Faculty of Medicine

University of Dhaka

"Effectiveness of Cardiorespiratory Endurance Training for Wheelchair Basketball Trainees who sustained Paraplegic Spinal Cord Injury"

Kulsum Akter

Master of Science in Physiotherapy

Registration no: 1761

Roll no: 11

Session: 2021-2022

BHPI, CRP, Savar, Dhaka-1343.

Bangladesh Health Professions Institute (BHPI)

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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 Cardiorespiratory Endurance Training for Wheelchair Basketball Trainees who sustained Paraplegic Spinal Cord Injury"

Submitted by
Kulsum Akter, for the partial fulfilment of the requirements for the degree of Master of Science in Physiotherapy.

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Declaration Form

- This work has not previously been accepted in substance for any degree and isn't concurrently submitted in candidature for any degree.
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- This dissertation is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. A Bibliography is appended.
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Contents

Page No.

List of Table

List of Figures

Acronyms

BHPI	Bangladesh Health Professions Institute
BMRC	Bangladesh Medical Research Council
CRP	Centre for the Rehabilitation of the Paralysed
IRB	Institutional Review Board
IS	Incentive Spirometry
PEFR	Peak Expiratory Flow Rate
PO	Pulse Oximetry
PT	Physiotherapist
SCI	Spinal Cord Injury
SPSS	Statistical Package for Social Sciences
TSCI	Traumatic Spinal Cord Injury
VO2 MAX	Maximal Oxygen Consumption
CVD	Cardiovascular Disease
WB	Wheelchair Basketball
HR	Heart Rate
TM	Transverse Myelitis
BP	Blood Pressure
6- MPT	6-Minute Push Test
WHO	World Health Organization
QoL	Quality of Life

ABSTRACT

Introduction: A decline in strength, endurance, and functional capacity are major health concerns for the individual living with SCI. sedentary behavior and inactivity are major risk factors for the development of cardiovascular disease and metabolic disorders and have been linked to decreased muscular strength, reduced aerobic capacity, and increased disability

CHAPTER-I INTRODUCTION

1.1 Background

Spinal cord injury (SCI) is a dangerous event that affects a patient's physiological, emotional, and social well-being by causing a motor and sensory deficiency (Yuan et al., 2018). Determining the causes of SCI is an essential first step in creating reasonable and successful preventative programs (Chan et al., 2016). SCI occurs traumatic or non-traumatic, is a sudden destructive and weak nervous condition is restrained throughout history (Rahman et al., 2017). The untimely event of spine injuries can lead to the dramatic change in the persons, family, and activities of daily living of the individual with SCI (Kang, Shin, & Kim, 2014). SCI is probably the most disorderly and deadly incident that can happen to someone else's life and the person with SCI has present huge challenges in the form of cooping processes as well as rehabilitation, although through the rehabilitation process some person recover partial ability to perform daily life activities' but some activities are permanently altered (Kumar & Gupta, 2016).

Traumatic spinal cord injury (TSCI), one of the worst kinds of traumas, can result in different degrees of paralysis, sensory loss, and issues with the bladder or intestines (Kang et al., 2018). More than 90% of SCI cases are attributed to trauma resulting from some incidents such as violent crimes, sports injuries, traffic accidents, or falls, regardless of etiology (Alizadeh, Dyck, & Abdolrezaee, 2019). Non-traumatic spinal cord injury is a special sort of SCI that is not caused by trauma (Chan et al., 2016). Spinal stenosis, vascular ischemia, transverse myelitis, congenital disorders, and tumorous compression can all result in non-traumatic SCI (Kang et al., 2018). Reports state that the male to female ratio for SCI is 2:1 and that adults are more likely than young people to be affected (Alizadeh, Dyck, & Abdolrezaee, 2019). Among of all SCI person male SCI is more than the female SCI person (Kang et al., 2018).

The epidemiology of spinal cord injuries differs from country to country like developed to developing (Rahman et al., 2017). According to Singh et al. (2014), incidence and prevalence are crucial for determining appropriate prevention strategies, better understanding the rate of recurrence, and providing better treatment

for those with SCI. The incidence rate is a measure of the proportion of newly diagnosed illnesses in a population over a particular period of time. The incidence rates of industrialized nations ranged from 13.121 to 163.420 per million people, according to (Kang et., 2018). The frequency of spinal cord injury appears to be increasing, with an annual rate of 15–40 occurrences per million, an elevated proportion of men, and an increased likelihood to affect people with less fortunate socioeconomic backgrounds (Rahman et al., 2017). Health care is influenced by the prevalence issue in in addition to personal and social resources (Kang et al., 2018). Moreover, there are 15 to 40 cases of SCI for every million people all over the world, with an incidence rate that fluctuates from 10.4 to 83 cases per million for a single year (Moghimian, Kashani, Cheraghi & Mohammadnejad, 2015).

The annual rate of admission at specialized centers such as the Centre for Rehabilitation of the Paralyzed (CRP) indicates that SCI and its health-related complications cause an extensive number of economic and social problems concerns throughout Bangladesh which is a poor but developing country in South Asia (Rahman et al., 2017). Acute complication after SCI such as pain, pressure ulcer, neurogenic shock, sweat secretion, temperature regulation, neurogenic bowel-bladder, respiratory and also cardiovascular (Hagen, 2015). Chronic consequence of SCI such as respiratory issues, heart problems, bowel and urine issues, spasticity, pain syndromes, pressure ulcers, osteoporosis, and bone fractures (Sezer, Akkus, & Ugurlu, 2015). Common complications of respiratory issues are atelectasis which ultimately lead to pneumonia as well as respiratory failure. The mortality rate of both acute and chronic stage of SCI are outmost 31.10% and 19.90% respectively (Van et al., 2016).

Compared to the other able bodied individual, spinal cord injured people perform little bit exercise that’s why they are considerably less and have worse physical conditioning (Van et al., 2017). A sedentary lifestyle may interfere with normal breathing, thus to enhance the health of those with impairments, promote the participants in different types of sports and different level of physical exercise (Pereira et al., 2016). Physical ability is the degree to which an individual uses their cardiovascular, respiratory, and muscle systems. It has also been demonstrated that physical skills are associated with a lower risk of lower levels health problems, which may lower one's quality of life (QoL) (Yanci et al., 2015). In people with chronic

SCI, regular physical activity has been extensively advised to enhance outcomes related to cardiorespiratory fitness, respiratory muscle strength and endurance, and cardio metabolic health (Lemos et al., 2020). Through changes in body composition, lipid profiles, and bone mineral density, exercise may also have positive health effects (e.g., lower risk of osteoporosis and cardiovascular exercise reduce metabolic illness) (Van et al., 2017).

According to Van et al. (2017), exercise is defined as repeated, scheduled, and organized physical activity done to maintain or increase physical fitness. A small number of studies show that regular exercise also enhanced SCI patients' autonomic parameter and quality of sleep (Gomes et al., 2018). Developing and putting into practice SCI-specific, evidence-based exercise guidelines is a crucial first step in employing exercise to enhance fitness and health (Van et al., 2017). According to Frez et al. (2015), vulnerable outcomes of SCI frequently restrict mobility, involvement in everyday activities, and capacity to execute daily tasks. Adapted activities like sports, which were first used as a form of physical and psychological rehabilitation, have been recognized as one technique that is appropriate for encouraging physical activity in individuals with chronic SCI (Lemos et al., 2020).

People with paraplegic SCI engaged in different type of group sports like wheelchair Basketball (WB) (Lemos et al., 2020). WB is well known team sports for paraplegic SCI patients (Frez et al., 2015). Recent study reported that WB is the most popular and competitive sports for inactive people (Yanci et al., 2015). According to some literature when SCI people playing WB as a part of rehabilitation purpose, it’s not only improve physical activity but also advantageous for socialization, improved quality of life and recovery of self-esteem (Gomes et al., 2018). During playing WB, the heart rate of the SCI increased highly (Yanci et al., 2014). Wheelchair athletes must play basketball, which is a fast-paced sport that involves quick changes in direction as well as strong and quickly develop body strength (Frez et al., 2015). Preventive, power, velocity, integration, and flexibility are the primary physical material goods to attributes of WB performance; in particular, aerobic fitness is crucial because a perfect match lasts longer around 65 minutes (dos et al., 2017).

For people with SCI to become self-regulating in their everyday tasks and acitivity, avoid complications from the disease or disability, and maintain an active lifestyle for

a long time, aerobic exercise is crucial (Bye et al., 2017). There are several benefits to exercise, including improved cardiac output, increase muscle strength and endurance (West et al., 2015). To improve strength and endurance, a wide range of treatment option are suggested and implemented (Bye et al., 2017). Physical activity guidelines are methodically formulated, empirically supported declarations that offer age- and ability-specific details on the necessary course of action to preserve or improve health, fitness, or overall performance (Ginis et al., 2018). Even adult person with SCI who performed exercise increase physical fitness including power output, muscular strength and cardiorespiratory fitness (Van et al., 2017). Progressive resistance training program is the most popular kind of strength training (Bye et al., 2017).

Respiratory muscle strength is an important characteristic for the estimation of the substantial enable person specially who for those who have had muscular dysfunction as a result of trunk instabilities (Pereira et al., 2016). Several evidence concluded that SCI people should participate in at least 20 minutes of moderate to vigorous intensity aerobic exercise 2 times per week and also added strength-training exercises perform twice per week for achieve the significant fitness advantages (Van et al. 2017). Right now SCI patients have a greater chance of survival, a longer life expectancy, and a higher quality of life in addition to increasing physical activity and engaging sports activities (Lee et al., 2017).

1.2 Rationale

SCI means damage spinal cord. Since the spinal cord transmits information from the brain to every area of body & conveys messages from the body to the brain. It is a serious kind of physical trauma that will probably have a major & long-lasting effect on the majority of everyday activities. People with SCI experience a variety of physical issues & secondary bodily system complications (Hoque et al., 2018). Cardiorespiratory complaints are among the most prevalent of them. One crucial but rarely acknowledged aspect of cardiorespiratory fitness (Hoque et al., 2018). SCI person is thought to be the least active member of society due to multiple barriers that prevent them from engaging in physical exercise. Generally, SCI person has low anaerobic, aerobic capacity & strength in comparison with other able individual (Van et al., 2015). SCI patients are primarily bedridden and require little exercise during the acute phase, but as patients go through the rehabilitation phase, their demand increased day by day for example using a wheelchair outside the house requires more cardiorespiratory fitness. Additionally, it appears that cardiorespiratory fitness is important for both their QoL & functional recovery.

WB is one of the most popular and vital sports for paraplegic SCI (Skucas et al., 2014). Sports participation has been shown to improve bone mineral density, muscular strength, and cardiorespiratory endurance in wheelchair users (Ozman, 2014). The WB exercise is a well-known effective technique for improving aerobic endurance (Skucas et al., 2014). Numerous studies have shown that aerobic performance, stretching, and strengthening can enhance the cardiorespiratory fitness of WB trainees with SCI. In Centre for the Rehabilitation of the Paralyzed (CRP), SCI patients who are paraplegic, can turn on wheelchair. They are playing WB as a part of their rehabilitation. But in Bangladesh there is no research about the effectiveness of cardiorespiratory endurance training for the paraplegic SCI who playing WB as a part of their rehabilitation. As cardiorespiratory function is important for SCI patient, so we need to know the changes of cardiorespiratory component by performing cardiorespiratory endurance training whereas several studies reported that endurance training can improve the cardiorespiratory fitness of WB trainees with SCI. That’s why I want to do this research. This study may progress the cardiorespiratory fitness as well as reduce the mortality rate of SCI people.

