION

I declare that the work presented here is my own. All sources used have been cited appropriately. Any mistakes or inaccuracies are my own. I also decline that for any publication, presentation or dissemination of information of the study. I would bound to take written consent from the department of Bangladesh Health Professions Institute (BHPI).

Signature: Nishitha Nandy **Date:** 03-11-2018

Nishitha Nandy
Bachelor of Science in Physiotherapy (B. Sc. PT)
Roll no: 135
Registration no: 6252
Session: 2013-2014
BHPI, CRP, Saver, Dhaka-1343

CONTENTS

Acknowledgement

First of all, I would like to pay my gratitude to **GOD** who has given me the ability to complete this project in time with success. The second acknowledgement must go to my family members who have always inspired me for preparing the project properly. I am extremely grateful to my honorable and praiseworthy Supervisor **Mohammad Habibur Rahman**, Associate Professor, Department of Physiotherapy, Bangladesh Health Professions Institute (BHPI) for giving me his valuable time, his keen supervision and excellent guidance without which I could not be able to complete this project. I would like to express my gratitude to **Ehsanur Rahman**, Assistant Professor, Department of Physiotherapy, BHPI, for sanctioning me to select this title. I am also very thankful to **Md. Shofiqul Islam,** Assistant Professor, **Prof. Md. Obaidul Haque**, Vice principal, Head, Department of Physiotherapy, BHPI, **Mohammad Anwar Hossain**, Associate Professor, Head, Department of Physiotherapy, and all board members and also all of my respected teachers for helping me in this study.

My special thanks to all the staffs of SCI Indoor Physiotherapy Department especially to the Head of the department for giving me the permission to collect data. I am grateful to **Kazi Imdadul Hoque**, Clinical Physiotherapist, SCI Indoor Physiotherapy Department, Department of Physiotherapy, CRP, Savar, Dhaka for his excellent guidelines throughout the period of this study.

I am grateful to the intern Physiotherapists, Department of Physiotherapy, CRP, Savar, Dhaka for their excellent guidelines throughout the period of this study. I would like to thank the Librarian of BHPI and her associates for their kind support to find out related books, journals and also access to internet. Finally I would like to thank to all participants of the study for their enormous co- operation.

Acronyms

BHPI	Bangladesh Health Professions Institute
BMRC	Bangladesh Medical Research Council
CRP	Centre for the Rehabilitation of the Paralysed
IRB	Institutional Review Board
SCI	Spinal Cord Injury
WHO	World Health Organization
SPSS	Statistical Package for the Social Service

List of Tables

List of Figures

Abstract

Purpose: Spinal Cord Injury is described as one of the most devastating neurological impairment. It has profound effects on spinal injured person and their activity. SCI patient with cervical injury has respiratory problem. The present study was conducted to analyze and identify the therapeutic effectiveness of Glossopharyngeal Breathing along with Conventional Physiotherapy for the treatment of tetraplegic patient with SCI. This study has made the comparison, in order to discover the most effective treatment to alleviate the symptoms of the condition. **Objectives**: The objectives of the study is to investigate the effectiveness of Glossopharyngeal Breathing along with Conventional Physiotherapy in case of Chest Expansibility, Peak Expiratory Flow, Force Expiratory Volume in one second and Inspiratory Capacity among the tetraplegic patient in CRP. **Methodology:** The study was randomized control trial design. Total 20 samples were selected conveniently and then randomly assigned to either groups for pretest and posttest this study from inpatient treatment service of Spinal Cord Injury Unit, Physiotherapy Department, Centre for the Rehabilitation of the Paralysed (CRP), Savar, Dhaka. Initially all the subjects were assessed by SCI Assessment Form at the clinical settings using and then the data were collected by questionnaires, structured questionnaire was used to assess the socio-demographic and other informations of the patients. Pre-test was performed before beginning the treatment. The same procedure was performed to take post-test at the end of 2 weeks of treatment. Between and within group analysis was done in case of Chest expansibility, Peak expiratory flow, Forced expiratory flow in one second and Inspiratory capacity by using unrelated and related t test **Result:** The results were found to be significant in between group analysis, in case of chest expansibility, peak expiratory flow, force expiratory volume in one second (p value=0.002) except inspiratory capacity (p value=0.278). In within Group analysis (trial and control), in case of the above mentioned variables, the results were found to be significant (p value=0.002). **Conclusion:** The study concluded as the Glossopharyngeal Breathing along with Conventional Physiotherapy is significantly capable of producing beneficial effects on the improvement of their respiratory problems.

Keywords: SCI, tetraplegic, respiratory complication, conventional physiotherapy, Glossopharyngeal breathing.

CHAPTER –I INTRODUCTION

1.1. Background:

Bangladesh is a developing country that has a dense population. Near about 10% of total population are disable in Bangladesh where 43% are physically disable (Haque, 2012). Bangladesh has poor occupational safety measures, roads and mixed traffic, with vehicle users unwilling to use seat-belts. This makes the population vulnerable to Spinal Cord Injury (Razzak et al., 2017). Spinal cord injury (SCI) is a most common injury that is medically complex and also a life-disrupting condition (World Health Organization, 2013).

Spinal Cord Injury mostly occurs due to trauma. Traumatic spinal cord injury (TSCI) causes partial or complete loss of motor, sensory and autonomic function below the neurological level of the injury in which the neural tissue within the spinal canal is damaged by an external force. Traumatic Spinal Cord Injury is related with long-lasting disabilities and centrals to recurrent complications that have significant impacts on personal life and the health care system (Koskinen, 2015).

The most common complications that occurs in Spinal Cord Injury patients include fever, pulmonary complications, electrolyte disturbances, urinary tract infections, postural hypotension, autonomic dysreflexia, cardiovascular disease, osteoporosis and fractures, myositis ossificans, deep vein thromboses, bedsores, and so on (Yang et al., 2014).

Survival rates in subjects with Spinal cord injury (SCI) are pointedly lesser than in the able-bodied population is well known to all. Risk factors of Spinal Cord Injuries are identified through several studies. Some certain factors may predispose to a higher risk of sustaining an Spinal Cord Injury such as Gender, Age, Engaging in risky behavior, Having a bone or joint disorder etc. which impact quality of life and survival time of Spinal Cord Injury patients (DiMarco & Dawson, 2014).

Spinal cord injuries are described as either complete or incomplete. In a complete spinal cord injury, there is complete loss of sensation and muscle function in the body below the level of the injury. In an incomplete spinal cord injury there is some remaining function below the level of the injury. In most cases both sides of the body are affected equally. An injury to the upper portion of the spinal cord in the neck can cause tetraplegia-paralysis of both arms and both legs. If the injury to the spinal cord occurs lower in the back it can cause paraplegia-paralysis of both legs only. Tetraplegia mainly occurs due to an injury or lesion of the cervical spinal cord that can lead in a partial or total sensory and motor of the four limbs. When the injuries occurs above level C4, this may often result in respiratory insufficiency (Spooren et al., 2009).

The main reason of morbidity and death after Spinal Cord Injury are the Respiratory complications. Due to having Respiratory complications, there may occur reduced lung volumes, vital capacity and flow rates as a result of respiratory muscle weakness in patients with Tetraplegic spinal cord injury. These features have been investigated in relation to the combined effects of injury level and posture (Kumar, 2016).

In order to lessen the threat of respiratory complications in patients with Tetraplegic Spinal Cord Injury, it is necessary to have an important goal and that is conventional physiotherapy. Conventional physiotherapy should be designed in such pattern through which spontaneous respiratory work may initially be maintained by positive end-expiratory pressure therapy, vibratory therapy, Deep breathing and coughing exercises the respiratory muscles and aids in the mobilization and expulsion of pulmonary secretions and should be done by the tetraplegia (incomplete and complete cervical injuries) patient several times during the day (Wong et al., 2012).

It is not bounded that only Conventional physiotherapy can minimize the respiratory problems in tetraplegic Spinal cord injury. There are also some other manual techniques through which respiratory problems can be minimized in patients with tetraplegia. The most commonly used manual technique is glossopharyngeal breathing which is very beneficial in the treatment of Spinal cord injury (Torres-Castro et al., 2016).

The use of glossopharyngeal muscles to gulp small amounts of air into the lungs for lung insufflation is known as Glossopharyngeal breathing. In many reports, it has found that about 67-80% Tetraplegic patients are capable of learning Glossopharyngeal breathing. The patients who have learned Glossopharyngeal breathing, have demonstrated an ability to increase their vital capacity by adding volumes of air (Johansson et al., 2011).

1.2. Rationale of the study:

Traumatic Spinal cord injury is the most common injury that occurs mainly in the spine. Traumatic Spinal Cord Injury can cause fracture and dislocation of the spine that occurs in cervical and lumber spine. Injury of the cervical spinal cord causes Tetraplegia which is a paralysis as per limb involvement. In tetraplegic cervical cord injury patients, Respiratory dysfunction is a frequent common problem. A systematic review showed that in most cases injury to the cervical spinal cord occurs between C4 and C5 which affects the Diaphragm which is the main muscle for maintaining the function of respiration and is innervated by C3 – C5 spinal root fibers. This impairment can lead to severe respiratory deficiency because of partial or total paralysis of respiratory muscles. Conversely another systematic review found that due to having respiratory muscle paralysis, cough may also be adversely affected, cough flows get typical. The vital capacity and compliance in the lungs and thorax may decrease also. As the vital capacity decreases, there occurs an instability to increase the lung volume that can lead to insufficient ventilation, shortness of breath and decreased active expiratory force. Through a systematic review it is found that Pulmonary complications are one of the most common causes of mortality and morbidity in these patients. From another systematic review it is ensured that in order to minimize all those problems, a treatment protocol should be designed on this purpose. Evidence showed that in order to minimize the problems that arise from the respiratory muscle paralysis, conventional physiotherapy management can be used. On a systematic review it is proven that the conventional physiotherapy is effective in respiratory muscle paralysis when it is applied with appropriate doses and repetition. But conventional physiotherapy becomes more effective when it is applied combinedly with another treatment technique. Another systematic review found that Glossopharyngeal breathing is an effective technique in minimizing respiratory problems. It should be used with appropriate dosage and repetition according to evidence. Glossopharyngeal Breathing helps to improve cough flow, to increase chest expansion, peak expiratory flow, forced expiratory volume in one second and inspiratory capacity and maintain pulmonary compliance. If Glosspharyngeal breathing and conventional physiotherapy are used combinedly, all pulmonary functioning including vital capacity and chest expansibility will get improved more efficiently if applied with appropriate doses and repetition. So, hopefully Glossopharyngeal breathing

along with conventional physiotherapy might be an effective treatment approach in minimizing respiratory problems in patients with tetraplegia

1.3. Null Hypothesis and Alternate Hypothesis:

Null Hypothesis:

Glossopharyngeal Breathing along with conventional physiotherapy is no more effective than only conventional physiotherapy for the patients with tetraplegic Spinal Cord Injury.

Ho: $\mu 1-\mu 2 = 0$ or $\mu 1=\mu 2$, where the experimental group and control group initial and final mean difference is same.

Alternate Hypothesis:

Glossopharyngeal Breathing along with conventional physiotherapy is more effective than only conventional physiotherapy for patients with tetraplegic Spinal Cord Injury.

Ha: $\mu 1- \mu 2 \neq 0$ or $\mu 1 \neq \mu 2$, where the experimental group and control group initial and final mean difference is not same.

1.4. Aim and objectives of the study:

Aim:

To find out the effectiveness of glossopharyngeal breathing along with conventional physiotherapy in patients with tetraplegic spinal cord injury patients at CRP.

Objectives:

General-

To investigate the effectiveness of glossopharyngeal breathing along with conventional physiotherapy in patients with tetraplegic spinal cord injury patients at CRP.

Specific-

- To evaluate the socio-demographic state and medical informations of Tetraplegic Spinal Cord Injury patients.
- To find out the skeletal and neurological level in spinal cord injury patients.
- To make an evaluation on using Glossopharyngeal breathing along with conventional physiotherapy in Tetraplegic Spinal Cord Injury patients by between and within group analysis on chest expansibility, peak expiratory flow, forced expiratory capacity and inspiratory capacity.

1.5. Variables:

Independent Variables:

- Glossopharyngeal Breathing
- Conventional Physiotherapy

Dependent Variables:

- Chest expansion of tetraplegic spinal cord injury patients
- Peak Expiratory Flow of tetraplegic spinal cord injury patients
- Force Expiratory Volume in one second of tetraplegic spinal cord injury patients
- Inspiratory Capacity of tetraplegic spinal cord injury patients

1.6. Operational definition:

Spinal Cord Injury-

A Spinal Cord Injury is defined as damage or trauma to the spinal cord that causes loss or impaired function and sensation in parts of the body served by the spinal cord below the level of the lesion.

Skeletal level-

This term has been used to denote the level at which, by radiographic examination, the greatest vertebral damage is found.

Neurological level-

The neurological level of injury is determined by identifying the most caudal segment of the cord with both intact sensation and normal antigravity muscle function strength.

Tetraplegia-

Tetraplegia, also known as quadriplegia, is paralysis caused by illness or injury that results in the partial or total loss of use of all four limbs.

Paraplegia-

Paraplegia is an impairment in motor or sensory function of the lower extremities.

Complete injury-

A complete injury means there is no function, no sensation and no voluntary movement below the level of the injury. Both sides of the body are equally affected.

Incomplete injury-

An incomplete injury means there is some function below the primary level of injury. A person with an incomplete injury may be able to move one limb more than another.

Effectiveness-

Effectiveness is the capacity of producing a desired result. When something is seemed effective, it means it has an anticipated or expected outcome or produces a deep, vivid impression.

Conventional physiotherapy-

Treatment that is widely accepted and used by most health care professionals.

Glossopharyngeal breathing-

Glossopharyngeal breathing (GPB, glossopharyngeal insufflation, buccal pumping, or frog breathing) is a means of pistoning air into the lungs to volumes greater than can be achieved by the person's breathing muscles (greater than maximum inspiratory capacity).

Lung volume and lung capacity-

Lung volumes and lung capacities refer to the volume of air associated with different phases of the respiratory cycle.

The average total lung capacity of an adult human male is about 6 liters of air.

Chest Expansibility-

Chest expansion is symmetrical. Both sides take off at the same time and to the same extent. Take a tape and encircle chest around the level of nipple. Take measurements at the end of deep inspiration and expiration. Normally, a 2-5" of chest expansion can be observed. Any lung or pleural disease can give rise to a decrease in overall chest expansion. These patients have a very high Forced Respiratory Capacity and have limited capability to expand the chest from this position.

Peak Expiratory Flow-

The peak expiratory flow (PEF), also called peak expiratory flow rate (PEFR) is a person's maximum speed of expiration, as measured with a peak flow meter, a small, hand-held device used to monitor a person's ability to breathe out air. It measures the airflow through the bronchi and thus the degree of obstruction in the airways. Peak expiratory flow is typically measured in units of liters per minute (L/min).

FEV1 (Forced Expiratory Volume In One Second)-

FEV1 is the maximum amount of air you can forcefully blow out of your lungs in one second and is measured using a spirometer.

Inspiratory Capacity-

The inspiratory capacity (IC) is the amount of air that can be inhaled after the end of a normal expiration. The normal value of it is 3.6 litre.

CHAPTER –II LITERRATURE REVIEW

Spinal cord is considerably flattened in anterior and posterior areas and is cylindrical in form (Back, 2006). It starts on the foramen magnum inside the cranium and it continues with the medulla oblongata within the brain. It terminates inferiorly at the extent of the lower border of the first lumber vertebra. The region of the spinal cord is within the vertebral foramen that is known as the vertebral canal (Snell, 2010). The spinal cord is protected by the vertebral bodies anteriorly and shielded by vertebral arches laterally and posteriorly. The spinal nerves and the brain get interlinked by the spinal cord. The spinal cord is the major canal through which motor and sensory information travels between the brain and the body (Kirshblum et al., 2011). The sensory stimuli is received by the receptor of the body from environment. The sensory stimuli transmits information to the brain and after that the transmitted information is sent by the brain to the spinal nerves via spinal cord. This information helps in the movements of the body (Snell, 2010).

According to Lam et al. (2008), the spinal cord incorporates longitudinal orientation of spinal tracts (white matter) surrounding the central regions (gray matter) where maximum spinal neuronal cell bodies are positioned. The gray matter is arranged into segments comprising sensory and motor neurons. Axons from spinal sensory neurons enter and axons from motor neurons leave the spinal cord via segmental nerves or roots. According to the foramina, the roots are numbered and named through which they enter and exit the vertebral column. As for instance, the two C6 roots (left and right) pass through foramina situated among the C5 and C6 vertebrae. Sensory information is received by each root from skin areas called dermatomes. In a similar way, a group of muscles that are innervated by each root is known as a myotome. At the same time, a dermatome normally represents a discrete and contiguous skin area, maximum roots innervate more than one muscle, and most muscles are innervated by more than one root.

When the dermatomes, myotomes of the body gets interrupted after having spinal cord injury. An unexpected, traumatic and non- traumatic damage to the spinal cord may generally cause spinal cord injury. This damage or harm effects fracture, dislocation of vertebrae, intervertebral disc which turns into rupture the spinal cord partially or completely. The Spinal cord Injury is a medical term that can be defined as any kind of damage or trauma to the spinal cord that successively results in a loss or impaired activities ensuing in decreased mobility or feeling (Curtin et al., 2005).

Currently there is no appropriate and correct number of individuals of Spinal Cord Injury in Bangladesh. So, it is hard to find out or estimate the total wide variety of patients with Spinal Cord Injury in Bangladesh. The most common age group for Spinal Cord Injury ranges from 25-29 years in Bangladesh and 83% of them are male (Islam et al., 2011).

Carrying heavy load on the head is a usual practice in Bangladesh. The actual and common reasons of having Spinal Cord Injury in Bangladesh are fall while carrying heavy load on head, road traffic accidents, falling from a height, fall of a heavy object onto the head or neck, bull attack and diving into shallow water (Hoque et al., 2012).

Coppla & Marlin (2013) found that the main reasons of spinal cord injuries are the car and motorbike accidents. According to the National Institute of Neurological Disorders and Stroke, 1.5% of spinal cord injuries occurs due to violent encounters, gunshot and knife wounds. Fall is very usual reason of having Spinal Cord Injury among the old age about sixty-five. One-quarter of spinal cord injuries occurs via falls. Approximately 8% of spinal cord injuries occur by the athletic activities, which includes impact sports and diving in shallow water. Almost one out of every four spinal cord injuries occurs due to alcohol consumption. Cancer, arthritis, osteoporosis, TB spine and inflammation can also be the causes of the spinal cord injuries.

Dawodu (2001) also stated spinal cord injury (SCI) as an insult to the spinal cord that usually results in a change, either temporary or permanent, in its normal motor, sensory, or autonomic characteristics. Complete and incomplete injuries are mainly two types of spinal cord injury. Complete spinal cord injury can be defined as absence of sensory and motor functions in the lowest sacral segments. An over view of complete spinal injury provided that a complete spinal cord lesion is the term used to describe damage to the spinal cord that is absolute. It causes complete and permanent loss of ability to send sensory and motor nerve impulses and, therefore, complete and usually permanent loss of function below the level of the injury. This will result in complete paraplegia or tetraplegia.

Paraplegia takes place in spinal cord injuries beneath the primary thoracic spinal levels (T1-L5). Paraplegics are capable of using their arms and hands absolutely, however the degree to which their legs are disabled relies upon the damage. Some of them are absolutely paralyzed from the waist down. The rest of the paraplegics undergo nothing but minor mobility issues, tingling within the legs, or reduced sensations within the lower limb. Tetraplegia usually directs to a spinal cord injury above the primary thoracic vertebra, or within the cervical sections of C1-C8. The ultimate result is some degree of paralysis in all four limbs- the legs and arms. Sometimes tetraplegia becomes severe also. Typically speaking, the higher up the injury is, the more extensive the damage will be. Tetraplegia can be so intense that it intervenes with the injured character's capacity of breathing (Zawn, 2015)

Breathing mainly involves the main muscle of respiration named the diaphragm. The Diaphragm helps in respiration and works as the main inspiratory muscle. When The Diaphragm gets affected it may arise respiratory complications. The most prominent complication of Spinal Cord Injury is paralysis in body part such as upper and lower extremities. A wide range of complications can also arise from Spinal Cord Injury. Spinal Cord Injury patient might have the complications like lack of skin sensation, pressure sore, bowel and bladder complexities, respiratory complications, and autonomic dysreflexia, sexuality dysfunction etc. (Somers, 2006).

