Faculty of Medicine

University of Dhaka

Effectiveness of Wheelchair Skills on Physical Activity and Stress Level of Spinal Cord Injured Persons.

By

Maisha Hoque Mifta
Master of Science in Physiotherapy
Registration no: 780
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We the undersigned certify that we have carefully read and recommended to the Faculty of Medicine, University of Dhaka, for acceptance of this thesis entitled, **"Effectiveness of Wheelchair Skills on Physical Activity and Stress Level of Spinal Cord Injured Persons",** submitted by Maisha Hoque Mifta, for the partial fulfillment 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 is not concurrently submitted in candidature for any degree.

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

- 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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Table of Contents

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List of abbreviations

ASIA	American Spinal Injury Association
BHPI	Bangladesh Health Professions Institute
BMRC	Bangladesh Medical & Research Council
CRP	Center for the Rehabilitation of the Paralysed
IRB	Institutional Review Board
PSS	Perceived Stress Scale
SCI	Spinal Cord Injury
SPSS	Statistical Package of Social Science
SPO_2	Saturation of Oxygen
WST	Wheelchair Skill Test

List of tables

List of figures

Abstract

Introduction: Injury to spinal cord is considered as a severe health condition that causes major damages to the spinal cord and ultimately results into multiple health problems of an individual. Major problems happen to individuals, their families and society as an end result of spinal cord injury (Noonan et al., 2012). Injury to the spinal cord causes various problems and individual suffers a lot through physical, psychological, economical problems. ***Methodology:*** Study design was pre experimental. Researcher selected a single group of participants. There was no control group to compare with this single group. Those selected participants received training then again examined after post training. Among the types of pre experimental designs researcher chose one group pre test and post test design. The purpose of the study is to observe the effect of the training. ***Results:*** Results of the study suggest that after training of one month wheelchair skills there were no participants in high stress level. Previously there were three participants in high stress level. Number of participants also reduced in moderate stress level. Ten participants were found in moderate stress levels which were previously fifteen in number. Ten participants were found in low stress level. Compared to tetraplegia participants paraplegia participants showed better progress. The paired t test provides t value 6.850, degrees of freedom (df) 19 with p value (p=.000).Therefore the test is statistically significant. As the t value is large than the critical value so null hypothesis is rejected. To compare the mean differences of pre test and post test physical activity t statistics test was performed. T statistics test showed t value of 3.918 with degrees of freedom 19. The t value is larger than the critical value. Thereby null hypothesis is rejected and alternative hypothesis is accepted. ***Conclusion:*** It is strongly recommended to perform a randomized controlled trial with a larger sample size. More participation of female participants should be highly recommended. Multicenter set up should be included with follow up.

Key words: Spinal cord injury, wheelchair skill test, physical activity, participants, stress level, perceived stress scale, training, wheelchair skills.

CHAPTER -I INTRODUCTION

1.1Background

Injury to spinal cord is considered as a severe health condition that causes major damages to the spinal cord and ultimately results into multiple health problems of an individual. Major problems happen to individuals, their families and society as an end result of spinal cord injury (Noonan et al., 2012). Injury to the spinal cord causes various problems and individual suffers a lot through physical, psychological, economical problems. Spinal cord injured persons also faces a lot of difficulties due to social barriers as well perception of other people who are living in the community. As spinal cord injured persons are also a part of the community still they experience many difficulties while moving, transferring, and performing daily activities due to their health condition. Spinal cord injury may happen to any person at any time throughout the globe.

Furlan, Sakakibara, Miller and Krassioukov (2013) said that it is considered the incidence spinal cord injury due to trauma globally per million is estimated between 9.2 to 246.0 cases; the incidence of spinal cord injury in America is estimated between 20.7 to 83.0 per million per year; in Europe the incidence spinal cord injury due to trauma is estimated between 8.0 to 130.6 per million in each year; in Asia and Middle East is estimated between 14.6 to 246 per million per year as well as prevalence is estimated between 236 to 1298 per million per year globally. Prevalence of spinal cord injury is also rising throughout the globe. There are very few studies that identified prevalence of traumatic and non traumatic spinal cord injury. According to Noonan et al. (2012) the prevalence of traumatic spinal cord injury is fifty one percent and prevalence of non traumatic spinal cord injury is forty nine percent in Canada. Considerable mortality and morbidity caused by spinal cord injury (Grant, Quon, & Abbed, 2015). As the end result of spinal cord injury people need to use assistive devices for their mobility and transport. Wheelchair is an essential device for mobility of a spinal cord injured person.

Spinal cord injured persons performs most of them their daily activities in a wheelchair as well as wheelchairs are considered as an ultimate mobility device for them (Qi et al., 2018). They are dependent on wheelchairs for their mobility. Spinal cord injured persons need to acquire wheelchair skill to use wheelchair for their mobility. It also enhances chances of participation in social life situation. For that reason rehabilitation professionals need to emphasize on wheelchair skill.

To identify the level of wheelchair skill of spinal cord injured persons wheelchair skill test questionnaire is an important tool. According to Kirby, Smith and Parker (2011) to identify the capability to securely and efficiently perform wheelchair skills with varying level of difficulty an effective method is wheelchair skill test. To train and assess wheelchair users, caregivers as well as clinicians a useful method is wheelchair skill program (Kirby, 2010). Wheelchair skill test is an objective testing method which is based on clinical and research experience (Rushton, Kirby & Miller, 2011). Spinal cord injured persons are dependent on wheelchairs for their daily activities, functional activities, transferring. As they are dependent on others or some sort of assistive devices for performing certain activities they suffers a lot from mental stress.

Spinal cord injured persons when suffering from mental stress it results in a negative impact on their rehabilitation process. It is really important to emphasize on their psychological well being for enhancing the rehabilitation program. To discover stress level of spinal cord injured persons along with to understand the perception of their stress level, there are several instruments. Perceived stress scale is one of them. For understanding the perception of stress, to measure the scale in which situation person's life is considered to be stressful the most widely used equipment is Perceived stress scale.

Spinal cord injury leads to various complications as well as physical, psychological and social problems. Several exercises can improve the health status, psychological status and social participation. Physical activity can improve their level of independence in performing functional activities. To remain active after spinal cord injury exercise plays an important role.

After spinal cord injury exercise can prevent secondary complications of a spinal cord injured person. Several exercises can improve circulation of blood in body and thereby improve the ability to intake oxygen effectively. Previous studies showed that excise can improve the saturation of oxygen in body. For measuring oxygen saturation in body pulse oximetry is an important and valid measurement tool. For measuring oxygenation in blood pulse oximetry is used worldwide which is a non invasive technique (Bilan, Behbahan, Abdinia & Mahallei, 2010). Accurate and objective values of peripheral oxygen are measured by pulse oximetry (Narayen et al., 2014).

1.2 Justification

Injury to the spinal cord is a major health condition that causes various health problems. Due to spinal cord injury the majority of the persons have to rely on wheelchair for their mobility. For these consequences they have to achieve some wheelchair skill along with other rehabilitation exercise. Spinal cord injury leads to various secondary problems such as psychological problems. There are no studies to see the effectiveness of wheelchair skill on physical activity and stress level of spinal cord persons. As impaired psychological status may affect spinal cord injured persons and can delay rehabilitation program.

Wheel chair has become an important mobility aid for spinal cord injured persons. Effective wheel chair skill training helps to enhance mobility performance. If training is not sufficient enough wheel chair users might find difficulty and suffers from lack of confidence about their mobility status. This will leads to negative influences on their physical activity.

From this study rehabilitation professionals will be able to recognize the level of spinal cord injured person in acquiring wheelchair skill activities which plays a vital role in rehabilitation program, effects of wheelchair skills on physical activity through measuring saturation of oxygen and stress level of spinal cord injured persons.

1.3 Aim

Aim of the study is to identify the effectiveness of wheel chair skills on physical activity and stress level of spinal cord injured persons.

1.4 Objectives

1.4.1 General Objective

To identify the effectiveness of wheel chair skills on physical activity and stress level of spinal cord injured persons.

1.4.2 Specific Objectives

- To identify the socio demographic information of the participants
- To assess the wheel chair skill level of the participants
- To determine the stress level of the participants
- To explore the level of physical activity through oxygen saturation rate

1.5. Null Hypothesis (H_0)

Wheel chair skill is not an effective training for improving physical activity and reducing stress level among spinal cord injured persons.

H_0: μ 1-μ2=0 or μ1=μ2,

There is no statistical significant difference on before and after training of wheelchair skills on improving physical activity and reducing stress level.

1.5.1 Alternative Hypothesis (H_A)

Wheel chair skill is an effective training for improving physical activity and reducing stress level among spinal cord injured persons.

H_A: μ 1-μ2 $\neq$ 0, or μ1$\neq$ μ2,

There is statistical significant difference on before and after training of wheelchair skills on improving physical activity and reducing stress level.

CHAPTER – II LITERATURE REVIEW

Miller et al. (2019) conducted a study to observe the effects of peer led wheelchair skill training program on wheel chair skill and participation among older participants. It was a randomized controlled trial. This study was conducted in communities and different rehabilitation centers at Canada. One hundred and twenty participants were screened for this study. Participants were included in this study who lives in the community, equal or more than fifty years of age, participants who are able to communicate, manual wheel chair users who are able to propel wheel chair by self for more than one hour in a day. Participants were excluded from this study if they are involved with other wheel chair training program or not able to communicate properly, if they are suffering from any kind of degenerative disease condition. Finally forty participants were recruited in this study. Eighteen participants were allocated to experimental group and twenty two participants were allocated in control group. Experimental group received peer led wheel chair training for about one and half hours. Control group received information regarding wheel chair skill training via presentations. Wheelchair Skills Test (WST), Wheelchair Skills Test Questionnaire (WST-Q), Wheelchair Use Confidence Scale for Manual Wheelchair Users-Short Form (Wheel Con-M-SF), Wheelchair Outcomes Measure (WhOM), Life Space Mobility (LSA), and Late Life Function and Disability Index (LLFDI) were the outcome measures used in this study.

Data were collected at baseline, at post intervention and after six months of post intervention. Researchers hypothesized that a peer led Wheelchair Self-Efficacy Enhanced for Use program has a moderate to large effect size on wheel chair training. It was the primary objective. The secondary objective were to find out effects of Wheelchair Self-Efficacy Enhanced for Use program on perceived wheel chair skills capacity and performance, wheel chair use self-efficacy, satisfaction with participation, life-space mobility as well participation frequency. Finally at the end of the study researchers found that peer led Wheelchair Self-Efficacy Enhanced for Use program has no greater effects on wheel chair skill training; they also found that while planning interventions for older adults' sex and depression are important factors to be considered.

Best et al. (2016) conducted a pilot randomized controlled trial to discover the effects of peer led wheel chair training program on self efficacy for manual wheel chair users. This was the primary objectives of this study. To identify effects on manual wheel chair skills capacity and performance, satisfaction with participation and life space mobility were the secondary objectives. To identify the perceived benefit was the tertiary objective. It was a parallel group randomized controlled trial. Participants were selected from community who are discharge from rehabilitation. Participants were included in this study aged nineteen years or above; able to use manual wheel chair for two hours or more than two hours per day; able to propel wheel chair for ten meters by self; participants without any cognitive problem and participants with manual wheel chair mobility goals.

Participants were excluded from this study if they received wheel chair skill training before; participants with a degenerative health condition or if unable to communicate in English. On the basis of inclusion and exclusion criteria total twenty eight participants were included in this study. Sixteen participants were included in experimental group and twelve participants were included in control group. In experimental group participants received training sessions for one and half hours for one to two sessions in a week. No training session was provided for the participants in control group. Data were collected at baseline and post intervention. Post intervention assessment was not completed by one participant. Outcome measurement tools were Wheelchair Use Confidence Scale (WheelCon3.0), wheelchair skills capacity and performance (Wheelchair Skills Test-Questionnaire (WST-Q 4.1), Life space mobility (Life-space Assessment (LSA), and satisfaction with participation (Wheelchair Outcome Measure (WhOM).

Training sessions took place at different locations of community such as research centers, public gardens and shopping malls. A manual was given to each participant and they use their own wheel chairs during the training session. At the end of the study findings suggests that peer led wheel chair training program has potential benefits. It also showed statistically significant effects on wheel chair self efficacy, capacity and performance. Researchers did not found any statistical significant difference in life space mobility and satisfaction with participation between two groups.

Wheel chair has become an important mobility aid for spinal cord injured persons. Effective wheel chair skill training helps to enhance mobility performance. If training is not sufficient enough wheel chair users might find difficulty and suffers from lack of confidence about their mobility status. Several studies are performed on wheel chair training program. Sakakibara et al. (2013) conducted a study to find out the effectiveness of wheel chair skill training on confidence level among older adults. This study was parallel group, single blind randomized controlled trial. Study setting was research laboratory of a rehabilitation center.

Participants were included in this study, aged sixty five years old, living in the community, without experience of using manual wheel chair, able to propel a wheel chair for 10 meters. Participants were excluded if they are not able to communicate in English; diagnosed with osteoporosis or osteopenia, injury of upper extremity or pain. Thirty six participants were screened for this study. Sixteen participants were excluded based on inclusion and exclusion criteria. Total twenty participants were recruited in this study. Ten participants were included in experimental group and ten participants in control group. Fifty percent of the participants were female. Participants in the experimental group received one hour training session and participants in the control group received only socialization contact for five minutes. Two types of wheel chairs are used in this study. One is elevation wheel chair and another is quickie 2 wheel chair.

At the time of training participants were given wheel chair according to their size. Outcome measurement tool was Wheel chair use confidence scale manual (WheelCon-M). This tool was used to assess confidence level among wheel chair users. This questionnaire contains sixty five items in six different areas which physical environment, activities performed, knowledge and problem solving, social situations, advocacy, and managing emotions. At the end of the study researchers found that older adults who are inexperienced in using manual wheel chair wheel chair skill training program improve their confidence level.

Scheer et al. (2016) conducted a study in Netherlands to identify the effects of low intensity wheel chair training on wheel chair skill performance, wheel chair specific fitness and activity levels in inactive people with long term spinal cord injury. It was a randomized controlled trial. Participants were included in this study who are inactive wheel chair users and suffering from spinal cord injury for more than 10 years.

Participants were excluded from the study if they had any progressive disease, psychiatric problems, musculoskeletal complaints and cardiovascular contraindications for exercise. Total twenty nine participants were recruited in this study. Among them fourteen participants were recruited in exercise group and fifteen participants were recruited in control group.

Study site was two rehabilitation centers in Netherlands. Exercise group received treatment for thirty minutes per sessions twice a week. This training program consists of wheel chair treadmill propulsion at thirty to forty percent heart rate reserve for sixteen weeks. Control group did not receive any treatment or training session. An odometer and a questionnaire were used to assess physical activity.

Data were collected at baseline, after eight weeks and after sixteen weeks. Results of the study suggest that there were no significant differences between exercise group and control group. Effects of low intensity wheel chair training on wheel chair skill performance, wheel chair specific fitness and activity levels in inactive people with long term spinal cord injury found insufficient.