1.3 Objectives of this study:

1.3.1 General objective:

To find out the effectiveness of cardiorespiratory endurance training on wheelchair basketball trainees who sustained paraplegic spinal cord injury.

1.3.2 Specific objectives:

- To obtain the socio-demographic information (Age, Sex, Occupation, Marital status etc.)
- To obtain the differences in the VO2 max after intervention.
- To evaluate the changes in oxygen saturation rate followed by cardiorespiratory endurance training programmed.
- To measure the changes in the lung (inspiratory and expiratory) capacity after the endurance training of WB trainee.
- To document the changes in the Blood pressure and pulse followed by endurance training.
- To measure the 6 MPT after endurance training of the paraplegic SCI person.

1.4 Research Hypothesis:

1.4.1 Null Hypothesis (H_0):

Cardiorespiratory endurance training is no more effective for wheelchair basketball trainees who sustained paraplegic spinal cord injury.

Ho: $\mu1-\mu2 = 0$ or $\mu1=\mu2$, where the experimental group and control group initial and final mean difference is same.

1.4.2 Alternative Hypothesis (Ha):

Cardiorespiratory endurance training is effective for wheelchair basketball trainees who sustained paraplegic spinal cord injury.

Ha: $\mu1-\mu2 \neq 0$ or $\mu1 \neq \mu2$, where the experimental group and control group initial and final mean difference is not same.

Where,

$H0$ = the null hypothesis,

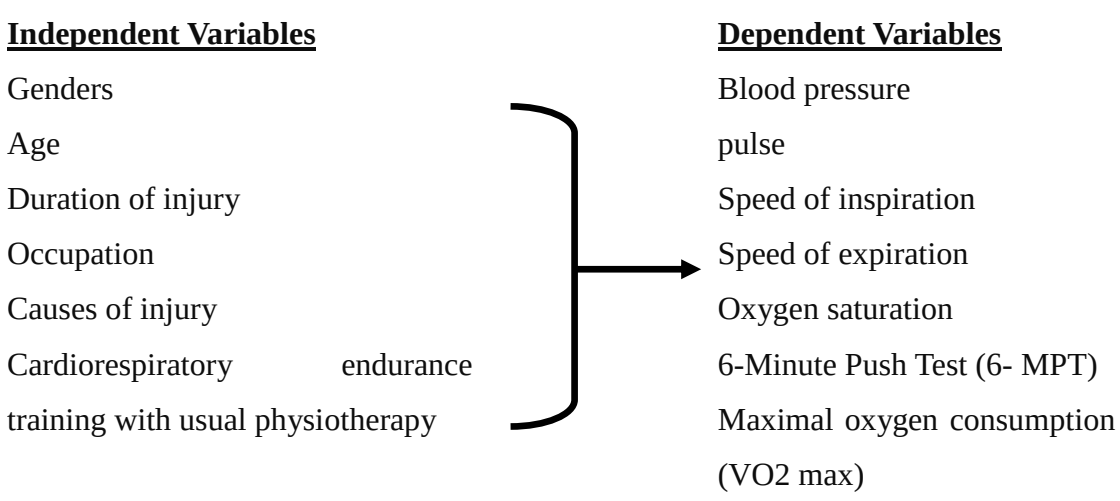
Ha = the alternative hypothesis,

$\mu1$ = the mean of population 1, and

$\mu2$ = the mean of population 2

1.5 List of Variables:

Independent Variables		**Dependent Variables**
Genders		Blood pressure
Age		pulse
Duration of injury		Speed of inspiration
Occupation		Speed of expiration
Causes of injury		Oxygen saturation
Cardiorespiratory endurance training with usual physiotherapy		6-Minute Push Test (6- MPT) Maximal oxygen consumption (VO2 max)



1.6 Operational definition:

Spinal Cord Injury:

According to (Kirshblum & Waring 2014) SCI is an insult to the spine that results in short-term or permanently changing the cord's normal motor, sensory or automatic function and patients with SCI suffered from neurologic deficit that lead to disability.

Paraplegia:

According to ASIA (2011) “Paraplegia means loss of motor or sensory function in the thoracic, lumber or sacral segment of the spinal cord, especially affects in the lower limb”.

Wheelchair Basketball:

Wheelchair basketball (WB) is one of the most popular and well-known adapted sports and in 1993, the International Wheelchair Basketball Federation (IWBF) was established as its world governing body with full responsibility for its development (Yanci et al., 2015).

Endurance Training:

Endurance training describes any type of athletic training that increases body's cardiovascular or muscular endurance. Endurance exercise training exerts many positive effects on health, including improved metabolism, reduction of cardiovascular risk, and reduced all-cause and cardiovascular mortality (Morici et al., 2016).

Cardiovascular fitness:

Cardiovascular fitness is the capacity to supply oxygen-rich blood to the heart, lung and blood cells and also working muscles which produce energy for movement (Hoque et al., 2018).

CHAPTER-II LITERATURE REVIEW

Spinal cord injury (SCI) is a kind of high disabling injury; it not only can lead to damage or loss of sensation and motor function, but also hamper individual health and quality of life (Kang et al., 2018). The SCI can be caused by trauma, infection, ischemia, tumor, TM or congenital disease, which implants both nerve impulses and voluntary and unintended motor controls (Gomes et al., 2018). causes of TSCI including fall from height, road traffic accident, injury, sports injury occurs around the world (Rahman et al., 2017). Motor vehicle accidents account for 38.6% of SCIs, whereas falls account for 32.2% of cases, violent activity (eg, gunshots) accounts for 14.0%, sports-related activity accounts for 7.8%, surgery accounts for 4.2%, and 3.2% accounts for all other (Eli, Lerner, & Ghogawala, 2021). Traumatic Spinal Cord Injury (TSCI) is a terrible incident that is occur abruptly and unexpectedly which is lead to demoralizing costly in terms of human and social life (Lee et al., 2014).

According to Tweedy et al. (2017), there is a notable local variation between North America (40 cases per million) and Australia (15 cases per million), but overall, the incidence ratio of SCI is predictable at 23 cases per million. SCI is most common in males between the ages of 18 and 32 worldwide, and it can also occur in highly populated countries in people over 65 Lee et al., 2014). From an epidemiologic study updated in 2011, the global incidence rate of traumatic spinal cord injury (TSCI) is estimated at 23 per million, or 179,312 new TSCI cases per year (Chan et al., 2016). the reported incidence occurs in high-income countries between 12.1 and 57.8 cases per million inhabitants, and in low-income countries between 12.7 and 29.7 cases (Amidei, Salmaso, Bellio, & Saia, 2022). Meanwhile, the incidence of SCI is rising

Yuan et al. Epidemiology of Spinal Cord Injury in China worldwide with annual estimated incidence at 10.4–83 cases per million even though prevention measures have been taken to lower the occurrence (Yuan et al., 2018). The prevalence rate in Europe ranges from 10.4 per million to 29.7 per million in a single year, whereas in Asia, it was reported to be 27.1. According to recently released data, Tehran, Iran has an incidence of 10.5 million cases of SCI annually (Moghimian et al., 2015). In USA, about 250,000 people suffer from varying degrees of SCI each year, with an annual rate of up to 28–50/million (Fu et al., 2019).

There are 16 million people in Bangladesh who lives in handicap (Disability in Bangladesh, 2016). Based on estimates of the world's population for 2010, it is expected that over one billion people live with a disability (Bofosa et al., 2019), representing approximately 15% of the global population. Motor, sensory, & cardiovascular impairments are among the disabilities experienced by SCI patients (Gomes et al., 2018). Evidence strongly said that 40% SCI suffer from cardiovascular disease and contributing cause of death in individuals at least 1-year post injury (Svircev, 2009). Among common developmental disability along with physical disability is the 3rd most common and the disability is unable to perform such a specific role and as a limitation to accomplish the task that the society expects to perform a person (Yanci et al., 2015). With a significant number of years spent disabled, this illness is a major cause of disability, particularly in younger individuals (Amidei, Salmaso, Bellio & Saia, 2022). The antagonistic properties of SCI on their performance, health, and fitness are a regular occurrence due to their sedentary lifestyle (Tweedy et al., 2017). According to Bofosa et al. (2019), physical inactivity, is regarded as the fourth most important risk factor for death worldwide at 6%.

Furthermore, because of this complication, it can result in morbidity and mortality (Akkurt, Karapolat, Kirazli, & Kose, 2017). People who have spinal cord injury (SCI) exhibit complications beyond paralysis that are secondary in nature. Some of the most devastating side effects of SCI relate to impaired cardiovascular function, which increases cardiovascular disease risk (Tweedy et al., 2017). Cardiovascular disorders are the primary cause of patients with brain injury and brain mortality (Gomes et al., 2018). Low levels of physical activity and cardiovascular disease have an inverse relationship, and according to robust analytic mortality catalogs, these conditions account for 1.9 million deaths annually (Papathanasiou et al., 2015).

People with SCI's exercise tolerance and cardiorespiratory fitness are adversely affected by these complications, which frequently result in cardiovascular and respiratory deficiencies (Lemos et al., 2020). Pulmonary infection, urinary tract infection and bedsore were common complications, accounting for approximately 70% of SCI patients in China (Quadri et al., 2020). 50–67% of patients experience respiratory complications following SCI, including pneumonia, atelectasis, pleural effusions, sleep disordered breathing, or symptoms like dyspnea (Van et al., 2016).

Studies have demonstrated that people with SCI are incredibly lead sedentary life (Tweedy et al., 2017). Since ancient times, people have participated in physical activities like games and sports to maintain their current level of health and physical fitness (George et al., 2014). According to Dos et al. (2017), WB is a significant international multisport competition that features athletes with a variety of physical disabilities. Participating in sports is said to improve health by changing lifestyles and lowering risk factors related to sedentary behavior. Physical fitness is defined as having or achieving cardiorespiratory fitness, body component, elasticity, and muscular strength. It is also associated with the ability to perform activities of daily living (ADLs) (Tiu & Dubey, 2017). Evidence strongly said that exercise can develop muscle strength, progress cardiorespiratory fitness, effective individuality and thus standard living of persons with SCI (Tweedy et al., 2017).

Engaging in physical activity is the primary means of maintaining good health and is beneficial for all people (Choi, Ahn, & Jung 2023). Tiu et al. (2017) suggest that exercise is a type of physical movement that is intended to improve the appropriateness of the body through well-planned, organized performances. To improve health and physical fitness, physical activity promotion is necessary for the SCI population due to their low physical capacity (Wouda, Lundgaard, Becker, & Strøm, 2018). According to research, adults with SCI who want to improve their cardiorespiratory fitness and muscular strength should perform three sets of moderate-to-intense strength training for their main functioning muscle groups twice a week, as well as at least 20 minutes of aerobic exercise on two occasions a week. (Ginis et al., 2017).