Sinclair et al., (2006) stated that there are some other complications like deep vein thrombosis, decreased vital capacity, osteoporosis, postural hypotension, spasticity and heterotrophic ossification. The complications that have been seen, are pressure sore, urinary tract infection, bowel and bladder problem, burning sensation, autonomic dysreflexia, abdominal distension, psychosocial distress etc. from the practical observation of the researcher at CRP. Very few complications of tetraplegic patients are as common as respiratory distress or chest complication. These can be developed at any time after the injury.

Respiratory or breathing complications as a consequence of spinal cord injury (SCI), brings about medical implications which are usually the main reasons of morbidity, mortality, and financial burden. Risk of pulmonary infection and death and higher rates of symptoms of respiratory dysfunction may get increased by pulmonary complications of Spinal Cord Injury. The individuals with higher level lesions have diminished inspiratory capacity, contributing to micro atelectasis, shortness of breath with exertion and in people with greater severe impairments, respiratory insufficiency. Maximum patients with spinal cord injury have impairments in muscles of expiration with profound effects on cough effectiveness and, probably, on clearance of secretions and susceptibility to lower respiratory tract infections. The quality of life is diminished in individuals with Spinal Cord Injury, by respiratory symptoms that include cough, phlegm, and wheezing (Christopher, 2007).

Respiratory Physiotherapy in case of Spinal Cord Injury patient, can assist to breathe effectively. Occasionally, there might be presence of too thick mucus. Mucus causes air blockage from moving inside and outside of Spinal Cord Injury patient's lungs. If there is mucus in the lungs, then it becomes very difficult to take breathe for Spinal Cord Injury patient. The main motive of respiratory physiotherapy is to loosen the mucus of Spinal Cord Injury patient, so that they can cough it up. The pillars of early treatment of respiratory dysfunction in Spinal Cord Injury are intensive management of secretions and atelectasis, which has been shown to improve the results in patients with Spinal Cord Injury (Singh et al., 2005).

The expansion of the lungs and the clearing of secretions are the most important goals of treatment In order to remove secretions, these techniques are usually used such as assisted coughing, percussion, vibrations, aspiration and assisted postural drainage. Respiratory exercises can be applied for muscle training, in order to increase ventilation, in patients (Hicks et al., 2011).

In case of Postural Drainage, if the patient is immobilized, postural drainage and passive positioning techniques using gravity can facilitate the movement of secretions. The goal is to move the secretions from the most peripheral regions of the lungs to the main airway, where the secretions can be more easily removed using coughing or other methods of aspiration. Each position (Trendelenburg, supine, prone, and left and right lateral) should be held for at least 5 to 10minutes, depending on tolerance. Percussion and Vibration consist of external manipulations of the chest to mobilize secretions. Percussion consists of rhythmically tapping on different areas of the chest with a cupped hand. Vibration consists of the application of vibration with the hands to the chest wall and soft tissues of the chest during the expiratory phase. The techniques may be combined with postural drainage. Assisted Coughing Techniques are those techniques that helps to generate effective cough strength. They are often used with postural drainage, Intermittent Positive Pressure Breathing, and insufflator. Several techniques are used as manually or mechanically. Manually Assisted Coughing consists of chest compressions coordinated with the patient's breathing. This attempts to imitate the normal cough, helping to move secretions from the lowest areas of the lungs (Galeiras et al., 2013)

Mechanically Assisted Coughing is a procedure which is started by applying positive pressure to the airway (insufflations) via a mechanical apparatus to immediately then transform this positive pressure into negative pressure (exsufflation). This sudden change of pressure in a short period of time (<0.02 s) generates an air flow able to pulling respiratory secretions to the exterior. Each session consists of 6–8 cycles with pressures approximately (Van Houtte et al., 2006).

In order to improve cough flow, vital capacity and chest expansibility the most commonly used technique is Glossopharyngeal breathing. Glossopharyngeal breathing is an alternative breathing technique that people who are dependent on ventilators can use in emergencies and to promote respiratory health. Glossopharyngeal breathing involves a series of gulps using the lips, tongue, pharynx, and larynx to pull air into the lungs when the normal inspiratory muscles are not functioning (Warren, 2002)

The gulping action looks like a frog gulping, and so Glossopharyngeal Breathing is often known as 'Frog Breathing'. It helps to clear sputum which may make your breathing more difficult and can lead to a chest infection or pneumonia. It also helps to make strong and good cough. The physiotherapist will teach the patient to take deep breath in, then to add enough gulps of air to produce an effective cough, or an assisted cough, to clear phlegm more easily. A physiotherapist with specialist skills in managing respiratory or neurological problems will help the patient to learn GPB. It can be quite tiring to learn, so the physiotherapist might see the patient for short periods of time quite often. Once the patient can do GPB it is not tiring. To learn how to do an effective gulp it is best to think of it in 3 stages. **Stage 1:** Make extra space in your throat, by lowering your jaw and keeping your tongue flat. At the same time you should be able to feel your throat cartilages moving down. It may be helpful to look in a mirror to make sure that your tongue is flat. It is very important to get this movement right before going on to stage 2. **Stage 2:** Once your throat is open (as described in stage 1) close your lips gently, so that you trap the air in your large throat cavity. Don't let your tongue or throat cartilages move up. **Stage 3:** Keep your lips shut and let the cartilages and tongue go 'up', back to their normal position. At first you will need to do these movements slowly, as you learn how to do them. At first the physiotherapist will need to do these movements slowly, as the patient learn how to do them. Once the patient are able to do these stages the patient can gradually speed up the gulps. During stage 3, the patients will then be forcing each throatful of air through the vocal cords and into the lungs. The vocal cords then close and hold the air in the lungs while taking the next gulp until lungs are 'full' (Association of Chartered Physiotherapists in Respiratory Care, 2011)

The volume of air thus injected, with each of the above cycles, is known as the "stroke volume", by analogy with a piston pump. After several strokes thus taken the lungs expand considerably, and the air is then allowed to escape passively by a prolonged opening of the larynx. The accumulated volume of air thus released is called the Glossopharyngeal Breathing tidal volume. Simply, therefore, glossopharyngeal breathing is active step-by-step inspiration followed by passive expiration (Burke, 1957)

The mechanics and risks of glossopharyngeal breathing are described in previous studies. Collier et al.91 showed that in patients with reduced respiratory muscle function, the arousal of pulmonary gas caused a drop in arterial blood pressure. Many reports have shown that significant hemodynamic abnormalities occur during glossopharyngeal breathing. Arterial blood pressure falls and heart rate increases in healthy people. In earlier studies, contraindications have included- bulbar dysfunction, failing cardiac function or diseases that affect the lungs (Nygren-bonnier, 2008).

Glossopharyngeal breathing and conventional physiotherapy was used to increase chest expansion, peak expiratory flow, force expiratory volume in one second and inspiratory capacity and in order to measure this things, measuring tap, peak flow meter and incentive spirometry was used as measuring tool.

Measuring tap: Malaguti et al. (2009) mentioned that measuring tap was used to measure chest expansion. They had used in case of in Patients with Chronic Obstructive Pulmonary Disease.

Peak Flow Meter: Hetzel & Clark, (1980) stated that peak expiratory flow was measured by peak flow meter and in their research, they had used it in order to create a comparison of normal and asthmatic patient in peak expiratory flow rate and in the of Wright (1959) demonstrated that peak flow meter is used to measure forced expiratory rate as a measure of ventilatory capacity.

Incentive Spirometry: Bellet et al. (1995) had used incentive spirometry to measure inspiratory capacity in case of sickle cell diseases in their study.

CHAPTER –III METHODOLOGY

The study was a true or classic experimental design to evaluate the effectiveness of glossopharyngeal breathing along with conventional physiotherapy and also to compare their effectiveness with conventional physiotherapy alone for the management of Tetraplegic Spinal Cord Injury. To identify the effectiveness of this treatment regimen, measuring tap in order to measure Chest expansibility, peak flow meter in order to measure peak expiratory flow (PEF) And Forced expiratory volume in one second (FEV1) and incentive spirometry in order to measure Inspiratory capacity were used as measurement tools in this study.

3.1. Study Design:

Here Randomized controlled trial was used for the study design.

According to DeyPoy & Giitlin (2013) the design could be shown by-

Experimental group: r O_1 X_1 O_2

Control group: r O_3 X_2 O_4

Here, researcher had chosen that glossopharyngeal breathing along with conventional physiotherapy was applied to the Experimental group and only conventional physiotherapy was applied to the Control group.

The subjects were administered a pre-test followed by treatment intervention and a post test in order to compare their effectiveness.

3.2. Study Area:

Spinal Cord Injury Unit of Physiotherapy Department at CRP, Savar, Dhaka.

3.3. Study Population:

The study population was Tetraplegic spinal cord injury patients of CRP who got admitted within the next three months at the Spinal Cord Injury Unit of CRP.

3.4. Sampling Techniques:

The sampling technique was simple randomized sampling. A simple random sample is a subset of a statistical population in which each member of the subset has an equal probability of being chosen. Subjects who met the inclusion criteria, was taken as samples. 20 patients with Tetraplegic Spinal Cord Injury was selected from Spinal Cord Injury Unit of Physiotherapy Department of CRP and then 10 patients was randomly assigned to Experimental group comprising of treatment approaches of Glossopharyngeal Breathing along with Conventional Physiotherapy and other 10 patients was randomly assigned to Control group comprising of treatment approach of only Conventional Physiotherapy for this study. Double binding procedure was followed here. After completion of the sampling procedure, the researcher randomly assigned the participants into Experimental and Control group because it improves the internal validity of Experimental research. The participants were assigned into experimental and control group by using computer generated random number from 1 to 20. The samples was given in numerical number C1, C2, C3 etc. for the control group and E1, E2, E3 etc. for experimental group. The random numbers in experimental group were 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 and the random numbers in control group are 1, 3, 5, 7, 9, 11, 13, 15, 17, 19. Finally, the sample size was 20 in number consisting of 10 participants in experimental group and 10 participants in control group.

3.5. Sample Size:

Total 20 samples were selected conveniently and then randomly allocated in both groups.

3.6. Selection Criteria:

3.6.1. Inclusion Criteria:

- ✓ **Study participants:** Tetraplegic Spinal Cord Injury patient were included. Galeiras et al. (2013) had demonstrated that tetraplegic spinal cord injury patients were mostly affected with respiratory problems
- ✓ **Age:** Age range 20-70 years. Ahn et al. (2015) had showed that within these age range, the participants had possibilities to get mostly affected with spinal cord injury.
- ✓ **Gender:** Both male & female patients could be included. According to Shackelford et al. (1998), they had included that both male and female might get affected.
- ✓ The Patients who had decreased lung volume and capacity were included. Baydu et al. (2001) stated that in case of tetraplegic spinal cord injury, there might arise respiratory complication and might cause decreased lung volume and capacity.
- ✓ The Patients with intact cognition were included. Allen & Dewilde, (2016) mentioned that in case of tetraplegic patients, cognition level might be intact at time of data collection as cognitive ability helps to identify the insight information from the participants.
- ✓ The patients who had shown willingness to participate were included. Trgovcevic et al. (2014) showed that patient should have willingness to participate at the time of data collection.

3.6.2 Exclusion Criteria:

- ✓ Rib fracture patients (Berlowitz et al., 2016) .
- ✓ Head injury patients (Paiva et al., 2011)
- ✓ Subject who were unwillingness to participate (Melin et al., 2018)
- ✓ Mentally disturbed patients (Post & van Leeuwen, 2012).

3.7. Data Processing:

3.7.1. Data Collection tools:

- ✓ Record or Data collective form.
- ✓ Consent form.
- ✓ Socio-demographic Questions
- ✓ Structured Questionnaire.
- ✓ Close-ended Questionnaire.
- ✓ Pen.
- ✓ Papers.

3.7.2. Measurement Tools:

- ✓ Peak flow meter was used for measuring Peak Expiratory Flow (PEF) and Forced Expiratory Volume In One Second (FEV1).
- ✓ 150 cm measuring tape was used for measuring Chest Expansibility.
- ✓ 4000 ml ranged Incentive spirometer was used for measuring Inspiratory Capacity.

3.7.3. Data Collection Procedure:

The study procedure was conducted through assessing the patient, initial recording, treatment and final recording. After screening the patients at the department, the patients was assessed by a qualified physiotherapist. 12 sessions of treatment was provided for every subject. 20 subjects were chosen for data collection according to the inclusion criteria. All participants were divided into two groups and codes were C1, C2, C3, C4, C5,C6, C7, C8, C9, C10 for control group and E1, E2, E3, E4, E5, E6, E7, E8, E9, E10 for experimental group.

Data was gathered through a pre-test, intervention and a post-test and the data was collected by using a structured and close-ended written questionnaire form which had been formatted by the researcher. Data collection procedure was double blinded as the researcher was not get involved here. Data was collected by the data collector and intervention was given by the clinical physiotherapist with the supervision of a qualified physiotherapist Pre-test was performed before beginning the treatment. The same procedure was performed to take post-test at the end of 12 sessions of treatment. Researcher provided the assessment form to the data collector to collect information from the selected participants before starting treatment and after having first 6 sessions of intervention and again after the rest 6 sessions of intervention. The data collector collected all the data from the group in front of the qualified physiotherapist and verified by a witness selected by the Head of clinical setting in order to reduce the biasness. At the end of the study, for statistical analysis, different tests were carried out to perform statistical analysis.

3.8. Data Analysis:

Statistical analysis was performed by using descriptive statistics for demographic data and inferential statistics for group differences of chest expansibility, peak expiratory flow, forced expiratory volume in one second and inspiratory capacity through Statistical Package for the Social Science (SPSS) version 20.

3.8.1. Statistical Test:

According to Hicks (2009), "Experimental studies with the different subject design where two groups are used and each will be tested in two different conditions and the data is nominal or scale should be analysed with the unrelated t test." The between group analysis of chest expansion, peak expiratory flow, forced expiratory volume in one second was done by Independent t test. The within group analysis of chest expansion, peak expiratory flow, forced expiratory volume in one second was done by Paired t test.

3.8.2. Level of significance:

In order to find out the significance of the study, the "p" value was calculated. The p values refer to the probability of the results for experimental study. The word probability refers to the accuracy of the findings. A p value is called level of significance for an experiment and a p value of <0.05 was accepted as significant result for health service research. If the p value is equal or smaller than the significant level, the results are said to be significant.

3.9. Treatment Regimen:

Control group:

Control group was given conventional physiotherapy only according to patient's response to treatment.

Before starting conventional physiotherapy, all the patients was assessed properly by Spinal Cord Assessment Form in the study clinical settings.

Experimental group

Experimental group was given Glossopharyngeal Breathing along with Conventional physiotherapy. Conventional Physiotherapy was common treatment protocol for both groups. But Glossopharyngeal Breathing was given along with Conventional Physiotherapy given by single qualified physiotherapist who was expertized in Glossopharyngeal Breathing Technique.

Glossopharyngeal Breathing Treatment Protocol

The Glossopharyngeal Breathing Treatment was designed to increase chest expansibility, peak expiratory flow, forced expiratory volume in one second and inspiratory capacity and The participants will perform 10 cycles of Glossopharyngeal breathing technique per training session, with each cycle consisting of a 14 gulps. This technique should be performed 4 times a week, for 8 weeks (Nygren-Bonnier et al., 2009).

3.10. Ethical Consideration:

The Bangladesh Medical Research Council (BMRC) guidelines and World Health Organization (WHO) Research guidelines were followed in order to complete the whole process of this research project. The dissertation proposal including methodology was presented to the Institutional Review Board (IRB). Then the dissertation proposal including methodology was approved and obtained permission from the concerned authority of ethical committee of Bangladesh Health Professions Institute (BHPI). Again before the beginning of the data collection, researcher had to obtain the permission from the concerned authorities ensuring the safety of the participants. The confidentiality regarding participants condition and treatments were strictly maintained by the researcher.

3.11. Informed Consent:

An information sheet and consent form both in English and Bengali were used by the researcher to take the participants consent. The researcher obtained consent of participation from every individuals. A signed informed consent form was received from each participant. The participants informed that they had the right to meet with outdoor doctor if it was found by them that the treatment was not enough to control the condition or if the condition became worsen. That's why, it had been informed to all the participants that they were completely free to decline answering any question as well as to withdraw their consent and terminate participation at any time during the study. The researcher also ensured that withdrawal of participation from the study would not affect their treatment in the physiotherapy department and they could get the same facilities. Every individuals had the opportunity to discuss their problem and ask any questions related to their problem with the senior authority or administration of CRP for their own satisfaction.

3.12. Elimination of Source of errors:

The odder effects are source of error and order effects was controlled by making random allocation between the group and the same order of treatments were given and maintained every time. To control order effects in this study, Counterbalancing is maintained through which all possible treatments are offered in all possible orders in order to control order effect. There can be a possibility of having experimenter bias effect in an experimental research. To overcome bias effect in this study, double blinding procedure was used. Data collector was selected for data collection and he was absolutely unaware of the hypothesis, group allocation and subjects from whom the data were collected, also unaware of hypothesis and group allocation. In this way, any bias due to expectations and predictions was eliminated from this study.

CHAPTER –IV RESULTS

4. Comparison of baseline characteristics:

Table-1: Comparison of baseline characteristics

Variable(s)	Experimental Group	Control Group
Age, mean(±SD), years	35.90 ± 18.03	46.00 ± 13.17
Length of injury, mean (±SD), in days	107.7 ± 73.01	95.2 ± 37.4
Total motor score, mean (±SD)	24.9 ± 29.2	26.4 ± 19.4
Total sensory score, mean (±SD)	27.8 ± 15.9	52.8 ± 26.9

Table 1 compares the baseline characteristics of participants between trial and control group. In addition, two groups did not show significant differences at baseline regarding demographic characteristics and disease-related parameters. In trial group, the mean age (± SD) of the participants was 35.9 (± 18.03) years in experimental group and in control group 46.00 (± 13.17) years. In trial group, the mean (±SD) value of length of injury from the date of accident was 107.7 (± 73.01) and in control group was 95.2 (± 37.4). In addition, in both experimental and control group, the mean (±SD) value of total motor score in trial group was 24.9 (± 29.2) and in control group was 26.4 (± 19.4) and mean (±SD) value of total sensory score in both experimental and control group were 27.8 (± 15.9) and 52.8 (± 26.9).

4.1. Socio-demographic Information:

4.1.1. Gender of the participants:

Among the 20 participants, all of the participants were male and the percentage of them was 100%.

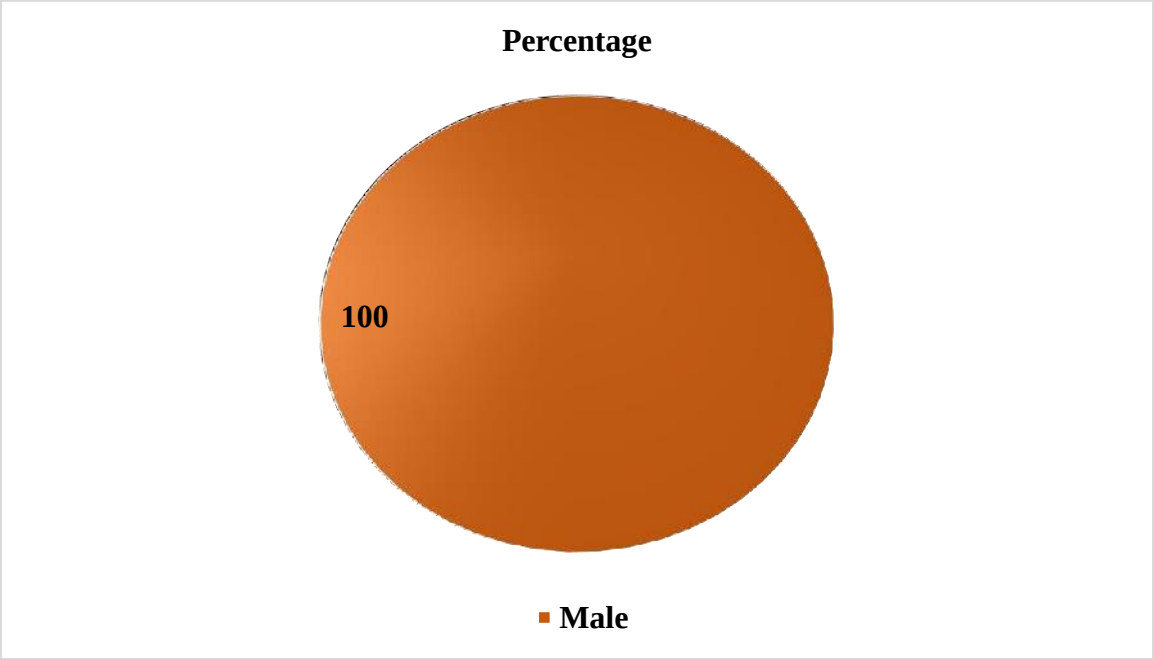


Figure-1: Gender of the participants

4.1.2. Marrital Status of the Particiapants:

Among the 20 participants, 85% (17 participants) was married, 15% (3 participants) was unmarried.