A study conducted by Worobey et al. (2016) was to find out the effectiveness of group wheel chair skill training for spinal cord injured persons. It was a double blinded randomized controlled trial. Study settings were four spinal cord injury model system centers. Researchers hypothesized that wheel chair training program enhances greater improvements in capacity and performance of wheel chair skills.

Participants were included in this study aged between 18-75 years; participants who are manual wheel chair users; had a history of traumatic or non traumatic spinal cord injury; participants living in the community; participants who are able to propel wheel chair by self. One hundred and fourteen participants were recruited in this study. They were divided in to two groups.

Interventions were Wheel chair skill training program six classes for ninety minutes or two classes of active control session. Outcome measurement tools were Wheelchair Skills Test Questionnaire Version 4.2 for capacity and performance and Goal Attainment Score (GAS). Data were collected at baseline and after one month follow up. Total seventy nine participants completed follow up.

At baseline there were no significant differences in between two groups. Wheel chair skill training group showed greater improvement compared to control group. At the end of the study researchers conclude that group wheel chair skill training program improve capacity to complete manual wheel chair skills.

Gauthier et al. (2018) conducted a study to discover feasibility, safety and preliminary effectiveness of home based self managed high intensity interval training with a moderate intensity continuous training program among long term manual wheel chair users. Participants were included in this study aged between 18-65 years, manual wheel chair users; participants who are living in the community; participants who are able to propel wheel chair by self.

Eleven participants were recruited in this study. Six participants were recruited in high intensity interval training program and five participants were recruited in moderate intensity continuous training program. This training program lasts for six weeks. Both group received three sessions of forty minutes of propulsion training session in a week.

Researchers hypothesized those participants in the high intensity interval training program will showed greater improvement in cardiovascular fitness and upper limb strength compared to participants in the moderate intensity continuous training program. Before and after the training program cardiovascular fitness, upper limb strength and shoulder pain was assessed.

At the time of high intensity interval training program some participants experienced shoulder pain. At the end of the study high intensity interval training program group and moderate intensity continuous training program group did not showed any significant change in cardiovascular fitness and upper limb strength. Findings of the study suggest that high intensity interval training program is safe and feasible.

Yeo and Kwon (2018) performed a study to evaluate effectiveness of wheel chair skills training on functional activity among cervical spinal cord injured persons. To find out the effectiveness of group wheel chair skill training for improvement of wheel chair skills and upper arm skilled performance of cervical spinal cord injured persons was the objective of this study. This study was randomized controlled trial. Twenty six participants were recruited in this study. Thirteen participants were in the training group and thirteen participants were in the control group.

Participants were included in this study aged between 18-50 years; cervical spinal cord injured persons (ASIA-B, C); participants living in the community; alert and cooperative; with a stable mental condition; able to perform wheel chair skill training, without any visual impairment. There were two drop outs in this study. Twenty four participants completed this study. Study duration was eight weeks.

Training session was provided for both groups for three days per week for about one hour. Data were collected at baseline, after 4 weeks and after 8 weeks. Outcome measurement tools were Wheel Chair Skill test and Van Lieshout Test which was used to measure upper arm skill performance. In the training group participants practiced wheel chair skills for 5-10 minutes then practiced warm up for ten minutes. Then they learned new skills in the following 30-35 minutes.

Then they performed 10 minutes of warm down. Participants also performed breathing exercise, aerobics and upper extremity stretching. Participants in the control group received strengthening exercise, aerobic exercise and endurance exercise. Finally researchers suggest that wheel chair skill training program enhances functional activities among adults with cervical spinal cord injury.

Sawatzky, Rushton, Denison and Mcdonald (2012) performed a pilot study to identify the effectiveness of wheelchair skills training program for the children with spinal cord injury. This training program for children with spinal cord injury last for two days. Children were given wheelchair skill training for subsequent Saturdays. Six children were recruited in this study. Participants of this study were aged between six to fifteen years. Children were included in this study who were manual wheelchair users and able to understand instruction from the trainers.

An experienced physical therapist that has an experience of providing wheelchair skill training more than twenty five years was the trainer of this two days training program. Wheelchair skills were assessed by occupational therapist or occupational therapy students who were trained in assessing these wheelchair skills. Wheelchair training was given to participants for about nine hours each day with a lunch break. At the first day of this training program all skills were taught by the trainers with verbal instruction and proper demonstration. Proper safety measures were taken during the training session.

To measure the wheelchair skill scores a modified wheel chair skill test version 3.2 was used. Scores were measured before and after training session. Another outcome measurement tool was used known as Activity skills for kids to find out the effect of the program on participation. This measurement tool was used before training and one month after training. The scale Activity skills for kids was a thirty items of questionnaire which includes dressing, personal care, eating, transfer, locomotion, play as well as standing skills. To find out the impact and general usefulness of the program impact questionnaire was used. This questionnaire was used after four month of training program.

The pre test and post test scores of wheelchair skills training was analyzed by wilcoxon t test due to small number of participants. A qualitative content analysis was used for the impact questionnaire. At the end of the study results showed that participants achieved significant improvement in wheelchair skill test. Activity skills for kids scale showed no change in participation. Those skill training had a positive effect on children with less change of fatigue or pain suggested by the impact questionnaire. Authors conclude that children with spinal cord injury can improve their skill level by two days of training program.

Kirby et al. (2016) performed a randomized controlled trial to identify the effectiveness of manual wheelchair skill training among community dwelling veterans with spinal cord injury. Hypothesis of this study was participants who received wheelchair skill training program improved their wheelchair skill capacity and participation compared to educational group. This study was conducted in three different sites. These are James A. Haley Veterans Hospital, Charlie nor-wood veteran's administration medical center and West Roxbury campus of the veteran's administration Boston health care system. Ethical approval was taken from each of three different centers before conducting the study.

Participants were included in this study aged between eighteen to seventy five years, if manual wheelchair users and able to propel wheelchair by self, had a spinal cord injury for at least one year, willing to participate in this study and able to understand the instructions. Total one hundred and six participants were recruited in this study. Fifty three participants were recruited in the wheelchair training program group and other fifty three participants were in the educational control group. Participants were excluded from this study if medically unstable or pregnant, any kind of progressive disease, and any cardiac or respiratory condition that restricts performance. A computer generated blocked randomization was used for group allocation. Participants were randomly assigned to wheelchair training group and educational group.

Trainers of this study were trained in administrating wheelchair training program. Duration of this training program was thirty to forty five minutes. On the other hand educational control group received home based five sessions regarding nutrition, prevention of respiratory complications, infections and pressure sores and importance of exercise for forty five minutes. Outcome measures are wheelchair skill test version 4.1 and Craig handicap assessment and reporting technique. Participants were given training for about over five weeks. Data were collected at baseline, after four to five weeks and twelve months of post intervention. At the end of the study authors found that in home environment wheelchair training program improved scores of wheelchair skills capacity but in case of participation it showed less significant results.

Van der scheer et al. (2015) conducted a randomized controlled trial to investigate the effects of low intensity wheelchair training in inactive people with spinal cord injury. Researchers wanted to see the effects of wheelchair training particularly on propulsion technique. This study was conducted in two different rehabilitation centers. It was a non blinded randomized controlled trial. Total twenty nine participants were recruited in this study. Fourteen participants were in the exercise group and fifteen participants were in the control group. Participants were randomly allocated in both groups. Wheelchair training provided for sixteen weeks and duration of training session was thirty minutes.

Participants were recruited in this study if they had spinal cord injury for more than ten years and manual wheelchair users. Participants were excluded if they had any kind of psychiatric problems, contraindications to exercise, musculoskeletal problems or any progressive disease. Exercise training was given for eighteen to twenty four minutes for first four sessions and then progress to thirty minutes per sessions. Fit and skilled participants provided continuous training for thirty minutes whereas other participants were provided intermittent exercise training. Treadmill exercise blocks using a measurement wheel was attached to participant's wheelchair to assess propulsion technique. Data were assessed at baseline, eight weeks after baseline, sixteen weeks after baseline and after forty two weeks.

Data were analyzed by using Mann Whitney U test, wilcoxon test and Friedman analysis of variance. There are three drop outs in this study. Due to lack of motivation, problem of kidney stones and lack of time they stopped their training during seven or nine session. At the end of the study researchers found that there was no significant change on propulsion technique.

Ozturk and Ucsular (2011) performed a randomized controlled trail in Turkey to identify that wheelchair training program is effective for community living manual wheelchair users. Ethical approval was taken from the local ethics committee before conducting the study. Total thirty two participants were recruited in this study. Seventeen participants were in the exercise group and fifteen participants were in the control group. Participants were manual wheelchair users living in the community. Participants were recruited in this study if they were willing to participate, able to provide inform consent and able to answer questions regarding manual wheelchair use. Participants were excluded from this study if they were presented with unstable medical condition or had any emotional problem that might affect testing or training program.

Though all the participants had their own wheelchair during the training session they had to use standardized wheelchair from the rehabilitation unit. An experienced physical therapist was responsible for supervising wheelchair training program. Participants in the training group attended this training program for four weeks. Duration of this training program was forty five minutes. Training session was provided to participants for three times a week. Progression of training program was arranged from basic skill to advanced wheelchair skill. Placebo treatment was not provided for the control group. Wheelchair skill test was tested twice for both groups at the beginning of the training and after competition of training session.

Covariance analysis was used to compare the wheelchair skill test scores. Wheelchair experience and interval between tests were measured by wilcoxon signed rank test. Because of health and transportation problem eight people were dropped out from this study. Thereby total twenty four people done this study, fourteen people were in the training group and ten people were in the control group. Wheelchair skill test version 4.1 was used in this study. At the end of the study researchers found that both groups improved performance scores in wheelchair skill test but training group improved more compared to control group. Improvement found in safety scores in training group but in control group no improvement was found. Researchers conclude that community living manual wheelchair users achieved better performance and safety scores compared to control group.

Ginis et al. (2017) performed a mixed method study to investigate psychosocial factors associated with physical activity among participants with spinal cord injury who were manual wheelchair users and ambulant adults. Researchers wanted to identify psychosocial factors that explain lower level of leisure time physical activity among spinal cord injured persons. Three hundred and forty seven participants were recruited in this study. Seventy eight percent of the participants were male. Physical activity recall assessment for people with spinal cord injury was used to assess leisure time physical activity. Information was collected by a face to face interview. Duration of this face to face interview was held between 18 to 133 minutes. To find out participants perspective regarding leisure time physical activity researchers took semi structured interviews.

Subjective norms, behavioral control and intensions as well as baseline measures of leisure time physical activity was completed by the participants. Then leisure time physical activity was assessed six months later. An underestimated disability, low wheelchair skill self efficacy and experience of chronic pain these three things were revealed in qualitative analysis. All these three themes were considered as a barrier for leisure time physical activity that was experienced by the ambulant adults. Findings of this mixed method study suggest that ambulant adults showed more negative impression regarding leisure time physical activity compared to manual wheelchair users.

Ambulant adults were not much aware about the benefits of leisure time physical activity compared to manual wheelchair users. Thereby ambulant adults were found to be less active in qualitative analysis. Due to lack of wheelchair skills ambulant individuals considered wheelchair sports inaccessible for them. Researchers found negative relationship between perceived behavioral control and leisure time physical activity. In quantative and qualitative findings of this study suggest that ambulant adults need to improve wheelchair skills, raise their consciousness towards physical activity and their attitudes. Otherwise they will stay behind in terms of achieving a healthy and active life style.

Giesbrecht et al. (2013) conducted a randomized controlled trail to identify feasibility of the program enhancing participation in the community by improving wheelchair skills. To develop manual wheelchair skill among novice older adults this program enhancing participation in the community by improving wheelchair skills or EPIC wheels was introduced. It was a one month home monitored training program. This study was conducted in two metropolitan cities of Canada. This program was customized and also mobile structured training program. This training program was ten hours long and a wheelchair expert was responsible for two personalized training sessions. First training session was at the beginning and second one at the midpoint of the program. Researchers wanted to identify the effects of EPIC wheels on wheelchair skill capacity, wheelchair skill safety, wheelchair use confidence, mobility, health related quality life, satisfaction with activity performance.

Total forty participants were recruited in this study. As this study was conducted in two metropolitan cities of Canada, twenty participants were recruited in each city. These twenty participants were divided into four groups. Each group contains five members. Participants were divided into two groups training group and control group. Participants were recruited in this study who were fifty five years old, able to propel wheelchair more than one hour in a day, manual wheelchair users for less than one year, living in the community, caregiver willing to participate in this study. If participants were not able to communicate and presented with any health condition that might affect physical activity will be excluded from this study. Trainers of this program were occupational therapists with more than five years of clinical experience.

Home training session was provided for five days in a week with duration of fifteen to thirty minutes. Data were collected at baseline and after one month. Wheelchair skill test version 4.1 was used as primary outcome measure. At the end of the trail researchers conclude that this home based training program showed a greater potential effect on clinical uptake and future opportunities.

Lemay et al. (2012) performed a study to find out relationship among wheelchair skills, mobility and level of injury of spinal cord injured persons. It was a cross sectional study. This study was conducted in two different sites of Canada. Participants were recruited in this study if they were eighteen years old or above, manual wheelchair users for at least one year and able to propel wheelchair. Participants were excluded if they were presented with multiple sclerosis or cognitive impairment. Total fifty four participants were recruited in this study. To measure wheelchair skills the wheelchair skill test version 4.1 was used. It contains thirty two items.

Participants in this study were experienced manual wheelchair users both at home and in the community. Researchers wanted to identify association between their level of injury, mobility, age, experience and skills of manual wheelchair use both at the home and in the community. On the basis of qualitative analysis participants showed expertise in manual wheelchair skills. Findings of this study suggest that participant's manual wheelchair skills were related to their level of injury. Participants with impairment with their upper body faced difficulty in performing some wheelchair skills. 46.2 percent of the participants were not able to perform wheelie. Spinal cord injured persons with different degrees of trunk control could not identified by the skills of wheelchair skill test. Younger people with spinal cord injury showed much better skills of wheelchair compared to the older people.

Another finding of this study was influence of season on wheelchair mobility. Eighty percent of the participants were tested during winter season when temperature was below zero degree. Participants experienced less mobility due to cold, winter clothing, snow fall and muscular spasm. Tetraplegia and paraplegia participants showed no significant difference on wheelchair mobility at home and in the community. Finally researchers suggest that manual wheelchair skills were related to the level of injury and age of the participants.

Kirby, Groot and Cowan (2020) performed a study to find out the relationship among wheelchair skills as well peak aerobic exercise capacity of spinal cord injured persons. This study was cross sectional. Participants of this research were total twenty six in number. Convenience sampling technique was used to select participants. Eighty percent of the participants were paraplegic. Participants were included in this study if they were aged eighteen years old or above, spinal cord injured for more than six months, manual wheelchair users, and living in the community and able to propel wheelchair by self. Participants were excluded if they were presented with shoulder pain, hypertension, pregnancy, myocardial infarction, history of hospitalization and unstable angina.