The highest amount that frequently referred to event in response to exercise in high level SCI is poor HR and BP (Blood pressure) response (Lee et al., 2017). The body

constantly checks blood pressure to make sure it is meeting its needs (Herawati & Azizah, 2016). It is widely acknowledged that an individual with a spinal cord injury (SCI) has a lower resting systolic blood pressure (about 15-20 mmHg) than a healthy person if their injury is severe (Lee et al., 2017). The participant is asked to take their blood pressure while seated using a standard mercury sphygmomanometer (Papathanassiou et al., 2015). According to Staessen et al. (2017), cuff pressure is displayed digitally or as a mercury column simulation using an array of light emission diodes. The unique receptors called baroreceptors, which are found within the blood vessel wall and are capable of detecting changes in blood pressure, are responsible for this observation (Herawati & Azizah, 2016). Additionally, ideal (120/80 mm Hg) and normal (130/85 mm Hg) dimensions (Herawati & Azizah, 2016). According to Staessen et al. (2017), cardiovascular hazards arise when blood pressure falls to 115 mmHg systolic or 75 mmHg diastolic. Low levels of physical activity and cardiovascular disease have an inverse relationship, and according to robust analytic mortality catalogs, these conditions account for 1.9 million deaths annually (Papathanasiou et al., 2015). However, a person's level of fitness can influence an excessive rise in blood pressure during exercise (Kokkinos et al., 2014).

A non-invasive method for tracking arterial oxygen saturation is pulse oximetry (PO) (Kohyama et al., 2015). PO is a value that indicates the oxygen saturation level and pulse in the peripheral blood and is widely used to monitor oxygenation in critical intensive care situations (Jubran et al., 2015). According to Kohyama et al. (2015), PO is a useful instrument for determining the rate of saturation of peripheral oxygenated blood. Pulse oximetry measurements of SpO2 changes have demonstrated delayed responses in prior research (Cheung et al., 2021). Using a variety of light wavelengths ranging from 600 to 950 nanometers, PO measure changes in the light absorption of arterial and venous blood by penetrating the skin and using the spectrophotometric method (Jubran et al., 2015). In critical situations, the tool's sensitivity has been demonstrated to be approximately 90% in order to prevent hypoxia (Kohyama et al., 2015). When there is a significant decline in oxygen saturation, the instruments help the physician manage the patient's condition in real-world scenarios and assess how well standard care is working (Jubran et al., 2015).

A restrictive lung disease that results in a decrease in lung volume and capacity can also be brought on by the weakening of the expiratory muscles (Jung et al., 2014).

Peak flow meters are compact, portable devices that measure the rate at which an individual expels air from their lungs through forceful expiration following maximum inspiration (Soumyashree & Kaur, 2018). Speed of expiration of the patient was measured using a peak flow meter (An & Shin, 2018). The participants held their noses while sitting and inhaled as much air as they could before be coughing violently and quickly through a mouthpiece (Soumyashree & Kaur, 2018). An and Shin (2018) selected the maximum value out of a total of three times.

Due to changes in the function of the inspiratory and expiratory muscles, patients with spinal cord injury (SCI) have a decrease in lung volume (Tiftik et al., 2015). Incentive spirometry is the term used to describe the method of deep breathing exercise using an incentive spirometer (IS) (Narayanan, Hamid, & Supriyanto, 2016). In an upright sitting position, incentive spirometry was used to strengthen the respiratory muscles (Shin, Han, Cho, & Im, 2019). It was instructed to the participants to exhale fully and slowly (to residual volume). In order to avoid breathing through the nose after that, a nose clip was affixed (Soumyashree & Kaur, 2018). Participants were instructed to tightly seal their lips around the manometer's mouthpiece in order to stop air leaks (Shin, Han, Cho, & Im, 2019). It was requested of them to take a deep breath. "Pull in hard, like you are trying to suck up a thick milk shake," was the instruction given to the participants. The maneuver was performed three times, with the greatest negative pressure sustained for one second being recorded. Three values were averaged (Soumyashree & Kaur, 2018).

VO2max, or maximum oxygen uptake, is a crucial indicator for forecasting cardiovascular death. Given its strong correlation with CVD, VO2max is a crucial indicator for sedentary individuals with SCI (Lee, Bae, Choi & Lee, 2023). According to Astorino et al. (2019), VO2max is a commonly used indicator of aerobic function, cardiorespiratory fitness, and overall health risk. High-intensity aerobic exercise that targets 85–95% of maximal heart rate and works several large muscle groups appears to be the most effective way to increase physical capacity (Wouda, Lundgaard, Becker, & Strøm, 2018). Hoque et al. (2018) state that the maximum heart rate determined by the 220–present age formula. As of late, aerobic performance has satisfied the need to reach peak performance (Habibi et al., 2014). The formula for VO2max is then VO2max= 15 x (maxHR÷ RestHR) (Hoque et al., 2018). According

to Habibi et al. (2014), there are two types of measurement procedures: direct and indirect. The indirect method uses heart rate. As per Vik, Lannem, Rak, and Stensrud (2017), the unit of measurement for this measurement is (ml/kg/min). Three times, the participants' heart rates were recorded (Hoque et al., 2018).

The 6-minute Push test has been shown to be a valid and dependable method for assessing aerobic fitness in patients with SCI (Solanki, Chaudhari & Bhise, 2016). The assessment of oxygen consumption (VO2) and functional change is a widely recognized field-based assessment method (Westhuizen, Mothabeng, & Nkwenika, 2017). As a result, there is a significant decline in physical fitness as well as a reduction in peak oxygen uptake and metabolic demands (Solanki, Chaudhari & Bhise, 2016). Wheelchair users are more likely to be physically inactive and have poor physical fitness due to their restricted mobility (Westhuizen, Mothabeng, & Nkwenika, 2017). As a result of low physical fitness, low endurance and exercise tolerance, it can be difficult to meet the physical demands of tasks like pushing a wheelchair over gravel roads (Westhuizen, Mothabeng, & Nkwenika, 2017). A wheelchair user's endurance is evaluated with this test (Soumyashree & Kaur, 2018). Since their limited mobility causes them to be physically inactive, people with SCI who use wheelchairs for mobility (Westhuizen, Mothabeng, & Nkwenika, 2017).

On the 30-meter propulsion course, which had two cones placed 15 meters apart and 2.8 meters on either end to accommodate turning, the participants propelled the wheelchair as far as they could. For a 30-meter loop, two 180-degree turns were needed. The distance covered in six minutes was calculated by adding the last lap's distance in meters and multiplying the number of completed laps by 15 meters (Soumyashree & Kaur, 2018). It measures the total distance that subjects can cover in six minutes while pushing a wheelchair (Solanki, Chaudhari, & Bhise, 2016). Research has demonstrated that the 6MPT is an extremely sensitive and dependable tool for assessing cardiovascular fitness in people with SCI (Westhuizen, Mothabeng, & Nkwenika, 2017). According to Solanki, Chaudhari, and Bhise (2016), patients who had a longer 6-minute push test distance recovered from their heart rate more quickly. Good levels of fitness are indicated by distances of 604 m for paraplegics and 445 m for tetraplegics (Westhuizen, Mothabeng, & Nkwenika, 2017).

CHAPTER-III METHODOLOGY

3.1. Study Design

The aim of this study was to find out the cardiorespiratory endurance training on wheelchair basketball trainee who sustained paraplegic SCI. So, Experimental design of quantitative research type of Randomized Clinical Trail (RCT) had been chosen because the experimental study of RCT is the best way to find out the effectiveness of the study. The researcher had conducted the study with experimental group and control group with an aim to compare between experimental group and control group (Ortiz et al., 2015). It was a single blinded (Assessor) study where the researcher was blinded.

3.2 Study site

The researcher is a M.Sc. in Physiotherapy (Part-II) student of Bangladesh Health Professions Institute (BHPI) in session 2021-2022 and the research is a part of the course curriculum. For this reason, the researcher has to be collecting data with in short time to maintain the contrasts. Data was collected from paraplegic SCI people attending at Center for the Rehabilitation of the Paralysed (CRP), Savar, Dhaka. The patients came at CRP from all over the Bangladesh from all economic groups for comprehensive rehabilitation. So it reflects the entire population. CRP is the biggest hospital and renowned Rehabilitation Centre for Spinal Cord Injury (SCI) in South Asia.

3.3 Study Population and sample population

A population is the total group or set of events or totality of the observation on which a research is carried out. It is the group of interest to the researcher, the group whom the researcher would like to generalize the result of the study. In this study the

paraplegic SCI people who playing WB at CRP was chosen as a sample population to carry out this study. About 32 samples were selected for this study. Subjects, who met the inclusion criteria, were taken in this study from SCI unit of CRP, Savar.

3.4 Sample size calculation

We conducted power calculation using the online tool ClinCalc to calculate the right sample size based on the mean of VO2 max from previous study that would have been considered statistically relevant. Based on the previous study and by estimating an inter-experiment standard deviation of 0.2 (20% variation), using a power of 80% and an alpha value of 0.05, our power calculations revealed that n = 8 per group will be enough to provide sufficient statistical power. However, to generalize the study, we will include 16 SCI participants per group (Burkett et al., 1990).

3.5 Duration of Study

Duration of this study was October 2023 to May 2024.

3.6 Sampling technique

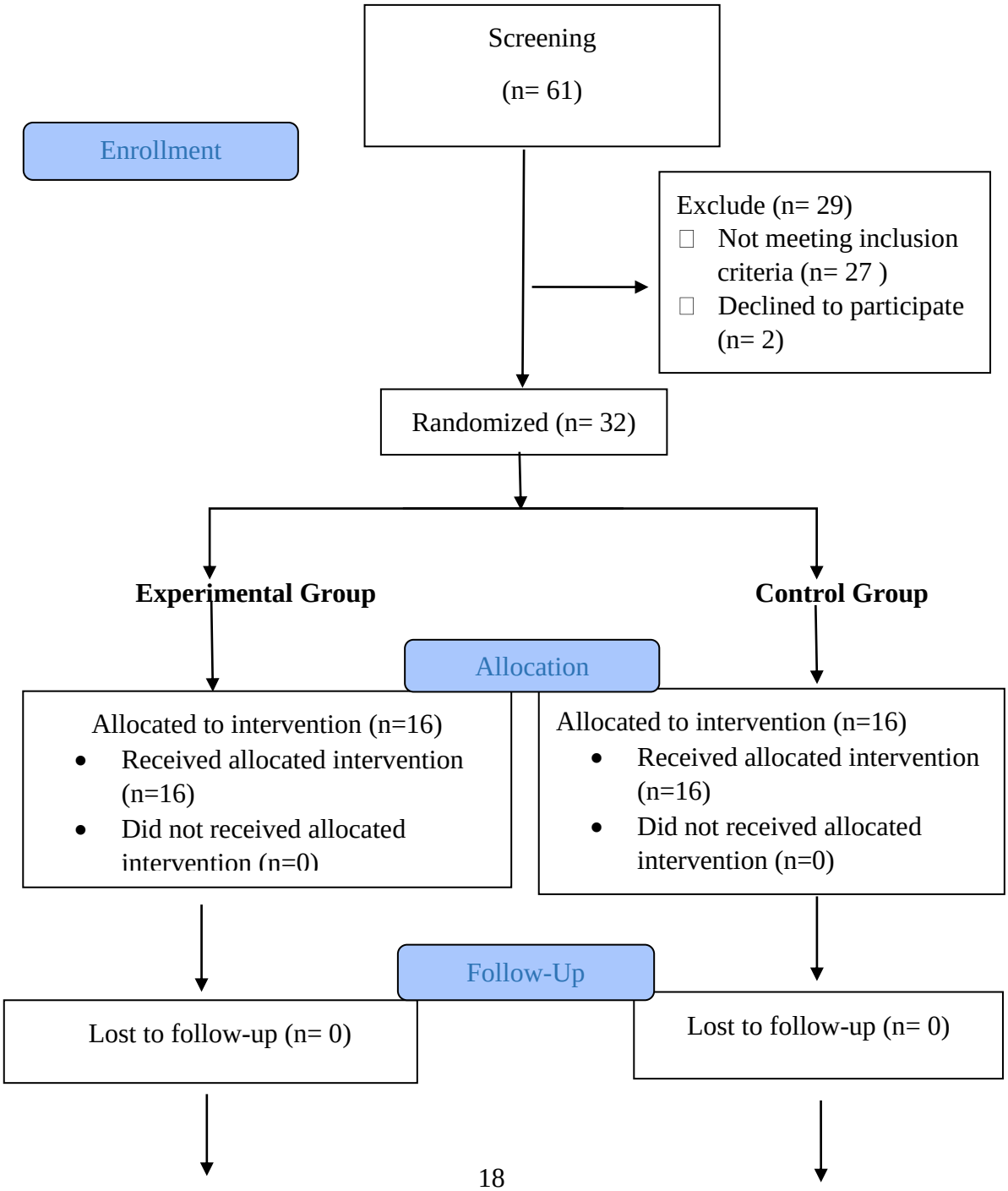
Sampling refers to the process of selecting the subjects or individual by computer generated simple random sampling using MS excel 2016. Searching an appropriate number and kind of people who are a part of this study is called –Sampling (Hicks, 1999). Participants were selected from SCI unit of CRP because they were easily accessible for the researcher. Sampling was an important concept in research. Basically it was a procedure to how to choose the people who will study or who would participate in research.

