Assessing cardiovascular fitness of patients with spinal cord injury at CRP, Bangladesh compare with normal population

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Submitted in Partial Fulfillment of the Requirements for the Degree of

MSc in Rehabilitation Science

May 2018

Bangladesh Health Professions Institute (BHPI)

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Supervisor's Statement

As supervisors of Kazi Imdadul Hoque's M.Sc Thesis work, we certify that we consider her thesis "**Assessing cardiovascular fitness of patients with spinal cord injury at CRP, Bangladesh compare with normal population. "** to be suitable for examination.

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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, "**Assessing cardiovascular fitness of patients with spinal cord injury at CRP, Bangladesh compare with normal population",** submitted by Kazi Imdadul Hoque, for the partial fulfillment of the requirements for the degree of Master of Science in Physiotherapy.

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Acknowledgement

First I am paying my profound gratitude to the Almighty Allah for completing the study within the due time. I am immensely grateful to my supervisor, **Md. Fazlul Karim Patwary, Professor,**for his guidance, cordial cooperation, support and encouragement during the entire period of the study. I would like to express my deepest gratitude to the Bangladesh Health Professions Institute, to give me the opportunity to perform this study.

I am expressing my sincere gratitude to my honourable teacher **Nasirul Islam,** associate Professor, BHPI, **Md. Millat Hossain**, Associate Professor, BHPI for their support and guidance.

I would like to thank my honorable teacher **Shamima Islam Nipa**, **Ummul Ambia,** Lecturer of M.Sc in Rehabilitation Science program, BHPI and other board members for their support and guidance.

I would like to give special thanks to **Md. Anwar Hossain Associate Professor, Physiotherapy Department** for his guidance. I also like to pay special gratitude to **Nur E Najnin Nipa, Srishti Bajrachario, Dolly Bokalial, Niru Lama, Rabindra shrestha** for supporting me to conduct this study.

I wish to thanks all of the **participants** and **Fatematuj-johora**, **Tithi Anthonia Corraya, Raihan Minhaz f**or their pervasive support and help.

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List of Abbreviations

ASIA	American Spinal Impairment Association
CRP	Centre for the Rehabilitation of the Paralysed
FEF	Peak expiratory flow
FEV1	Force expiratory volume in 1 sec
ICF	International Classification of Functioning, Disability and Health
NITOR	National institute of Traumatology Orthopedic and Rehabilitation
QOL	Quality Of Life
SCI	Spinal Cord Injury
SPSS	Statistical Package for Social Sciences
USA	Unite States of America
WHO	World Health Organization

Abstract

Introduction: Spinal cord injury(SCI) is a devastating condition that can affect any individual in any stage of life. Cardiovascular fitness is the ability of the heart, blood cells and lungs to supply oxygen-rich blood to the working muscle tissues and the ability of the muscles to use oxygen to produce energy for movement(Mairbäurl, 2013). Poor cardiovascular fitness is an impairment which commonly prevent patient with spinal cord injury to perform various motor task(Ditor et al., 2003) The aim of this study is to find out the level of cardiovascular fitness of spinal cord injury patient who can perform walking and compare the cardiovascular fitness with people without spinal cord injury with their same age **General Objectives:** 1. To compare the level of cardiovascular fitness of patient with spinal cord injury at CRP with normal population 2. To measure the cardiovascular fitness in respective of VO2max, 3. To compare the cardiovascular fitness with non SCI people 4. To measure walking speed of patient with SCI and non SCI population 5. To measure the BMI of person with and without SCI **Methodology:** Case control method was used to fulfill the objective of this study. 25 patients with SCI who can walk with or without assistive device were selected as case and 25 normal populations with same age group without SCI around CRP were selected as control. Both group were performed a two minute and 10 Meter walk test. Heart rate were measured before ending and after two minute of walking test. BMI was calculated from height and weight of the participants. **Result:** Mean age of the participants was 28±5 in both case and control group. Among case majority was paraplegic were 68 % and Incomplete D were 80 %. In fitness case mean VO2 max was 39.34±5.2 ml/kg/m and in control group 38.48±4.5 ml/kg/m. There were no significant association between case/control with Vo2max score. Vo2max had strong negative co relation (r=-.94) with resting heart rate and weak co relation with age, BMI and walking speed. In age range 25 to 30 year cases sample had highest mean VO2max score(39.96), and in control group this age range were 20-25 years(40.84). VO2max had strong association with type of injury and AIS B had significantly low VO2max score. **Conclusion** This study found no significant relationship between case and control groups with fitness of VO2max. Significant association found between VO2max and types of injury and it also differ with neurological level of injury. Researcher didn't found any positive co relationship of VO2max with BMI, AGE, and walking distance and speed. Average VO2max score was lower in both case and control group. Further study with larger sample size in community environment can be done to find out the actual relationsip between Vo2max and spinal cord injury.