Wheelchair skill test questionnaire version 4.3 was used in this study. It contains total thirty four wheelchair skills. Wheelchair skill capacity, performance and confidence scores were recorded by using zero to two ordinal scales. Percentage was calculated by using the wheelchair skill test manual. Total percentage was from zero to hundred percent. Wheelchair treadmill was used to perform the aerobic fitness test of the participants. Participants' heart rate and oxygen uptake were also measured during this time. Data were analyzed by using statistical package of social science version 20. Missing data were not present in this study.

For analysis of data researchers performed Shapiro wilks test, post hoc logistic regression analysis and spearman correlation. Findings of the study suggest that there were significant correlation found among wheelchair skill capacity, confidence and performance on regression analysis. During rehabilitation wheelchair skill training and exercise are beneficial for spinal cord injured persons who are manual wheelchair users and living in the community. Researchers marked some limitation in their study one is limited number of participants and the presence of female participants is less than the male participants which might affect the findings of the study.

Macgillivray, Janice, Dean and Sawatzky (2019) conducted a study to identify effects of motor skill based training on wheelchair propulsion biomechanics. This was a randomized controlled trial. This study was conducted among older people. Participants were fifty years old or above recruited in this study. Sixteen participants were male and eighteen participants were female. Total thirty four participants were included in this study. Participants were divided in to three groups. Those are experimental group, inactive control group and active control group. Fourteen participants were in the experimental group and ten participants in remaining each group. Experimental group received training of six sessions. Inactive control group did not receive any treatment or practice. Active control group only received uninstructed practice.

Duration of training session was about sixty minutes. This time duration was divided by two five minutes of propulsion training and then five minutes of break. During training session discussion and education regarding wheelchair propulsion also provided to participants. Increasing push angle, decreasing push frequency, decreasing negative barking force and circular wheelie pattern those were focused during training session. Trainer of this program had an experience of ten years of providing wheelchair skill training. During group allocation tester was blind. Active control group practice wheelie with a duration of sixty minutes but trainer did not give any feedback regarding their practice. Inactive control group did not receive any training. They only attended the training sessions. While collecting baseline measures participants' age, sex, weight, body mass index, education and exposure to manual wheel chair those were evaluated. Data were collected at baseline, post training and two weeks after post training.

All participants attended training sessions. Due to medical and family emergency two training sessions were missed. Data were analyzed by using statistical package of social science version 24. One way analysis of variance and chi square test were used. There was no difference in between groups regarding baseline data. There were no significant differences found in between active control group and in inactive control group. Researchers suggest that biomechanical variables can be improved by six training sessions which might reduce chances of overuse injuries.

CHAPTER-III METHODOLOGY

This study was an experimental study to identify the effectiveness of wheel chair skills on physical activity and stress level of spinal cord injured persons. To identify the effectiveness wheel chair skill test questionnaire was used; to identify the stress level among participants perceived stress scale was used and to identify physical activity oxygen saturation was measured through a pulse oximetry device.

3.1 Study design

Study design was pre experimental. Researcher selected a single group of participants. There was no control group to compare with this single group. Those selected participants received training then again examined after post training. Among the types of pre experimental designs researcher chose one group pre test and post test design. This is called a before-after study. This design is considered as pre-experimental design as it involves neither randomization or nor the use of a control group. The purpose of the study is to observe the effect of the training.

Pre-test	***Training***	***Post –test***
O_1	X	O_2

3.2 Study Site

The study site was Spinal cord injury unit, CRP, Savar, Dhaka. Centre for the rehabilitation of the paralysed (CRP) is a nongovernment organization. Centre for the rehabilitation of the paralysed (CRP) was chosen as study site because of availability of spinal cord injured persons.

3.3 Study Area

Study area was Spinal cord injury unit of Physiotherapy Department at Centre for the rehabilitation of the paralysed (CRP), Savar, Dhaka. Spinal cord injury unit was selected as study area because of accessibility for data collection.

3.4 Study population

Study population was the patients diagnosed with spinal cord injury receiving treatment from Spinal cord injury unit of Physiotherapy Department at Centre for the rehabilitation of the paralysed (CRP), Savar, Dhaka.

3.5 Sampling procedure

On the basis of inclusion and exclusion criteria from November 2019 to December 2019 twenty participants were selected from Spinal cord injury unit of Physiotherapy Department at Centre for the rehabilitation of the paralysed (CRP), Savar, Dhaka. Participants were selected in this study by hospital random sampling.

3.5.1 Inclusion Criteria

- Age ranged between 18-65 years. (Gauthier et al. 2018)
- Independent wheel chair users were included who were able to propel wheelchair by themselves
- Both paraplegic and tetraplegic (ASIA-A, B, C, D) spinal cord injured persons were included
- Spinal cord injured persons received treatment from spinal cord injury unit
- Both male and female were included
- Saturation of oxygen within normal level at least 95 percent
- Participants who were psychologically stressed regarding their present condition
- Neurological level C7-C8, T6-T12 were included in this study
- Willingness to participate in this study

3.5.2 Exclusion Criteria

- Undiagnosed with spinal cord injury
- Saturation of oxygen below normal level or less than 95 percent
- Mentally unstable patients
- Unwillingness to participate in this study
- Patients attended at wheelchair skills with their caregivers
- Unable to propel wheelchair independently

3.6 Pilot study

Before performing the study researcher performed a two weeks of pilot study. This pilot study helped researcher to draw a map of data collection procedure. This study provided a direction toward further progress of work. After getting permission of data collection researcher consult with the clinical staffs working at spinal cord injury unit. Researcher visited spinal cord injury unit and gather information regarding patients attending the wheelchair skill training, types of participants, their level of injury, willingness to participate. After performing this pilot study researcher had an idea regarding availability of patients. From this pilot study researcher gathered all important information's that provided guideline for data collection.

3.6.1 Sample size

Sample size for this study was total twenty participants. Twenty participants were selected by hospital random sampling.

3.7 Data Collection tools

Written consent form, Socio-demographic questionnaire, pulse oximetry, wheel chair skill test questionnaire (WST-Q), Version 4.3 which consists of 34 different items of individual skill those evaluate capacity, confidence and performance of wheel chair users. Wheelchair skills, Wheelchair skill capacity, performance and confidence scores were recorded by using zero to two ordinal scales. Percentage was calculated by using the wheelchair skill test manual. Total percentage was from zero to hundred percent. It is an important and valid tool for measuring wheel chair skills.

Perceived stress scale was used to evaluate stress level of spinal cord injured persons. Perceived stress scale ranges from 0-40. Scores from 0-13 indicates low stress level; scores from 14-26 indicate moderate stress level; scores from 27-40 indicate high perceived stress level. Pulse oximetry is an important tool for measuring oxygen level in blood. The normal range is between 95 to 100 percent. Below 90 percent is low level of oxygen in blood. The more oxygen in blood it will keep the body functionally active.

3.8 Data analysis

Data were collected wheel chair skill test questionnaire (WST-Q) questionnaire, Perceived stress scale and pulse oximetry device. Data will be analyzed by SPSS (Statistical package of social science) version 16. Results were comparing through paired t test, t test statistics. Results showed in table, bar charts.

3.8.1 Statistical test

Pre test and post test scores of perceived stress scale compared through paired t test to find out statistical significant differences. T test statistics was performed to compare the pre test and post test scores of physical activity. Wheelchair skill test capacity, confidence and performance scores compared through paired t test.

3.8.2 Estimated predictor

Pre and post test scores mean differences were measured through t test statistics and paired t test.

T test statistics

The t equation

$$t = \frac{\sum D}{\frac{\sqrt{(n \times \sum D^2) - \sum D^2}}{n-1}}$$

$$= \frac{36}{\frac{\sqrt{(20 \times 82) - 36}}{20-1}}$$

$$= \frac{36}{\sqrt{\frac{1640 - 36}{19}}}$$

$$= 3.918$$

Calculating the degree of freedom df = n-1

=20-1

=19

Here, n= number of participants

$\sum D$= sum of difference between pre & post test

D^2= square of difference between pre & post test

3.8.3 Level of significance

To test the hypothesis researcher used 5% level of significance. Calculated t value and compared with the critical values of t in with appropriate degrees of freedom. When the calculated t value is larger than the critical values of t than the null hypothesis will be rejected and the alternative hypothesis will be accepted.

Researcher calculated p value to find out the significance of the study. P value stands for quantitative estimate of probability. Accuracy of findings is measured by p value. If p value is less than 0.05 results considered significant. So it is called critical level of significance. If p value is equal or large than the significance level then result is not statistically significant.

3.9 Ethical consideration

A research proposal was submitted to the Institutional Review Board (IRB) of Bangladesh Health Professions Institute (BHPI) for approval and the proposal was approved by the board. Before data collection, consent was given by the Head of Department of Physiotherapy, BHPI, and CRP to ensure the safety of the participants. World Health Organization (WHO) and Bangladesh Medical and Research Council (BMRC) guideline were also following to conduct the study.

Informed consent

All participants were given a written consent form before conducting the study. Consent form was explained to the participants verbally. Purpose of the study was explained to each participant. Thereby participant can understand their role and importance in this study. Researcher also assured that the study would not be harmful for them. Their personal information will be kept confidential. They can withdraw from this study if any problem arises. They have the right to continue or withdraw from this study.

CHAPTER-IV RESULTS

Socio demographic information of the participants:

The total participants were 20. Among the twenty participants male were 90% (n=18) and female were 10% (n=2). Marital status of the participants was married 70% (n=14), unmarried 30% (n=6).

Among the twenty participants minimum age range was 18 years and maximum age range was 50 years. Mean age of the participants was 33 years and standard deviation was 9.45. Age range of the participants was divided into two groups. First age group was between (18-30 years) 50% (n=10), and second age group was between (31-50 years) 50% (n=10).

Educational status of the participants was illiterate 20% (n=4), Primary 20% (n=4), Secondary 10% (n=2), SSC 10% (n=2), HSC 35% (n=7), Madrasa 5% (n=1).

Occupation before injury was Student 15% (n=3), Business 40% (n=8), Agriculture 15% (n=3), day laborer 15% (n=3), Homemaker 5% (n=1), Service 10% (n=2). Occupation after injury was Student 10% (n=2), Business 35% (n=7), Homemaker 5% (n=1), Unemployed 50% (n=10).

Family type of the participants was Nuclear 65% (n=13), Extended 35% (n=7). Monthly income of the family <5000 was 25% (n=5), 5000-10000 was 55% (n=11), and >10000 was 20% (n=4).

Residence of the participants was Urban 5% (n=1), Rural 95% (n=19). (Table-1)

Participant's information	*Number(N)*	*Percentage (%)*
Age (years)		
18-30	10	50
31-50	10	50
Gender		
Male	18	90
Female	2	10
Marital status		
Married	14	70
Unmarried	6	30
Educational status		
Illiterate	4	20
Primary	4	20
Secondary	2	10
SSC	2	10
HSC	7	35
Madrasa	1	5
Occupation before injury		
Student	3	15
Business	8	40
Agriculture	3	15
Day laborer	3	15
Homemaker	1	5
Service	2	10
Occupation after injury		
Student	2	10
Business	7	35
Homemaker	1	5
Unemployed	10	50
Family type		
Nuclear	13	65
Extended	7	35
Monthly income		
<5000	5	25
5000-10000	11	55
>10000	4	20
Residence		
Urban	1	5
Rural	19	95

Table -1: Socio-demographic information of the participants

Injury related information of the participants:

Injury related information of the participants was traumatic spinal cord injury 90% (n=18), Non traumatic spinal cord injury 10% (n=2).

Causes of traumatic injury was fall from height 30% (n=6), Fall of heavy object 5% (n=1), Fall from tree 15% (n=3), Fall of while carrying heavy object 5% (n=1), road traffic accident 25% (n=5), others 10% (n=2).

Causes of non traumatic injury TB spine 5% (n=1), Spinal tumor 5% (n=1).

Type of paralysis of the participants was paraplegia 65% (n=13), Tetraplegia 35% (n=7). Type of injury was complete 50% (n=10), Incomplete 50% (n=10), Incomplete-B was 30% (n=6), Incomplete C was 15% (n=3), Incomplete D was 5% (n=1) (Table-2)

Injury related information	*Number*	*Percentage (%)*
Causes of injury		
Traumatic	18	90
Non traumatic	2	10
Causes of traumatic injury		
Fall from height	6	30
Fall of heavy object	1	5
Fall from tree	3	15
Fall of while carrying heavy object	1	5
Road traffic accident	5	25
Others	2	10
Causes of non traumatic injury		
TB spine	1	5
Spinal tumor	1	5
Type of paralysis		
Paraplegia	13	65
Tetraplegia	7	35
Type of injury		
Complete	10	50
Incomplete	10	50
Type of incomplete injury		
Incomplete-B	6	30
Incomplete-C	3	15
Incomplete –D	1	5

Table-2: Injury related information of the participants

Level of stress before and after training

Participants stress level was measured by perceived stress scale (PSS). Stress level measured two times before performing wheelchair skill and after performing wheelchair skill for about one month of training. Stress level was divided in to three categories low stress level, moderate stress level and high stress level. Scores between 0-13 considered low stress level, scores 14-26 considered moderate stress level and scores 27-40 considered high stress level.(Fig:-1) Figure showed before training of wheelchair low stress level found in two participants, fifteen participants were in moderate stress level and three participants were in high stress level. After training ten participants were in low stress level, ten participants were in moderate stress level and no participants found in high stress level among the twenty participants.

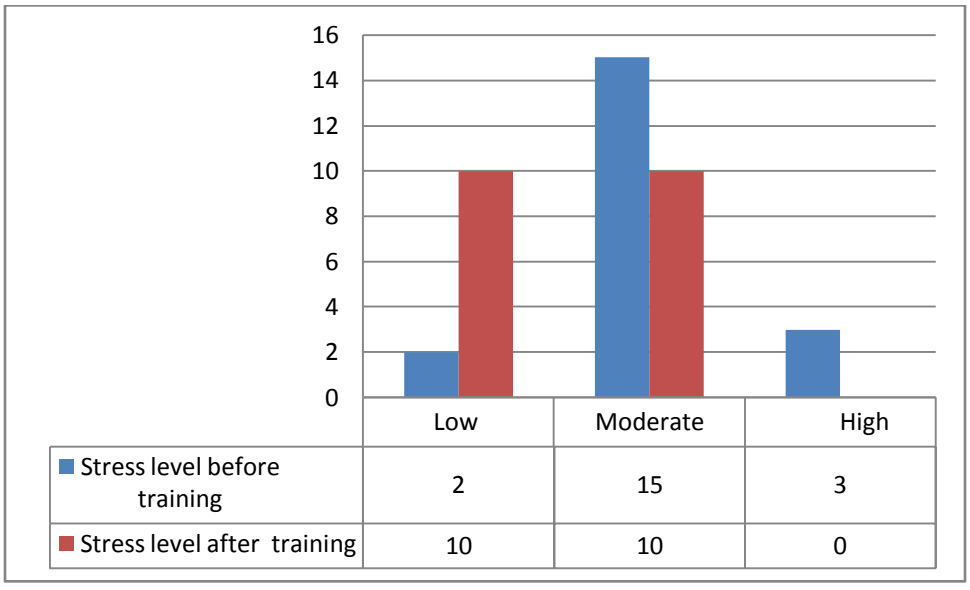

Fig: 1- Stress level before & after training

Among the 20 participants 13 participants were paraplegia. Before training there were 11participants were in moderate stress level, 2 participants in high stress level. After training 8 participants were in low stress level, 5 participants were in moderate stress level and no participants were in high stress level. Comparison of scores showed that numbers of participants were reduced in moderate & high stress level after training (Fig-2).