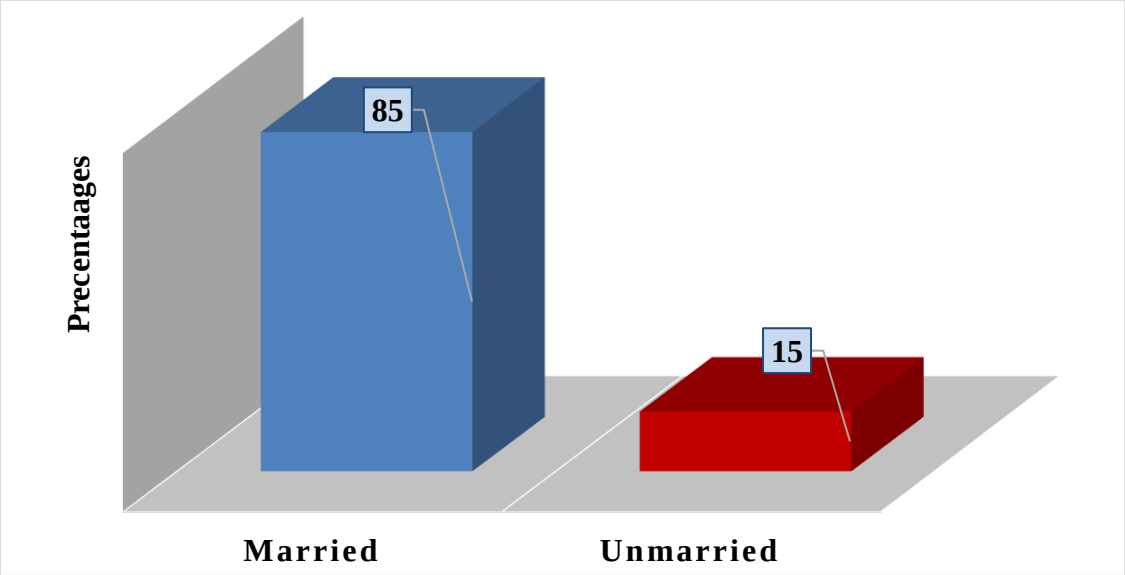


Figure -2: Marrital status of the participants

4.1.3. Educational Status of the Participants:

Total sample size was 20 and the educational status among them 3 participants (15%) was illiterate, 9 participants (45%) was in primary school, 4 participants (20%) studied till secondary school certificate, 2 participants (10%) studied till higher secondary, 1 participant (5%) of them completed bachelor degree and 1 participant (5%) of them completed masters or above degrees.

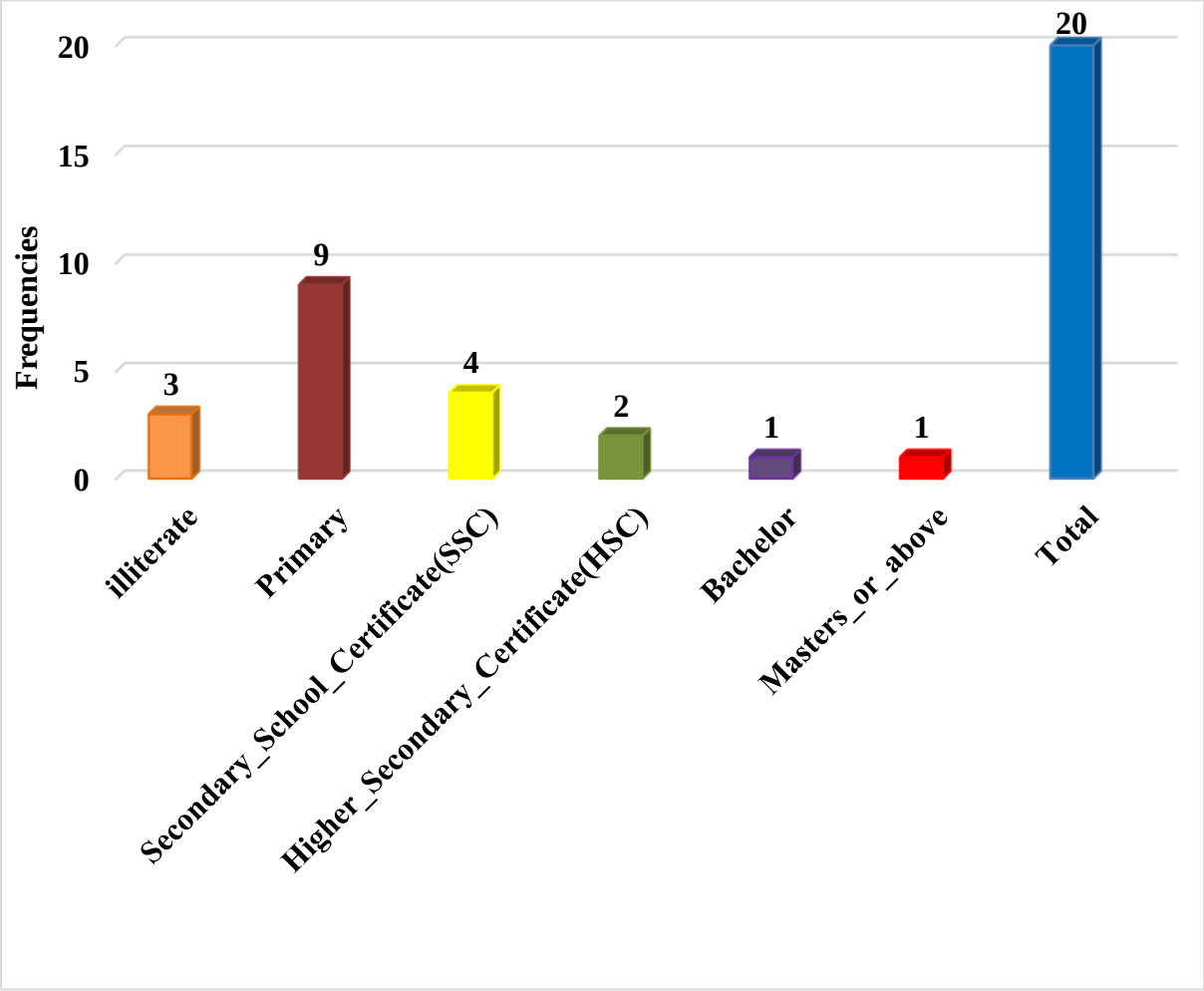


Figure-3: Educational Status of the Participants

4.1.4. Occupational Status of the participants:

Among 20 participants, the percentage of occupational status would be- 10% (2 participants) was engaged in the other field, 30% (6 participants) was engaged with job, 15% (3 participants) of them was day labourer, 30% (6 participants) of them was farmer and 15%(6 participants) of them was students.

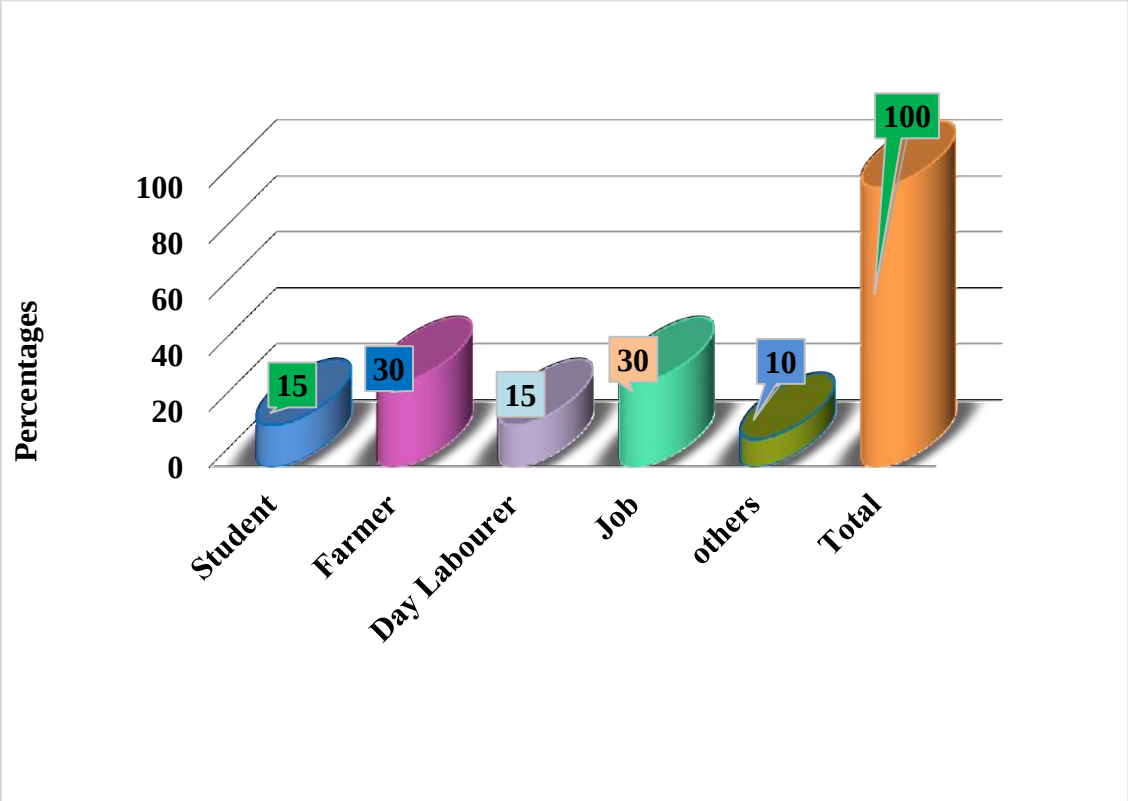


Figure-4: Occupational Status of the Participants

4.2. Injury related information:

4.2.1. Causes of Injury of the participants:

There were 20 participants in this study. Among them 16 (80%)of the participants had spinal cord injury due to trauma and the other 4 (20%) of the participants had spinal cord injury due to any other pathological reasoning or causes, that is non-traumatic in nature.

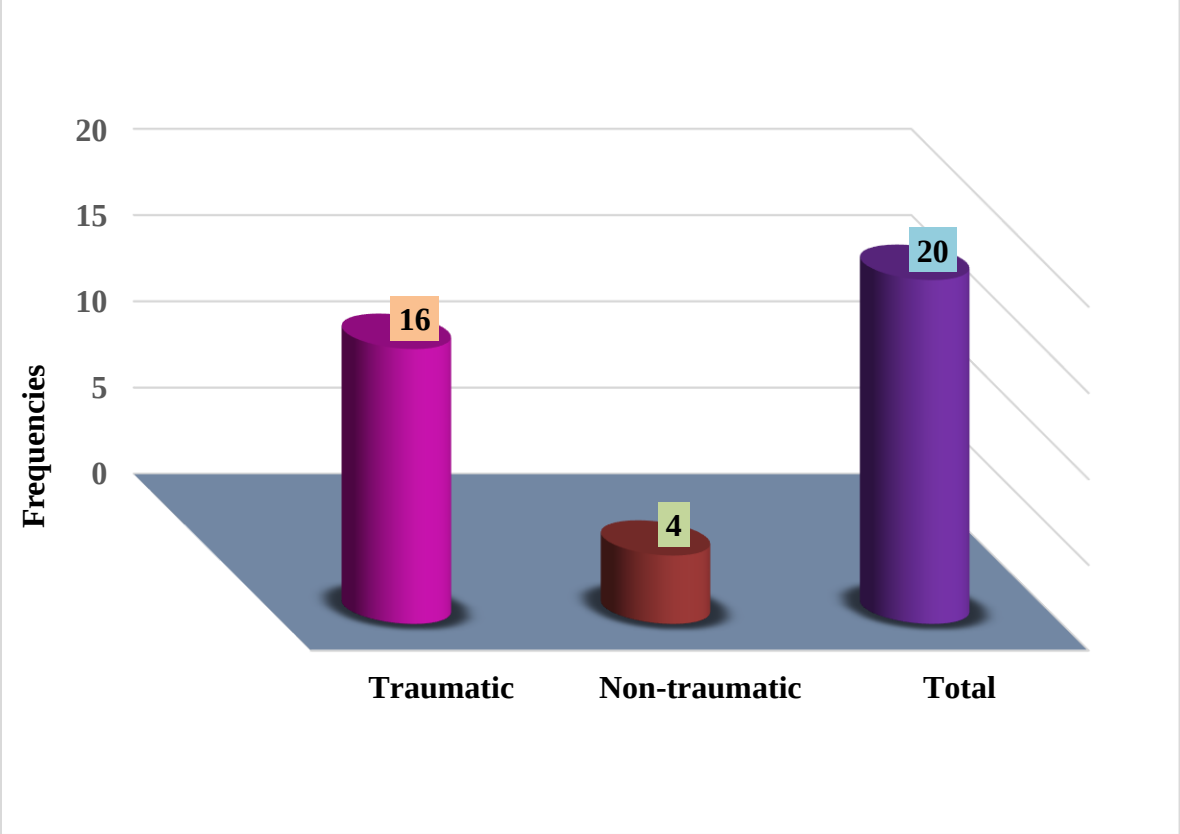


Figure-5: Causes of injury of the participants

4.2.2. Length of injury from the date of accident of the participants:

20 participants were selected in this study and the length of injury from the date of accident among the participants (in days) were shown within 37 to 300 days. Here, the length of injury from the date of accident varies from person to person in each group.

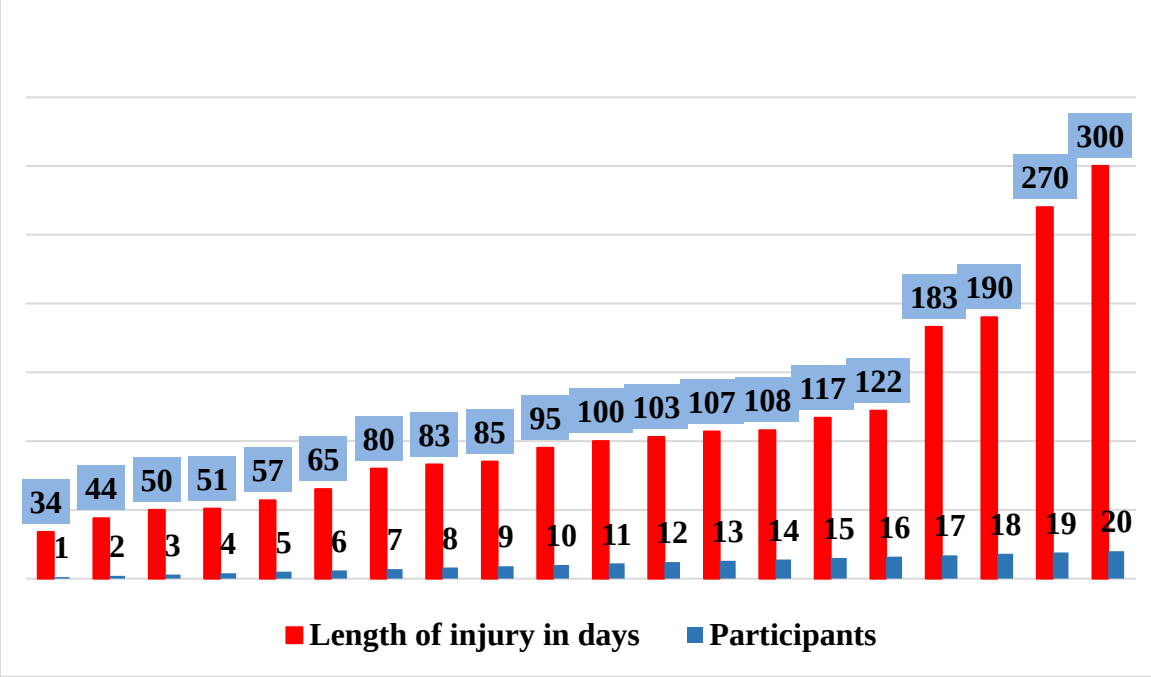


Figure-6: Length of injury from the date of accident (in days)

4.2.3. Types of Injury according to ASIA Scale:

Among the overall study population (20 participants), the types of injury varied from person to person according to ASIA. The percentages of types of injury were found- 40% was Complete –A, 40% was Incomplete-B, 5% was Incomplete-C and 15% was Incomplete-D.

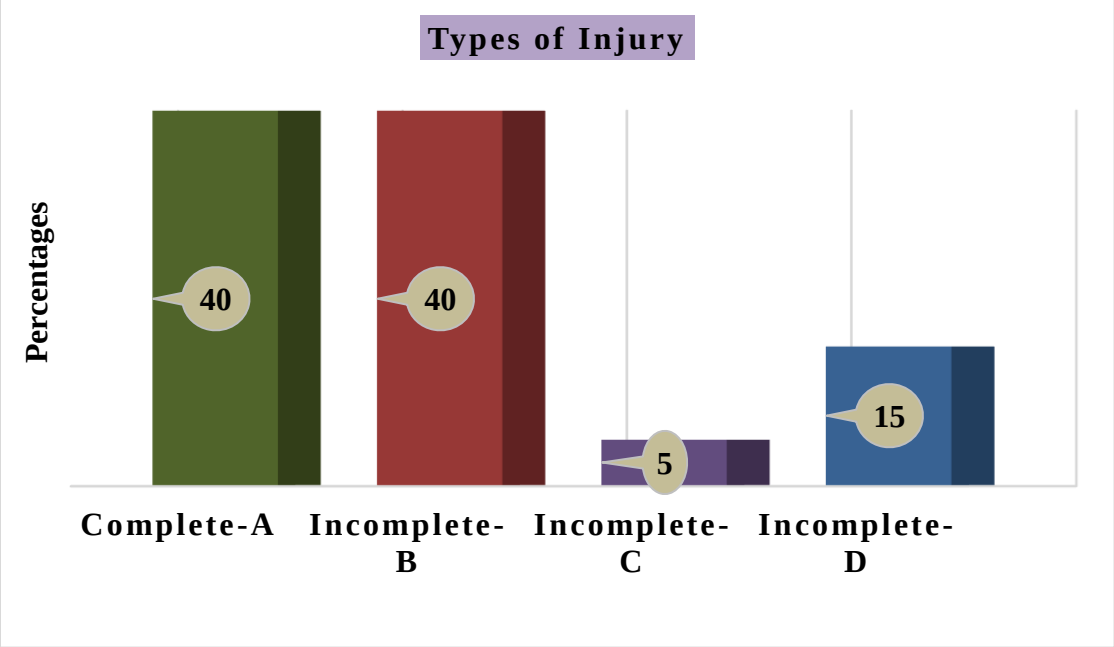


Figure-7: Types of injury according to ASIA

4.2.4. Neurological Level of the Participants:

20 participants were engaged in this study and among them the neurological levels of the participants were found in percentage and frequencies in this figure. The percentages of neurological level of the participants were- 1 (5%) subjects' neurological level were in C1, 2 (10%) subjects' neurological level were C2, Another 2 (10%) subjects' neurological level were C3, 10 (50%) subjects' neurological level were C4, then C5 neurological level were noticed in 2 (10%) subjects and further neurological level was C6 which was noticed in 2 (10%) of the total population and lastly the rest 1 (5%) subjects' neurological level were T1.