Key words: Spinal Cord Injury, cardiovascular fitness, fitness assessment, VO2max

Chapter 1 Introduction

1.1 Introduction

Bangladesh is a developing and most densely populated country in the world. Approximately hundred and fifty million people live in this small country. It is considered as one of the least developed countries in the world as measured in term of average income, calories intake, high infant mortality rate and low literacy rate. Near about 10% of total population are disable in Bangladesh where 43% are physically disable (Islam et al., 2011). The total figure of disability is increasing with population growth and aging. With such a large number of disables people it is quite possible to achieve national development. But it is real phenomenon's of our society that disable people are very often deprived of their social opportunity and their rights (Haque, et al. 1999). Spinal cord injury(SCI) is a catastrophic event that can change day to day life of any individual(C. Sadowsky, Volshteyn, Schultz, & McDonald, 2002). It is a devastating condition that can affect any individual in any stage of life (Silva, Sousa, Reis, & Salgado, 2014). It refers to damage to neural elements of the spinal canal (spinal cord, cauda equina and spinal nerves), frequently resulting in permanent impairments of motor, sensory and/or autonomic function(Kirshblum et al., 2011). Etiology may be traumatic (e.g., motor vehicle accident and falls) or non-traumatic (e.g., myelomengiocele, spinal stenosis, transverse myelitis and tumor) and it vary in country to country and region to region(New & Marshall, 2014).

Damage to the spinal cord can result in chronic motor and sensory impairment with a lifetime profound disability (Nash, 2005).(Gurcay, Bal, Eksioglu, & Cakci, 2010) showed that ''Spinal cord injury (SCI) is generally a catastrophic disorder that can have consequences including impairment in physical, psychological, and

social functioning". Persons with SCI represent a significant portion of the population so we can somehow it affect our total community(The National Spinal Cord Injury Statistical Center, 2015).

Spinal cord injury profoundly affects functioning at the level of body systems e.g., neuro musculoskeletal and cardiovascular functioning, person e.g. walking, grasping, lifting and carrying and society e.g., employment, sports participation, social engagement. It is extremely costly in human,social and economic terms(Lee, Cripps, Fitzharris, & Wing, 2014)..

Many people with long-term spinal cord injury (SCI) are physically inactive and deconditioned(J. A. Haisma et al., 2006). This can be the result of muscle paralysis, impairments in the autonomic nervous system and wheelchair dependence(Nash, 2005).

Cardiovascular fitness is the ability of the heart, blood cells and lungs to supply oxygen-rich blood to the working muscle tissues and the ability of the muscles to use oxygen to produce energy for movement(Mairbäurl, 2013). Poor cardiovascular fitness is an impairment which commonly prevent patient with spinal cord injury to perform various motor task(Ditor et al., 2003).The performance of motor task with paralysis like spinal cord injury is often an inefficient way of moving and physically challenging(C. L. Sadowsky & McDonald, 2009).