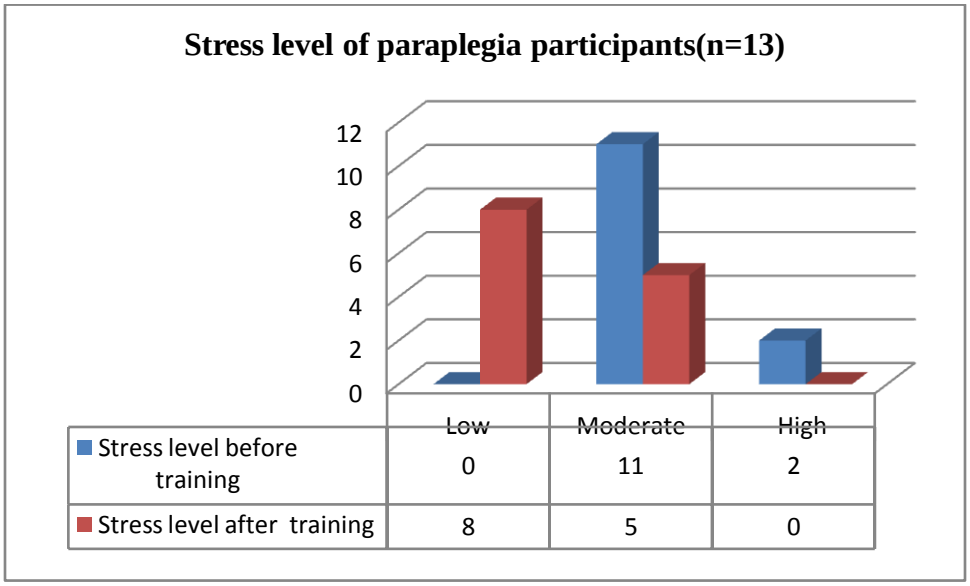

Fig: 2- Stress level of paraplegia participants

Among the 20 participants 7 participants were tetraplegia. Before training two participants were in low stress level, 4 were in moderate stress level and 1 was in high stress level. After training only one participant who was in high stress level showed moderate level of stress. Rest of the participants remained unchanged after training (Fig-3).

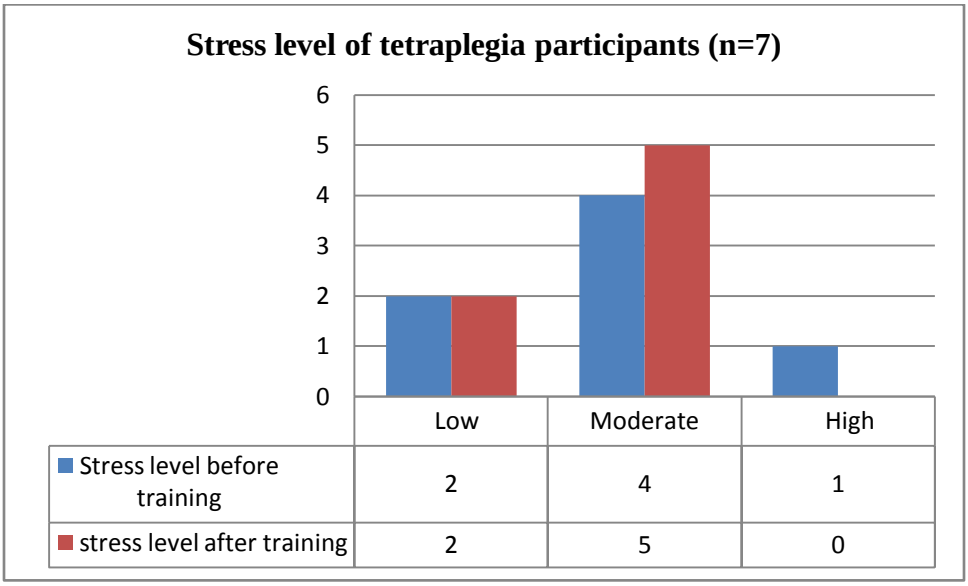

Fig-3:- Stress level of tetraplegia participants

Stress level of the participants also measured according to ASIA impairment scale. According to ASIA-A scale before training 1 participant was in low stress level, 7 participants were in moderate stress level and 2 participants were in high stress level. After training 6 participants were in low stress level, 4 participants were in moderate stress level and no participant in high stress level (Fig-4).

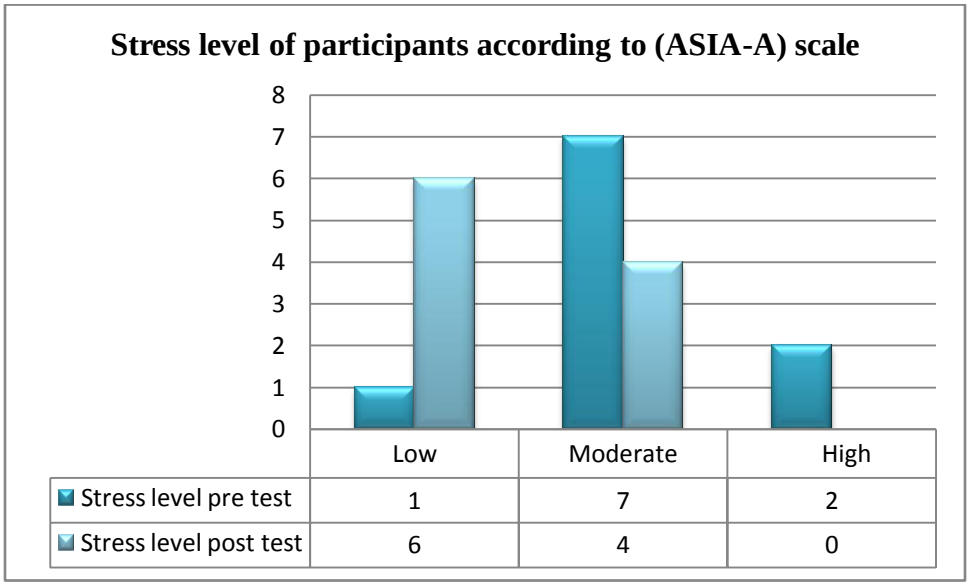

Fig: 4- Stress level of participants according to (ASIA-A) scale

Stress level of the participants according to ASIA-B scale before training 1 participant was in low stress level, 4 participants were in moderate stress level and 1 participant was in high stress level. After training 3 participants were in low stress level, 3 participants were in moderate stress level and no participant was in high stress level (Fig-5)

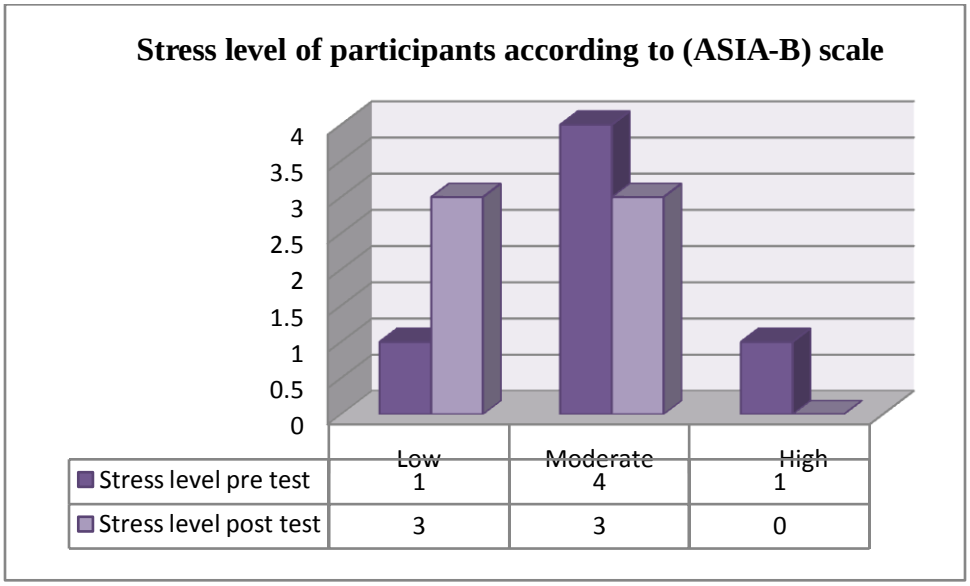

Fig: 5- Stress level of participants according to (ASIA-B) scale

Stress level of the participants according to ASIA-C scale before training 3 participants were in moderate stress level, no participant was in high and low stress level. After training 2 participants were in moderate stress level and 1 in low stress level (Fig-6)

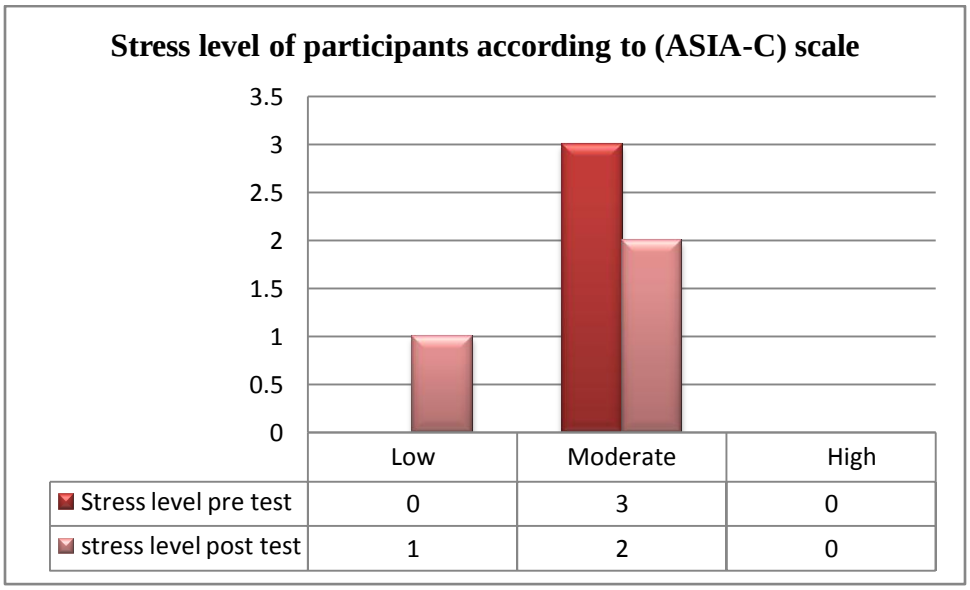

Fig: 6- Stress level of participants according to (ASIA-C) scale

Physical activity before and after training

Participants' physical activity was measured by finding saturation of oxygen through pulse oximetry device. Pulse oximetry is an important tool for measuring oxygen level in blood. The normal range is between 95 to 100 percent. Below 90 percent is low level of oxygen in blood. The more oxygen in blood it will keep the body functionally active. Thereby pulse oximetry device is used. (Table: 3) showed pre test and post test scores of twenty participants before and after training of wheelchair skills.

Participants(n)	***Pre test score SPO_2 (%)***	***Post test score SPO_2 (%)***	***Difference (D)Post test-Pre test***	***$(Difference)^2$ $(D)2$***
1	97	100	3	9
2	96	99	3	9
3	97	99	2	4
4	98	100	2	4
5	99	99	0	0
6	97	99	2	4
7	97	99	2	4
8	96	98	2	4
9	98	99	1	1
10	98	99	1	1
11	99	99	0	0
12	96	99	3	9
13	97	99	2	4
14	98	99	1	1
15	95	98	3	9
16	97	98	1	1
17	98	99	1	1
18	97	99	2	4
19	96	98	2	4
20	96	99	3	9
Sum	1942	1978	36	82
Mean	97	98	1.8	4.1

Table- 3: t statistics test

T statistics test showed t value of 3.918 with degrees of freedom 19. The t value is larger than the critical value. Thereby null hypothesis is rejected and alternative hypothesis is accepted.

Among the 13 paraplegia participants comparison between pre test and post test scores showed in (Fig-7). After training post test scores were increased. Minimum score of pre test was 97% and maximum was 98%. Minimum score of post test was 98% and maximum was 100.

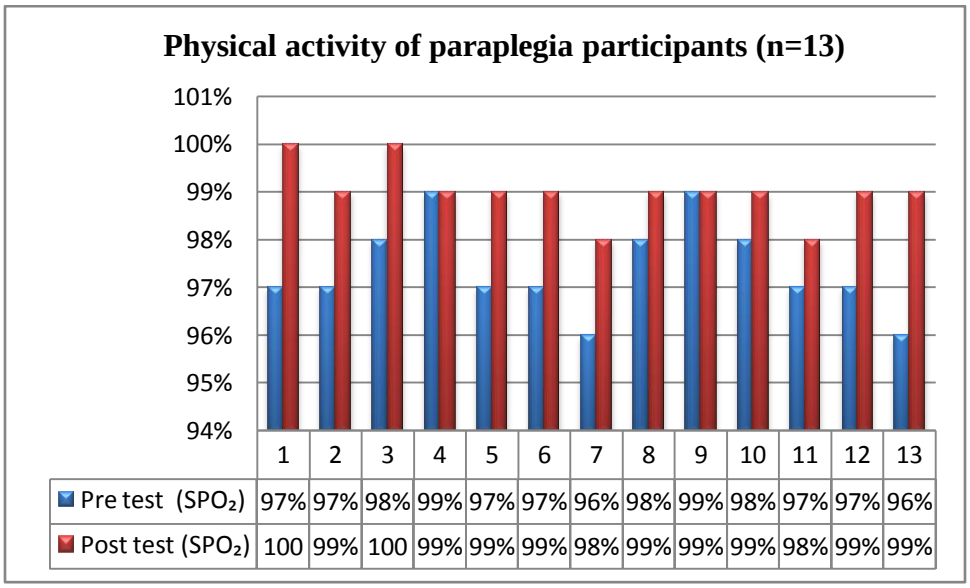

Fig: 7- Physical activity of paraplegia participants

Among the 20 participants 7 were tetraplegia. Minimum score of pre test of tetraplegia participants was 95% and maximum was 97%. Minimum score of post test was 98% and maximum score was 99% (Fig-8).