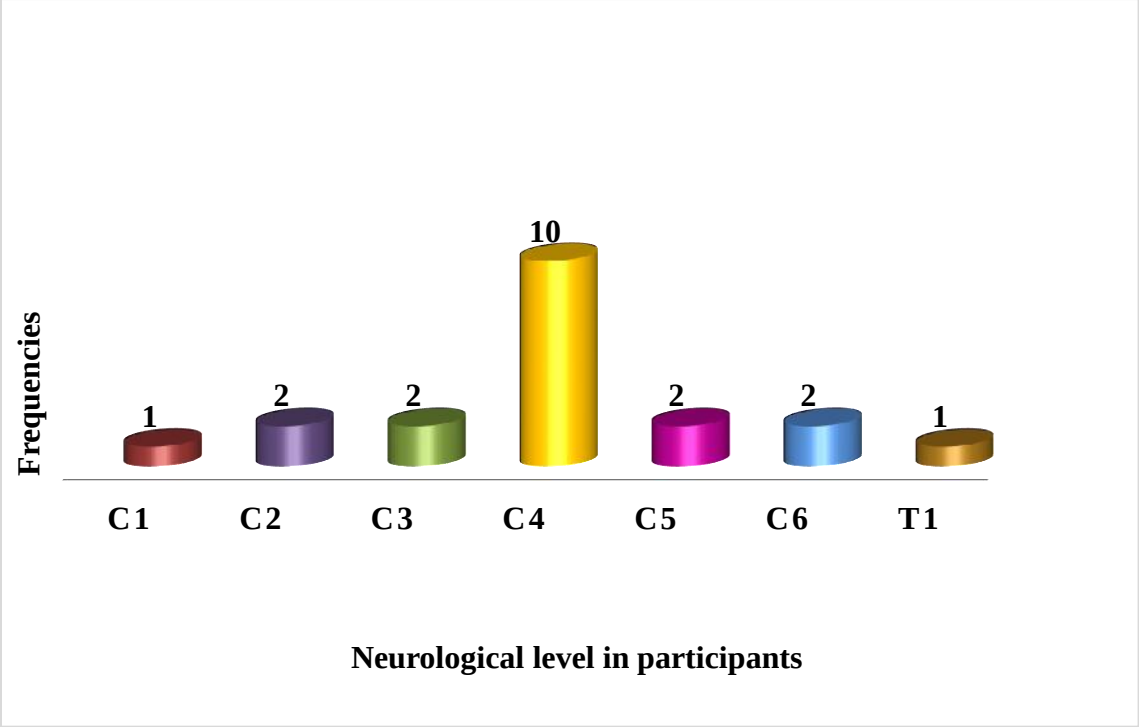


Figure-8: Neurological level of the Participants

4.2.5. Skeletal Level:

Among 20 participants, 15% (3) persons' skeletal level was C7, another 15% (3) persons' skeletal level was C6. C5 was found as skeletal level in 25% (5) of the overall population and the rest 45% populations' (9) skeletal level was C4.

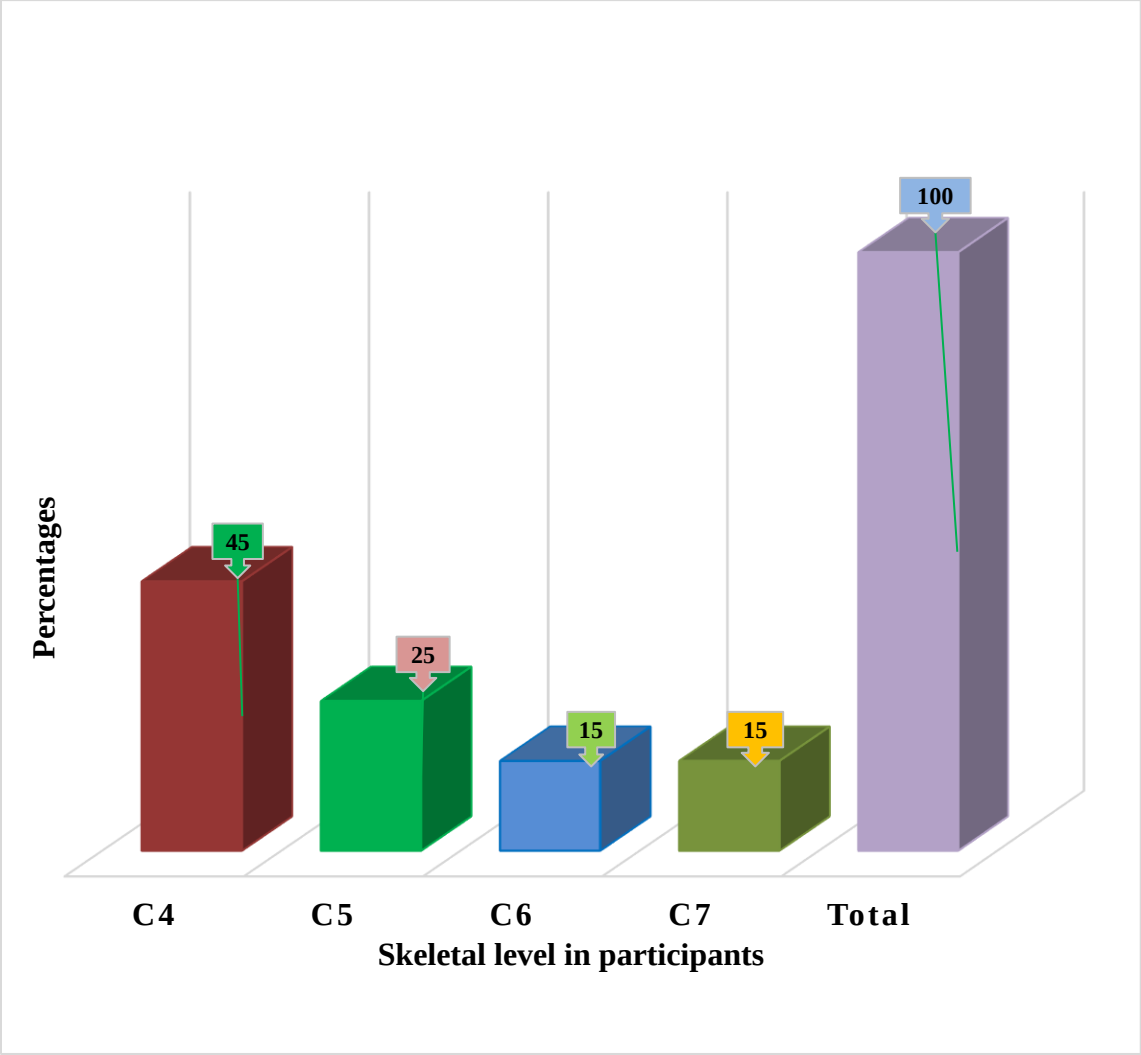


Figure-9: Skeletal level of the participants

4.2.6. Total motor score:

Tthe study was designed with 20 study population and among them 1 person's total motor score was 0, then 1 person's total motor score was 1, 1 subject's total motor score was 5, the next 1 subject's total motor score was 9, another 1 subject's total motor score 11. The total motor score of the 2 of the total population was 14, and the 1 person's total motor score was 16, total motor score of another 1 subject was 17, furthermore 1 subject's total motor score was 19, 3 subjects' total motor score was 22, another 3 subjects' total motor score was 25. It was shown in this figure that another 1 subject's total motor score was 46, 1 subject's total motor score was 53, the next 1 subject's total motor score was 67. The last and the rest 1 subject's total motor score was 100.

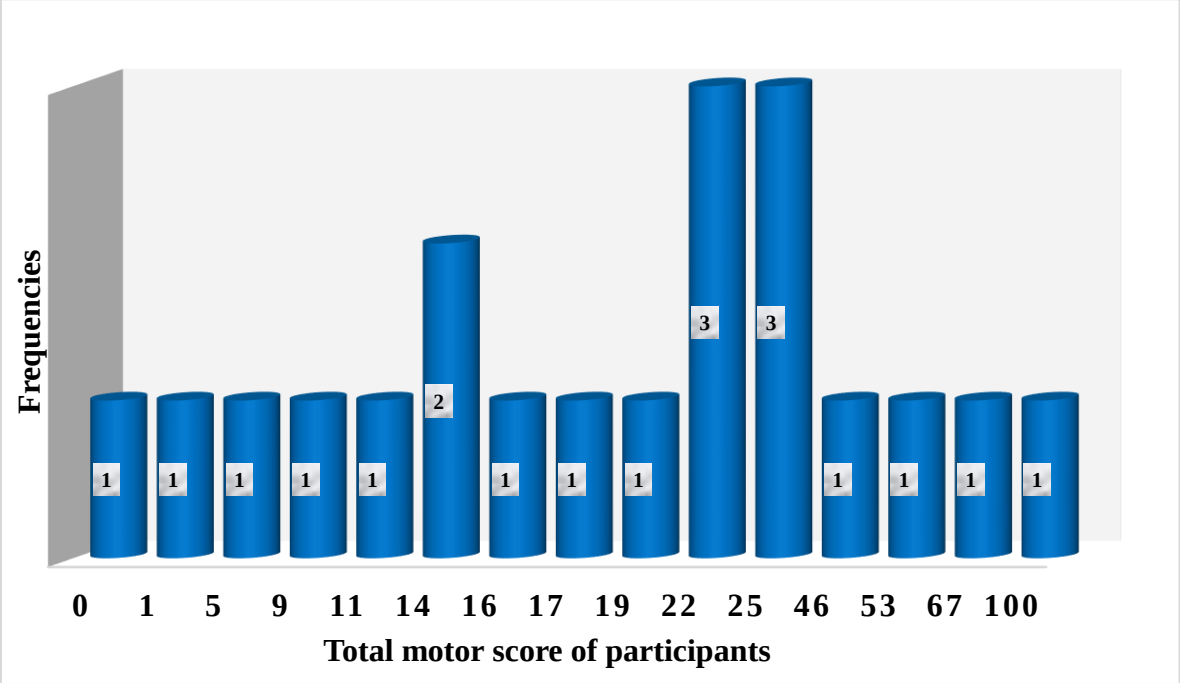


Figure-10: Total Motor score

4.2.7. Total Sensory Score:

Among 20 samples, 2 (10%) person's total sensory score was 12, then 1 (5%) person's total sensory score was 13, 1 (5%) subject's total sensory score was 18, the next 1 (5%) subject's total sensory score was 22, another 1 (5%) subject's total sensory score 24. The total sensory score of the 3 (15%) of the total population was 25 and the 1 (5%) person's total sensory score was 28 , total sensory score of the another 1 (5%) subject was 31, furthermore 1 (5%) subject's sensory score was 46, 1 (5%) subject's total sensory score was 47, another 1 (5%) subject's total sensory score was 48. It was shown in this figure that another 1 (5%) subject's total sensory score was 55, 1 (5%) subject's total sensory score was 58, the next 1 (5%) subject's total sensory score was 64 and the total sensory score of the further 1 (5%) subject was 72 and another 1 (5%) subject's total sensory score was 80. The last and the rest 1 (5%) subject's total sensory score was 101.

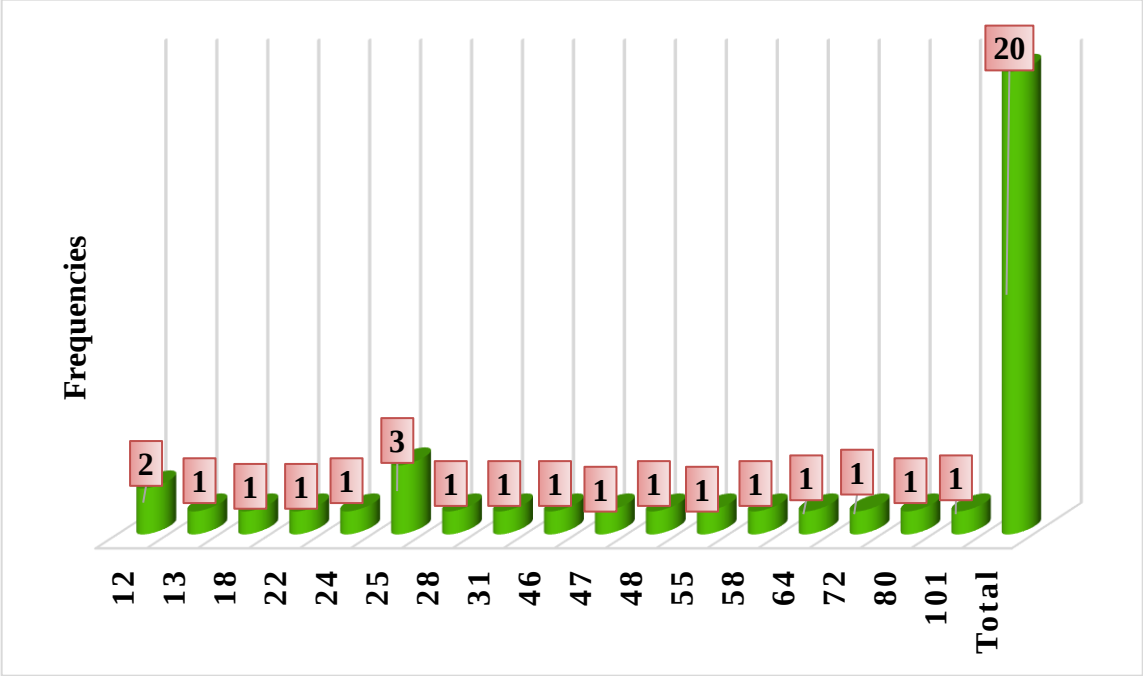
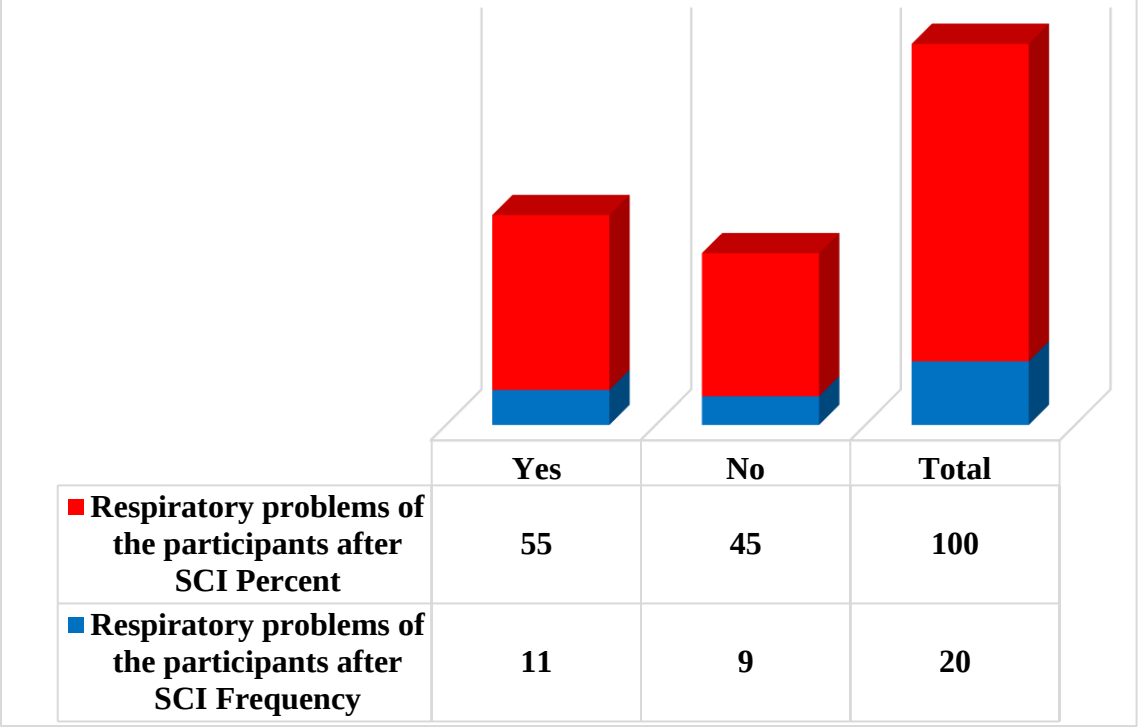


Figure- 11: Total sensory score of the participants

4.3. Respiratory problem related information:

4.3.1. Respiratory problems of the participants after SCI:

The study population was about 20. The subjects who had respiratory problems after spinal cord injury among the total population were 55% (11 participants) and those who had no respiratory problems were 45% (9 participants).



	Yes	No	Total
Respiratory problems of the participants after SCI Percent	55	45	100
Respiratory problems of the participants after SCI Frequency	11	9	20

Figure-12: Respiratory problems after Spinal cord injury

4.3.2. If yes, which type of respiratory problem of the participants after SCI:

20 study population was included in this study as sample size. From Figure-12, it had found that among the 20 population 55% (11 participants) had respiratory problem after spinal cord injury and the rest 45% (9) had no respiratory problem. The types of respiratory problem had been identified for those who had respiratory problem after spinal cord injury through Figure-13. Here, among 20 study population, the percentage of types of injury would be- 30% (6 subjects) had shortness of breath, 10% (2 subjects) had cough with sputum, 5% (1 subject) had dry cough, 10% (2 subjects) had chest pain. In total the percentage of those subjects who had these types of respiratory problem was 55% (11 subjects). As the rest 45% (9 subjects) of the entire study population had no respiratory problem, so their report was showing missing in Figure-13.

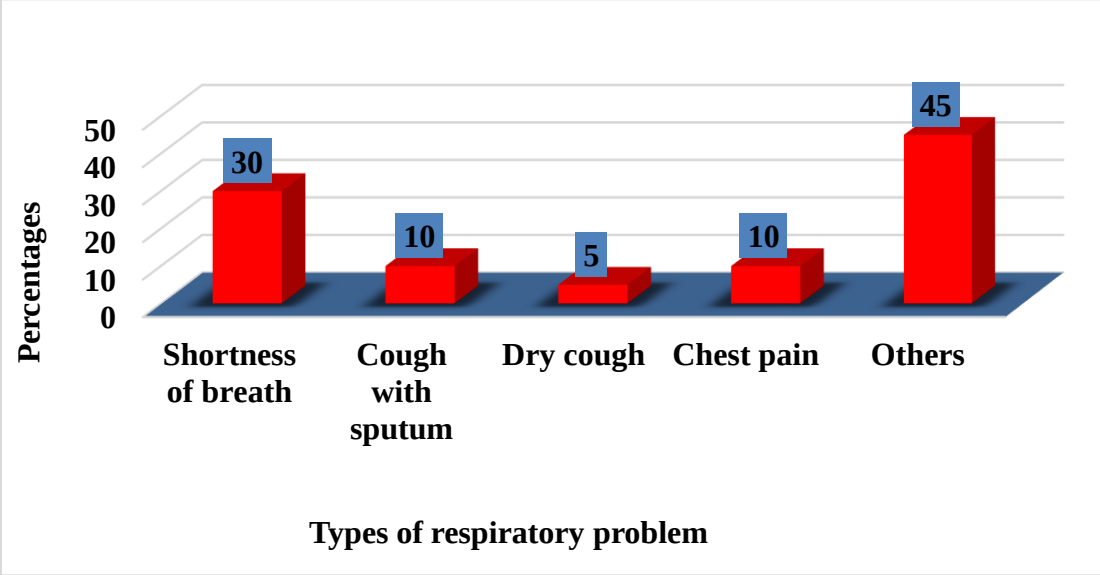


Figure-13: Types of Respiratory Problem after Spinal Cord Injury

4.3.3. Taking treatment for respiratory problem after SCI:

Among 20 study population, those who had faced respiratory problem after spinal cord injury, had taken treatment after having respiratory problem. The percentage of treatment taken for respiratory problem after SCI would be-5% (1 subject) had taken only medication, 10% (2 subjects) had taken only physiotherapy and 40% (8 subjects) had taken both medication and physiotherapy. In total, these was within 55% (11 subjects), the other 45% (9) had no respiratory problem and for this reason their report was not showing in Figure-14.