Cardiovascular fitness is a relatively new term and often neglected in rehabilitation as well as people with spinal cord injury. The aim of this study is to find out the level of cardiovascular fitness of spinal cord injury patient who can perform walking and compare there cardiovascular fitness with people without spinal cord injury with their same age.

1.2 Justification:

A person with SCI is considered to be the most physically inactive segment of society who faces many challenges and barriers to physical activity participation (Ginis, Jorgensen, & Stapleton, 2012). Spinal cord injury leady to several complication on body system(Raineteau & Schwab, 2001). One of the important but occasionally ignored area cardiopulmonary fitness. According to (Scheer et al., 2015) Physically inactive people with long-term SCI seem a group in The population with SCI with relatively low anaerobic work capacity, isometric strength and peak aerobic work capacity.

Cardiovascular fitness appears more important during their rehab period as well as real life also(Nooijen et al., 2012). During acute or stabilization phase they require very low level of activity but rehabilitee phase it emerge with more demand. Like mobilizing wheel chair in outdoor require more cardiovascular fitness.

There are many factor regarding reducing cardiovascular fitness after spinal cord injury like impaired re distribution of arterial blood, venous blood pooling below the level of the spinal cord lesion , altered cardiovascular autonomic control (Harvey, Lin, Glinsky, & De Wolf, 2009)and a more sedentary lifestyle in comparison to able-bodied people(Phillips et al., 1998).

Relative to the general population, most individuals with SCI have reduced cardiovascular fitness (VO2peak) and a diminished physical work capacity.8 Inactivity and low VO2peak are modifiable risk factors associated with cardiovascular disease. By improving VO2peak in individuals with SCI, both the risk for cardiovascular disease and physical strain during activities of daily living can be decreased(Adrienne et al., 2007).

From this study researcher will find out the level of cardiovascular fitness among the patient those who can walk with or without assistive device. This measurement will help the physiotherapist provide more precious treatment to their patient. It will also be help full to find out norm value of cardiovascular fitness with and without SCI population.

1.3 Research question:

What is the level of cardiovascular fitness of patient with spinal cord injury who receive treatment from CRP?

1.4 Operational definition

Spinal cord injury (SCI):

According to (Kirshblum & Waring 2014) spinal cord injury is an insult to the spinal cord resulting in a change, either temporary or permanent, in the cord's normal motor, sensory, or autonomic function. Patients with SCI usually have permanent and often devastating neurologic deficits and disability. The most important aspect of clinical care for the SCI patient is preventing complications related to disability.

Spinal cord injury classification:

A = Complete: No sensory or motor function is preserved in sacral segments S4-S5

B = Incomplete: Sensory, but not motor, function is preserved below the neurologic level and extends through sacral segments S4-S5

C = Incomplete: Motor function is preserved below the neurologic level, and most key muscles below the neurologic level have a muscle grade of less than 3

D = Incomplete: Motor function is preserved below the neurologic level, and most key muscles below the neurologic level have a muscle grade that is greater than or equal to 3

E = Normal: Sensory and motor functions are normal

(Kirshblum & Waring 2014).

Wheelchair:

A wheelchair is a device used for mobility by people for whom walking is difficult or impossible, due to illness or disability.

Paralysis: Injury or disease to the nervous system can affect the ability to move a particular part of the body. This reduce motor/sensory ability is called paralysis.

Tetraplegia: Paralysis of both legs and both arms, it is also called quadriplegia.

Paraplegia: Paralysis of both legs.

Assistive device: An Assistive Device is any device that helps someone do something that they might not otherwise be able to do well or at all. Generally the term is used for devices that help people overcome a handicap such as a mobility, vision, mental, dexterity or hearing loss.

Mobility device: A mobility aid is a device designed to assist walking or otherwise improve the mobility of people with mobility impairment.

Cardiovascular fitness: Cardiovascular fitness is the ability of the heart, blood cells and lungs to supply oxygen-rich blood to the working muscle tissues and the ability of the muscles to use oxygen to produce energy for movement.