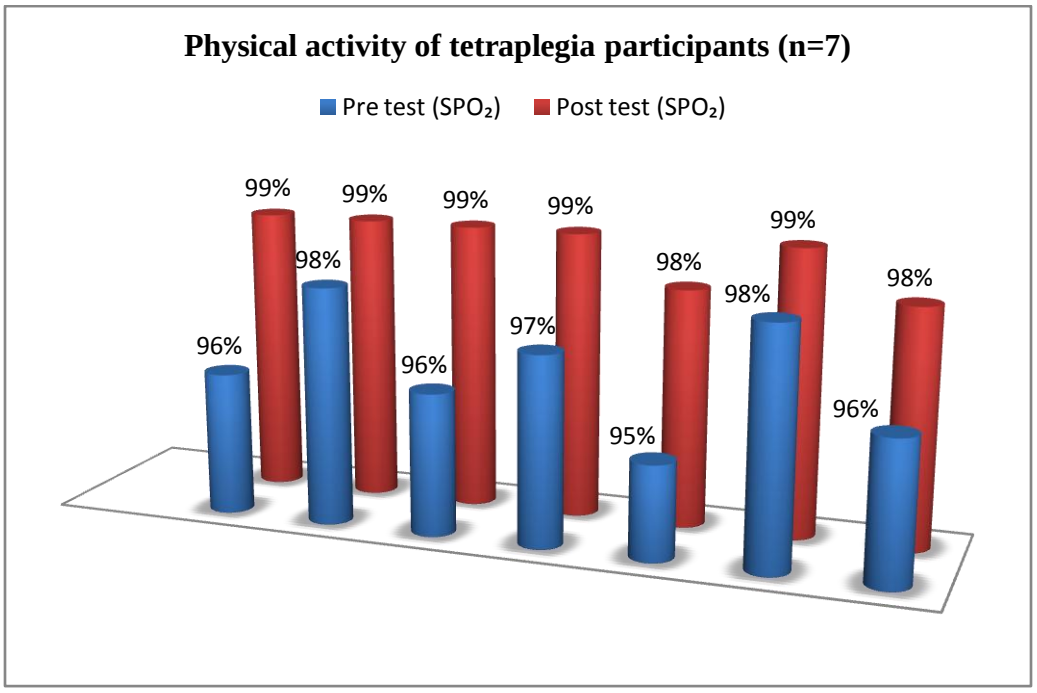

Fig: 8- Physical activity of tetraplegia participants

Wheelchair skill test (Capacity) scores before and after training

Wheel chair skill test questionnaire (WST-Q), Version 4.3 which consists of 34 different items of individual skill those evaluates capacity, confidence and performance of wheel chair users. Wheelchair skills, Wheelchair skill capacity, performance and confidence scores were recorded by using (0-2) ordinal scales. Scores were measured by calculating total score obtained in thirty four different items of individual skills. Wheelchair skill capacity scores were measured before training after training of wheelchair skills. (Fig-9) showed pre & post test scores of capacity skills in which participants' scores increased after performing wheelchair skills. Among the twenty participants pre test minimum score was 0, maximum score was 50% and post test minimum score was 7% and maximum score was 62% (Fig-9).

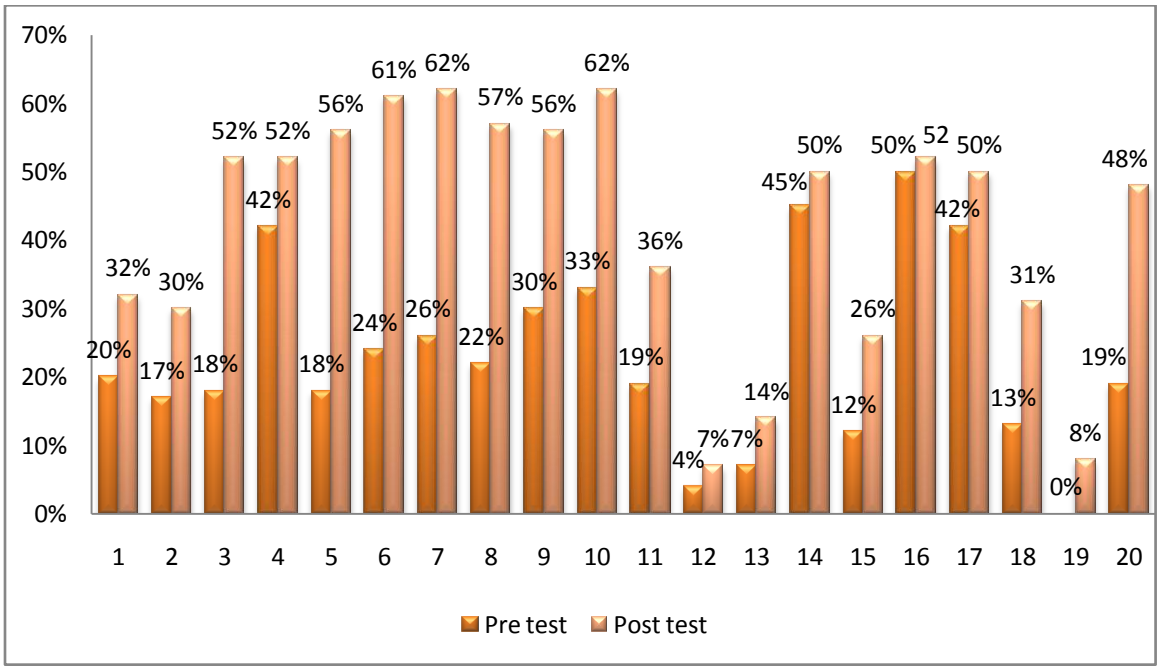

Fig: 9- Wheelchair skill test (Capacity) pre & post test scores

Wheelchair skill test scores (Confidence) before and after training

Wheelchair skill confidence scores were measured before training after training of wheelchair skills. (Fig:-10) showed pre and post test scores of wheelchair skill test confidence skills of all twenty participants. After training of wheelchair skills participants showed progress in their confidence skills. Among the all participants minimum score of pre test was 0 and maximum score was 48 and the minimum score of post test was 8 and maximum score was 58 (Fig:-10).

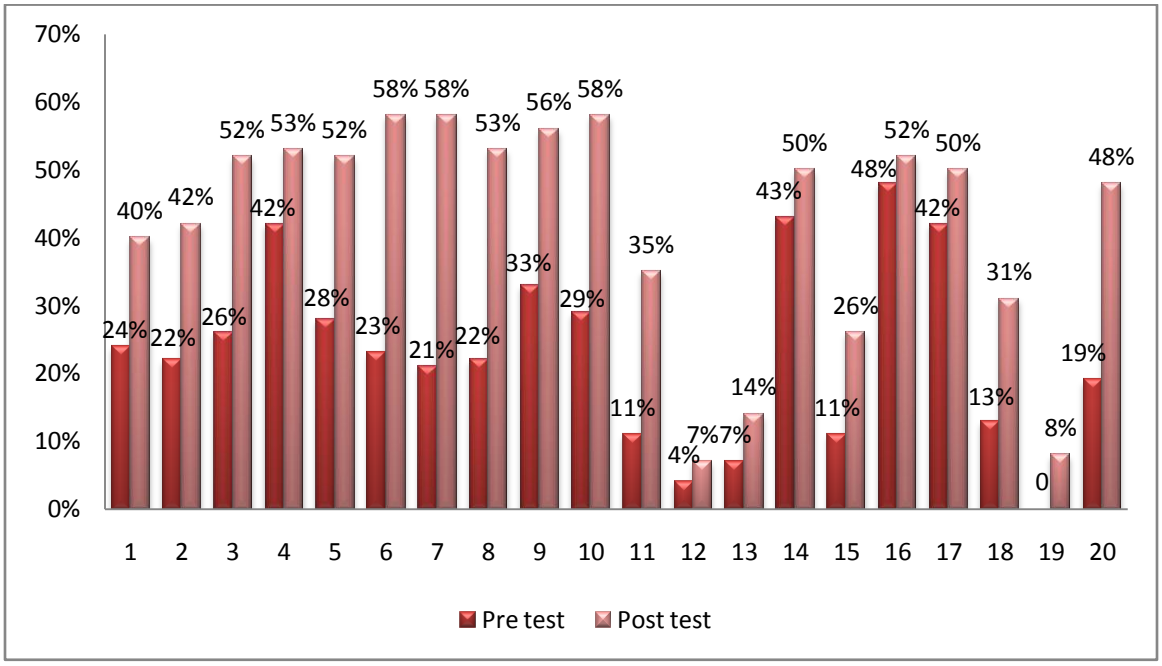

Fig: 10- Pre & Post test scores of wheelchair skills test (confidence)

Wheelchair skill test scores (Performance) before and after training

Wheelchair skill performance scores were measured before training after training of wheelchair skills. (Fig:-11) showed pre and post test scores of wheelchair skill test performance skills of all twenty participants. After training of wheelchair skills participants showed progress in their performance skills. Among the twenty participants minimum score of pre test was 0 and maximum score was 96 and the minimum score of post test was 20 and maximum score was 98 (Fig:-11)

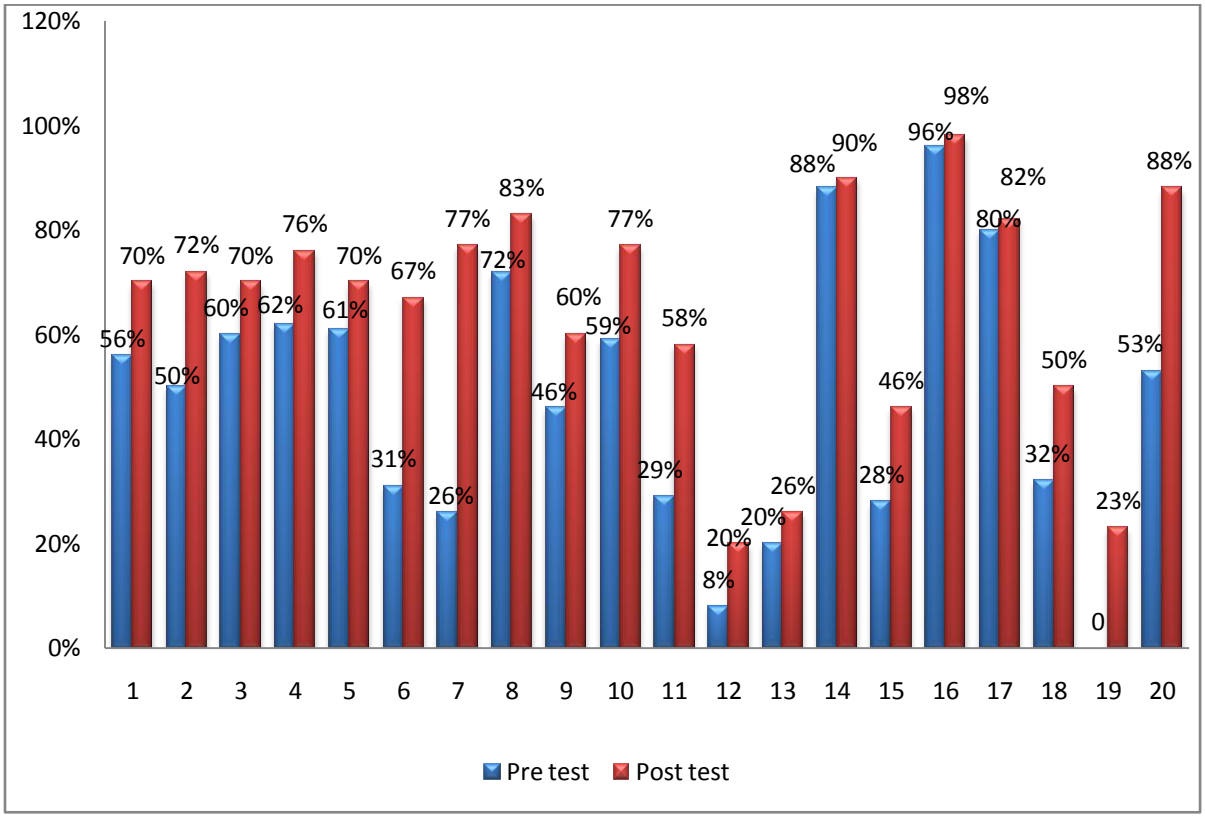

Fig: 11- Pre & Post test scores of wheelchair skill test (performance)

Perceived stress level score before and after training

Pair 1	Mean	Std. Deviation	N
Pre test score of stress level	22.0500	4.48946	20
Post test score of stress level	15.7000	3.88113	20

Table: 4- Paired sample statistics (PSS)

Sample statistics provided information about sample size (N=20), Pre test mean score 22.0500, Std. deviation 4.48946, & post test mean score 15.7000, Std. deviation 3.88113 (Table-4).

Pair 1	Mean	Standard deviation	Paired t	df	p value	95% confidence interval	
						upper	lower
Difference between pre test & post test scores	6.35000	4.14750	6.850	19	.000	8.29025	4.40975

Table: 5- Paired sample test (PSS)

The paired t test provides t value 6.850, degrees of freedom (df) 19 with p value (p=.000) (Table:-5). Therefore the test is statistically significant. As the t value is large than the critical value so null hypothesis is rejected. There is a strong evidence to conclude that the difference in before-after values is considered statistically significant.

Oxygen saturation scores before and after training

Pair 1	Mean	Std. Deviation	N
SPO_2 pre test score	97.10000	1.07115	20
SPO_2 post test score	98.90000	.55251	20

Table: 6- Paired sample statistics (SPO_2)

Sample statistics provided information regarding sample size (N=20), Pre test mean SPO_2 97.10000, Standard deviation 1.07115, and post test mean was 98.90000, Standard deviation .55251 (Table-6).

Pair 1	Mean	Standard deviation	Paired t	df	p value	95% confidence interval	
						upper	lower
Difference between pre test & post test scores(SPO_2)	-1.80000	.95145	-8.461	19	.000	-1.35471	-2.24529

Table: 7- Paired sample test (SPO_2)

The paired t test provides t value -8.461, degrees of freedom 19 with p value (p= .000) (Table-7). As the t value is large than the critical value so null hypothesis is rejected. Therefore the test is significant at any reasonable level of significant. It can be concluded that the difference in before-after values is considered statistically significant.

Wheelchair skill test (WST) capacity scores before and after training

Pair 1	Mean	Std. Deviation	N
WST capacity pre test score	23.0500	13.74380	20
WST capacity post test score	42.1000	17.86470	20

Table: 8- Paired sample statistics (WST) capacity scores

Sample statistics showed that WST pre test mean was 23.0500, Standard deviation 13.74380, and WST post test mean was 42.1000, standard deviation 17.86470, with sample size (N=20) (Table-8)

Pair 1	Mean	Standard deviation	Paired t	df	p value	95% confidence interval	
						upper	lower
Difference between pre test & post test scores (Capacity)	-1.905E1	12.62193	-6.750	19	.000	-13.14275	-24.95725

Table 9: Paired samples test (WST) capacity scores

The paired t test provides t value -6.750 with p value (p= .000) (Table-9). Therefore the test is significant at any reasonable level of significant. It can be concluded that the difference in before-after values is considered statistically significant.