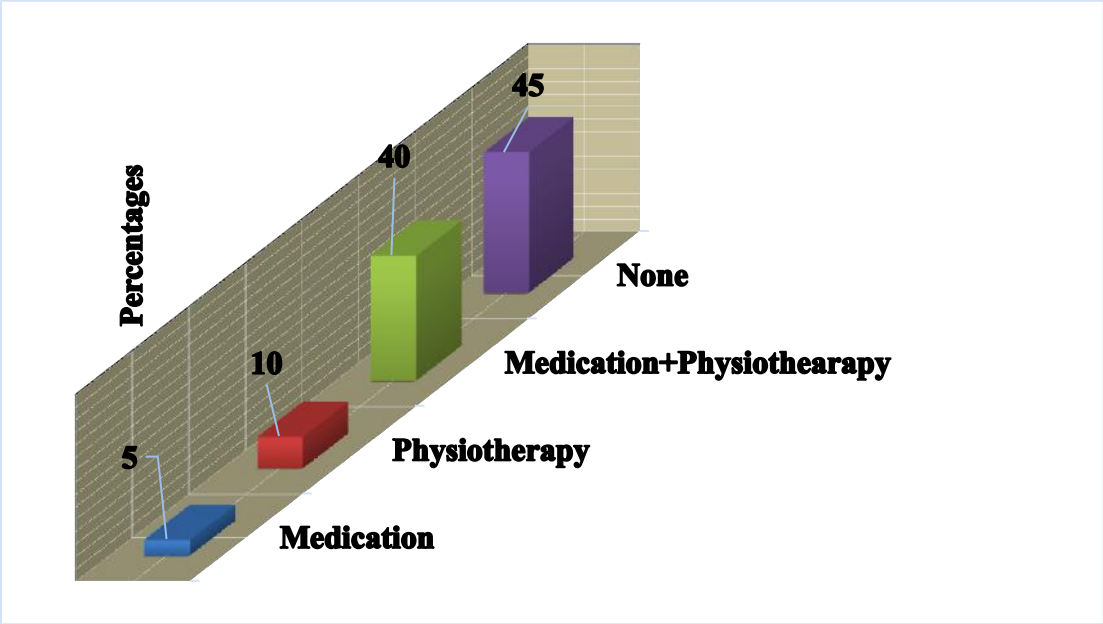
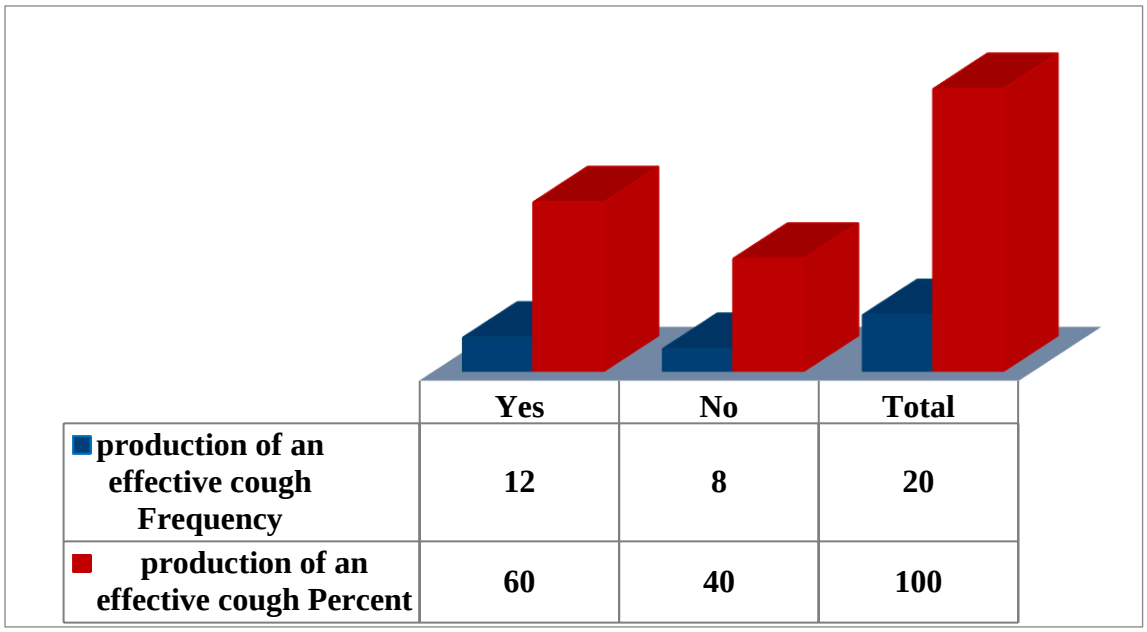


Figure-14: Taking treatment for respiratory problem after SCI

4.3.4. Production of an effective cough:

The sum of the study population was 20 and among them 60% (12 subjects) of the entire population was able to produce an effective cough and the rest 40% (8 subjects) was not efficient enough to produce cough effectively.



	Yes	No	Total
production of an effective cough Frequency	12	8	20
production of an effective cough Percent	60	40	100

Figure-15: Production of an effective cough

4.4. Pretest and Posttest score of chest expansibility (cm) in general (Trial and Control)

4.4.1. Comparison of pretest and posttest score of chest expansibility (cm) in both trial and control group:

Table-2: Comparison of pretest and posttest score of chest expansibility (cm) in both experimental and control group

Serial No		**Trial Group**		**Serial no.**		**Control group**	
No.	**Pretest**	**Posttest**	**Difference**	**No.**	**Pretest**	**Posttest**	**Difference**
Score		**Score**		**Score**		**Score**	
T1	88	92.0	4.00	**C1**	86	89.0	3.00
T2	77	81.0	4.00	**C2**	87	89.0	2.00
T3	84	90.0	6.00	**C3**	78	81.0	3.00
T4	95	99.0	4.00	**C4**	87	89.0	2.00
T5	82	87.0	5.00	**C5**	83	85.0	2.00
T6	74	78.0	4.00	**C6**	72	75.0	3.00
T7	79	85.0	6.00	**C7**	78	80.0	2.00
T8	90	97.0	7.00	**C8**	101	103.0	2.00
T9	74	78.0	4.00	**C9**	85	88.0	3.00
T10	57	62.0	5.00	**C10**	97	100.0	3.00
Total	**800**	**849**	**49**	**Total**	**854**	**879**	**25**
Mean	**80**	**84.90**	**4.90**	**Mean**	**85.40**	**87.90**	**2.50**

Table-2 demonstrated that the pretest and posttest between the control group and trial group. Mean pretest chest expansibility score was 80 cm and posttest was 84.90cm with a mean difference of 4.90 cm in the trial group. In contrast, the mean pretest chest expansibility score in the control group was 85.40 cm and posttest was 87.90 cm with a mean difference of 2.50 cm. In this part, data analysis was done using Independent samples t test (between group analysis) and there was two different groups (one was glossopharyngeal breathing combined with conventional physiotherapy as trial group and other was only conventional physiotherapy as control group). Conversely, the effectiveness

of trial group treatment as well as control group treatment was analyzed by Paired sample t test (within group analysis).

4.4.2. Chest Expansibility (cm) between groups (Trial and Control):

Table-3: Statistical outcome of chest expansibility between trial and control group

	Unpaired t test	**df**	**P value**	**95% confidence interval**	
				Lower	**Upper**
Difference between trial and control group in chest expansibility (in cm)	6.220	18	.002	1.58934	3.21066

Table 3 showed that the calculated t value is 6.220 and for df= 18 has an associated significance level of 0.2%. This means that the probability of random error being responsible for the outcome of this experiment was 0.2 in 100. As the usual cut- off point for claiming support for the experimental hypothesis was 0.2% and it could be said that the result was significant. Thus, glossopharyngeal breathing along with conventional physiotherapy was effective than only conventional physiotherapy in case of chest expansibility among patients with tetraplegic spinal cord injury.

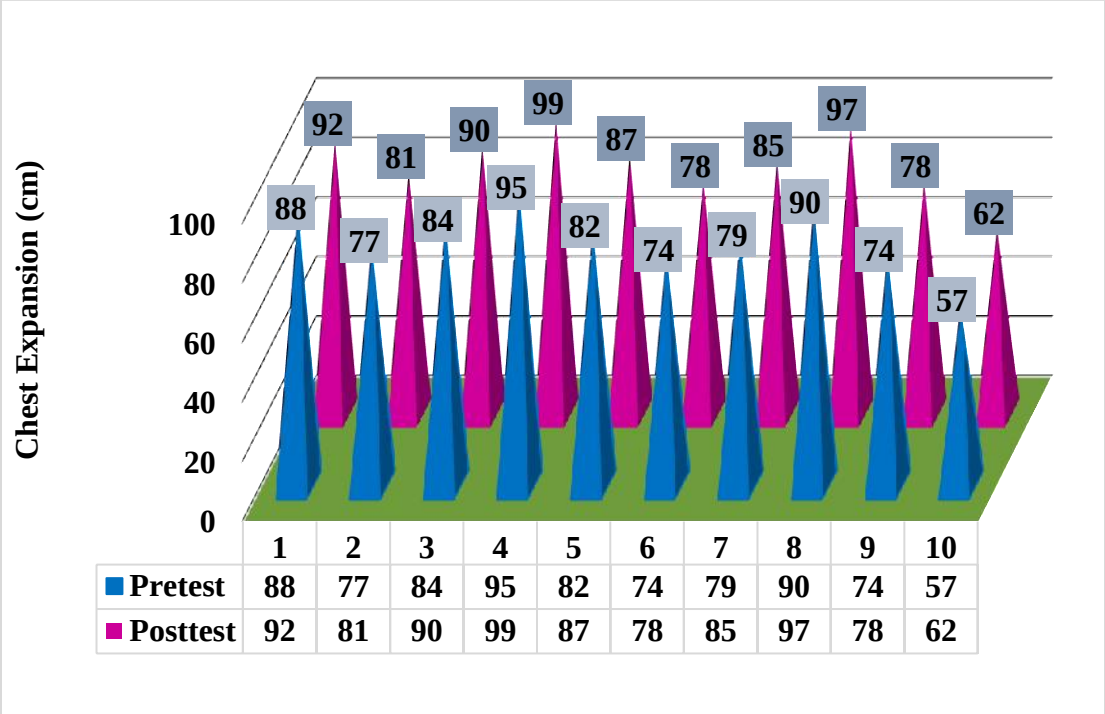
4.4.3. Chest Expansibility (cm) within experimental and control group:

Table-4: Statistical outcome of chest expansibility within trial and control group

	Mean	**Std. Deviation**	**95% confidence interval**		**Paired t test**	**df**	**P value**
			Lower	**Upper**			
Experimental group	4.9000	1.1005	4.1127	5.6873	14.080	9	.002
Control group	2.5000	0.5270	2.1230	2.8770	15.000	9	.002

Table 4 showed that in case of within group analysis of chest expansibility, the improvement was highly significant in experimental group (p value=0.002) where the glossopharyngeal breathing along with conventional physiotherapy was used and in fact in control group (p value=0.002), the conventional physiotherapy was only used and it showed higher significance also.

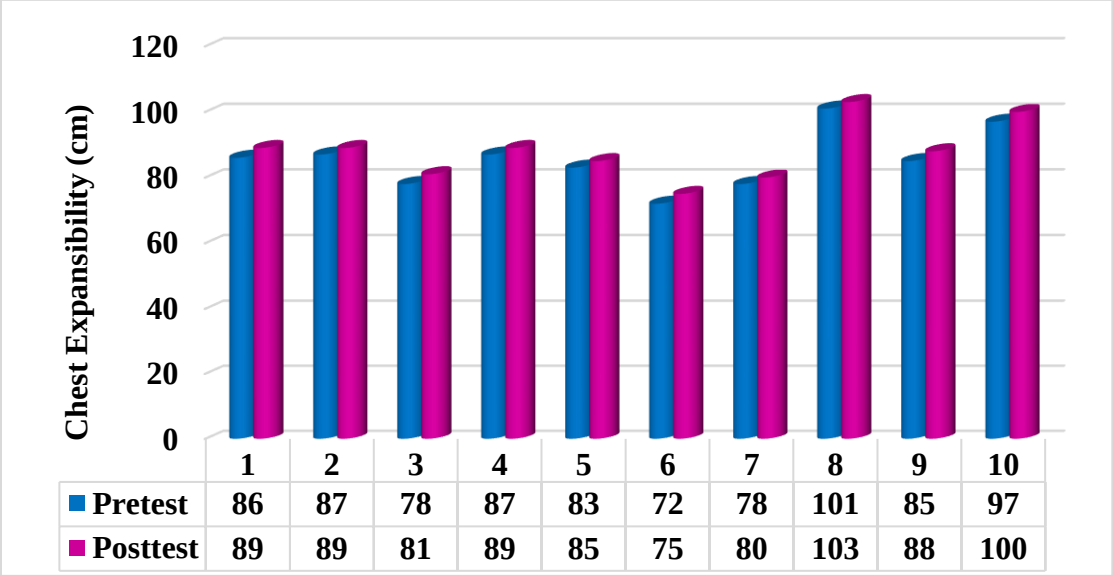
4.5.1. Pretest and posttest chest expansibility (cm) in trial group:



	1	2	3	4	5	6	7	8	9	10
Pretest	88	77	84	95	82	74	79	90	74	57
Posttest	92	81	90	99	87	78	85	97	78	62

Figure-16: Pretest and posttest score comparison of chest expansibility (cm) in trial group

4.5.2. Pretest and posttest chest expansibility (cm) in control group:



	1	2	3	4	5	6	7	8	9	10
Pretest	86	87	78	87	83	72	78	101	85	97
Posttest	89	89	81	89	85	75	80	103	88	100

Figure-17: Pretest and posttest score comparison of chest expansibility (cm) in control group

4.6. Pretest and Posttest score of peak expiratory flow (l/min) in general (Experimental and Control)

4.6.1. Comparison of pretest and posttest score of peak expiratory flow (l/min) both experimental and control group:

Table-5: Comparison of pretest and posttest score of peak expiratory flow (l/min) in both experimental and control group

Serial No		**Experimental Group**		**Serial no.**		**Control group**	
No.	**Pretest**	**Posttest**	**Difference**	**No.**	**Pretest**	**Posttest**	**Difference**
	Score	**Score**			**Score**	**Score**	
E1	67	84	17.00	**C1**	80	90	10.00
E2	93	111	18.00	**C2**	217	226	9.00
E3	184	200	16.00	**C3**	301	310	9.00
E4	270	285	15.00	**C4**	124	134	10.00
E5	182	200	18.00	**C5**	94	104	10.00
E6	86	100	14.00	**C6**	150	159	9.00
E7	334	350	16.00	**C7**	235	244	9.00
E8	183	200	17.00	**C8**	330	339	9.00
E9	181	195	14.00	**C9**	94	104	10.00
E10	79	95	16.00	**C10**	220	229	9.00
Total	**1659**	**1820**	**161**	**Total**	**1845**	**1939**	**94**
Mean	**165.90**	**182.00**	**16.1**	**Mean**	**184.50**	**193.90**	**9.4**

Table-5 showed that the pretest and posttest between the control group and experimental group of peak expiratory flow. Mean pretest peak expiratory flow score was 165.90 L/min and posttest was 182.00 L/min with a mean difference of 16.1 L/min in the experimental group. In contrast, the mean pretest peak expiratory flow score in the control group was 184.50 L/min and posttest was 193.90 L/min with a mean difference of 9.40 L/min. In this part, data analysis was done using Independent samples t test (between group analysis) and there was two different groups (one was glossopharyngeal breathing combined with

conventional physiotherapy as trial group and other was only conventional physiotherapy as control group). Conversely, the effectiveness of trial group treatment as well as control group treatment was analyzed by Paired sample t test (within group analysis).

4.6.2. Peak expiratory flow (l/min) between groups (Experimental and Control):
Table-6: Statistical outcome of peak expiratory flow between experimental and control group

	Unpaired t test	**df**	**P value**	**95% confidence interval**	
				Lower	**Upper**
Difference between experimental and control group in peak expiratory flow (in l/min)	13.772	18	.002	5.67794	7.72206

Table-6 described that the calculated t value is 13.772 and for df= 18 has an associated significance level of 0.2%. This means that the probability of random error being responsible for the outcome of this experiment was 0.2 in 100. As the usual cut- off point for claiming support for the experimental hypothesis was 0.2% and it could be said that the result was significant. Thus, glossopharyngeal breathing along with conventional physiotherapy was effective than only conventional physiotherapy among patients with tetraplegic spinal cord injury.

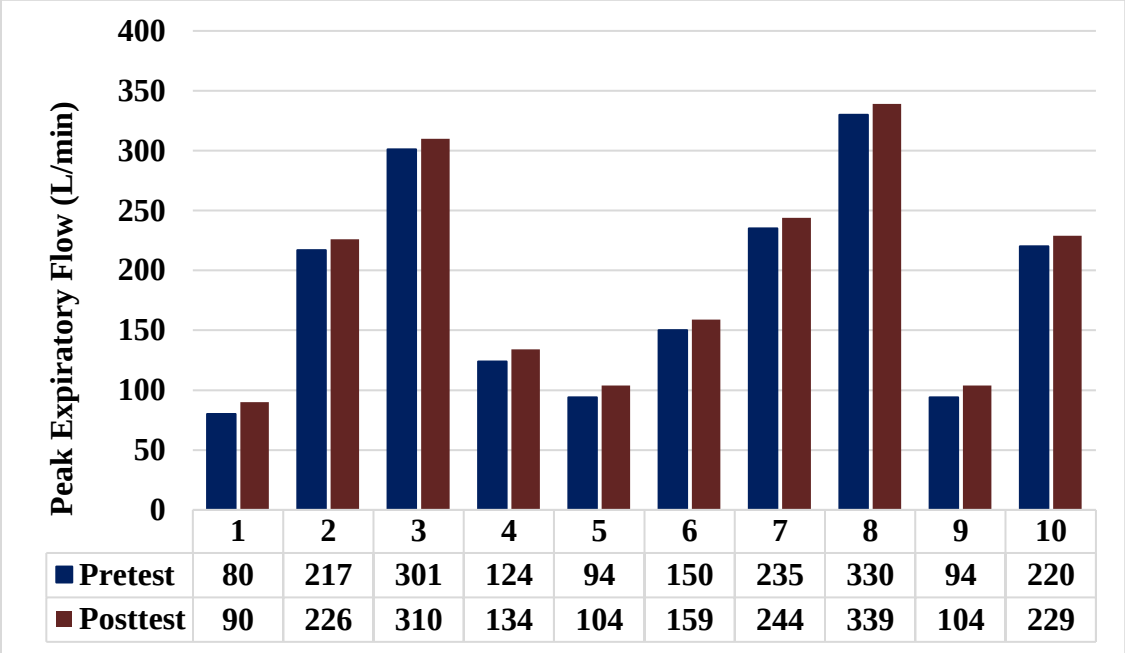
4.7.2. Peak expiratory flow (l/min) within experimental and control group:

Table-7: Statistical outcome of peak expiratory flow within experimental and control group

	Mean	**Std. Deviation**	**95% confidence interval**		**Paired t test**	**df**	**P value**
			Lower	**Upper**			
Experimental group	16.100	1.449	15.063	17.137	35.133	9	.002
Control group	9.400	0.516	9.031	9.769	57.563	9	.002

Table 7 showed that in case of within group analysis of Peak expiratory flow, the improvement was highly significant in experimental group (p value=0.002) where the glossopharyngeal breathing along with conventional physiotherapy was used and in fact in control group (p value=0.002), the conventional physiotherapy was only used and it showed higher significance also.