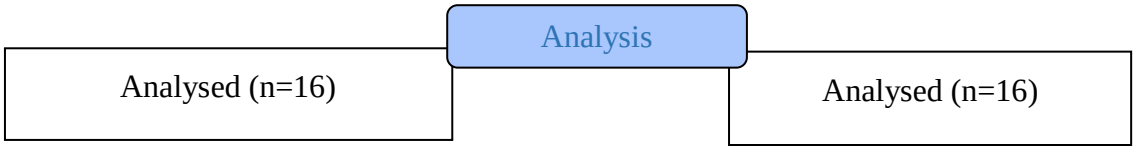
All the patients with paraplegic SCI attended at SCI indoor from 10 November 2024 to 10 May 2024 had been chosen as subject. From the participants, screening procedure had been performed by qualified Physiotherapist to examine the inclusion and exclusion criteria. All the participants have an equal probability of assigning to any of two groups, because they are choosing by ‘Therapist Randomization’ which are assigning them either to trial group or to control group. Patients those who were randomly assigned to trial group was received endurance training protocol combine with usual physiotherapy technique and the control group treated by usual physiotherapy techniques in this study. Single blinding (Assessor) procedure was

followed in this study. Finally, the sample size was 32 in number consisting of 16 participants in the control group and 16 in the trial group.

Although, samples are not selected by the researcher's choice, there is no scope for biasness. Therefore, computer generated simple random sampling has been used to select the participants for group allocation.

CONSORT Flowchart: Sampling technique





3.7 Selection Criteria

3.7.1 Inclusion criteria:

The inclusion criteria have been set up incorporating studies on wheelchair basketball in similar cultural context by Imran, et al., (2018).

- Persons with paraplegic spinal cord injury attending at CRP.
- Age range 15-45 years.
- Both male and female.
- Have trunk control.
- Indoor participants who are receive ongoing rehabilitation service.

3.7.2 Exclusion criteria:

- Undiagnosed injury or other condition.
- SCI patient with psychological problem (such as cognitive or mental impairment).
- Patient suffering from serious pathological disease. E.g. tumors, tuberculosis etc.
- SCI patients with head injury.
- Pregnant women will be excluding from this study.

3.8 Data collection tools

During data collection, collector used informed consent for ethical issues. Data would be collected by using a semi structured type questionnaire paper. Also used other accessories of Pen, Pencil, File, Eraser, Clip board, White paper, note book, Laptop, Calculator and record file to make collection fruitful. The questionnaire sought information on identification socio-demographic information (name, age, sex, occupation) and cardiorespiratory effect related questions.

3.9 Measurement tools

Researcher completed several measurement tools that were incorporating global outcome measures tools for cardiorespiratory effect after endurance training:

- Blood pressure and pulse measured by Sphygmomanometer.
- Oxygen Saturation by Pulse Oximetry.
- Speed of expiration by Peak Flow Meter.
- Inspiratory capacity by Spirometry.
- Vo2 Max by calculating resting heart rate and maximum heart rate.
- 6MPT by Stopwatch.

3.10 Intervention:

3.10.1 Treatment Protocol

The following treatment will be given:

Table 01: Treatment for intervention group (40 minutes)

Exercises for cardiovascular endurance			
Name	**Duration**	**Repetition**	**Cited by**
Chest squeezes	4 weeks	3 to 5 set 5 repetition per day for 5 days	(Van et al., 2006)
Seated Squat	4 weeks	3 to 5 set 5 repetition per day for 5 days	(Jan et al., 2017), (Zelman et al., 2020)
Punches out to the site	4 weeks	3 to 5 set 5 repetition per day for 5 days	(Evans., 2015)
Alternate biceps curl	4 weeks	3 to 5 set 5 repetition per day for 5 days	(Agarwal et al., 2023), (Zelman et al., 2020)

March in place	4 weeks	3 to 5 set 5 repetition per day for 5 days	(Darren et al., 2007)
Exercise name for respiratory endurance			
Name	**Duration**	**Repetition**	
Stretching of the chest wall	4 weeks	3 to 5 set 10 repetition per day for 5 days	(Park et al., 2017)
Opening chest wall	4 weeks	3 to 5 set 10 repetition per day for 5 days	(Eitivipart., 2019)
Chest sniffles	4 weeks	3 to 5 set 10 repetition per day for 5 days	(Zelman et al., 2020)
Elbow circle	4 weeks	3 to 5 set 10 repetition per day for 5 days	(Fisher, 2015), (Zelman et al., 2020)
Chest fly	4 weeks	3 to 5 set 10 repetition per day for 5 days	(Fisher., 2015) (Patric, 2004),

3.19.2: Conventional treatment for control group

Conventional treatment as per CRP policy

3.11 Procedure of data collection

Data collection procedure was conducted through assessing the patient, initial recording, intervention and final recording. A data collector assigned to conduct for data collection for the study time frame. Therefore, trained him about the procedure of data collection screening. After screening the patient at indoor departments, 4 weeks' intervention was carried out by a qualified physiotherapist. The researcher organized the materials to successfully complete the interview session. After quantitative investigation, the data collector took a face to face interview in a setting far from the treatment room by preset open ended questionnaire and recorded the interview. Each questionnaire took approximately 20-30 minutes to complete.

3.12 Data analysis procedure (Statistical analysis)

Data was analyzed with the software which named Statistical Package for Social Science (SPSS) version 25.0 and Microsoft Excel 2016. Every questionnaire was rechecked for missing information or unclear information. At first put the name of variables in the variable view of SPSS and the types, values, decimal, label alignment

and measurement level of data. The next step was to input data view of SPSS. After input all data researcher checked the inputted data to ensure that all data had been accurately transcribed from the questionnaire sheet to SPSS data view. Then the raw data was ready for analysis in SPSS. Descriptive statistic test, Paired t Test was performed for finding result. Data was presented by using the bar graph and table.

Paired t test:

Paired t-test was used to compare difference between means of paired variables. Selection of test of hypothesis is mean difference under t distribution.

Assumption:

- Paired variables
- Variables were quantitative
- Parent population of sample observation follows normal distribution

Formula: Paired t test defined by- According to Hicks (2009),

$$t = \frac{\bar{d}}{SE(\bar{d})}$$
$$= \frac{\bar{d}}{\frac{SD}{\sqrt{n}}}$$

Where,

$\bar{d}$= Mean of difference (d) between paired values
SE ($\bar{d}$) = Standard Error of the mean difference
SD= Standard deviation of the differences d and
n= number of paired observations.

Unrelated or Independent t test:

t test was used to compare difference between two means of independent variables. Selection of test of hypothesis was two independent mean differences under independent t distribution.

Assumption

- Different and independent variables
- variables were quantitative

Formula: test statistic t is follows:

$$t = \frac{\bar{x_1} - \bar{x_2}}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Where,

$\bar{x}\mathbf{1}$ = Mean of the Experimental Group,

$\bar{x}\mathbf{2}$ = Mean of the Control Group,

$\boldsymbol{n1}$ = Number of participants in the Experimental Group,

$\boldsymbol{n2}$ = Number of participants in the Control Group

S = Combined standard deviation of both groups

3.13 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 result is said to be significant (Tarin, 2015). Also, calculated the 't' value to compare with tabulated t value. If the observed t value is greater than the table t value, the result is said to be significant.

3.14 Ethical consideration

The researcher maintained some ethical considerations: The research proposal including methodology was submitted to Institutional Review Board (IRB) of Bangladesh Health Professions Institute (BHPI) for oral presentation and defense was done in front of IRB. Then IRB approved the proposal. The whole process of this research project has been done by following the national guidelines of Bangladesh Medical Research Council (BMRC) and World Health Organization (WHO) Research

guidelines. This protocol presentation was firstly submitted to the Institutional Review Board (IRB) of BHPI and initial permission was taken. Permission was taken from the Head of the Department of Physiotherapy, BHPI**,** CRP before data collection. Researcher ensured the confidentially of participants and shared the information only with research supervisor. All rights of the participants were reserved and researcher was accountable to the participant to answer any type of study related question.

3.15 Informed Consent

Written consent **(see in appendix)** was given to all participants prior to completion of the questionnaire. The data collector explained to the participants about his or her role in this study and aim and objective of this study. Data received a written consent form every participants including signature. So the participant assured that they could understand about the consent form and their participation was on voluntary basic. The participants were informed clearly that their information would be kept confidential. The researcher assured the participants that the study would not be harmful to them. It was explained that there might not a direct benefit from the study for the participants but in the future cases like them might be get benefit from it. The participants had the rights to withdraw consent and discontinue participation at any time without prejudice to present or future care at the SCI unit of CRP. Information from this study was anonymously coded to ensure confidentiality and was not personally identified in any publication containing the result of this study.

CHAPTER-IV RESULTS

4.1. Baseline variables

After meeting the inclusion and exclusion criteria, 32 participants were enrolled and randomized to two groups. 32 participants were randomly divided into two groups one is the control group (n=16) and another is an interventional group (n=16). The baseline characteristics of the participants are outlined in **Table 1.** These factors include age, gender, marital status, education status, occupation, living area, monthly income, pressure sore and complications. Additionally, a result from a baseline compatibility test was provided. There were no significant differences in the sociodemographic profile of the respondents.