Wheelchair skill test (WST) confidence score before & after training

Pair 1	Mean	Std. Deviation	N
WST confidence pre test score	23.40000	13.51568	20
WST confidence post test score	42.1500	16.64577	20

Table: 10- Paired sample statistics (WST) confidence scores

Sample statistics showed that WST confidence pre test mean 23.40000, standard deviation 13.51568, and WST confidence post test mean 42.1500, standard deviation 16.64577, with sample size (N=20) (Table-10).

Pair 1	Mean	Standard deviation	Paired t	df	p value	95% confidence interval	
						upper	lower
Difference between pre test & post test scores (Confidence)	-1.875E1	10.61218	-7.902	19	.000	-13.78335	-23.71665

Table: 11- Paired samples test (WST) confidence scores

The paired t test provides t value -7.902 with p value (p=.000) (Table- 11). Therefore the test is statistically significant. There is a strong evidence to conclude that the difference in before-after values is considered statistically significant.

Wheelchair skill test (WST) performance score before and after training

Pair 1	Mean	Std. Deviation	N
WST performance pre test score	47.8500	25.86254	20
WST performance post test score	65.1500	22.19833	20

Table 12:- Paired sample statistics (WST) performance score

Sample statistics showed wheelchair skill test (performance) pre test mean was 47.8500, standard deviation 25.86254, and post test mean was 65.1500, standard deviation 22.19833, with sample size (N=20).

Pair 1	Mean	Standard deviation	Paired t	df	p value	95% confidence interval	
						upper	lower
Difference between pre test & post test scores (Performance)	-1.730E1	12.65785	-6.112	19	.000	-11.37595	-23.22405

Table: 13- Paired samples test (WST) performance scores

The paired t test provides t value -6.112 with p value (p=.000) (Table- 13). Therefore the test is statistically significant. There is a strong evidence to conclude that the difference in before-after values is considered statistically significant.

CHAPTER -V DISCUSSION

This study was an experimental study to identify the effectiveness of wheel chair skills on physical activity and stress level of spinal cord injured persons. To identify the effectiveness wheel chair skill test questionnaire was used. Wheelchair skill test is a valid questionnaire to identify wheelchair skill level of individual wheelchair users on the basis of total scores of three domains capacity, confidence and performance. Individual wheelchair skill levels were measured before and after training of wheelchair skills. To identify the stress level among participants perceived stress scale was used. Perceived stress scale (PSS) consists of ten questions. On the basis of these questions participant's level of stress was identified. There were three categories of stress level low stress level, moderate stress level and high stress level. Individual stress levels were also measured before and after training of wheelchair skills. To identify physical activity oxygen saturation was measured through a pulse oximetry device. Saturation of oxygen measured twice before and after training of wheelchair skills.

Study design was pre experimental. Pre experimental means criteria of true experimental study was absent in this research which are control group and randomization. Researcher selected a single group of participants. There was no control group to compare with this single group. Those selected participants received training then again examined after post training. Among the types of pre experimental designs researcher chose pre test and post test design. The purpose of this research was to identify the effects of training thereby researcher chose this one group pre test and post test design.

Data were collected from Spinal cord injury unit of Physiotherapy Department at Centre for the rehabilitation of the paralysed (CRP), Savar, Dhaka. Total participants were twenty. Participants were collected by hospital random sampling. Single group pre test and post test design was used to conduct this study. Data were collected before training of wheelchair skills and again data were collected after one month of training.

Compared to the male participants there were less number of female participants in this study. Among the twenty participants male were 90% (n=18) and female were 10% (n=2). Numbers of the female participants were less compared to male participants who were attended at wheelchair skills. For this reason researcher collected data of only two female participants. Fourteen participants were married and six participants were unmarried.

Among the twenty participants minimum age range was 18 years and maximum age range was 50 years. Mean age of the participants was 33 years and standard deviation was 9.45. Age range of the participants was divided into two groups. First age group was between (18-30 years) 50% (n=10), and second age group was between (31-50 years) 50% (n=10). In both groups there were equal numbers of participants.

Four participants were illiterate among the twenty participants. Four participants studied in primary level. Two participants studied in secondary level and SSC. Seven participants completed HSC and only one participant studied in madrasa. Before injury three participants were student. Eight participants did business, three participants did agriculture. Three participants were day laborer. Only one participant was homemaker. Two participants did service job. After injury fifty percent of the participants became unemployed. After injury two participants were student. Seven participants did business and only one participant was homemaker.

Findings of the study showed family type of the participants was Nuclear 65% (n=13), Extended 35% (n=7). Monthly income of the family <5000 was 25% (n=5), 5000-10000 was 55% (n=11), and >10000 was 20% (n=4). Residence of the participants was Urban 5% (n=1), Rural 95% (n=19). Most of the participants lived in rural area. Findings of the study provided information regarding socioeconomic condition as well as injury related information of the participants.

Findings of the study showed that eighteen participants were presented with traumatic spinal cord injury whereas two participants were presented with non traumatic spinal cord injury. Ninety percent of the participants were presented with a history of traumatic spinal cord injury. Causes of spinal cord injury were fall from height, fall of heavy object, fall from tree, fall of while carrying heavy object and road traffic accidents. Among them most common causes were road traffic accidents and fall from height. Tuberculosis of spine and spinal tumor were the causes of non traumatic spinal cord injury.

Thirteen participants were paraplegia and seven participants were tetraplegia. Fifty percent of the participants were complete and fifty percent of the participants were incomplete. Ten participants were complete A. Six participants were incomplete B, three participants were incomplete C and only one participant was incomplete D. Clinical data of the participants also provided information regarding physical status of the participants. Thirteen participants were presented with paralysed lower limb, four participants were presented with paralysed four limbs and three participants were presented with weakness in all four limbs.

All these participants attended at wheelchair skills at spinal cord injury unit of center for the rehabilitation of the paralysed. Participants attended at wheelchair skills every week from Saturday to Wednesday. Total five days in a week. Time duration of wheelchair skills was 3.30-4.00pm. Participants performed different types of wheelchair skills under the supervision of Clinical physiotherapists, Intern physiotherapists and Occupational therapists. Participants took one month of training of wheelchair skills. Data were collected before training and after one month of training of wheelchair skills. Information gathered from participants two times to see the effects of training on physical activity and the level of stress of the participants. Individual wheelchair skill levels were measured before training and after four weeks of training all these participants were reexamined if there any change or improvement in their skills or remain same as before.

Participants stress level was measured by perceived stress scale (PSS). Stress level measured two times before performing wheelchair skills and after performing wheelchair skills for about one month of training. Perceived stress level consists of ten questions to identify stress level of the participants. Stress level was divided in to three categories low stress level, moderate stress level and high stress level. Scores between 0-13 considered low stress level, scores 14-26 considered moderate stress level and scores 27-40 considered high stress level. Among the twenty participants before training of wheelchair skills low stress level found in two participants, fifteen participants were in moderate stress level and three participants were in high stress level. After training of wheelchair skills ten participants were in low stress level, ten participants were in moderate stress level and no participants found in high stress level among the twenty participants.

There were differences found in between pre test and post test scores of perceived stress scale (PSS). Participants were presented with different level of stress after performing wheelchair skills. Results of the study suggest that after training of one month wheelchair skills there were no participants in high stress level. Previously there were three participants in high stress level. Number of participants also reduced in moderate stress level. Ten participants were found in moderate stress levels which were previously fifteen in number. Ten participants were found in low stress level. There were 13 paraplegia and 7 tetraplegia participants. Compared to tetraplegia participants paraplegia participants showed better progress.

To compare the mean differences between pre tests and post test scores of perceived stress level and to find out t value paired sample t test was performed. Results showed that there were differences between means of pre test and post test scores. Pre test mean score was 22.0500 and post test mean score was 15.7000. Paired sample t test provides t value 6.850 which is larger than the critical values of t. So it could be said that as the t value is large than the critical value at 5% level of significance thereby it rejects null hypothesis. P value (p=.000) which is less than .001 so it could be said that result is statistically significant.

Macgillivray, Janice, Dean and Sawatzky (2019) conducted a study among older age group people to see the effects of motor skill based training on wheelchair propulsion biomechanics. Fifty years old or above years old participants was recruited in their study. Participants were divided into three groups' experimental group, inactive control group and active control group. Experimental group received training of six sessions. Inactive control group did not receive any treatment or practice. Active control group only received uninstructed practice. Duration of training session was about sixty minutes. This time duration was divided by two five minutes of propulsion training and then five minutes of break. All participants attended at training session. Data were analyzed by using statistical package of social science version 24. One way analysis of variance and chi square test were used. There was no difference in between groups regarding baseline data. There were no significant differences found in between active control group and in inactive control group.

In current study participants recruited from eighteen to fifty years. So basically minimum age range was eighteen and maximum age was fifty years. Mean age of the participants was thirty three years. In this study only one single group is measured before and after training. Wheelchair training session duration was thirty minutes. There was no break in between this time. All the participants took total twenty sessions of training of wheelchair skills. In this study data were analyzed by using statistical package of social science version 16. T test statistics and paired t test were used in this study. There were significant differences found in before and after training of wheelchair skills.

Sawatzky, Rushton, Denison and Mcdonald (2012) performed a pilot study to identify the effectiveness of wheelchair skills training program for the children with spinal cord injury. This training program for children with spinal cord injury last for two days. Children were given wheelchair skill training for subsequent Saturdays. Six children were recruited in this study. Participants of this study were aged between six to fifteen years. Children were included in this study who were manual wheelchair users and able to understand instruction from the trainers.

To measure the wheelchair skill scores a modified wheel chair skill test version 3.2 was used. Scores were measured before and after training session. Another outcome measurement tool was used known as Activity skills for kids to find out the effect of the program on participation. The scale Activity skills for kids was a thirty items of questionnaire which includes dressing, personal care, eating, transfer, locomotion, play as well as standing skills. Wheelchair training was given to participants for about nine hours each day with a lunch break. The pre test and post test scores of wheelchair skills training was analyzed by wilcoxon t test due to small number of participants. At the end of the study results showed that participants achieved significant improvement in wheelchair skill test.

In current study no children were included. Duration of training session was four weeks. To measure the wheelchair skill scores wheel chair skill test version 4.3 was used. Wheelchair training was given to participants for about thirty minutes from Saturday to Wednesday. Scores were measured before and after training session. Another questionnaire was used perceived stress level which contains domains of ten questions. In this study pre test and post test scores of wheelchair skills training was analyzed by paired t test. Results of the study showed that participants achieved improvement in wheelchair skill test after four weeks of training.

In another study performed by Kirby et al. (2016) to identify the effectiveness of manual wheelchair skill training among community dwelling veterans with spinal cord injury. Hypothesis of this study was participants who received wheelchair skill training program improved their wheelchair skill capacity and participation compared to educational group. This study was conducted in three different sites. These are James A. Haley Veterans Hospital, Charlie nor-wood veteran's administration medical center and West Roxbury campus of the veteran's administration Boston health care system.

This study was multicenter randomized controlled trial. In my study data were collected from only one center. Data were collected from spinal cord injury unit, Center for the rehabilitation of the paralysed, savar. Hypothesis of my study was participants who received wheelchair training improved physical activity and reduce their stress level.

Participants were included in this study aged between eighteen to seventy five years, if manual wheelchair users and able to propel wheelchair by self, had a spinal cord injury for at least one year, willing to participate in this study and able to understand the instructions; Total one hundred and six participants were recruited in this study; Fifty three participants were recruited in the wheelchair training program group and other fifty three participants were in the educational control group; Participants were excluded from this study if medically unstable or pregnant, any kind of progressive disease, and any cardiac or respiratory condition that restricts performance; A computer generated blocked randomization was used for group allocation; Participants were randomly assigned to wheelchair training group and educational group (Kirby et al. 2016).

In current study participants aged ranged between eighteen to sixty five years; Independent wheel chair users were included; both paraplegic and tetraplegic (ASIA-A, B, C, D) spinal cord injured persons were included; spinal cord injured persons received treatment from spinal cord injury unit were included in this study; both male and female were included; participants who performed wheel chair skills and neurological level C7-C8, T6-T12 were included in this study as well as willingness to participate in this study. Participants were excluded from this study if they were mentally unstable, not diagnosed with spinal cord injury and unwillingness to participate in this study. Hospital based random sampling was used to select participants for this study. One single group with twenty participants was selected for wheelchair training.

Kirby et al. (2006) found in their study that in home environment wheelchair training program improved scores of wheelchair skills capacity but in case of participation it showed less significant results. In current study after four weeks of training program improved scores of wheelchair skill capacity, confidence and performance.

Van der scheer et al. (2015) conducted a randomized controlled trial to investigate the effects of low intensity wheelchair training in inactive people with spinal cord injury. Researchers wanted to see the effects of wheelchair training particularly on propulsion technique. This study was conducted in two different rehabilitation centers. It was a non blinded randomized controlled trial. Total twenty nine participants were recruited in this study. Fourteen participants were in the exercise group and fifteen participants were in the control group. Participants were randomly allocated in both groups. Wheelchair training provided for sixteen weeks and duration of training session was thirty minutes.

Exercise training was given for eighteen to twenty four minutes for first four sessions and then progress to thirty minutes per sessions. Fit and skilled participants provided continuous training for thirty minutes whereas other participants were provided intermittent exercise training. Treadmill exercise blocks using a measurement wheel was attached to participant's wheelchair to assess propulsion technique. Data were assessed at baseline, eight weeks after baseline, sixteen weeks after baseline and after forty two weeks. Data were analyzed by using Mann Whitney U test, wilcoxon test and Friedman analysis of variance. There are three drop outs in this study. Due to lack of motivation, problem of kidney stones and lack of time they stopped their training during seven or nine session. At the end of the study researchers found that there was no significant change on propulsion technique.

Current study was pre experimental design. It was a single group pre test and post test design. There was no control group to compare with. Participants assessed before training of wheelchair skills then reassessed after four weeks of training. My study was conducted in one rehabilitation center. There was no multicenter to collect data. In current study there were no drop outs. Data were analyzed by paired t test. Each participant attended at wheelchair skills as well as completed their training. In current study no measures were taken to assess propulsion technique of wheelchair only skills were assessed based on three categories capacity, confidence and performance skills. At the end of the study researcher found changes in pre test and post test scores of these three categories. There were significant changes before and after training.

Ginis et al. (2017) performed a mixed method study to investigate psychosocial factors associated with physical activity among participants with spinal cord injury who were manual wheelchair users and ambulant adults. Researchers wanted to identify psychosocial factors that explain lower level of leisure time physical activity among spinal cord injured persons. Three hundred and forty seven participants were recruited in this study. Seventy eight percent of the participants were male. Physical activity recall assessment for people with spinal cord injury was used to assess leisure time physical activity. Information was collected by a face to face interview. Duration of this face to face interview was held between 18 to 133 minutes. To find out participants perspective regarding leisure time physical activity researchers took semi structured interviews.