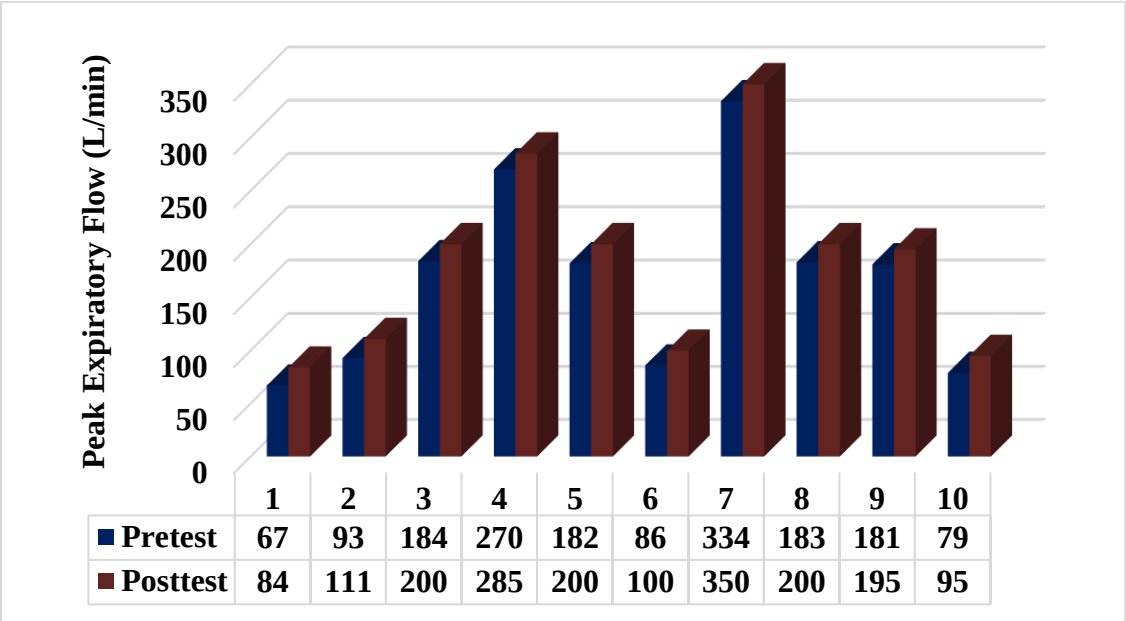
4.7.1. Pretest and posttest peak expiratory flow (l/min) in control group:



	1	2	3	4	5	6	7	8	9	10
Pretest	80	217	301	124	94	150	235	330	94	220
Posttest	90	226	310	134	104	159	244	339	104	229

Figure-18: Pretest and posttest score comparison of peak expiratory flow (l/min) in control group

4.7.2. Pretest and posttest peak expiratory flow (l/min) in experimental group:



	1	2	3	4	5	6	7	8	9	10
Pretest	67	93	184	270	182	86	334	183	181	79
Posttest	84	111	200	285	200	100	350	200	195	95

Figure-19: Pretest and posttest score comparison of peak expiratory flow (l/min) in experimental group

4.8. Pretest and Posttest score of forced expiratory volume in one second (l/min) in general (Trial and Control)

4.8.1. Comparison of pretest and posttest score of forced expiratory volume in one second (l/min) both trial and control group:

Table-8: Comparison of pretest and posttest score of forced expiratory volume in one second (l/min) in both trial and control group

Serial No		**Trial Group**		**Serial no.**		**Control group**	
No.	**Pretest**	**Posttest**	**Difference**	**No.**	**Pretest**	**Posttest**	**Difference**
	Score	**Score**			**Score**	**Score**	
T1	.93	2.10	1.17	**C1**	1.20	1.40	.20
T2	.82	1.97	1.15	**C2**	1.50	1.85	.35
T3	1.10	2.50	1.40	**C3**	1.80	2.20	.40
T4	1.87	3.20	1.33	**C4**	1.07	1.47	.40
T5	1.35	3.10	1.75	**C5**	1.40	1.90	.50
T6	1.94	3.20	1.26	**C6**	1.50	1.95	.45
T7	1.95	3.70	1.75	**C7**	1.70	2.20	.50
T8	.69	2.10	1.41	**C8**	1.10	1.95	.85
T9	1.50	3.30	1.80	**C9**	1.30	1.90	.60
T10	.63	1.85	1.22	**C10**	.75	1.70	.95
Total	**12.78**	**27.02**	**14.24**	**Total**	**13.32**	**18.52**	**5.20**
Mean	**1.278**	**2.702**	**1.424**	**Mean**	**1.332**	**1.852**	**0.052**

Table-8 demonstrated the pretest and posttest between the control group and trial group of forced expiratory volume in one second (FEV1). Mean pretest forced expiratory volume in one second (FEV1) score was 1.278 L/min and posttest was 2.702 L/min with a mean difference of 1.424 L/min in the trial group. In contrast, the mean pretest forced expiratory volume in one second (FEV1) score in the control group was 1.332 L/min and posttest was 1.852 L/min with a mean difference of 0.052 L/min. In this part, data analysis was done using Independent samples t test (between group analysis) and there was two different groups (one was glossopharyngeal breathing combined with conventional physiotherapy

as trial group and other was only conventional physiotherapy as control group). Conversely, the effectiveness of trial group treatment as well as control group treatment was analyzed by Paired sample t test (within group analysis).

4.8.2. Forced expiratory volume in one second (l/min) between groups (trial and Control):

Table-9: Statistical outcome of forced expiratory volume in one second between trial and control group

	Unpaired t test	**df**	**P value**	**95% confidence interval**	
				Lower	**Upper**
Difference between trial and control group in Forced expiratory volume in one second (in L/min)	8.419	18	.002	0.67841	1.12959

Table-9 showed that the calculated t value is 8.419 and for df= 18 has an associated significance level of 0.2%. This means that the probability of random error being responsible for the outcome of this experiment was 0.2 in 100. As the usual cut- off point for claiming support for the experimental hypothesis was 0.2% and it could be said that the result was significant. Thus, glossopharyngeal breathing along with conventional physiotherapy was effective than only conventional physiotherapy among patients with tetraplegic spinal cord injury.

4.8.3. Forced expiratory volume in one second (l/min) within trial and control group:

Table-10: Statistical outcome of forced expiratory volume in one second within trial and control group

	Mean	**Std. Deviation**	**95% confidence interval**		**Paired t test**	**df**	**P value**
			Lower	**Upper**			
Trial group	1.42400	0.25202	1.24371	1.60429	17.868	9	.002
Control group	0.52000	0.22755	0.35722	0.68278	7.227	9	.002

Table 10 showed that in case of within group analysis of Forced expiratory volume in one second, the improvement was highly significant in experimental group (p value=0.002) where the glossopharyngeal breathing along with conventional physiotherapy was used and in fact in control group (p value=0.002), the conventional physiotherapy was only used and it showed higher significance also.

4.9.1. Pretest and posttest forced expiratory volume in one second (l/min) in trial group:

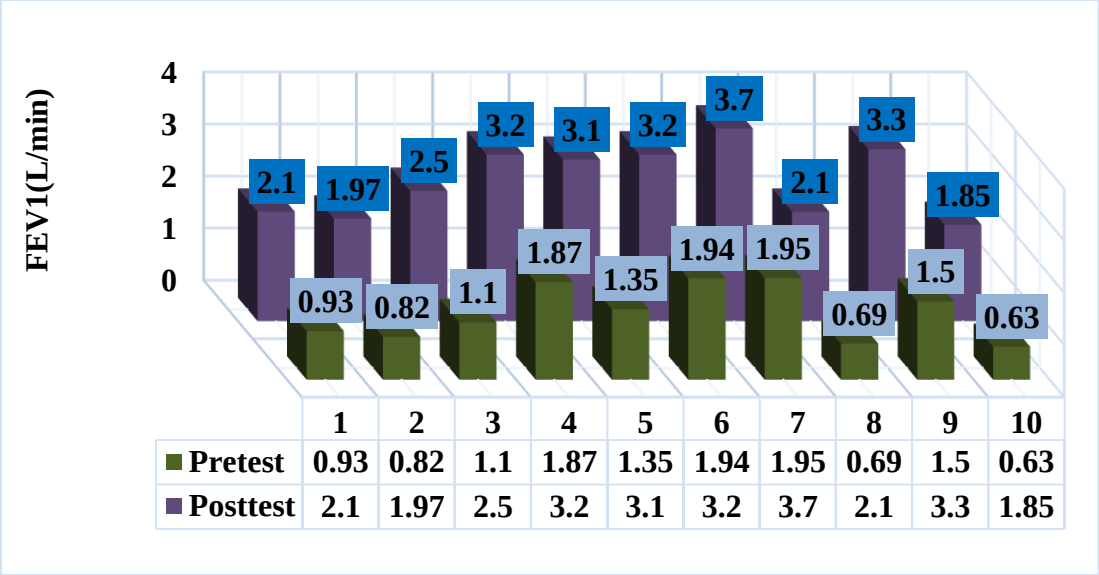


Figure-20: Pretest and posttest score comparison of forced expiratory volume in one second (l/min) in trial group

4.9.2. Pretest and posttest forced expiratory volume in one second (l/min) in control group:

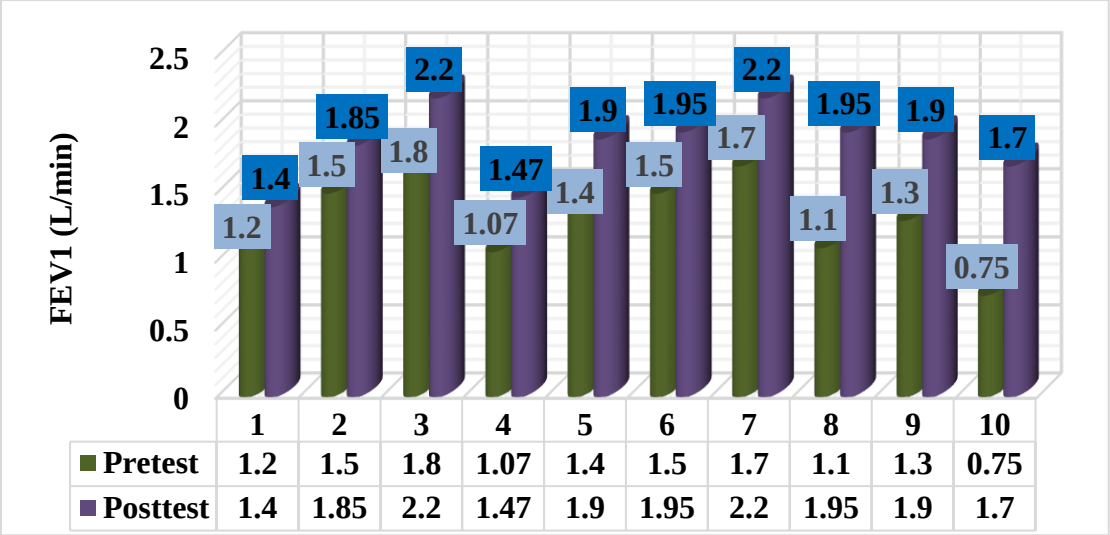


Figure-21: Pretest and posttest score comparison of forced expiratory volume in one second (l/min) in control group

4.10. Pretest and Posttest score of inspiratory capacity (ml) in general (Experimental and Control)

4.10.1. Comparison of pretest and posttest score of inspiratory capacity both experimental and Control group:

Table-11: Comparison of pretest and posttest score inspiratory capacity (ml) in both experimental and control group

Serial No		**Experimental Group**		**Serial no.**		**Control group**	
No.	**Pretest**	**Posttest**	**Difference**	**No.**	**Pretest**	**Posttest**	**Difference**
	Score	**Score**			**Score**	**Score**	
E1	2250	2750	500.00	**C1**	1250	1750	500.00
E2	1250	1750	500.00	**C2**	1000	1500	500.00
E3	2000	2500	500.00	**C3**	1750	2250	500.00
E4	1500	2000	500.00	**C4**	1500	2000	500.00
E5	1250	1750	500.00	**C5**	750	1500	750.00
E6	1000	2000	1000.00	**C6**	1250	2000	750.00
E7	1750	2500	750.00	**C7**	1000	1500	500.00
E8	1000	1750	750.00	**C8**	1250	1750	500.00
E9	1500	2250	750.00	**C9**	1000	1500	500.00
E10	750	1500	750.00	**C10**	1500	2250	750.00
Total	**14250**	**20750**	**6500**	**Total**	**12250**	**18000**	**5750**
Mean	**1425**	**2075**	**650**	**Mean**	**1225**	**1800**	**575**

Table-11 demonstrated the pretest and posttest between the control group and experimental group of inspiratory capacity. Mean pretest inspiratory capacity score was 1425 ml and posttest was 2075 ml with a mean difference of 650 ml in the experimental group. In contrast, the mean pretest inspiratory capacity score in the control group was 1225 ml and posttest was 1800 ml with a mean difference of 575 ml. In this part, data analysis was done using Independent samples t test (between group analysis) and there was two different groups (one was glossopharyngeal breathing combined with conventional physiotherapy

as experimental group and other was only conventional physiotherapy as control group). Conversely, the effectiveness of experimental group treatment as well as control group treatment was analyzed by Paired sample t test (within group analysis).

4.10.2. Inspiratory capacity (ml) between groups (experimental and Control):

Table-12: Statistical outcome of inspiratory capacity between experimental and control group

	Unpaired t test	**df**	**P value**	**95% confidence interval**	
				Lower	**Upper**
Difference between trial and control group in inspiratory capacity (ml)	1.549	18	0.278	-35.61393	235.61393

Table-12 described that the calculated t value is 1.549 and for df= 18 has an associated significance level of 27.8%. This means that the probability of random error being responsible for the outcome of this experiment was 27.8 in 100. As the usual cut- off point for claiming support for the experimental hypothesis was 27.8% and it could be said that the result was not significant. Thus, glossopharyngeal breathing along with conventional physiotherapy was effective than only conventional physiotherapy among patients with tetraplegic spinal cord injury.

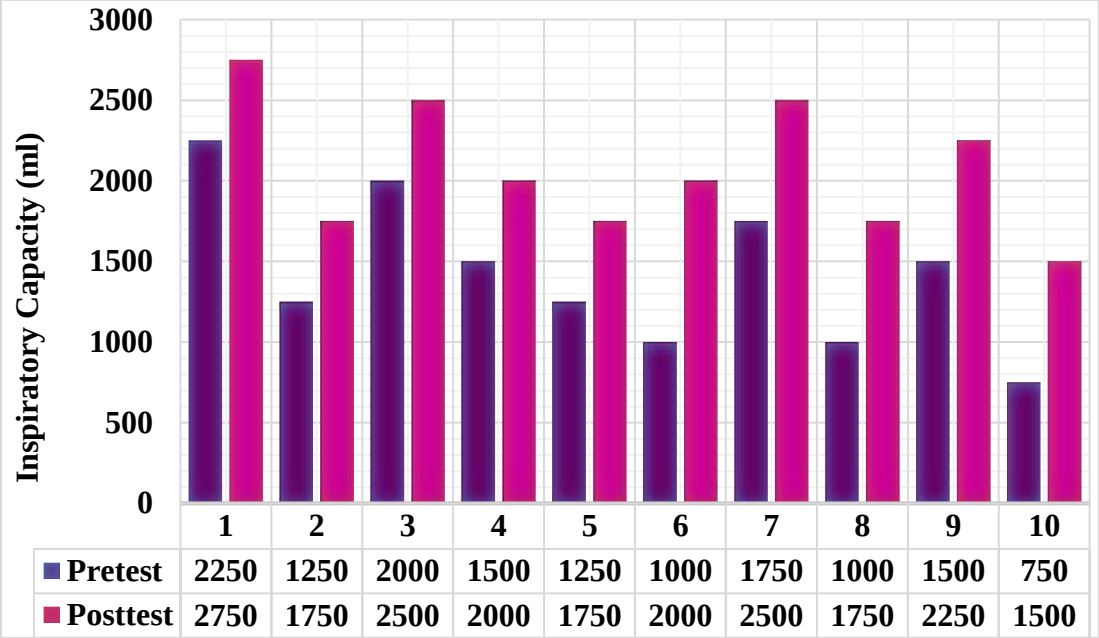
4.10.3. Inspiratory capacity (ml) within experimental and control group:

Table-13: Statistical outcome of inspiratory capacity within experimental and control group

	Mean	**Std. Deviation**	**95% confidence interval**		**Paired t test**	**df**	**P value**
			Lower	**Upper**			
Experimental group	650.000	174.801	524.955	775.045	11.759	9	0.002
Control group	575.000	120.761	488.612	661.388	15.057	9	0.002

Table 13 showed that in case of within group analysis of inspiratory capacity, the improvement was highly significant in experimental group (p value=0.002) where the glossopharyngeal breathing along with conventional physiotherapy was used and in fact in control group (p value=0.002), the conventional physiotherapy was only used and it showed higher significance also.

4.11.1. Pretest and posttest inspiratory capacity (ml) in experimental group:



	1	2	3	4	5	6	7	8	9	10
Pretest	2250	1250	2000	1500	1250	1000	1750	1000	1500	750
Posttest	2750	1750	2500	2000	1750	2000	2500	1750	2250	1500

Figure-22: Pretest and posttest score comparison of inspiratory capacity in experimental group

4.11.2. Pretest and posttest inspiratory capacity (ml) in control group:

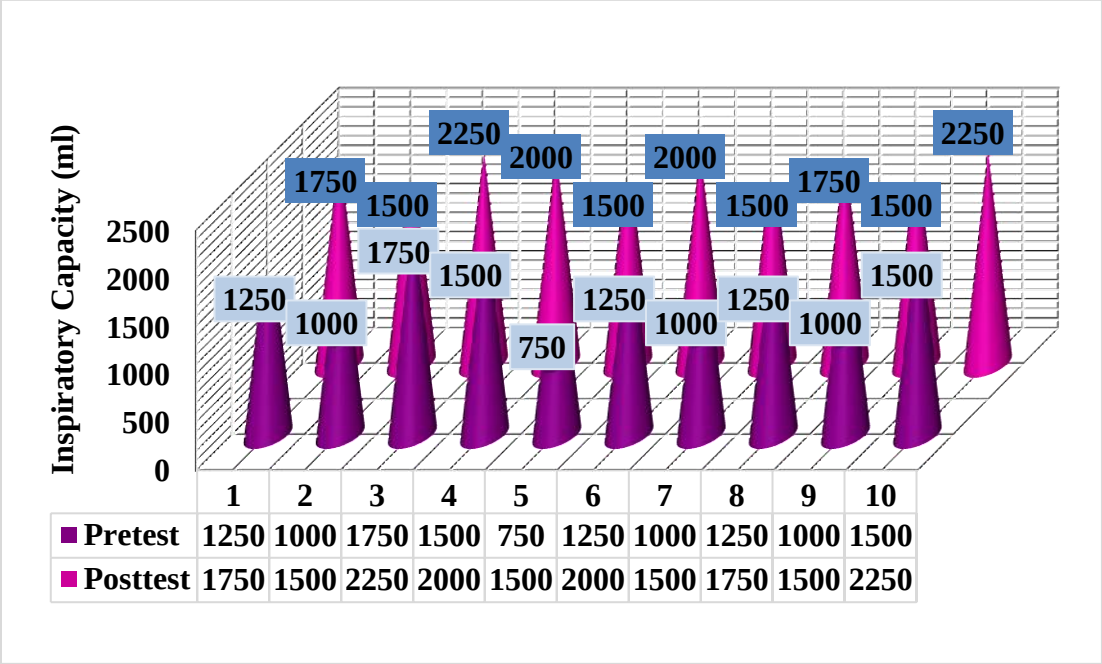


Figure-23: Pretest and posttest score comparison of inspiratory capacity in control group

CHAPTER –V: DISCUSSION

The purpose of this study was to evaluate the effectiveness of Glossopharyngeal Breathing along with Conventional Physiotherapy in patients with Tetraplegic Spinal Cord Injury patients. In this experimental study 20 tetraplegic patients with SCI were randomly assigned with computer generated random numbers. Among these 20 patients, they were divided into two groups. One was experimental group and other was control group. These group attended in the SCI indoor department of physiotherapy, CRP, Savar in order to demonstrate the improvement. The outcome was measured by using structured questionnaire. The researcher found significant improvement of chest expansibility, peak expiratory flow, forced expiratory volume in one second and inspiratory capacity.

The current study had found similarities on baseline characteristics in age, length of injury (in days), total motor score, and total sensory score between both groups of the participants in pretest. Similarities on baseline characteristics indicated successful randomization in study (de Boer et al., 2015). Gender, marital status, educational status and occupational status were taking to consideration as demographic variables. In this study, all the participants were male. From a recent study of 2017 on spinal cord injury, it had found that there were also male members predominantly and this was the similarity between two studies. On the other hand, within 20 study population, the majority of the participants were married in this study and on a recent study of 2017, there were also the same report had found. The difference between the current study and the previously published study was that the current study was an experimental study whereas the previously published study was a cross sectional study (Rahman et al., 2017).

Tzanos et al. (2016) stated on their study that their study was on designed with spinal cord injury patients of Greece and there they found that the majority of the population has an average educational status and it was almost 78.7% whereas the present study showed that among the overall population, maximum individual had continued their studies till primary level which shows partial similarities on both studies. In case of occupational status of the

participants, the research done by Tzanos et al. (2016) demonstrated that in Greece, the Spinal cord affected population were found poorly engaged with occupation and the same picture had emerged from the present study in case of occupation. Averagely, 20%-30% of the spinal cord affected population had found engaged with occupation on both studies. The dissimilation between both studies had come out that the current study had progressed for outcome with only 20 study population whereas Tzanos et al., 2016 had included overall spinal cord injury population of the Greece for finding the appropriate outcome.

After completion of discussion on socio-demographic aspects, focus should be given on spinal cord injury related information. It may include- the causes of injury, the types of injury according to ASIA impairment scale, the length of injury from the date of occurrence, the neurological level, skeletal level, total motor score and total sensory score of the spinal cord injury participants. The causes of injury in this study mainly leading to trauma and in the previous studies, there had established that the traumatic are more significant than the non-traumatic causes. The only difference of this study with the previous studies was on the previous studies the traumatic and non-traumatic causes were pointed specifically and on the other hand, the causes were not particularly discussed in this research (Draulans et al., 2011).