Table 02: Result of Descriptive Statistics

Variables	Total Frequency(%)	Experimental group Frequency(%)	Control group Frequency(%)	P
Overall Age	27.09 ± 9.33	25.88 ± 8.197	28.1± 10.467	.571[a]

Previous occupation				
Car driver	1 (3.1)	1 (6.3%)	0 (0%)	.539[a]
Student	7 (21.9%)	3 (18.8%)	4 (25%)	
Labour	7 (21.9)	5 (31.3%)	2 (12.5%)	
Businessman	3 (9.4%)	1 (6.3%)	2 (12.5%)	
Farmer	8 (25.0%)	3 (18.8%)	5 (31.3%)	
Mason	2 (6.3%)	1 (6.3%)	1 (6.3%)	
Service holder	3 (9.4%)	2 (12.5%)	1 (6.3%)	
Housewife	1 (3.1)	0 (0%)	1 (6.3%)	
Average monthly income of family				
0-9999	15 (46.9%)	9 (56.3%)	6 (37.5%)	.427[a]
10000-19999	11 (34.4%)	4 (25%)	7 (43.8%)	
20000-29999	2 (6.3%)	1 (6.3%)	1 (6.3%)	
Above 30000	4 (12.5%)	2 (12.5%)	2 (12.5%)	
Caregiver support				
Yes	14 (46.9%)	9 (56.3%)	6 (37.5%)	.296[a]
No	17 (53.1%)	7 (43.8%)	10 (62.5%)	
Duration of injury				
0-3 month	13 (40.6%)	6 (37.5%)	7 (43.8%)	.406[a]
4-6 month	8 (25.0%)	3 (18.8%)	5 (31.3%)	
7-9 month	7 (21.9%)	4 (25%)	3 (18.8%)	
10-12 month	2 (6.3%)	2(12.5%)	0 (0%)	
More than 1 year	2 (6.3%)	1 (6.3%)	1 (6.3%)	
Pressure sore in admission at CRP				1.00[a]
Present	14 (43.8%)	7 (43.8%)	7 (43.8%)	
Absent	18 (56.3%)	9 (56.3%)	9 (56.3%)	
Complications				
Pressure sore	1 (3.1%)	1 (6.3%)	0 (0%)	.007[a]
Urinary tract	3 (9.4%)	2(12.5%)	1 (6.3%)	

infection				
Postural hypotension	3 (9.4%)	3 (18.8%)	0 (0%)	
Autonomic Dysreflexia	5 (15.6%)	5 (31.3%)	0 (0%)	
Other	7 (21.9%)	1 (6.3%)	6 (37.5%)	
No	13 (40.9%)	4 (25%)	9 (56.3%)	
Rehabilitation duration at CRP				.456[a]
1 month	15 (46.9%)	9 (56.3%)	6 (37.5%)	
2 month	8 (25.0%)	3 (18.8%)	5 (31.3%)	
3 month	6 (18.8%)	2(12.5%)	4 (25%)	
More than 4 month	3 (9.4%)	2(12.5%)	1 (6.3%)	
Baseline variable				
Systolic Blood Pressure	118.28± 13.820	118.75±11.722	117.8± 26.026	.851[b]
Diastolic Blood Pressure	75.59 ± 10.942	74.56 ±11.821	76.62 ± 10.269	.852[b]
Oxygen saturation	97.00 ± 2.828	96.44 ± 3.054	97.56 ± 2.555	.602[b]
Pulse	80.88 ± 7.644	80.13 ± 6.510	81.63 ± 8.785	.587[b]
Speed of expiration	407.56 ± 63.231	415.31±56.078	399.81 ±70.639	.497[b]
Speed of inspiration	712.81±231.102	762.50±227.347	663.13±231.134	.230[b]
Vo2 Max	38.0428±2.6224	38.56± 2.33	37.53± 2.864	.273[b]
6 MPT	374.38±76.630	395.31± 80.01	353.44±69.275	.124[b]

The baseline compatibility was performed through the Mann-Whitney U test [a] and independent t test [b.] The baseline characteristics had no statistically significant compatibility is any of the sociodemographic, clinical, or intended outcomes before the treatment procedure.

This table describes about baseline characteristics of different variables. In the experimental group mean age of the participants were 25.88 years, in control group 28.1 years. Most of the participants living rural area in both group and also most of the participants are suffer SCI due to fall from height.

4.1.1 Gender of the participants

Male was predominantly higher than female. Among the respondent's male were 30 in number (93.8%), female were 2 persons (6.3%). In experimental had separately 16 (100%) male, no female participants and 14 (87.5%) were male and 2 (12.5%) were female in control group.

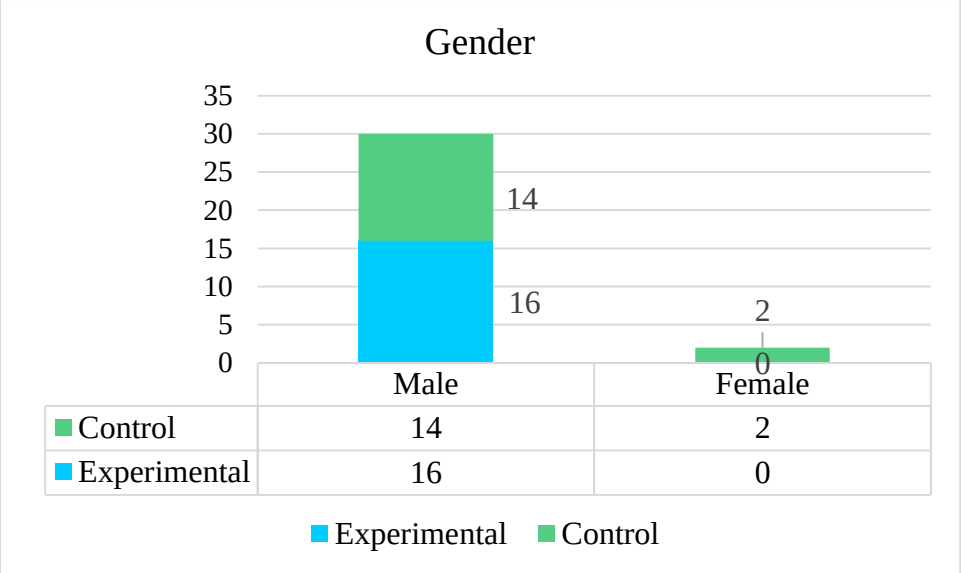


Figure 01: Gender of the participants

4.1.2 Marital status of the participants

Around 32 participant's researcher found married person 53.1% (n=17), unmarried person 46.9% (n=15). Most frequent status in married that was higher than unmarried.

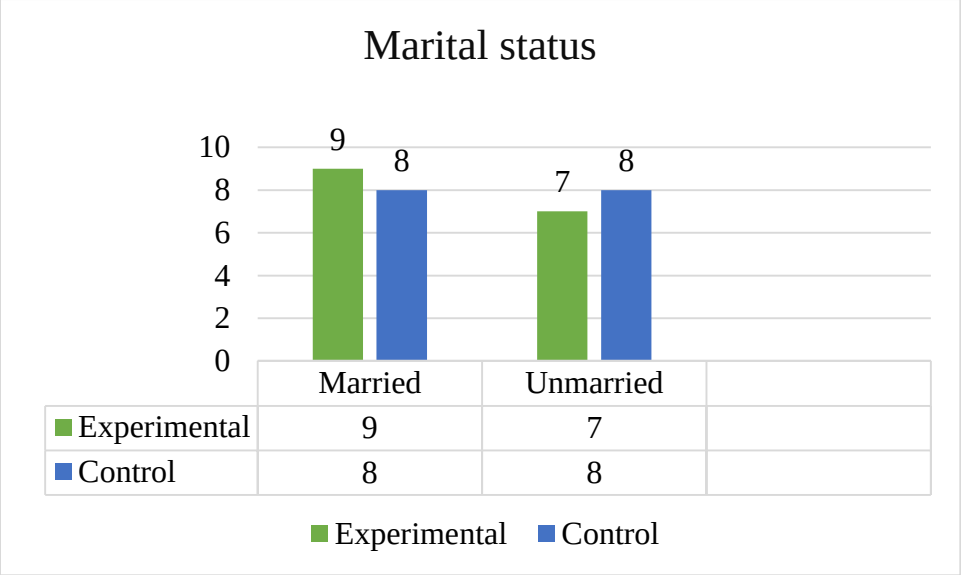


Figure 02: Marital status of the participants

4.1.3 Educational Status of the participants

In this study participants of experimental group were 16, among them up to 31.3 % (n=5) receive primary education, complete secondary education 25% (n=4), 3 participants have no formal education (18.8%) and 3 participants complete higher secondary (18.8%) and only 1 participant's complete graduation (6.3%). In the control group, among 16 participants, 6 participants (37.5%) complete primary education only, 5 participants passed secondary level (31.3%), 2 complete Higher secondary (12.5%) and 2 complete graduations (12.5%), only 1 person (6.3%) had no formal education.

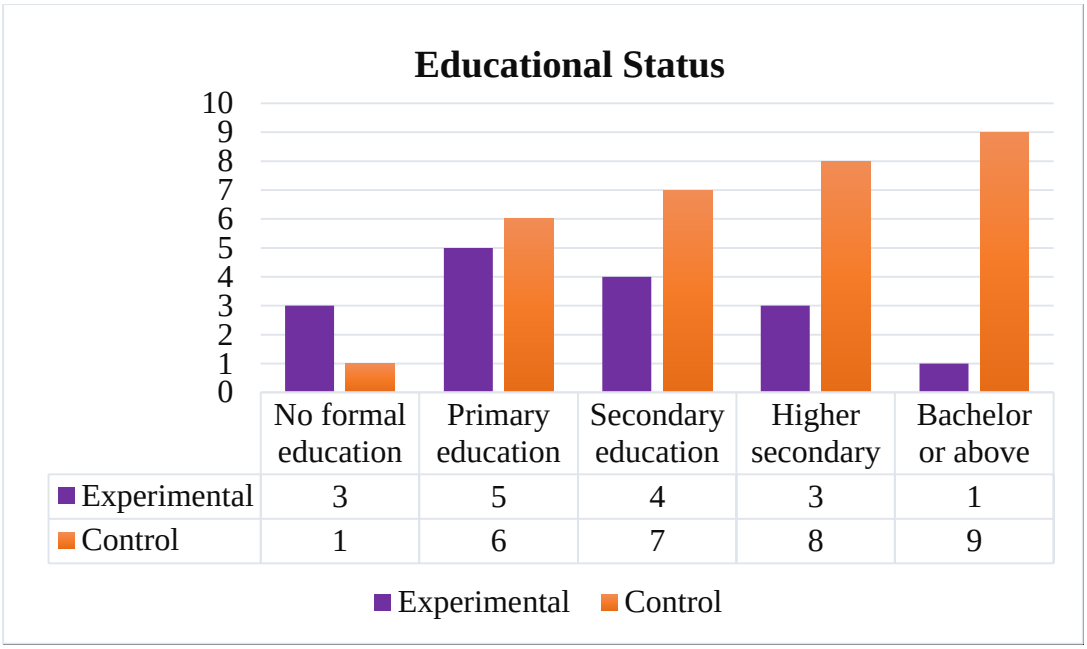


Figure 03: Educational Status of the participants

Results of Parametric Test

Table 03: Between group Comparison (Unpaired / Independent 't' test)

Variable	Group	Mean	SD	t	df	Sig (P-value)
		Intervention Group VS Control Group				
Systolic Blood Pressure	Experimental	114.00	8.996	-1.027	30	.289
	Control	121.94	29.571			
Diastolic Blood Pressure	Experimental	72.44	10.869	.019	30	.285
	Control	72.38	7.830			
Oxygen saturation	Experimental	97.69	1.740	-1.182	30	.530
	Control	98.38	1.544			
Pulse	Experimental	72.44	5.633	-2.185	30	.804
	Control	76.81	5.695			

Speed of expiration	Experimental	509.06	92.596	2.427	30	.407
	Control	438.13	71.388			
Speed of inspiration	Experimental	1123.75	398.160	2.280	30	.085
	Control	845.63	282.063			
Vo2 Max	Experimental	40.2163	2.61662	1.753	30	.442
	Control	38.4544	3.05290			
6 MPT	Experimental	494.69	125.982	2.105	30	.133
	Control	412.81	91.305			