Subjective norms, behavioral control and intensions as well as baseline measures of leisure time physical activity was completed by the participants. Then leisure time physical activity was assessed six months later. An underestimated disability, low wheelchair skill self efficacy and experience of chronic pain these three things were revealed in qualitative analysis. All these three themes were considered as a barrier for leisure time physical activity that was experienced by the ambulant adults. Findings of this mixed method study suggest that ambulant adults showed more negative impression regarding leisure time physical activity compared to manual wheelchair users.

Current study was performed to identify the effectiveness of wheelchair skill on physical activity and stress level of person with spinal cord injury. Psychological factors were not identified. Only three different stress levels were measured. Physical activity was measured through pulse oximetry device. This device helps us to measure oxygen saturation rate in our body. If the oxygen saturation rate is high than it indicates increase amount of oxygenated blood in our body. If body tissue gets more oxygen it will become more active to perform function. Thereby physical activity was measured through this device. In my study there were significant mean differences in physical activity in pre test and post test scores.

Giesbrecht et al. (2013) conducted a randomized controlled trail to identify feasibility of the program enhancing participation in the community by improving wheelchair skills. To develop manual wheelchair skill among novice older adults this program enhancing participation in the community by improving wheelchair skills was introduced. It was a one month home monitored training program. This study was conducted in two metropolitan cities of Canada. This program was customized and also mobile structured training program. This training program was ten hours long and a wheelchair expert was responsible for two personalized training sessions. First training session was at the beginning and second one at the midpoint of the program. Researchers wanted to identify the effects of EPIC wheels on wheelchair skill capacity, wheelchair skill safety, wheelchair use confidence, mobility, health related quality life, satisfaction with activity performance.

Total forty participants were recruited in this study. As this study was conducted in two metropolitan cities of Canada, twenty participants were recruited in each city. These twenty participants were divided into four groups. Each group contains five members. Participants were divided into two groups training group and control group. Participants were recruited in this study who were fifty five years old, able to propel wheelchair more than one hour in a day, manual wheelchair users for less than one year, living in the community, caregiver willing to participate in this study. If participants were not able to communicate and presented with any health condition that might affect physical activity will be excluded from this study. Home training session was provided for five days in a week with duration of fifteen to thirty minutes. Data were collected at baseline and after one month. Wheelchair skill test version 4.1 was used as primary outcome measure. At the end of the trail researchers conclude that this home based training program showed a greater potential effect on clinical uptake and future opportunities.

In current study wheelchair skill test version 4.3 was used. Wheelchair skill safety, mobility, health related quality life, satisfaction with activity performance were not assed in this study. Current study was not a home based training program. Training program was performed in a rehabilitation center.

Kirby, Groot and Cowan (2020) performed a study to find out the relationship among wheelchair skills as well peak aerobic exercise capacity of spinal cord injured persons. This study was cross sectional. Participants of this research were total twenty six in number. Convenience sampling technique was used to select participants. Eighty percent of the participants were paraplegic. Participants were included in this study if they were aged eighteen years old or above, spinal cord injured for more than six months, manual wheelchair users, and living in the community and able to propel wheelchair by self. Participants were excluded if they were presented with shoulder pain, hypertension, pregnancy, myocardial infarction, history of hospitalization and unstable angina. In current study relationship among wheelchair skills as well peak aerobic exercise capacity of spinal cord injured persons was not assessed.

Wheelchair skill test questionnaire version 4.3 was used in this study. It contains total thirty four wheelchair skills. Wheelchair skill capacity, performance and confidence scores were recorded by using zero to two ordinal scales. Percentage was calculated by using the wheelchair skill test manual. Total percentage was from zero to hundred percent (Kirby et al.2020). In current study similar questionnaire was used. In my study aerobic fitness test was not performed. But in their study they used wheelchair treadmill to perform the aerobic fitness test of the participants. Participants' heart rate and oxygen uptake were also measured during this time. Data were analyzed by using statistical package of social science version 20. Missing data were not present in this study.

For analysis of data researchers performed Shapiro wilks test, post hoc logistic regression analysis and spearman correlation. Findings of the study suggest that there were significant correlation found among wheelchair skill capacity, confidence and performance on regression analysis. During rehabilitation wheelchair skill training and exercise are beneficial for spinal cord injured persons who are manual wheelchair users and living in the community. Researchers marked some limitation in their study one is limited number of participants and the presence of female participants is less than the male participants which might affect the findings of the study. In my study number of female participants was also less than compared to the male participants.

In current study participants' physical activity was measured by finding saturation of oxygen through pulse oximetry device. Pulse oximetry is an important tool for measuring oxygen level in blood. The normal range is between 95 to 100 percent. Below 90 percent is low level of oxygen in blood. The more oxygen in blood it will keep the body functionally active. Thereby pulse oximetry device is used. Pre test and post test scores of twenty participants before and after training of wheelchair skills showed significant differences.

To compare the mean differences of pre test and post test physical activity t statistics test was performed. T statistics test showed t value of 3.918 with degrees of freedom 19. The t value is larger than the critical value. Thereby null hypothesis is rejected and alternative hypothesis is accepted. Sample statistics provided information regarding pre test mean was 97.10000, Standard deviation 1.07115and post test mean was 98.90000, Standard deviation .55251. The paired t test provides t value -8.461, degrees of freedom 19 with p value (p=.000). As the t value is large than the critical value so null hypothesis is rejected. Therefore the test is significant at any reasonable level of significant. It can be concluded that the difference in before-after values is considered statistically significant.

In present study wheel chair skill test questionnaire (WST-Q), Version 4.3 was used. This questionnaire consists of 34 different items of individual skill those evaluates capacity, confidence and performance of wheel chair users. Wheelchair skills, Wheelchair skill capacity, performance and confidence scores were recorded by using (0-2) ordinal scales. Scores were measured by calculating total score obtained in thirty four different items of individual skills. Wheelchair skill capacity scores were measured before training after training of wheelchair skills. Post test scores of capacity skills in which participants' scores increased after performing wheelchair skills. Among the twenty participants pre test minimum score was 0, maximum score was 50 and post test minimum score was 7 and maximum score was 62.

Current study results showed that wheel chair skill test (Capacity) pre test mean was 23.0500, Standard deviation 13.74380, and post test mean was 42.1000, standard deviation 17.86470. The paired t test provides t value -6.750 with p value (p= .000). Therefore the test is significant at any reasonable level of significant. It can be concluded that the difference in before-after values is considered statistically significant.

In present study wheelchair skill (Confidence) scores measured twice before and after training of wheelchair skills. There were differences in scores of before and after training. Among the twenty participants minimum score of pre test was 0 and maximum score was 48. Minimum score of post test was 8 and maximum score was 58. So it could be said participants showed progress in their confidence skill after training of wheelchair skills.

Mean differences were calculated through sample statistics test that showed that wheelchair skill test (confidence) pre test mean 23.40000, standard deviation 13.51568, and wheelchair skill test confidence post test mean 42.1500, standard deviation 16.64577. Paired t test was performed to find out t value and significance level. The paired t test provides t value -7.902 with p value (p= .000) which is less than .001.Therefore the test is statistically significant. There is a strong evidence to conclude that the difference in before-after values is considered statistically significant.

In present study wheelchair skill performance scores were measured before training after training of wheelchair skills. Post test scores of wheelchair skill test performance skills of all twenty participants has increased after training. After training of wheelchair skills participants showed progress in their performance skills. Among the twenty participants minimum score of pre test was 0 and maximum score was 96 and the minimum score of post test was 20 and maximum score was 98.

Wheelchair skill test (performance) pre test mean was 47.8500, standard deviation 25.86254, and post test mean was 65.1500, standard deviation 2.19833. Paired t test was performed to find the t value and p value. The paired t test provides t value -6.112 with p value (p=.000) which is less than .001.Therefore the test is statistically significant. There is a strong evidence to conclude that the difference in before-after values is considered statistically significant.

Another study was performed at turkey about wheelchair skill training program. Ozturk and Ucsular (2011) performed a randomized controlled trail to identify that wheelchair training program is effective for community living manual wheelchair users. Ethical approval was taken from the local ethics committee before conducting the study. Total thirty two participants were recruited in this study. Seventeen participants were in the exercise group and fifteen participants were in the control group. Participants were manual wheelchair users living in the community. Participants were recruited in this study if they were willing to participate, able to provide inform consent and able to answer questions regarding manual wheelchair use. Participants were excluded from this study if they were presented with unstable medical condition or had any emotional problem that might affect testing or training program.

Though all the participants had their own wheelchair during the training session they had to use standardized wheelchair from the rehabilitation unit. An experienced physical therapist was responsible for supervising wheelchair training program. Participants in the training group attended this training program for four weeks. Duration of this training program was forty five minutes. Training session was provided to participants for three times a week. Progression of training program was arranged from basic skill to advanced wheelchair skill. Placebo treatment was not provided for the control group. Wheelchair skill test was tested twice for both groups at the beginning of the training and after competition of training session.

Covariance analysis was used to compare the wheelchair skill test scores. Wheelchair experience and interval between tests were measured by wilcoxon signed rank test. Because of health and transportation problem eight people were dropped out from this study. Thereby total twenty four people done this study, fourteen people were in the training group and ten people were in the control group. Wheelchair skill test version 4.1 was used in this study. At the end of the study researchers found that both groups improved performance scores in wheelchair skill test but training group improved more compared to control group.

In present study wheelchair skill test version 4.3 was used to assess pre test and post test scores of wheelchair skill training. Paired t test was used to compare the wheelchair skill test scores. There was no control group to compare. Only one single group was measured for wheelchair skill test. At the end of the study results suggest that capacity, confidence and performance scores have improved after training of wheelchair skills.

Another study was performed in two different sites of Canada about wheelchair skills. Lemay et al. (2012) performed a study to find out relationship among wheelchair skills, mobility and level of injury of spinal cord injured persons. It was a cross sectional study. Participants were recruited in this study if they were eighteen years old or above, manual wheelchair users for at least one year and able to propel wheelchair. Researchers wanted to identify association between their level of injury, mobility, age, experience and skills of manual wheelchair use both at the home and in the community. On the basis of qualitative analysis participants showed expertise in manual wheelchair skills. Findings of this study suggest that participant's manual wheelchair skills were related to their level of injury. Participants with impairment with their upper body faced difficulty in performing some wheelchair skills.

In present study relationship among wheelchair skills, mobility and level of injury of spinal cord injured persons were not identified. Association between their level of injury, mobility, age, experience and skills of manual wheelchair use both at the home and in the community were not assessed. Participants with different degrees of trunk control could not be identified by wheelchair skill test.

CHAPTER -VI LIMITATION

Design of the study was pre experimental thereby there was no randomization or control group it may limit generalization of the results.

Researcher took data from only one clinical setting and sample size was twenty participants.

Number of female participants was less compared to male participants only two female participants were included in this study. Because compared to male participants less female participants attended at wheelchair skills.

CHAPTER-VII CONCLUSION & RECOMMENDATION

This study was an experimental study to identify the effectiveness of wheel chair skills on physical activity and stress level of spinal cord injured persons. To identify the effectiveness wheel chair skill test questionnaire was used; to identify the stress level among participants perceived stress scale was used and to identify physical activity oxygen saturation was measured through a pulse oximetry device.

To compare the mean differences of pre test and post test physical activity t statistics test was performed. T statistics test showed t value of 3.918 with degrees of freedom 19. The t value is larger than the critical value. Thereby null hypothesis is rejected and alternative hypothesis is accepted.

Results of the study suggest that after training of one month wheelchair skills there were no participants in high stress level. Previously there were three participants in high stress level. Number of participants also reduced in moderate stress level. Ten participants were found in moderate stress levels which were previously fifteen in number. Ten participants were found in low stress level. Compared to tetraplegia participants paraplegia participants showed better progress. The paired t test provides t value 6.850, degrees of freedom (df) 19 with p value (p=.000).Therefore the test is statistically significant. As the t value is large than the critical value so null hypothesis is rejected. There is a strong evidence to conclude that the difference in before-after values is considered statistically significant.

Wheelchair skill capacity, performance and confidence scores were recorded by using (0-2) ordinal scales. Scores were measured by calculating total score obtained in thirty four different items of individual skills. Wheelchair skill capacity scores were measured before training after training of wheelchair skills. Pre & post test scores of capacity skills in which participants' scores increased after performing wheelchair skills. Among the twenty participants pre test minimum score was 0, maximum score was 50 and post test minimum score was 7 and maximum score was 62.

Results suggest that after training of wheelchair skills participants showed progress in their confidence skills. Among the all participants minimum score of pre test was 0 and maximum score was 48 and the minimum score of post test was 8 and maximum score was 58. After training of wheelchair skills participants showed progress in their performance skills. Among the twenty participants minimum score of pre test was 0 and maximum score was 96 and the minimum score of post test was 20 and maximum score was 98 in performance skills.

After one month of training participants improved their wheelchair skills as well as improved physical activity and reduce scores in their stress level. So it can be concluded wheelchair skills is an effective training to improve physical activity and to reduce stress level of spinal cord injured persons.

There are some recommendations. It is strongly recommended to perform a randomized controlled trial with a larger sample size. More participation of female participants should be highly recommended. Multicenter set up should be included with follow up.

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Appendix -A

(Institutional Review Board Letter)

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

Ref.
CRP-BHPI/IRB/09/19/1358

Date: 02/10/2019

To
Maisha Hoque Mifta
M.Sc. in Physiotherapy
Session: 2017-2018 Student ID: 111170046
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Subject: Approval of thesis proposal, **"Effectiveness of wheel chair skills on physical activity and stress level of spinal cord injured persons"** by ethics committee**.**

Dear Maisha Hoque Mifta,

Congratulations.
The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct 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	Thesis Proposal
2	Questionnaire (English & Bangla version)
3	Information sheet & consent form.

The purpose of the study is to see the effectiveness of wheel chair skills on physical activity and stress level of spinal cord injured persons. The study involves use of Wheelchair Skills Test Questionnaire (WST-Q), Version 4.3 to assess wheel chair skills of the participants. Perceived Stress Scale will be used to measure stress level of the participants. It may take approximately 15-20 minutes to answer the questionnaires and there is no likelihood of any harm to the participants. The members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 10.00 AM on 25th September, 2018 at BHPI.

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

Best regards,

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

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

Date: 2. 10. 2019

To
The Chairman,
Institute Review Board (IRB)
Bangladesh Heath Profession Institute (BHPI)
CRP, Chapain, Savar, Dhaka-1343, Bangladesh

Subject: Application for review and ethical approval of thesis.

Sir,
With due respect I am Maisha Hoque Mifta, Student of M.Sc in Physiotherapy (Part-II) at Bangladesh Health Professions Institute (BHPI) under the faculty of medicine at University of Dhaka. I have to conduct a thesis as per my course curriculum, my thesis entitled "Effectiveness of wheel chair skills on physical activity and stress level of spinal cord injured persons" under supervision of my honorable supervisor Professor Md. Obaidul Haque. This study will be conducted at Spinal cord injury unit of Centre for the Rehabilitation of the Paralysed (CRP), Savar. Thirty participants will be recruited in this study. Wheelchair skills test Questionnaire (WST-Q), Version 4.3 will be used to assess wheel chair skills of the participants. Perceived stress scale will be used to measure stress level of the participants. Before conducting the study consent will be taken from each participants and their confidentiality will be maintained.