In this research, within 20 study population, the types of injury according to ASIA impairment scale had shown significance on ASIA-A and ASIA-B and that was near about 80% in total and on ASIA-C, the percentage was 5% and ASIA-D, the percentage was 15%. On the other hand, in the preceding research, the degree of impairment according to ASIA had shown priority on ASIA-D(27%) rather than ASIA-A(26%),ASIA-B(26 %), ASIA-C (19%). Consequently, it could be said that similarities within the two studies were both of them used ASIA impairment scaling for measurement. Moreover, there were some dissimilarities that had found actually between the two studies. In the ancient study, the mean time between the injury date and the admission to the hospital was 52.4 days whereas in the current study it had demonstrated that the mean time between the length of injury from the date of accident was 107.7 days in experimental group and was 95.2. So, these mean time between two studies had shown differences significantly due to having differences on sample size and study designs (Nulle et al., 2017).

Razzak et al. (2017), on their study of spinal cord injury which had covered the overall population of the Asian Countries described that the neurological level of spinal cord injury participants resulted in paraplegia 70.49% and tetraplegia 29.51%. But in this study, only the participants of a particular region was included and here the tetraplegic spinal cord injury participants were included only. So, the neurological level of injury had checked specifically in this study as the study population was limited and it had been found here that neurological level of injury was predominant in C4 level. These are the specific differences between two studies. The similarities of these studies are- both of them had emphasized on the neurological level of spinal cord injury participants to get a clear conception of the condition of Spinal cord injury affected participants.

In case of skeletal level of spinal cord injury participants, the recent study had demonstrated that the most common site for injury was in the cervical spine which had similarities with an ancient study. In spite of having similarities, there were some differences too. In this research, it had been showed that C5 level was predominant in case of skeletal level of spinal cord injury whereas in the previous research they had not included any specific area of cervical spine, but they included that the thoracic and lumber spine may also get included in their study (Rathore et al. 2008).

On the research of Koskinen (2015), it had found that they had checked total motor and sensory score and in this research, we had also checked the total motor score and sensory score and this was the main similarities of these two studies. The dissimilarities were, in their research they had checked motor and sensory score for both upper and lower extremity and for functional outcome but here in this research, we had checked only the motor score of upper extremity and it had been checked to know the patient's physical condition.

In this research, it had showed the chest expansibility in pre-test and post-test and in a previous research, they had also measured chest expansibility through pre-test and post-test. In this research, in experimental group, the mean difference of pre-test (mean=80cm) and post-test (mean=84.9cm) was 4.9cm and in trial group, the mean difference of pre-test and post-test was 2.5cm and both group had significance also and in the previous research they had found the pre-test value (mean= 1.7cm) and the post-test value (mean=3.95cm) and the basic difference was 2.25 cm and it was also significant with time. But here the

basic difference is they had checked the effectiveness of ventilator facilitation for increasing chest expansion in cerebral palsy and we had checked the effectiveness in spinal cord injury patients (Jan et al., 2017).

In the research of Mayfield et al. (1971), they had demonstrated the forced expiratory volume in one second and the inspiratory capacity and in the present research also included forced expiratory volume in one second and inspiratory capacity. These were the similarities between both researches, but the dissimilarities between both researches were many. In the previous research they had designed their research into three groups and there had specificity of this group but in this research we had tried to find the effectiveness of the treatment techniques in two groups and had found significance in forced expiratory volume in one second but not in inspiratory capacity. On their research they had measured forced expiratory volume in one second and inspiratory capacity with spirometry but in the present research, we had measured the forced expiratory volume in one second and inspiratory capacity with peak flow meter.

Limitation of the study:

Though Glossopharyngeal Breathing along with Conventional Physiotherapy has effectiveness on dependent variables in this study but there were some limitations also. The main limitation was the shorter sample size. As the samples were collected only from CRP- Savar, it could not represent the wider spinal cord injury patients. In addition to this, it should be included here that the study was conducted with 20 tetraplegic patients with Spinal Cord Injury, which was a very small number of samples and was not sufficient enough for the study in comparison with the world wide prevalence. For this reason, the study has lacking in generalizability of results to the wider population of this condition. In this study, interventions were given by clinical physiotherapists. So, the inter-rater reliability was not maintained due to lack of time and patient's availability. The study did not offer any follow up for participants which was essential component to find out effectiveness of treatment for longer period of time. In spite of these all, the participants were selected conveniently and then randomly assigned to single group and the effectiveness was found only in case of those participants who had been chosen from CRP for this purpose, it could not be able to represent the effectiveness of this treatment technique on the overall population whom were related with tetraplegic spinal cord injury in the world. So, this was also a limitation of this research. In this research there were also limitations of advanced measurement tools, which was a major limitation of this research.

CHAPTER –VI: CONCLUSION AND RECOMMENDATION

6.1 Conclusion:

Tetraplegic Spinal Cord injury is known as illness or injury causes paralysis that results in the partial or total loss of use of all four limbs. The current study was randomized control trial containing experimental and control group. Pre-test and post-test design were used in this study to examine the effectiveness of glossopharyngeal breathing along with conventional physiotherapy for patients with tetraplegic spinal cord injury, where the results of the study have demonstrated that the glossopharyngeal breathing along with conventional physiotherapy is significantly capable of producing beneficial effects on the improvement of the chest expansibility, peak expiratory flow, forced expiratory volume in one second in tetraplegic patient with Spinal Cord Injury. In this current study, appropriate measurement tools were selected to identify the improvement of the chest expansibility, peak expiratory flow, forced expiratory volume in one second.

From this study, researcher concluded the specific variables and comparison of their improvement. This will aid the professionals to decide the specific and effective treatment protocol for tetraplegic SCI patients and the outcome of this study would encourage the physiotherapists to suggest glossopharyngeal breathing for tetraplegic spinal cord injury patients in their clinical practice.

6.2 Recommendation:

As physiotherapist play a vital role and holistic treatment techniques for the persons with tetraplegic spinal cord injury, it is necessary to update their knowledge in this area. Physiotherapists need to provide more concentration on respiratory complications that arises after spinal cord injury during the treatment period and for these reason, it is necessary to involve the patients in respiratory physiotherapy treatment sessions. A recommendation for the further studies could be suggested that Future study should include large sample size and following the process of randomization when selecting sample from population. Both male and female patient should be included also and treatment session and time duration should be increased in the future study.

REFERENCES

- Ahn, H., Bailey, C.S., Rivers, C.S., Noonan, V.K., Tsai, E.C., Fourney, D.R., Attabib, N., Kwon, B.K., Christie, S.D., Fehlings, M.G. and Finkelstein, J., (2015). Effect of older age on treatment decisions and outcomes among patients with traumatic spinal cord injury. Canadian Medical Association Journal, doi: 10.1503/cmaj.150085.
- Allen, O., DeWilde, M. and Golob, J.E., (2016). Cognition in Clients with Acute Tetraplegia: Why Assessment Matters. Available at: http://soundideas.pugetsound.edu/ot_capstone/10 [assessed on 20 november 2018].
- Association of Chartered Physiotherapists in Respiratory Care (2011) 'Association of Chartered Physiotherapists in Respiratory Care', Acprc, p. Leaflet No. GL-05. Available at: http://www.acprc.org.uk/Data/Publication_Downloads/GL-05ACBT.pdf. [assessed on 20 november 2018].
- Back, S.A., (2006). Perinatal white matter injury: the changing spectrum of pathology and emerging insights into pathogenetic mechanisms. Mental retardation and developmental disabilities research reviews, 12(2):129-140.
- Baydur, A., Adkins, R.H. and Milic-Emili, J., (2001). Lung mechanics in individuals with spinal cord injury: effects of injury level and posture. Journal of Applied Physiology, 90(2):405-411.
- Bellet, P.S., Kalinyak, K.A., Shukla, R., Gelfand, M.J. and Rucknagel, D.L., (1995). Incentive spirometry to prevent acute pulmonary complications in sickle cell diseases. New England Journal of Medicine, 333(11):699-703.
- Berlowitz, D.J., Wadsworth, B. and Ross, J., (2016). Respiratory problems and management in people with spinal cord injury. Breathe, 12(4):328.
- Burke, B.E., (1957). Glossopharyngeal Breathing and its use in the treatment of Respiratory Poliomyelitis patients, with some notes on chest respiratory. Australian Journal of Physiotherapy, 3(1):5-12.
- Christopher, C.P., (2007). Respiratory Complications of Spinal Cord Injury. Journal of Spinal Cord, 30(4):307-308.

- Coppla and Marlin, (2013). Causes of Spinal Cord Injuries, [Online]. USA: Coppla & Marlin, P.C. retrieved on 26th May2016. Available: http://www.coppolamarlin.com/Spinal-Cord- Injuries/Causes-of-Spinal-Cord-Injuries.shtml> [accessed on 20 November 2018].
- Curtin, C.M., Gater, D.R. and Chung, K.C., 2005. Upper extremity reconstruction in the tetraplegic population, a national epidemiologic study. The Journal of hand surgery, 30(1):94-99.
- Dawodu, S.T., (2001). Spinal cord injury: definition, epidemiology, pathophysiology. Emed J, 2(8).
- de Boer, M.R., Waterlander, W.E., Kuijper, L.D., Steenhuis, I.H. and Twisk, J.W., (2015). Testing for baseline differences in randomized controlled trials: an unhealthy research behavior that is hard to eradicate. International Journal of Behavioral Nutrition and Physical Activity, 12(1):4.
- DiMarco, A.F. and Dawson, N.V., (2014). Risk factors for mortality in spinal cord injury. The journal of spinal cord medicine, 37(6):670.
- Draulans, N., Kiekens, C., Roels, E. and Peers, K., (2011). Etiology of spinal cord injuries in Sub-Saharan Africa. Spinal Cord, 49(12):1148.
- Galeiras Vázquez, R., Rascado Sedes, P., Mourelo Fariña, M., Montoto Marqués, A. and Ferreiro Velasco, M.E., (2013). l. BioMed Research International,2013:12.
- Haque, K. I. (2012). CHARACTERIZATION OF SPINAL CORD LESION IN CHARACTERIZATION OF SPINAL CORD LESION IN, 2005–2006.
- Hetzel, M.R. and Clark, T.J., (1980). Comparison of normal and asthmatic circadian rhythms in peak expiratory flow rate. Thorax, 35(10):732-738.
- Hicks, C.M., 2009. Research Methods for Clinical Therapists. [e-Book]. Churchill Livingstone: Elsevier Health Sciences.
  Available: British Library website
- Hicks, A.L., Ginis, K.M., Pelletier, C.A., Ditor, D.S., Foulon, B., and Wolfe, D.L., (2011). Literature review, 49(11):1103-1127.
- Hoque, M.F., Hasan, Z., Razzak, A.T.M.A. and Helal, S.U., (2012). Cervical spinal cord injury due to fall while carrying heavy load on head: a problem in Bangladesh. Spinal Cord, 50(4):275-277.

- Islam, M.S., Hafez, M.A. and Akter, M., (2011). Characterization of spinal cord lesion in patients attending a specialized rehabilitation centre in Bangladesh. Spinal Cord, 49(7):783-786.
- Jan, S., Pattnaik, M. and Mohanty, P., (2017). Effect of Ventilatory Facilitation on Chest Expansion And Pulmonary Functions in Children with Spastic Cerebral Palsy, 16(9):59–70.
- Johansson, K.M., Nygren-Bonnier, M., Klefbeck, B. and Schalling, E., (2011). Effects of glossopharyngeal breathing on voice in cervical spinal cord injuries. International Journal of Therapy and Rehabilitation, 18(9):501-510.
- Kirshblum, S.C., Burns, S.P., Biering-Sorensen, F., Donovan, W., Graves, D.E., Jha, A. and Waring, W., (2011). International standards for neurological classification of spinal cord injury (revised 2011). The Journal of Spinal Cord Medicine, 34(6):535-546.
- Koskinen, E., (2015). Traumatic Spinal Cord Injury-Current Epidemiology in Finland and Evaluation of Cervical Injury by Diffusion Tensor Imaging. Available at: http://tampub.uta.fi/bitstream/handle/10024/97030/978-951-44-9775-9.pdf?sequence=1. [assessed on 20 november 2018].
- Kumar, N., (2016). Respiratory care in traumatic spinal cord injury. J Spine S, 7:2.
- Lam, T., Noonan, V., Eng, J. & Team, S. R., (2008). A systematic review of functional ambulation outcome measures in spinal cord injury. Spinal Cord, 46(4): 246–254.
- Malaguti, C., Rondelli, R.R., de Souza, L.M., Domingues, M. and Dal Corso, S., (2009). Reliability of chest wall mobility and its correlation with pulmonary function in patients with chronic obstructive pulmonary disease. Respiratory care, 54(12):1703-1711.
- Mayfield, J.D., Paez, P.N. and Nicholson, D.P., (1971). Static and dynamic lung volumes and ventilation-perfusion abnormality in adult asthma. Thorax, 26(5):591-596.
- Melin, J., Persson, L.O., Taft, C., and Kreuter, M., (2018). Patient participation from the perspective of staff members working in spinal cord injury rehabilitation. Spinal cord, 56(6):614.

- Nygren-Bonnier, M., (2008). Glossopharyngeal breathing. Institutionen för neurobiologi, vårdvetenskap och samhälle/Department of Neurobiology, Care Sciences and Society.
- Nygren-Bonnier, M. et al. (2009). Glossopharyngeal pistoning for lung insufflation in patients with cervical spinal cord injury. Spinal Cord, 47(5):418–422.
- Nulle, A., Tjurina, U., Erts, R. and Vetra, A., (2017). A profile of traumatic spinal cord injury and medical complications in Latvia. Spinal cord series and cases, 3(1):17088.
- Paiva, W.S., Oliveira, A.M., Andrade, A.F., Amorim, R.L., Lourenço, L.J. and Teixeira, M.J., (2011). Spinal cord injury and its association with blunt head trauma. International journal of general medicine, 4:613.
- Post, M.W.M. and Van Leeuwen, C.M.C., (2012). Psychosocial issues in spinal cord injury: a review. Spinal cord, 50(5):382.
- Rahman, A., Ahmed, S., Sultana, R., Taoheed, F., Andalib, A. and Yasir, A., (2017). Epidemiology of spinal cord injury in Bangladesh: A five year observation from a rehabilitation center. J Spine, 6(367):2.
- Rathore, M.F.A., Hanif, S., Farooq, F., Ahmed, N. and Mansoor, S.N., (2008). Traumatic Spinal Cord Injuries at a Tertiary Care Rehabilitation Institute in Pakistan. Journal of Pakistan Medical Association, 58:53–57.
- Razzak, A.T.M.A., Roy, R. and Khan, S., (2016). Demographic Profile of Spinal Cord Injury (SCI): A Hospital-based Prospective study in Bangladesh. Disability, CBR & Inclusive Development, 27(4):138-155.
- Shackelford, M., Farley, T. and Vines, C.L., (1998). A comparison of women and men with spinal cord injury. Spinal Cord, 36(5):337.
- Sinclair, J., Chang, S.D., Gibbs, I.C. and Adler J.R., (2006). Multisession cyberknife radiosurgery for intramedullary spinal cord arteriovenous malformations. Neurosurgery, 58(6):1081-1089.
- Singh, T.M., Hung, R., Lebowitz, E., Wallbom, A., Shaver, D., Soria, J. and Zarins, C.K., (2005). Endovascular repair of traumatic aortic pseudoaneurysm with associated celiacomesenteric trunk. Journal of Endovascular Therapy, 12(1):138-141.

- Snell, R.S., (2010). Clinical neuroanatomy. Lippincott Williams & Wilkins.
- Somers, M.F., (2006). Spinal Cord Injury: Functional Rehabilitation, Connecticut: Appelton and Lang.
- Spooren, A.I., Janssen-Potten, Y.J., Kerckhofs, E. and Seelen, H.A., (2009). Outcome of motor training programmes on arm and hand functioning in patients with cervical spinal cord injury according to different levels of the ICF: a systematic review. Journal of rehabilitation medicine, 41(7):497-505.
- Torres-Castro, R., Vilaró, J., Vera-Uribe, R., Vasconcello, L. and Puppo, H., (2016). Acute effects of air stacking versus glossopharyngeal breathing in patients with neuromuscular disease. British Journal of Medicine and Medical Research, 14(3):1.
- Trgovcevic, S., Milicevic, M., Nedovic, G. and Jovanic, G., (2014). Health condition and quality of life in persons with spinal cord injury. Iranian journal of public health, 43(9):1229.
- Tzanos, I.A., Mitsiokapa, E., Megaloikonomos, P.D., Igoumenou, V.G., Panagopoulos, G.N., Papathanasiou, J., Tzanos, G. and Mavrogenis, A.F., (2016). Social reintegration and quality of life after spinal cord injury: the Greek paradigm. J Biomed, 1:36-43.
- Van Houtte, S., Vanlandewijck, Y., & Gosselink, R., (2006). Respiratory muscle training in persons with spinal cord injury: a systematic review. Respiratory Medicine, 100(11):1886-1895.
- Warren, V.C., (2002). Glossopharyngeal and neck accessory muscle breathing in a young adult with C2 complete tetraplegia resulting in ventilator dependency. Physical therapy, 82(6):590-600.
- Wong, S., Shem, K. and Crew, J., (2012). Specialized respiratory management for acute cervical spinal cord injury: a retrospective analysis. Topics in spinal cord injury rehabilitation, 18(4):283-290.
- World Health Organization., (2013). International perspectives on spinal cord injury. World Health Organization.
- Wright, B.M. and Mckerrow, C., (1959). Maximum forced expiratory flow rate as a measure of ventilatory capacity. British medical journal, 2(5159), p.1041.

- Yang, R., Guo, L., Wang, P., Huang, L., Tang, Y., Wang, W., Chen, K., Ye, J., Lu, C., Wu, Y. and Shen, H., (2014). Epidemiology of spinal cord injuries and risk factors for complete injuries in Guangdong, China: a retrospective study. PloS one, 9(1):84733.
- Zawn Villines., (2015). Tetraplegia vs. Quadriplegia vs. Paraplegia [Online]. Available-at:https://www.spinalcord.com/blog/tetraplegia-quadriplegia paraplegia-what-is-the-difference. [assessed on 20 november 2018].

Appendix-A

IRB Permission Letter

বাংলাদেশ হেল্‌থ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)

Bangladesh Health Professions Institute (BHPI)

(The Academic Institute of CRP)

BANGLADESH HEALTH PROFESSIONS INSTITUTE

Ref. CRP-BHPI/IRB/11/18/1271

Date: 13/4/2018

To
Nishitha Nandy
B.Sc. in Physiotherapy
Session: 2013-2014 Student ID:112130204
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Subject: Approval of the thesis proposal "Effectiveness of Glossopharyngeal Breathing along with Conventional Physiotherapy for patients with Tetraplegic Spinal Cord Injury" by ethics committee.

Dear Nishitha Nandy,
Congratulations,
The Institutional Review Board (IRB) of BHPI has reviewed the above mentioned dissertation, with yourself, as the Principal investigator. The Following documents have been reviewed and approved:

Sr. No.	Name of the Documents
1	Dissertation Proposal
2	Questionnaire (Bengali & English version)
3	Information sheet & consent form.

The purpose of the study is to determine the effectiveness of glossopharyngeal breathing for tetraplegic spinal cord injury patients. The study involves use of a structured questionnaire and measurement tools (tape, peak flow meter & Spirometry) to explore the chest expansibility, peak expiratory flow, forced expiratory volume in one second and inspiratory capacity that may take 20 to 25 minutes and there is no likelihood of any harm to the participants. The members of the Ethics committee approved the study to be conducted in the presented form at the meeting held at 09.30 AM on 5th February, 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,

Millat Hossain

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-B

Permission Letter

July 01, 2018
Head
Department of Physiotherapy,
Center for the Rehabilitation of the Paralysed (CRP)
CRP, Chapain, Savar,Dhaka-1343
Through: Supervisor and Head of Physiotherapy, BHPI.

Subject: Prayer for permission for data collection to conduct my research.