*** Level of significance (<.05)**

Table 04: Within group Experimental (Paired sample 't' test)

Variable	Mean	SD	t	df	Sig (p-value)
Systolic Blood Pressure-Pre Systolic Blood Pressure-Post	4.750	8.598	2.210	15	.043*
Diastolic Blood Pressure-Pre Diastolic Blood Pressure-Post	2.125	9.905	.858	15	.404
Oxygen saturation- Pre Oxygen saturation- Post	-1.250	1.732	-2.887	15	.011*
Pulse- Pre Pulse- Post	7.688	7.373	4.171	15	.001*
Speed of expiration- Pre Speed of expiration- Post	-93.750	68.946	-5.439	15	.000*
Speed of inspiration- Pre Speed of inspiration- Post	-361.250	219.541	-6.582	15	.000*
Vo2 Max- Pre Vo2 Max- Post	-1.65813	1.30684	-5.075	15	.000*

6 MPT- Pre **6 MPT- Post**	-99.375	74.024	-5.370	15	.000*

*** Level of significance (<.05)**

Table 05: Within group Control (Paired sample 't' test)

Variable	Mean	SD	t	df	Sig (p)
Systolic Blood Pressure-Pre **Systolic Blood Pressure-Post**	-4.125	28.512	-.579	15	.571
Diastolic Blood Pressure-Pre **Diastolic Blood Pressure-Post**	4.250	8.355	2.035	15	.060
Oxygen saturation- Pre **Oxygen saturation- Post**	-.813	2.073	-1.568	15	.138
Pulse- Pre **Pulse- Post**	4.813	9.418	2.044	15	.059*
Speed of expiration- Pre **Speed of expiration- Post**	-38.313	39.769	-3.854	15	.002*
Speed of inspiration- Pre **Speed of inspiration- Post**	-182.500	198.478	-3.678	15	.002*
Vo2 Max- Pre **Vo2 Max- Post**	-.92688	.62106	-5.970	15	.000*
6 MPT- Pre **6 MPT- Post**	-59.375	54.555	-4.353	15	.001*

*** Level of significance (<.05)**

Results of systolic Blood pressure

This study found that in the systolic Blood pressure, the Unrelated/independent t test in between group analysis observed t value was -1.027 and the p value was .289 (p<.05). Here p value was>.05 that means null hypothesis was accepted and alternative hypothesis was rejected which means cardiorespiratory endurance training were not statistically significant in between group comparison.

This study found that in the systolic blood pressure, observed t value was 2.210 (118.75±11.22) and p value was (.04%) in the experimental group at two tailed paired t test while this same variable for control group observed value was -.579

(117.8±26.03) and the p value .571 was in within group. Here p value was <0.05 group which indicate that null hypothesis was rejected and alternative hypothesis was accepted. The experimental group in aspect of systolic blood pressure were significant at .043% level.

In this study, systolic blood pressure analysis in within group were statistically significant where p value (p<.05) and the level was 0.043% in experimental group. But within control group were not statistically significant means cardiorespiratory endurance training is more effective than usual physiotherapy treatment for paraplegic SCI wheelchair basketball trainee.

Results of Diastolic Blood pressure

This study found that in diastolic blood pressure, the unpaired / independent t test in between group the observe t value was .019 and the p value was .285 (p<.05) means t value is less than the p value. That means null hypothesis was accepted and alternative hypothesis was rejected which there was no difference between cardiorespiratory endurance training and conventional physiotherapy for paraplegic spinal cord injury persons in the between group.

Besides this, observed t value was .858 (74.56±11.82) and the p value was .404 (p<.05) in the experimental group at two tailed paired t test while this same variable for control group observed t value was 2.035 (76.62±10.27) and the p value was .060 (p<.05). Here p value was greater than .05 means null hypothesis had accepted in both groups and alternative hypothesis was rejected. There was no statistical difference within experimental and control group. This can be uttered, cardiorespiratory endurance training combine with usual care and only usual care was no more effective for paraplegic wheelchair basketball trainee.

Results of Oxygen saturation

The Unpaired/independent t test in between group, in case of oxygen saturation the observe t value was – 1. 182 and the p value was .530. Here p value greater than 0.05 indicate that means null hypothesis was accepted and alternative hypothesis was rejected which means there was no effectiveness between control and experimental group after 6 weeks' treatment session.

Beside this, Observed t value was -2.887 (96.44±3.05) and p value was .011 (p<.05) in the experimental group at two tailed paired t test while this same variable for control group observed value was -1.568 (97.56±2.56) and p value .138. In this regard within experimental group the null hypothesis rejected and alternative hypothesis accepted. This can be concluded that cardiorespiratory endurance training along with usual physiotherapy was more effective and statistically significant at .011% level.

Results of pulse

This study found that in case of pulse, the Unpaired /independent t test reported t value was (-2.185) and p value was .804. Here p value was greater than 0.05. The test does not have a significant result according to statistical test revealing changes between control and experimental group. The test support that null hypothesis was accepted and alternative hypothesis was rejected means cardiorespiratory endurance training is no more effective for wheelchair basketball trainees who sustained paraplegic spinal cord injury.

Beside this, Observed t value was 4.171 (80.13± 6.51) and p value was .001 (p<0.05) level in the experimental group at two tailed paired t test while this same variable for control group observed value was 2.044 (81.63±8.79) and p value was .059 (p<0.05). For this result the null hypothesis rejected and alternative hypothesis accepted. This result support that cardiorespiratory endurance training is more effective for wheelchair basketball trainees who sustained paraplegic spinal cord injury. Both groups in aspect of pulse were significant at 0.001% level but the mean difference of the experimental group was greater than the control group mean that means cardiorespiratory endurance training is more effective for wheelchair basketball trainees who sustained paraplegic spinal cord injury in experimental within group.

Results of Speed of expiration

The Unpaired/independent t test in between group, the speed of expiration t value was 2.427 and p value was .407 (p<.05). For this reason, there were no statistically difference found between experimental and control group after cardiorespiratory endurance training means null hypothesis was accepted and alternative hypothesis was rejected.

Within group paired sample t test find out the t value was -5.439 (415.31 ± 56.08) and p value was .000 (<.05) in the experimental group at two tailed paired t test while this same variable for control group observed t value was -3.854 (399.81±70.64) and p value was .002. 5% level of significant at 15 (fifteen) degrees of freedom, in case of speed of expiration in both groups were statistically significant that meant null hypothesis was rejected and alternative hypothesis was accepted in within group. Experimental within group were statistically highly significant (0.000%) compared with control group means cardiorespiratory endurance training with usual physiotherapy was more effective to improve cardiorespiratory fitness of the wheelchair basketball trainees who sustained paraplegic spinal cord injury rather than only usual treatment.

Results of Speed of inspiration

This study found that in the speed of inspiration, unpaired/ independent t test in between group at 5% level and 30 degree of freedom observed t value was 2.280 and p value was .085. Here the p value is greater than 0.05% means null hypothesis was accepted and alternative hypothesis was rejected which there was no difference of endurance training and usual physiotherapy for wheelchair basketball trainees who sustained paraplegic SCI in the between group.

Beside this, observed t value was -6.582 (762.50±227.34) and p value was (p<.000%) in the experimental group at two tailed paired t test while this same variable for control group observed value was -3.678 (663.13±231.13) and p value was .002%. 5% level of significant at 15 (fifteen) degrees of freedom both group had p value (p<.05) means null hypothesis was rejected and alternative hypothesis was accepted in within group. Experimental group statistically highly significant in compare with control group. This can be concluded that cardiorespiratory endurance training with usual care is more effective in case of paraplegic wheelchair basketball trainee.

Results of Vo2 Max

Independent t test has been determined to measure the changes between experimental and control group of paraplegic wheelchair basketball trainee followed by cardiorespiratory endurance training. The observe t value of the between group was 1.753 and p value was .442. That means null hypothesis was accepted and alternative

hypothesis was rejected. There was no statistically deference found between experimental and control group after endurance training.

Paired sample "t" test has been determined to measure the changes between pretest and posttest followed by endurance exercise in within group. Observed t value was -5.075 (38.56±2.33) and p value was (p< .000%) in the experimental group at two tailed paired t test while this same variable for control group observed value was -5.970 (37.53± 2.86) and the p value was (p<.001%). Here p value less than .05 indicate null hypothesis was rejected and alternative hypothesis was accepted in the within group. In case of both group significant at 0.001% level means endurance training along with usual physiotherapy and only usual physiotherapy intervention were equal effective for paraplegic wheelchair basketball trainee.

Results of 6-MPT

The Unpaired/independent t test in between group, the 6-minute push test t value was 2.105 and p value was .133 (p<.05). Here p value was greater than 0.05% that means null hypothesis was accepted and alternative hypothesis was rejected in between group comparison for improving cardiorespiratory fitness in case of wheelchair basketball trainee with paraplegic spinal cord injury.

Beside this, observed t value was -5.370 (395.31 ± 80.01) and p value was (p<.000%) in the experimental group at two tailed paired t test while this same variable for control group observed value was -4.353 (353.44±69.28) and p value was (p<.001%). Here p value less than .05 indicate null hypothesis was rejected and alternative hypothesis was accepted in the within group. In case of both group significant at 0.001% level but the mean difference of the experimental group was greater than the control group mean that means cardiorespiratory endurance training is more effective for wheelchair basketball trainees who sustained paraplegic spinal cord injury in experimental within group.

CHAPTER-V: DISCUSSION

The study attempted to find out the sociodemographic information and effectiveness of cardiorespiratory endurance training on wheelchair basketball trainees who sustained paraplegic spinal cord injury. The study was randomized clinical trial where researcher employed control and experimental group, the control group received usual

physiotherapy management and experimental group received specialized cardiorespiratory endurance training in addition. Also researcher observed the changes as per repeated measurement weekly in 4 weeks. The present study found almost similar characteristics on baseline in age, gender, marital status, educational status, duration of injury, pressure sore, and rehabilitation duration at CRP in both group of participants. In randomized control trial several authors have indicated the relevance of spinal cord injury in decreased pulmonary function resulting from alterations in the mechanism of respiratory muscles.

The study was carried out on 32 subjects, overall age was 27.09 ± 9.33 years. The subjects were randomized into 2 groups i.e. Experimental group (cardiorespiratory endurance training along with usual care) and Control group (usual care). Experimental group had 16 male participants and control group had 14 males & 2 females. The mean age between the groups experimental and control was 25.88 and 28.1 years respectively. Henriques et al. (2016) stated that similarities in baseline characteristics between both groups confirmed successful randomization. Male participants were predominantly higher than female. Out of 32 participants 93.8% (n=30) were male. A recent study on SCI explored that there were also male members predominantly and this was the similarity between two studies (Rahman et al., 2017).

The results of the study revealed that 93.8% participants were male, and 6.3% participants were female. Among 16 participants in the trial group 05 (31.3%) participant performed labour work, 03 (18.8%) performed farming work, 03 (18.8%) participants are student, 02 (12.5%) are service holder, 01 (6.3%) involved in business and 01 (6.3%) involve in driving. Thus it is likely that causes of traumatic spinal cord injury was closely related to previous occupation where most of the participants were engaged in labour activity before SCI. In the study of Leiulfsrud (2020) at the Netherlands Switzerland, Norway and Denmark people of SCI, it was found that most of the person before accidents they involve middle class occupation and also after accident they had a lower employment status.