Therefore, I look forward to have your kind approval for the thesis proposal and to start data collection. I hope that you would be kind enough to grant my application.

Sincerely yours,
Maisha
Maisha Hoque Mifta
Roll: 06, Student of MSc. in Physiotherapy (Part-II), Session: 2017-2018
BHPI, CRP, Savar, Dhaka-1343, Bangladesh.

Recommendation from the thesis supervisor
02-10-19
Professor Md. Obaidul Haque
Head of Physiotherapy Department, Vice Principal,
BHPI, CRP

Attachment: Thesis Proposal, Questionnaire & consent

Appendix –B (Permission Letter)

Date: 02.10.19

To

Head of the department

Department of Physiotherapy

CRP, Savar, Dhaka-1343.

Subject: Application for permission of data collection.

Sir,

With due respect I am Maisha Hoque Mifta, Student of M.Sc in Physiotherapy (Part-II) at Bangladesh Health Professions Institute (BHPI) under the faculty of medicine at University of Dhaka. I have to conduct a thesis as per my course curriculum, my thesis entitled "Effectiveness of wheel chair skills on physical activity and stress level of spinal cord injured persons". I have to collect data from spinal cord injured persons who are receiving treatment from spinal cord injury unit of Centre for the Rehabilitation of the Paralysed (CRP). For this purpose I need permission for collecting data.

Therefore, I pray and hope that you would be kind enough to grant my application and oblige thereby.

Sincerely yours,

Maisha

Maisha Hoque Mifta
Roll: 06
Student of MSc. in Physiotherapy (Part-II)
Session: 2017-2018
Bangladesh Health Professions Institute (BHPI),
CRP, Savar, Dhaka-1343, Bangladesh.

Recommended & Forwarded
Prof. Md. Obaidul Haque
Head, Department of Physiotherapy
Bangladesh Health Professions Institute (BHPI)
CRP, Savar, Dhaka-1343

Approved
Mohammad Anwar Hossain
Associate Professor & Head
Physiotherapy Dept., CRP
CRP-Chapain, Savar, Dhaka-1343
2/10/19

Allow for data collection at SCS unit.
Hossain 5.11.19
MUZAFFOR HOSSAIN
Junior Consultant & Incharge SCI Unit
Physiotherapy Department
CRP, Savar, Dhaka

Appendix – C (Consent form)

VERBAL CONSENT STATEMENT

(Please read out to the participant)

Assalamualaikum, I am Maisha Hoque Mifta, Student of M.Sc in Physiotherapy (Part-II) at Bangladesh Health Professions Institute (BHPI) under the faculty of medicine at University of Dhaka. I have to conduct a thesis as per my course curriculum, my thesis entitled "Effectiveness of wheel chair skills on physical activity and stress level of spinal cord injured persons" under supervision of my honorable supervisor Professor Md. Obaidul Haque. I would like to know some information regarding your wheel chair skill training and what kind of stress do you feel after your training session. This will take approximately 20-30 minutes.

I would like to inform you that this study is purely academic and will not be used for any other purpose. As I am not involved in this department, thus your participation in the research will have no impact on your present or future treatment. All information provided by you will be treated as confidential and in the event of any report or publication it will be ensured that source of information remains anonymous.

Your participation in this study is voluntary and you may withdraw yourself at any time during the study without any negative consequences. You also have the right not to answer a particular question that you don't want to answer during interview. If you have any query about the study or your right as a participant, you may contact with me.

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 ----------

Signature of the interviewer----------

মৌখিক অনুমতি পত্র

(অংশগ্রহনকারীকে পড়ে শোনাতে হবে)

আসসালামুয়ালাইকুম, আমি মাইশা হক মিফতা,মাস্টার্স ইন ফিজিওথেরাপি পার্ট–২এর শিক্ষার্থী। আমি এই গবেষশনাটি বাংলাদেশ হেল্থ প্রফেসনস ইন্সিটিউট এ করছি। আমার গবেষণার শিরোনাম হল " স্নায়ুরজ্জুর আঘাতজনিত ব্যক্তিদের শারীরিক কর্মক্ষমতা ও মানসিক চাপের উপর হুইল চেয়ার প্রশিক্ষণের কার্যকারিতা"। আমি এক্ষেত্রে কিছু আনুষঙ্গিক তথ্য আপনার কাছ থেকে জানতে চাচ্ছি। যা আনুমানিক ২০-৩০ মিনিট সময় নিবে।

আমি আপনাকে অবগত করছি যে, এটা আমার অধ্যয়নের অংশ এবং অন্য কোন উদ্দেশে ব্যবহার হবে না।যেহেতু আমি এই ডিপার্টমেন্ট এর সাথে জড়িত নই তাই এই গবেষনায় আপনার বর্তমান এবং ভবিষ্যৎ চিকিৎসায় কোন প্রভাব ফেলবে না। আপনি যেসব তথ্য প্রদান করবেন তার গোপনীয়তা বজায় থাকবে এবং আপনার প্রতিবেদনের ঘটনাপ্রবাহে এটা নিশ্চিত করা হবে যে, এর উৎস অপ্রকাশিত থাকবে।

এই অধ্যয়নে আপনার অংশগ্রহন ঐচ্ছিক এবং আপনি যে কোন সময় এই অধ্যয়ন থেকে কোন নেতিবাচক ফলাফল ছাড়া নিজেকে প্রত্যাহার করতে পারবেন। সাক্ষাৎকারের সময় কোন প্রশ্ন পছন্দ না হলে উত্তর না দেওয়ার অথবা না দিতে চাওয়ার অধিকারও আপনার আছে।এই অধ্যয়নে অংশগ্রহণকারী হিসেবে আপনার যদি কোন প্রশ্ন থাকে তাহলে আপনি আমার সাথে যোগাযোগ করতে পারেন।

সাক্ষাৎকার শুরু করার আগে আপনার কি কোন প্রশ্ন আছে?

আমি আপনার অনুমতি নিয়ে এই সাক্ষাৎকার শুরু করতে যাচ্ছি।

হ্যাঁ ☐

না ☐

অংশগ্রহণকারীর সাক্ষর ----------

সাক্ষাৎগ্রহনকারীর সাক্ষর ----------

Appendix-D (Questionnaire)

Socio-demographic Questionnaire

Socio-demographic information

1.1. Name:

1.2. Age: …… years.

1.3. Sex:

1. Male

2. Female

1.4. Marital status:

1. Married

2. Unmarried

3. Widowed

4. Divorced

1.5. Educational status:

1. Primary

2. Secondary

3. Above Secondary

1.6. Occupation before injury:

1.7. Occupation after injury:

1.8. Family type:

1. Nuclear

Date of interview:

Interviewer:

Patient ID:

Address:

Mobile No:

2. Extended

1.9. Family members:

1.10. Family monthly income: ……. Taka.

1.11. Residence:

1. Urban

2. Rural

Disease related information

1.12. Year of lesion:

1.13. Causes of lesion:

1. Traumatic

2. Non-traumatic

1.13.1. Cause of traumatic lesion:

1.13.2. Cause of non-traumatic lesion:

1.14. Type of paralysis:

1. Tetraplegia

2. Paraplegia

1.15. ASIA SCALE

1. ASIA-A

2. ASIA-B

3. ASIA-C

4. ASIA-D

প্রশ্নাবলী

"স্নায়ুরজ্জুর আঘাতজনিত ব্যক্তিদের শারীরিক কর্মক্ষমতা ও মানসিক চাপের উপর হুইল চেয়ার প্রশিক্ষণের কার্যকারিতা"

১.১.নাম:

১.২.বয়সসামাজিক-জনতাত্ত্বিকতথ্য

: .....বছর.

১.৩. লিঙ্গ:

১.পুরুষ

২.মহিলা

১.৪. বৈবাহিকঅবস্থা:

১.বিবাহিত

২.অবিবাহিত

৩.বিধবা

৪.তালাকপ্রাপ্ত

১.৫. শিক্ষাগতঅবস্থা:

১। প্রাথমিক

২। মাধ্যমিক

৩। উচ্চ মাধ্যমিক

১.৬. আঘাতপূর্ববর্তীসময়পেশা:

১.৭. আঘাতপরবর্তীসময়পেশা:

১.৮. পরিবারেরধরন:

১. একক

২.বর্ধিত

সাক্ষাৎকারগ্রহণেরতারিখ:

সাক্ষাৎকারগ্রহণকারী:

রোগীরআইডি:

ঠিকানা:

মোবাইলনম্বর:

১.৯.পরিবারসদস্য:

১.১০.পরিবারের মাসিক আয়: ……..টাকা

১.১১. বাসস্থান:

১. শহর

২. গ্রাম

রোগসম্পর্কিততথ্য

১.১২.ক্ষতিপ্রাপ্তিরবছর:

১.১৩.ক্ষতিরকারণ:

১. আঘাতজনিত

২. আঘাতজনিতনয়

১.১৩.১. আঘাতজনিতক্ষতিরকারণ:

১.১৩.২.আঘাতজনিতনয়এমনক্ষতিরকারণ:

১.১৪. পক্ষাঘাতেরধরণ:

১. পুরোশরীরেরঅসাড়তা

২. নিম্নাঙ্গএবংউভয়পদেরঅসাড়তা

১.১৫. এশিয়া মান

১। এশিয়া-এ

২।এশিয়া-বি

৩।এশিয়া-সি

৪।এশিয়া-ডি

Perceived Stress Scale

Name- Date-

Age- Gender- Other-

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

1. In the last month how often have you been upset because of something that happened unexpectedly?

	1	2	3	4

2. In the last month how often have you felt that you were unable to control the important things in your life?

	1	2	3	4

3. In the last month how often have you felt nervous and stressed?

	1	2	3	4

4. In the last month how often have you felt confident about your ability to handle personal problems?

	1	2	3	4

5. In the last month how often have you felt that things were going your way?

	1	2	3	4

6. In the last month how often have you found that you could not cope with all the things that you had to?

	1	2	3	4

7. In the last month how often have you been able to control irritations in your life?

	1	2	3	4

8. In the last month how often have you felt that you were on top of things?

	1	2	3	4

9. In the last month how often have you been angered because of things that were outside of your control?

0	1	2	3	4

10. In the last month how often have you felt difficulties were piling up so high that you could not overcome them?

0	1	2	3	4

Scores ranging from 0-13 considered as low stress level

Scores ranging from 14-26 considered as moderate stress level

Scores ranging from 27-40 considered as high perceived stress level

অনুভুত চাপ পরিমাপক

নামঃ

তারিখঃ

বয়সঃ লিঙ্গঃ

অন্যান্যঃ

০- কখনো নয়, ১- প্রায় না,২-মাঝে মাঝে,৩-মাঝে মধ্যেই,৪- খুব প্রায়ই/প্রায় সময়

১। গত একমাসে অপ্রত্যাশিত ভাবে কিছু ঘটার কারণে আপনার কত সময় বিষণ্নতায় ভুগছিলেন?

০	১	২	৩	৪

২। গত একমাসে আপনার কত বার মনে হয়েছিল যে আপনার জীবনের গুরুত্বপূর্ণ বিষয়গুলো নিয়ন্ত্রণ করতে পারছেন না?

০	১	২	৩	৪

৩। গত একমাসে আপনার কতসময় নিজেকে উদ্বিগ্ন এবং বিষণ্ন মনে হয়েছে?

০	১	২	৩	৪

৪।গত একমাসে আপনার কতসময় মনে হয়েছে নিজের ব্যক্তিগত সমস্যা সমাধানে আপনি আত্মবিশ্বাসী?

০	১	২	৩	৪

৫।গত একমাসে আপনার কতসময় মনে হয়েছে সব কিছু আপনার নিয়মমাফিক হচ্ছে?

০	১	২	৩	৪

৬।গত একমাসে আপনার কতসময় মনে হয়েছে আপনি আগে যে কাজ করতেন তার সাথে এখন মানিয়ে নিতে পারছেন না?

০	১	২	৩	৪

৭। গত একমাসে আপনি কত বার প্রতিকূল পরিস্থিতি নিয়ন্ত্রণে আনতে সক্ষম হয়েছিলেন?

০	১	২	৩	৪

৮। গত একমাসে আপনার কতসময় মনে হয়েছে সব কিছু আপনার নিয়ন্ত্রণে আছে?

০	১	২	৩	৪

৯।গত একমাসে পরিস্থিতি আপনার অনুকূলে না থাকায় আপনি কতসময় রাগান্বিত বোধ করেছেন?

০	১	২	৩	৪

১০। গত একমাসে আপনার কত বার মনে হয়েছে যে আপনি প্রচণ্ড কঠিন অবস্থার মধ্যে দিয়ে যাচ্ছেন যার সাথে আপনি পেরে উঠতে পারেন নি?

০	১	২	৩	৪

মান ০-১৩ হলে মানসিক চাপ অল্প ধারণা করা হবে

মান ১৪-২৬ হলে মানসিক চাপ মাঝারি ধারণা করা হবে

মান ২৭-৪০ হলে মানসিক চাপ অনেক বেশি ধারণা করা হবে

Wheelchair Skills Test Questionnaire (WST-Q)

Name: **Date:**

#	Individual Skill	Capacity (0-2)	Confidence (0-2)	Performance (0-4)	Training goal? (Y/N)
1	Rolls forwards short distance				
2	Rolls backwards short distance				
3	Turns in place				
4	Turns while moving forward				
5	Turns while moving backward				
6	Maneuvers sideways				
7	Reaches high object				
8	Picks objects from floor				
9	Relieves weight from buttocks				
10	Operates body positioning options				
11	Level transfer				
12	Folds and unfolds wheelchair				
13	Gets through hinged door				
14	Rolls longer distance				
15	Avoids moving obstacles				
16	Ascends slight incline				
17	Descends slight incline				
18	Ascends steep incline				
19	Descends steep incline				
20	Rolls across side slope				
21	Rolls on soft surface				
22	Gets over threshold				
23	Gets over gap				
24	Ascends low curb				

25	Descends low curb				
26	Ascends high curb				
27	Descends high curb				
28	Performs stationary wheelie				
29	Turns in place in wheelie position				
30	Descends high curb in wheelie position				
31	Descends steep incline in wheelie position				
32	Gets from ground into wheel chair				
33	Ascends stairs				
34	Descends stairs				
Total scores:					

Capacity question: Can you do this skill?

Answer	Score	What this means
Yes	2	I can safely do this skill without any difficulty
Yes with difficulty	1	Yes but not as well as I would like
No	0	I have never done the skill/ I do not feel that I could do it right now
Not possible	NP	My wheelchair does not allow this skill

Performance question: How often do you actually do this skill during your daily life?

Answer	Score	What this means
Daily	4	At least once a day
Weekly	3	Generally at least once a week
Monthly	2	Generally at least once a month
Yearly	1	Generally at least once a year
Never	0	Never/less than once a year