Dear Sir,

With due respect and humble submission I beg to state that I am Nishitha Nandy, student of 4th Professional B.Sc In Physiotherapy at Bangladesh Health Professions Institute (BHPI). As per course curriculum, I need to conduct a research project for completion of B.Sc In Physiotherapy. My research project is entitled as "**Effectiveness of Glossopharyngeal Breathing along with Conventional Physiotherapy for patients with Tetraplegic Spinal Cord Injury**" under honorable supervisor Mohammad Habibur Rahman, Associate Professor, Department of Physiotherapy, BHPI, Savar. Ethical approval is received from the Institutional Review Board (IRB) of Bangladesh Health Professions Institute (BHPI). As my research topics area covers Spinal Cord Injury Patients and I would like to collect data from Spinal Cord Injury Unit of CRP, Savar. For this reason, I need your permission for data collection. I would like to assure that anything of my study will not be harmful for any study participants.

I therefore, pray and hope that you would be kind enough to give me the permission for data collection and oblige thereby.

Forwarded
Habib 01/07/2018

Sincerely yours,
Nishitha Nandy
Nishitha Nandy
4th Professional B.Sc. in physiotherapy
Roll- 09,
Session: 2013-2014
Bangladesh Health Professions Institute (BHPI)
(an academic institute of CRP)
CRP-Chapain, Savar, Dhaka-1343

02/07/18
Prof. Md. Obaidul Haque
Head, Department of Physiotherapy
Bangladesh Health Professions Institute (BHPI)
CRP, Savar, Dhaka-1343

Approved
12/07/18
Mohammad Anwar Hossain
Associate Professor & Head
Physiotherapy Dept., CRP
CRP-Chapain, Savar, Dhaka-1343

Allow to her Data Collection at SCI Unit.
Hossain

Appendix-C

সম্মতিপত্র

আসসালামু-আলাইকুম/নমস্কার,

আমি নিশীথা নন্দী, বাংলাদেশ হেলথ্ প্রফেশনস্ ইন্‌স্টিটিউট (বি.এইচ.পি. আই) এর বি.এস.সি ইন ফিজিওথেরাপী কোর্সের চতুর্থ বর্ষের একজন ছাত্রী। বি.এস.সি ডিগ্রী প্রাপ্তির জন্য আমার একটি গবেষনামূলক প্রকল্প করা প্রয়োজন এবং আমার প্রকল্পটি হচ্ছে- "মেরুদন্ডের আঘাত প্রাপ্ত টেট্রাপ্লেজিক রোগীদের ক্ষেত্রে প্রচলিত ফিজিওথেরাপীর পাশাপাশি গ্লুসোফারিনজাল শ্বাসের কার্যকারিতা।" এজন্য আমি আপনার কাছে কিছু তথ্য জানতে চাইব, যার জন্য শুধু মাত্র ২০-২৫ মিনিট সময় লাগবে। আমি আপনাকে আশ্বস্ত করছি যে, আপনার দ্বারা প্রদত্ত যাবতীয় সমস্ত তথ্য গোপন রাখা হবে।

উল্লেখ্য যে, এই গবেষনায় আপনার অংশগ্রহন হবে ঐচ্ছিক। তাই যে কোন সময় এই গবেষনা থেকে আপনি নিজেকে প্রত্যাহার করে নিতে পারবেন। এই গবেষনায় অংশগ্রহনে অনিচ্ছুক হওয়া বা গবেষনা থেকে প্রত্যাহার করার কারনে আপনার চিকিৎসায় কোন প্রভাব পড়বে না। আপনি যদি গবেষনা চলাকালীন সময়ে কোন সমস্যার সম্মুখীন হন, তাহলে আপনি যোগাযোগ করতে পারেন আমার সাথে অথবা আমার সুপারভাইজার মোহাম্মদ হাবিবুর রহমান, সহযোগী অধ্যাপক, ফিজিওথেরাপী বিভাগ, বি.এইচ.পি.আই, সি.আর.পি, সাভার, ঢাকা-১৩৪৩ এর সাথে ।

আমি শুরু করার আগে আপনি কি আরও কিছু তথ্য জানতে চান?

আমি কি আপনার অনুমতি নিয়ে শুরু করতে পারি?

□ হ্যাঁ □ না

রোগীর স্বাক্ষর/আঙ্গুলের ছাপ ঃ .....

তারিখ ঃ.....

তথ্য সংগ্রাহকের স্বাক্ষর ঃ .....

তারিখ ঃ.....

সাক্ষীর স্বাক্ষর ঃ .....

তারিখ ঃ.....

Appendix-D

Consent Form (English)

Assalamu-alaikum/Namaskar,

I am Nishitha Nandy, 4th year student of B.Sc. in Physiotherapy at Bangladesh Health Professions Institute (BHPI). I am conducting a research and my research title is **"Effectiveness of Glossopharyngeal Breathing along with Conventional Physiotherapy on respiratory parameters in Patients with Tetraplegic Spinal Cord Injury."** I am asking you to answer some questions, which will take 20-25 minutes. It is also ensured that the information provided by you will be kept confidential.

Hereby, your participation in the study would be voluntary basis. So, you can withdraw your participation at any time within the course of the study. Withdrawing from participation of the study would not disadvantage you to receive existing service. If you face any problem within the course of the study, you can contact with me or my supervisor **Mohammad Habibur Rahman,** Associate Professor, Department of Physiotherapy, BHPI, CRP, Savar, Dhaka-1343.

Do you have any question before I start?

Can I start the interview with your permission?

□Yes □No

Signature/Fingerprint of the Patient:

Signature of the Data collector:

Signature of the Witness:

Appendix-E

বাংলাপ্রশ্নাবলী

"মেরুদন্ডে আঘাতপ্রাপ্ত টেট্রাপ্লেজিক রোগীদের ক্ষেত্রে প্রচলিত ফিজিওথেরাপীর পাশাপাশি গ্লসোফারিনজাল শ্বাসের কার্যকারিতা"

ব্যক্তিগত তথ্য ঃ

রোগীর আইডি নং	
ঠিকানা	
মোবাইল নম্বর	
সাক্ষাৎকারীর নাম	
তারিখ	....
সময়	....

অনুগ্রহ করে নিম্নোক্ত প্রশ্নগুলো থেকে সঠিক উত্তর প্রদান করুন। নিম্নলিখিত প্রশ্নের প্রতিটির একাধিক বিকল্প আছে এবং আপনাকে একটা সঠিক উত্তরে টিকচিহ্ন(√) দিতে হবে যেটা আপনার কাছে সবচেয়ে উপযুক্ত মনে হবে। একটি নির্দিষ্ট প্রশ্নের একটির বেশী উত্তর আপনার কাছে মনে হতে পারে, কিন্তু আপনাকে শুধুমাত্র উপযুক্ত উত্তরে টিকচিহ্ন(√) দিতে হবে।

অংশ-১ঃ আর্থ-সামাজিকজীবনযাপনসংক্রান্তপ্রশ্নাবলী

ক্রমিকসংখ্যা	প্রশ্নাবলী	প্রতিক্রিয়া
১.	বয়স	.....বছর
২.	লিঙ্গ	□পুরুষ □মহিলা
৩.	বৈবাহিকঅবস্থা	□বিবাহিত □অবিবাহিত □তালাকপ্রাপ্ত □বিধবা
৪.	ধর্ম	□ইসলামধর্ম □হিন্দু ধর্ম □খ্রিস্টানধর্ম □বৌদ্ধ ধর্ম অন্যান্যঃ

ক্রমিকসংখ্যা	প্রশ্নাবলী	প্রতিক্রিয়া
৫.	শিক্ষাগত যোগ্যতা	□অশিক্ষিত □শিক্ষিত □প্রাথমিক বিদ্যালয় □মাধ্যমিক স্কুল সার্টিফিকেট □ উচ্চ মাধ্যমিক সার্টিফিকেট □ স্নাতক ডিগ্রী □মাস্টার্স ডিগ্রী বা তদুর্দ্ধ
৬.	আবাসিকএলাকা	□গ্রামীন □শহুর
৭.	পেশাগত যোগ্যতা	□ছাত্র □ কৃষক □দিনমজুর □চাকুরিজীবী □গৃহিনী □অন্যান্য

অংশ-২ঃ আঘাতসংক্রান্ত তথ্যাবলীঃ

ক্রমিকসংখ্যা	প্রশ্নাবলী	প্রতিক্রিয়া
৮.	রোগেরকারণ	□আঘাত প্রাপ্তির মাধ্যমে □আঘাত ছাড়া অন্য কোন কারনে
৯.	অসুস্থতারসময়কাল	.....দিন
১০.	এশিয়া স্কেল অনুযায়ীআঘাতেরধরন	□কমপ্লিট-এ □ইনকমপ্লিট-বি □ইনকমপ্লিট-সি □ইনকমপ্লিট-ডি
১১.	নিউরোলোজীকাল লেভেল	.....
১২.	স্কেলেটাল লেভেল	.....
১৩.	মোটমটর স্কোর	.....
১৪.	মোট সেনসরি স্কোর	.....

অংশ-৩ঃ শ্বাস-প্রশ্বাসের সমস্যার তথ্যাবলী

ক্রমিকসংখ্যা	প্রশ্নাবলী	প্রতিক্রিয়া
১৫.	আপনার কি পূর্বে থেকে বিদ্যমান কোন শ্বাস-প্রশ্বাসের সমস্যা আছে? (অনুগ্রহ করে ১৬-১৭ নম্বর প্রশ্নগুলো বাদ দিবেন, যদি এই প্রশ্নের উত্তর না হয়)	□হ্যাঁ □না
১৬.	শ্বাস-প্রশ্বাসের সমস্যার ধরন	□নিঃশ্বাসের দুর্বলতা/হাঁপানি □কাঁশির সাথে রক্ত যাওয়া □কাঁশির সাথে কফ □ শুষ্ক কাঁশি □ বেদনাদায়ক ও উৎপাদনশীলকাঁশি □বুক ব্যাথা □বুকে টান অনুভব করা □হাঁচি □শ্বাস নেওয়ার সময় বাঁশির মত অনুভব করা
১৭.	আপনি কি পূর্বে থাকা শ্বাস-প্রশ্বাসের সমস্যার জন্য কোন ঔষধ গ্রহন করেছেন?	□হ্যাঁ (যদি থাকে তাহলে তাদের নাম) . . . . . . □না
১৮.	মেরুদন্ডে আঘাত পাওয়ার পর আপনার কি শ্বাসজনিত কোন সমস্যা হচ্ছে? (যদি না হয় তাহলে ১৯নং প্রশ্ন বাদ দিবেন)	○হ্যাঁ, (যদি থাকে শ্বাস-প্রশ্বাসের সমস্যার ধরন) □নিঃশ্বাসের দুর্বলতা/হাঁপানি □কাঁশির সাথে রক্ত যাওয়া □কাঁশির সাথে কফ □ শুষ্ক কাঁশি □ বেদনাদায়ক ও উৎপাদনশীলকাঁশি □বুক ব্যথা □বুকে টান অনুভব করা □হাঁচি □শ্বাস নেওয়ার সময় বাঁশির মত শব্দ ○না
১৯.	মেরুদন্ডে আঘাতপ্রাপ্ত হওয়ার পরের শ্বাসজনিত সমস্যার জন্য আপনি কি কোন চিকিৎসা নিচ্ছেন?	□ঔষধসেবন □ফিজিওথেরাপী □ঔষধসেবন ও ফিজিওথেরাপী
২০.	আপনি কি একটি কার্যকর কাঁশি তৈরী করতে পারেন?	□হ্যাঁ □না

অংশ-৪ঃ পরিমাপ

(ক) পরীক্ষা পূর্ববর্তী পরিমাপঃ

ক্রমিক সংখ্যা	প্রশ্নাবলী	প্রতিক্রিয়া
২১.	বুকের সম্প্রসারন ক্ষমতা(ফিজিওথেরাপিস্ট পরিমাপের ফিতা ব্যবহার করে এটি পরিমাপ করবেন)	..... সে.মি
২২.	পিক্ এক্সপিরেটরী ফ্লো (ফিজিওথেরাপিস্ট এটি পিক্ ফ্লো মিটার নামক যন্ত্র দিয়ে পরিমাপ করবেন)	..... লি/মিনিট
২৩.	ফোর্সড্ এক্সপিরেটরী ভলিউম্ ইন ওয়ান সেকেন্ড (ফিজিওথেরাপিস্ট এটি পিক্ ফ্লো মিটার নামক যন্ত্র দিয়ে পরিমাপ করবেন)	..... লি/মিনিট
২৪.	শ্বাস গ্রহণের ক্ষমতা	..... সি.সি

(খ) পরীক্ষা পরবর্তী পরিমাপ

ক্রমিক সংখ্যা	প্রশ্নাবলী	প্রতিক্রিয়া
২১.	বুকের সম্প্রসারন ক্ষমতা (ফিজিওথেরাপিস্ট পরিমাপের ফিতা ব্যবহার করে এটি পরিমাপ করবেন)	.....সে.মি
২২.	পিক এক্সপিরেটরী ফ্লো (ফিজিওথেরাপিস্ট এটি পিক্ ফ্লো মিটার নামক যন্ত্র দিয়ে পরিমাপ করবেন)	..... লি/মিনিট
২৩.	ফোর্সড্ এক্সপিরেটরী ভলিউম্ ইন ওয়ান সেকেন্ড (ফিজিওথেরাপিস্ট এটি পিক্ ফ্লো মিটার নামক যন্ত্র দিয়ে পরিমাপ করবেন)	..... লি/মিনিট
২৪.	শ্বাস গ্রহণের ক্ষমতা	..... সি.সি

Appendix-F

English Questionnaire

Effectiveness of Glossopharyngeal Breathing along with conventional physiotherapy in patients with tetraplegic spinal cord injury

PERSONAL INFORMATION:

Patients ID:	
Address :	
Phone No. :	
Name of Interviewer :	
Date	……/……../…….
Time	…….am/pm

Please provide the right answer from the following questions. Each of the following question has multiple options and you have to give tick (√) mark into one correct answer that is mostly suited to you. It is realized that you may feel more than one correct answer in a particular question but please provide tick (√) mark in the best suited answer.

SECTION-1:Socio-demographic Information

Serial Number	Questions and filters	Responses
1.	Age (in year):	**……**years
2.	Sex:	☐ Female ☐ Male
3.	Marital status:	☐ Married ☐ Unmarried ☐ Divorced ☐ Widow
4.	Religion	☐ Islam ☐ Hinduism ☐ Christianity ☐ Buddhist Other (Specify):_____

Serial number	Questions and Filters	Responses
5.	Educational status	☐ Illiterate ☐ Literate ☐ Primary ☐ Secondary school certificate (SSC) ☐ Higher secondary certificate (HSC) ☐ Bachelor ☐ Masters or above
6.	Residential area	☐ Rural ☐ Urban
7.	Occupational status	☐ Student ☐ Farmer ☐ Day labourer ☐ Job ☐ Housewife

SECTION-2: Injury related information:

Serial number	Questions and Filters	Responses
8.	Causes of injury	☐ Traumatic ☐ Non-traumatic
9.	Length of injury from the date of accident	……days
10.	Types of injury according to ASIA scale	☐ Complete A ☐ Incomplete B ☐ Incomplete C ☐ Incomplete D
11.	Neurological level	……
12.	Skeletal level	……...
13.	Total motor score	……...
14.	Total Sensory score	……...

SECTION-3: Respiratory problem related information:

Serial number	Questions and Filters	Responses
15.	Do you have any pre-existing respiratory problem? (Please skip question number 16 and 17 if the answer is no)	☐ Yes ☐ No
16.	Types of respiratory problem	☐Shortness of breath ☐Coughing out of blood (Hemoptysis) ☐Cough with sputum ☐Dry cough ☐Productive and painful cough ☐Chest pain ☐Chest tightness ☐Sneezing ☐Wheezing ☐Cyanosis
17.	Do you take any drugs for the pre-existing respiratory problem?	○Yes**(** If any, please give some names**)** **…….** ○No

Serial number	Questions and Filters	Responses
18.	Do you have any respiratory problem after having spinal cord injury? (Please skip question 19 if the answer is no)	○Yes □Shortness of breath □Coughing out of blood (Hemoptysis) □Cough with sputum □Dry cough □Productive and painful cough □Chest pain □Chest tightness □Sneezing □Wheezing ○ No
19.	Are you taking any treatment for respiratory problems after spinal cord injury?	☐ Medication ☐ Physiotherapy ☐ Medication and Physiotherapy
20.	Can you produce an effective cough?	☐ Yes ☐ No

SECTION-4: Measurements:

(a)Pre-test measurements:

Serial number	Questions and Filters	Responses
21.	**Chest Expansion** (measured with the help of measuring tap, performed by Physiotherapist)	**……cm**
22.	**PEF(Peak Expiratory Flow)** (measured with the help of peak flow meter, performed by Physiotherapist)	**……l/min**
23.	**FEV1 (Force Expiratory Volume in 1st second)** (measured with the help of peak flow meter, performed by Physiotherapist)	**…….l/min**
24.	Inspiratory capacity	**……cc**

(b)Post-test Measurements:

Serial number	Questions and Filters	Responses
21.	**Chest Expansion** (measured with the help of measuring tap, performed by Physiotherapist)	**……cm**
22.	**PEF(Peak Expiratory Flow)** (measured with the help of peak flow meter, performed by Physiotherapist)	**……l/min**
23.	**FEV1 (Force Expiratory Volume in 1st second)** (measured with the help of peak flow meter, performed by Physiotherapist)	**…….l/min**
24.	Inspiratory capacity	**……cc**

Appendix-G

Treatment Protocol of Control Group

Centre for the Rehabilitation of the Paralysed (CRP)
Department of Physiotherapy
CRP, P.O: CRP-Chapain, Savar, Dhaka-1343, Bangladesh
Tel: 880-2-7745464-5, Fax: 880-2-7745069, E-mail: contact@crp-bangladesh.org, Website: www.crp-bangladesh.org

Ref :

Date :

Physiotherapy Treatment protocol for tetraplegia spinal cord injury patients Admitted at CRP

1. Positioning
2. Oxygen Therapy
3. Deep Breathing Exercise (DBT)
4. End Respiratory Hold
5. Coughing
6. Sneezing
7. Breathing relaxation
8. Secretion removal techniques

   -Huffing , Active Cycle of Breathing Technique
9. Postural Drainage
10. Percussion and Vibration
11. Assisted Coughing Techniques (Manual and Mechanical)
12. Respiratory Muscle Training (RMT)
13. Passive Limb Movement

Dosage and intensity of intervention may vary according to patient condition.

28/3/18

Mohammad Anwar Hossain
Associate Professor & Head
Physiotherapy Dept., CRP
CRP Chapain, Savar, Dhaka-1343

MHossain 22.3.18

Muzaffor Hossain
Senior PT & Incharge SCI Unit
Physiotherapy Department
CRP, Savar, Dhaka-1343

Branch Offices: CRP-Mirpur, Plot: A/5, Block-A, Section-14, Mirpur, Dhaka-1216, Tel: +880(0)2-8020170, 8053662, 8053663, 8053664, CRP-Gonokhasi P.O: Bolivadia Bazar, P.S. Ashulia, Savar, Dhaka, Tel: 880-2-7701251, CRP-Gobindapur: P.O. Kazoldhusa, P.S. Kidaura, Dist. Moulvibazar, Mobile: 01711 446104

Appendix-H

Treatment protocol of trial group

Nygren-Bonnier et al. (2009) mentioned that described the procedure of glossopharyngeal breathing. The participants will perform 10 cycles of Glossopharyngeal breathing technique per training session, with each cycle consisting of a 14 gulps. This technique should be performed 4 times a week, for 8 weeks.

According to Association of Chartered Physiotherapists in Respiratory Care (2011), "To learn how to do an effective gulp it is best to think of it in 3 stages.

Stage 1: Make extra space in your throat, by lowering your jaw and keeping your tongue flat. At the same time you should be able to feel your throat cartilages moving down. It may be helpful to look in a mirror to make sure that your tongue is flat. It is very important to get this movement right before going on to stage 2.

Stage 2: Once your throat is open (as described in stage 1) close your lips gently, so that you trap the air in your large throat cavity. Don't let your tongue or throat cartilages move up.

Stage 3: Keep your lips shut and let the cartilages and tongue go 'up', back to their normal position. At first you will need to do these movements slowly, as you learn how to do them. At first the physiotherapist will need to do these movements slowly, as the patient learn how to do them. Once the patient are able to do these stages the patient can gradually speed up the gulps. During stage 3, the patients will then be forcing each throatful of air through the vocal cords and into the lungs. The vocal cords then close and hold the air in the lungs while taking the next gulp until lungs are full."