Previous study mentioned the most common causes of injury were fall from height (54.2%) and road traffic accidents (37%) and others causes are (8.8%) (Marqués et al., 2017). These current study shows the similar findings of 32 participants like fall from height 16 (50%), RTA 11 (34.4%), Fall of heavy object on back 4 (12.5%) and

Fall while varying heavy load on head 1(3.1%). From this study most of the participants suffer from different type of complication after their injury whereas it was estimated that near about 70% of SCI people in China suffer from respiratory infection, UTI and pressure sore (Yuan et al., 2018).

The result of the study revealed that among 32 respondents, the maximum number of the participants were living in the rural area 22(68.8%), semi-urban 5(15.6%) and 5(15.6%) were living in urban cities. Mathur (2015), demonstrate that About 79% percent of the patients came from rural regions. In present study among 32 participants most of them 15 (46.9%) are earned 0-9999 taka. A recent Bangladeshi study observe that a large number of SCI people earn lee than 12000 takas (Kader et al., 2018). However, 56.3% SCI person had absent and 14 (43.8%) had present pressure sore during admission where another study reveal that out of 754 SCI respondents, 177 (23.5%) had suffer pressure sore during admission for inpatient rehabilitation (Flett et al., 2019).

In this study demonstrate mean of the systolic blood pressure (± SD) was 4.75 (±8.50) in trail group & -4.125 (±28.51) in control group. So it is obvious that the mean difference is higher in control group. In addition, diastolic BP mean was 2.12 (±9.90) at experimental group & 4.25 (±8.35) in the control group. That means the significant value was >.05 found between group as well as within group analysis. Several literatures stated that after exercises diastolic BP does not change significantly but systolic BP change respectively (Herawati & Azizah, 2016). In case of speed of inspiration and expiration between group analysis there were no Signiant changes noticed but within group analysis the observe value was statistically significant means after endurance training respiratory function improve significantly. After aerobic exercise their result suggest that exercise improve pulmonary function respectively (Akkurt, Karapolat, Kirazli, & Kose, 2017).

In comparison between group of pre and post pulse there were no significant changes observe but in within group showed that after aerobic training increase the cardiorespiratory fitness among the paraplegic wheelchair basketball trainee. Exercise is crucial for people with SCI since it is known to help avoid problems and a lower quality of life that can occur from a lack of physical activity (Lee et al., 2017). In addition, evidence showed a decline in the pulmonary function of subjects with spinal

cord injury (SCI), which they attributed to decline level of physical fitness. The literature features few studies on the effects of wheelchair sports training on respiratory muscle strength. Furthermore, the majority of these studies evaluated only subject with SCI (Pereira et al., 2016).

Between group comparison of Vo2 max has no differences found but in within experimental analysis p value was <.05 as well as also in within control group Vo2 max represented the significant changes after 4 weeks' physiotherapy intervention. A recent Randomized controlled trial where control group received usual treatment and experimental group received treadmill training and 6-minute walk test for 12 weeks. They also reported that no between-group difference but significant changes observed in control group (Wouda, Lundgaard, Becker, & Strøm, 2018). Another study also stated that the changes of Vo2 max after spinal cord injury depend on extending of lower limb paralysis (Hoque et al., 2018).

In quantitative analysis of 6MPT in this study showed that the significant improvement in case of paraplegic person with SCI after physiotherapy intervention. The 6-MPT has the potential to be an effective tool for physicians and researchers. In the present study within control and experimental group respondents recover heart rate and also enhance cardiorespiratory fitness. Some experimental study asses the cardiorespiratory fitness of the paraplegic SCI using 6MPT. The study included 47 randomly chosen individuals with spinal cord injuries. The 6-minute push test distance and heart rate recovery were measured. The average 6-minute push test distance was computed. Patients with a longer 6-minute push test distance had quicker heart rate recovery (Solanki, Chaudhari, & Bhise, 2016).

Study Limitation

The study had some limitations, the researcher tried to minimize the limitations yet there were some to mention. If the duration of the study is longer, the sample size will be larger so this is the limitation of my study. For the ensuring of the generalization of the research it is recommended to investigate large sample. As a first researcher, may be the lack of knowledge and experience. In this type of relevant study are not available in Bangladesh so the research related information is limited.

CHAPTER-VI : CONCLUSION AND RECOMMENDATION

High proportion of SCI in Bangladesh was due to traumatic causes, which were preventable. SCI, a disability-oriented injury seems to occur mostly in young males of low social status, in terms of education, occupation and income in their productive years, demolishing their physical and earning capability leading to grievous problem at individual, family and social level. Paraplegic SCI has low level of physical

outdoor activity that is the main source of decrease physical fitness of the wheelchair basketball trainee. Therefore, appropriate physiotherapy intervention and use appropriate measurement tools to find out the effectiveness of endurance training. Most of the persons with SCI had died with respiratory complication. The current study proved that the changes was significant in within group analysis after 4 weeks (3 to 5 set 5 repetitions per day for 5 days)' intervention. Endurance along with usual physiotherapy had beneficial effect on the improvement in cardiorespiratory area of the paraplegic wheelchair basketball trainee who sustained spinal cord injury. Physiotherapy also play important role for their improvement.

From this research, researcher concluded the specific variables and comparison of their improvement in within and between group. This will research helps the professionals to prediction patient's recovery time and progress. Though the study had some limitations but investigator identified some further step that might be taken for the better accomplishment of future research. We need to do more research on this subject. Randomized control trial is recommended in future with larger sample size. would give a specific result about their cardiorespiratory fitness. The duration of the study was short, the intervention was provided only for 4 (3 to 5 set 5 repetitions per day for 5 days) weeks, so in future wider time would be taken for conducting the study. The ratio of the male and female participants were not equal, in case of further the equality of the male and female respondents should be maintained for the accuracy of the result.

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Appendix-A

(Please read out to the participants)

Verbal Consent Form

Assalamualaikum / Greetings,

I am Kulsum Akter, Part-(II) M.Sc. in Physiotherapy student of Bangladesh Health Professions Institute (BHPI) under Medicine faculty of University of Dhaka. To obtain my Master's degree, I shall have to conduct a thesis and it is a part of my study. The participants are requested to participate in the study after reading the following:

My research title is **"Effectiveness of Cardiorespiratory Endurance Training for Wheelchair Basketball Trainees who sustained Paraplegic Spinal Cord Injury".** Through this study, I will find the effectiveness of cardiorespiratory endurance training for the basketball players who sustained paraplegic spinal cord injury. If I can complete the study successfully, effectiveness of cardiorespiratory function of peoples who are suffering paraplegic SCI may be drawn out. To implement my thesis, I need to collect data from SCI unit, CRP. Therefore, you could be one of my valuable subjects for the study.

I am committed that the study will not pose any harm or risk to you. You have the absolute right to withdraw or discontinue at any time without any hesitation or risk. I will keep all the information confidential which I obtained from you and personal identification of the participant would not be published anywhere.

If you have any query about the study, you may contact with me and my supervisor Professor Dr. Mohammad Sohrab Hossain, physiotherapy department (BHPI) & Executive director (CRP).

Do you have any questions before I start? So, may I have your consent to proceed with the interview? Yes……. No……

Signature of the participant & Date …….

Signature of the witness …….

Signature of the researcher & Date …….

সম্মতিপত্র বাংলা

(অংশগ্রহনকারীকে পড়ে শোনাতে হবে)

আসসালা্মুআলাইকুম,

আমি কুলছুম আক্তার, আমি এই গবেষনা প্রকল্পটি বাংলাদেশ হেলথ প্রফেশন্স ইন্সটিটিউট (বিএইচপিআই) এ পরিচালনা করছি যা আমার ৪র্থ বর্ষ বি এস সি ইন ফিজিওথেরাপী কোর্সের অধিভুক্ত।

আমি "সি আর পি তে মেরুরজ্জুতে আঘাত প্রাপ্ত হুইলচেয়ার বাস্কেটবল খেলোয়াড় ব্যক্তিদের – শ্বাস প্রশ্বাস সমন্ধনীয় প্রভাব" এর উপর গবেষনা করছি। আমি এক্ষেত্রে আপনাকে কিছু ব্যক্তিগত এবং সংশ্লিষ্ট বিষয়ের উপর কিছু প্রশ্ন করতে চাচ্ছি। এতে আনুমানিক ২০-৩০

মিনিট সময় লাগবে। আমি আপনাকে আশ্বস্থ করছি যে এটা আমার অধ্যয়নের অংশ এবং যা অন্য কোনো উদ্দেশ্যে ব্যবহৃত হবে না। এই গবেষনায় আপনার অংশগ্রহন বর্তমান ও ভবিষ্যত চিকিৎসাতে কোনো প্রকার প্রভাব ফেলবে না। আপনি যে সব তথ্য প্রদান করবেন তার গোপনীয়তা বজায় থাকবে এবং আপনার প্রতিবেদনের ঘটনা প্রবাহে এটা নিশ্চিত করা হবে যে এই তথ্যের উৎস অপ্রকাশিত থাকবে। এই গবেষনায় আপনার অংশগ্রহন স্বেচ্ছায় প্রনোদিত এবং আপনি যে কোনো সময় এই গবেষনা থেকে কোনো নেতিবাচক ফলাফল ছাড়াই নিজেকে প্রত্যাহার করতে পারবেন। এছাড়াও কোনো নির্দিষ্ট প্রশ্নে আপনি উত্তর দিতে না চাইলে সাক্ষাৎকারের যে কোনো সময় আপনার উত্তর না দেয়ার অধিকার ও আছে।

এ গবেষনায় অংশগ্রহনকারী হিসেবে যদি আপনার কোন প্রশ্ন থাকে তাহলে আপনি আমাকে অথবা আমার সুপারভাইজার মুহাম্মদ ওবায়দুল হক, বিভাগীয় প্রধান, ফিজিওথেরাপী, বিএইচপিআই, সিআরপি, সাভার, ঢাকা-তে যোগাযোগ করতে পারেন।

আমি কি আপনার অনুমতি নিয়ে সাক্ষাৎকার শুরু করতে পারি?

হ্যা ☐ না ☐

অংশগ্রহনকারীর স্বাক্ষরঃ তারিখঃ

উপাত্ত সংগ্রহকারীর স্বাক্ষরঃ তারিখঃ

স্বাক্ষীর স্বাক্ষরঃ তারিখঃ

Appendix- B

English questionnaire:

"Effectiveness of Cardiorespiratory Endurance Training for Wheelchair Basketball Trainees who sustained Paraplegic Spinal Cord Injury"

1. Personal information

1.1	Identification number:
1.2	Name of respondents:
1.3	Age: ☐ Years
1.4	Phone number:

2. Socio-demographic information

(Please put the √ mark in the box).