Vo2max: VO2 max is the measurement of the maximum amount of oxygen that an individual can utilize during intense, or maximal exercise. It is measured as milliliters of oxygen used in one minute per kilogram of body weight (ml/kg/min).

Chapter 2 Literature review

Spinal cord injury is a condition that results from damage or trauma to the nerve tissue of the spine and this trauma is considered one of the most severe and devastating incapacitating syndromes (Parizel et al., 2010). The neural elements in the spinal canal that is spinal cord and cauda equine damage which can arise resolving or permanent neurologic deficit (New & Marshall, 2014).

Research shows that it is occurred by traumatic or non-traumatic etiologies (Kennedy &Chessell, 2013). Traumatic spinal cord injury is caused by direct or indirect trauma. In developing countries, there are three main causes that patient is admitted into hospital. Those are fall from height, transportation accident and beingstruck by an object. Study says that 561 traumatic spinal cord injury whose injuries occurred between 2001 and 2010. The annual incidence in Beijing is 60.6 per million which is more than other countries and regions. TSCI patient may suffer from different conditions such as spasticity, sensory changes, exaggerated reflex activities that is depending on the different level of lesion (Carlson andGorden, 2002).

According the American Spinal Injury Association (ASIA) impairment scale, the classification of SCI severity is –A (complete): no motor or sensory function is preserved in the sacral segments S4-S5. B (incomplete): sensory but no motor function is preserved bellow the neurological level and includes the sacral segment S4 -S5. C (incomplete): Motor function is preserved below the neurological level, and more than a half of key muscles below the neurological level have a muscle grade of <3. D (incomplete): Motor function is preserved below the neurological level, and at least a half of key muscles below the

neurological level have a muscle grade of ≥3. E (normal): Motor and sensory functions are normal. C4 injury- tetraplegia, C6 injury- tetraplegia, T6 injury- paraplegia, L1 injury- paraplegia (Thuret, et al., 2006)

Most persons with a spinal cord injury (SCI) have an inactive lifestyle. Van den Berg-Emons et al. studied the course of everyday physical activity level of persons with SCI. During inpatient rehabilitation, the levels of physical activity improved. However, shortly after discharge from the rehabilitation center the levels declined sharply. One year after discharge, activity levels had recovered somewhat but were still much lower than those of able-bodied persons and were even lower than those of persons with other chronic diseases.(Nooijen et al., 2012)

Exercise and sports have significant physical and psychosocial health benefits for people with SCI although there are many challenges to physical activity participation for them (Martin Ginis, Jörgensen, & Stapleton, 2012).

Cardiovascular fitness, defined as the ability of the cardiorespiratory and musculoskeletal systems to attain a certain level of activity(Ruiz et al., 2014). It is reduced following a spinal cord injury for several reasons. The level of fitness is established by the aerobic capacity, for which the peak oxygen uptake (peak Vo2; L/min) is the gold standard(van der Woude, Bouten, Veeger, & Gwinn, 2002) and by the maximal maintainable workload, which is determined by the peak power output (peak PO; W)(van der Woude et al., 2002). Interruption of the spinal cord causes muscle paralysis and autonomic disturbance, both of which limit the level of fitness(J. a Haisma et al., 2007).

The importance of is shown by different study and it is also possible to modify it. According to (J. a Haisma et al., 2007) Physical fitness is a meaningful health

indicator,not only because of its proposed relation to complications, but also because it is associatedwith functioning and quality of life. The level of fitness is also modifiable; it changes over time and can give an indication of rehabilitation outcome(Dallmeijer, van der Woude, Hollander, & van As, 1999). Longitudinal data show that therecovery of fitness over time is associated with age, gender and level of the lesionUnfortunately, these data do not indicate modifiable determinants and, therefore, do not providetools to improve rehabilitation practice(Janneke A. Haisma et al., 2006).