Question and filters	**Response**	
2.1	Address:	
2.2	Sex	☐ 1=Male ☐ 2=Female
2.3	Marital status	☐ 1=Married ☐ 2=Unmarried ☐ 3=Widow/widower ☐ 4= Divorcee
2.4	Educational status	☐ 1= No formal education ☐ 2=Primary education ☐ 3=Secondary education ☐ 4=Higher secondary ☐ 5=Bachelor or above
2.5	Previous occupation	
2.6	Living area	☐ 1=Rural ☐ 2=Semi Urban ☐ 3=Urban
2.7	Average monthly income of family	

3. Spinal cord injury related information

3.1	Date of injury	
3.2	Causes of traumatic injury	☐ 1= Fall from height ☐ 2= Fall while carrying heavy load on head ☐ 3= Fall of heavy object on neck

		☐ 4= Fall of heavy object on back ☐ 5= Road traffic accident (RTA) ☐ 6= Others
3.3	Pressure sore on admission at CRP	☐ 1= Present ☐ 2= Absent
3.3	Complications	☐ 1= Pressure sore ☐ 2= Pneumonia ☐ 3= Urinary tract infection ☐ 4= Postural hypotension ☐ 5= Autonomic dysreflexia ☐ 5= Others
3.4	Rehabilitation duration at CRP	Day/ Month/ Year
3.5	Caregiver Support	☐ 1= Yes ☐ 2= No

4. Cardiorespiratory endurance training and wheelchair basketball sports related question

(Data were taken at baseline and after 6 weeks' cardiorespiratory endurance training)

		Baseline	**After training**
4.1	Blood Pressure	1. Systolic = 2. Diastolic =	1. Systolic = 2. Diastolic =
4.2	Oxygen Saturation		
4.3	Pulse		

4.4	Speed of Expiration		
4.5	Speed of Inspiration		
4.6	VO2 Max		
4.7	6 min Push Test		

বাংলা প্রশ্নোত্তর

"মেরুরজ্জুতে আঘাত প্রাপ্ত প্যারাপ্লেজিক হুইলচেয়ার বাস্কেটবল খেলোয়াড়দের উপর কার্ডিওরেসপিরেটরি সহনশীলতা প্রশিক্ষণের কার্যকারিতা"

১। ব্যক্তির তথ্য

১. ১	সনাক্তকরণ নম্বরঃ
১. ২	উত্তরদাতাদের নামঃ
১. ৩	বয়সঃ ☐ বছর
১. ৪	ফোন নম্বরঃ

২। আর্থ-সামাজিক তথ্যাবলি

(অনুগ্রহপূর্বক নিচের প্রশ্নগুলোর মধ্যে সঠিক উত্তরের ডান পাশে টিক (√) চিহ্ন)

	প্রশ্ন	উত্তর
২.১	ঠিকানা	
২.২	লিঙ্গ	☐ ১=পুরুষ ☐ ২= মহিলা
২.৩	বৈবাহিক অবস্থা	☐ ১=বিবাহিত ☐ ২=অবিবাহিত ☐ ৩= বিধবা/বিপত্নীক ☐ ৪= বিবাহ বিচ্ছিন্ন
২.৪	শিক্ষাগত অবস্থা	☐ ১= কোন প্রাতিষ্ঠানিক শিক্ষাবিহীন ☐ ২= প্রাথমিক শিক্ষা

		☐ ৩= মাধ্যমিক শিক্ষা ☐ ৪= উচ্চ মাধ্যমিক ☐ ৫= স্নাতক ডিগ্রী
২.৫	পূর্ব পেশা	
২.৬	বসবাসের এলাকা	☐ ১= গ্রামীণ ☐ ২= আধা শহুরে ☐ ৩= শহুরে
২.৭	পরিবারের গড় মাসিক আয়	

৩. মেরুদণ্ড আঘাত সংক্রান্ত সম্পর্কিত তথ্য

৩.১	আঘাতের তারিখ	
৩.২	দুর্ঘটনা জনিত আঘাতের কারন	☐ ১ = উচু স্থান থেকে পড়ে যাওয়া ☐ ২ = ভারী ভার মাথায় বহন করতে গিয়ে পড়ে যাওয়া ☐ ৩ = ঘাড়ে ভারী বস্তুর পতন ☐ ৪ = পিঠে ভারী বস্তুর পতন ☐ ৫ = সড়ক দুর্ঘটনা ☐ ৬ = অন্যান্য

		☐ ৩= মাধ্যমিক শিক্ষা ☐ ৪= উচ্চ মাধ্যমিক ☐ ৫= স্নাতক ডিগ্রী
২.৫	পূর্ব পেশা	
২.৬	বসবাসের এলাকা	☐ ১= গ্রামীণ ☐ ২= আধা শহুরে ☐ ৩= শহুরে
২.৭	পরিবারের গড় মাসিক আয়	

৩. মেরুদণ্ড আঘাত সংক্রান্ত সম্পর্কিত তথ্য

৩.১	আঘাতের তারিখ	
৩.২	দুর্ঘটনা জনিত আঘাতের কারন	☐ ১ = উচু স্থান থেকে পড়ে যাওয়া ☐ ২ = ভারী ভার মাথায় বহন করতে গিয়ে পড়ে যাওয়া ☐ ৩ = ঘাড়ে ভারী বস্তুর পতন ☐ ৪ = পিঠে ভারী বস্তুর পতন ☐ ৫ = সড়ক দুর্ঘটনা ☐ ৬ = অন্যান্য

Dear Bulbul bhai
Please assist her
Swapnil 18/1/2024

Permission Letter

1st January, 2024

To

The Head of the Department

Department of Physiotherapy

Centre for the Rehabilitation of the Paralysed (CRP)

Chapain,Savar,Dhaka-1343.

Through: Head, Department of Physiotherapy, BHPI.

Subject: Prayer for seeking permission to collect data for conducting research project.

Sir,

With due to respect and humble submission to state that I am Kulsum Akter, student of Part-II M.Sc. in Physiotherapy at Bangladesh Health Professions Institute (BHPI). This is a two-year full time course. The Ethical committee has approved my research project entitled: **"Effectiveness of Cardiorespiratory Endurance Training for Wheelchair Basketball Players who sustained Paraplegic Spinal Cord Injury"**- under the supervision of Professor Dr. Mohammad Sohrab Hossain, Department of Physiotherapy, BHPI, CRP-Savar, Dhaka-1343.I want to collect data for my research project from the Department of Physiotherapy at CRP. So, I need permission for data collection from the SCI Unit of Physiotherapy Department at CRP-Savar, Dhaka-1343 and ensure that the study will not be harmful for participants.

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

Sincerely,

Kulsum Akter

Kulsum Akter

Part-II M.Sc. in Physiotherapy,

Roll: 11, Session: 2021-22

BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Forwarded to HOD ERP
PT Dept. CRP
Savar
1/01/24

Approved
2/01/24

BANGLADESH HEALTH PROFESSIONS INSTITUTE

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

Ref: CRP-BHPI/IRB/10/2023/793 Date: 28/10/2023

To
Kulsum Akter
Part- II, M.Sc. in Physiotherapy
Session: 2021-2022, Roll:11
Student ID: 111210107BHPI, CRP, Savar, Dhaka-1343, Bangladesh.

Subject: Approval of the thesis proposal "Effectiveness of Cardiorespiratory Endurance Training for Wheelchair Basketball trainees who sustained Paraplegic Spinal Cord Injury" by ethics committee.

Dear Kulsum Akter,
Congratulations!
The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above mentioned dissertation, with yourself, as the thesis supervisor "Dr. Mohammad Sohrab Hossain". The Following documents have been reviewed and approved:

Sl. No.	Name of the Documents
1	Thesis Proposal
2	Questionnaire (English & / or Bengali version)
3	Information sheet & consent form.

The purpose of the study is to determine the effectiveness of cardiorespiratory endurance training on wheelchair basketball trainees with paraplegic spinal cord injury people at CRP. The study involves the use of a Semi- structured questionnaire exploring the effect of cardiorespiratory endurance training on wheelchair basketball trainees with SCI that may take 20 to 30 minutes to fill in the questionnaire or participate in the collection of specimen and there is no likelihood of any harm to the participants. Informed that consent will be received from all participants, data will be kept confidential. The members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at **09:00 am on 17th September, 2023 at BHPI (37th IRB Meeting).**

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring in the course of the study, any revision in the protocol and patient information or informed consent and ask to be provided a copy of the final report.

This Ethics committee is working accordance to Nuremberg Code 1947, World Medical Association Declaration of Helsinki, 1964 - 2013 and other applicable regulation.

Best regards,

Muhammad Millat Hossain
Associate Professor and Course coordinator, MRS
Member Secretary, Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

সিআরপি-চাপাইন, সাভার, ঢাকা-১৩৪৩, বাংলাদেশ। ফোন: +৮৮ ০২ ২২৪৪৪৫৪৬৪-৫, +৮৮ ০২ ২২৪৪৪১৪০৪, মোবাইল: +৮৮ ০১৭৩০ ০৫৯৬৪৭
CRP-Chapain, Savar, Dhaka-1343, Bangladesh. Tel: +88 02 224445464-5, +88 02 224441404, Mobile: +88 01730059647
E-mail : principal-bhpi@crp-bangladesh.org, Web: bhpi.edu.bd

To

The Chairmen

Institutional Review Board (IRB)

Bangladesh Health Professions Institute (BHPI)

CRP-Savar, Dhaka-1343, Bangladesh

Subject: Application for review and ethical approval.

Sir,

With due respect and humble submission to state that I am Kulsum Akter, student of Part-II M.Sc. in Physiotherapy at Bangladesh Health Professions Institute (BHPI). This is a 2 (two) year full time course. Conducting thesis project is partial fulfillment of the requirement for the degree of M.Sc. in physiotherapy. I have to conduct a thesis entitled, **"Effectiveness of Cardiorespiratory Endurance Training for Wheelchair Basketball Players who sustained Paraplegic Spinal Cord Injury"**-under the supervision of Professor Dr. Mohammad Sohrab Hossain, Department of Physiotherapy, BHPI, CRP-Savar, Dhaka-1343. The purpose of this study is to explore the cardiorespiratory fitness status of the wheelchair basketball players with paraplegic spinal cord injury. I would like to assure that anything of my study will not be harmful for the participants and informed consent will be taken from all participants before data collection, data will be kept confidential.

I, therefore pray and hope that your honor would be kind enough to approve my thesis proposal and give me permission to start data collection and oblige thereby.

Sincerely,

Kulsum Akter

Kulsum Akter

Part-II M.Sc. in Physiotherapy, Roll: 11
Session: 2021-22, ID: 111210107

BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Recommendation from the thesis supervisor:

Professor Dr. Mohammad Sohrab Hossain

Department of Physiotherapy (BHPI)

Executive Director, CRP

Attachment: Thesis proposal including process and procedure for maintaining confidentiality, Questionnaire (English version), Informed consent.

Date: 01/04/2024

To

The Chairman

Institutional Review Board (IRB)

Bangladesh Health Professions Institute (BHPI)

CRP-Savar, Dhaka-1343, Bangladesh

Subject: Application for research study update

With due respect and humble submission to sate that I am Kulsum Akter, Student of Part-II M.Sc. in Physiotherapy at Bangladesh Health Professions Institute (BHPI). As you know of my study title is **"Effectiveness of Cardiorespiratory Endurance Training for Wheelchair Basketball Players who sustained Paraplegic Spinal Cord Injury".** I made minor correction in the title (with the consent of my supervisor) instead of the **players**, it will be **trainees**.

So my new study title will be **"Effectiveness of Cardiorespiratory Endurance Training for Wheelchair Basketball trainees who sustained Paraplegic Spinal Cord Injury".**

I therefore pray and hope that you would be kind enough to approve my application.

Kulsum Akter

Kulsum Akter

Part-II M.Sc. in Physiotherapy, Roll: 11

Session: 2021-2022, ID: 111210107

BHPI, CRP-Savar, Dhaka-1343, Bangladesh

Recommendation from the thesis supervisor:

Prof, Dr. Mohammad Sohrab Hossain

Department of Physiotherapy (BHPI)

Executive Director, CRP.