Aerobic exercise is extremely important in individuals with SCI since it is known to play a major role in preventing a decreasing quality of life and increasing complications which result from a lack of physical activities. (Jacobs & Nash, 2004) reported that regular exercise directly influences the muscles involved in inspiration of individuals with SCI, and(Sutbeyaz, Koseoglu, & Gokkaya, 2005) demonstrated increased VO 2max through regular exercise.

Cardiovascular diseases is one of the leading cause ofMortality in both spinal cord injury and general population(Myers, Lee, & Kiratli, 2007). According to epidemiological evidence regarding physical activity and cardiovascular disease (CVD) provides substantial evidence from many different populations that leisure time physical activity is associated with reduced risk of coronary heart disease (CHD) and cardiovascular mortality in both men and women and in middle-aged and older individuals. Physical activity appears to be a critical factor in both primary and secondary prevention of CHD(Wannamethee & Shaper, 2001).It is also supported by (Nooijen et al., 2012) who stated that persons with a SCI who are more physically active have less risk of cardiovascular disease.

Measurement of Cardiovascular fitness:

The assessment of cardiovascular fitness is important for setting exercise programmes and monitoring response to training. Strenuous exercise can

precipitate adverse cardiovascular events and for this reason usual care and precautions need to be followed. A medical specialist should assess elderly patients and those at high risk of cardiovascular disease before they engage in strenuous physical activity. Assessments of cardiovascular fitness need to be done under reproducible test situations. Factors such as the wheelchair, cushion, trunk constraint and the position of the patient all need to be standardized. It is particularly important that the wheelchair is standardized for tests involving wheelchair propulsion. Different wheelchairs are associated with different mechanical efficiencies. There are three main ways to assess cardiovascular fitness.

Peak oxygen consumption tests:

The most accurate way to assess cardiovascular fitness is with a peak oxygen consumption (VO2peak) test.8,20,41 The V O2peak test measures the maximal capacity of the body to deliver oxygen from the lungs to the mitochondria of exercising muscles. The test can be performed with any type of exercise, although ideally with exercise incorporating as much available muscle mass as possible. It is typically performed with patients rotating arm ergometers, or propelling wheelchairs on treadmills or ergometers.20,40,43,44 Expired gases are collected during the test through a mouthpiece connected to a gas analysis system.45,46 Results are expressed as either the greatest absolute (l.min1) or relative (ml.kg1.min1) rate of oxygen consumption. The V O2peak test requires patients to exercise at gradually increasing intensities until exhaustion. Short rests of between 20 and 30 seconds are sometimes provided between each increment. The V O2peak test is equivalent to the V O2max test in able-bodied people. The different terminology is used to reflect the lower maximal rate of oxygen

consumption with arm versus leg exercise.11 Arm exercise is associated with a lower maximal rate of oxygen consumption because of the lower demand for oxygen from the smaller exercising upper limb muscles and the circulatory implications of arm exercise. The V O2peak test is the most accurate way of measuring cardiovascular fitness in patients with spinal cord injury and it is gold slandered but is not commonly used in spinal cord injury units because it is unnecessarily complex for the needs of clinicians.

Submaximal exercise tests:

Cardiovascular fitness is most commonly assessed in wheelchair-dependent patients with submaximal arm tests. Expired gases can be collected with portable and easy to use expired gas analysis systems although it is more common in spinal cord injury units to just measure heart rate. Submaximal arm tests are performed in a similar way to maximal arm tests but are terminated before exhaustion. The results of submaximal tests which solely rely on heart rate are primarily used to monitor the response of patients to training. For example, improvements in cardiovascular fitness are indicated by a decrease in heart rate at the same power output with training. The Borg exertion scale is widely used for this purpose .Improvements in fitness is indicated by lower levels of perceived exertion with exercise at the same power output.

Field exercise tests:

Cardiovascular fitness can also be assessed by measuring the distance walked, pushed, cycled or swam over a set time period. Alternatively, instead of measuring the distance covered in a set time, the distance can be standardized and the time taken to cover the distance measured. The more standardized tests

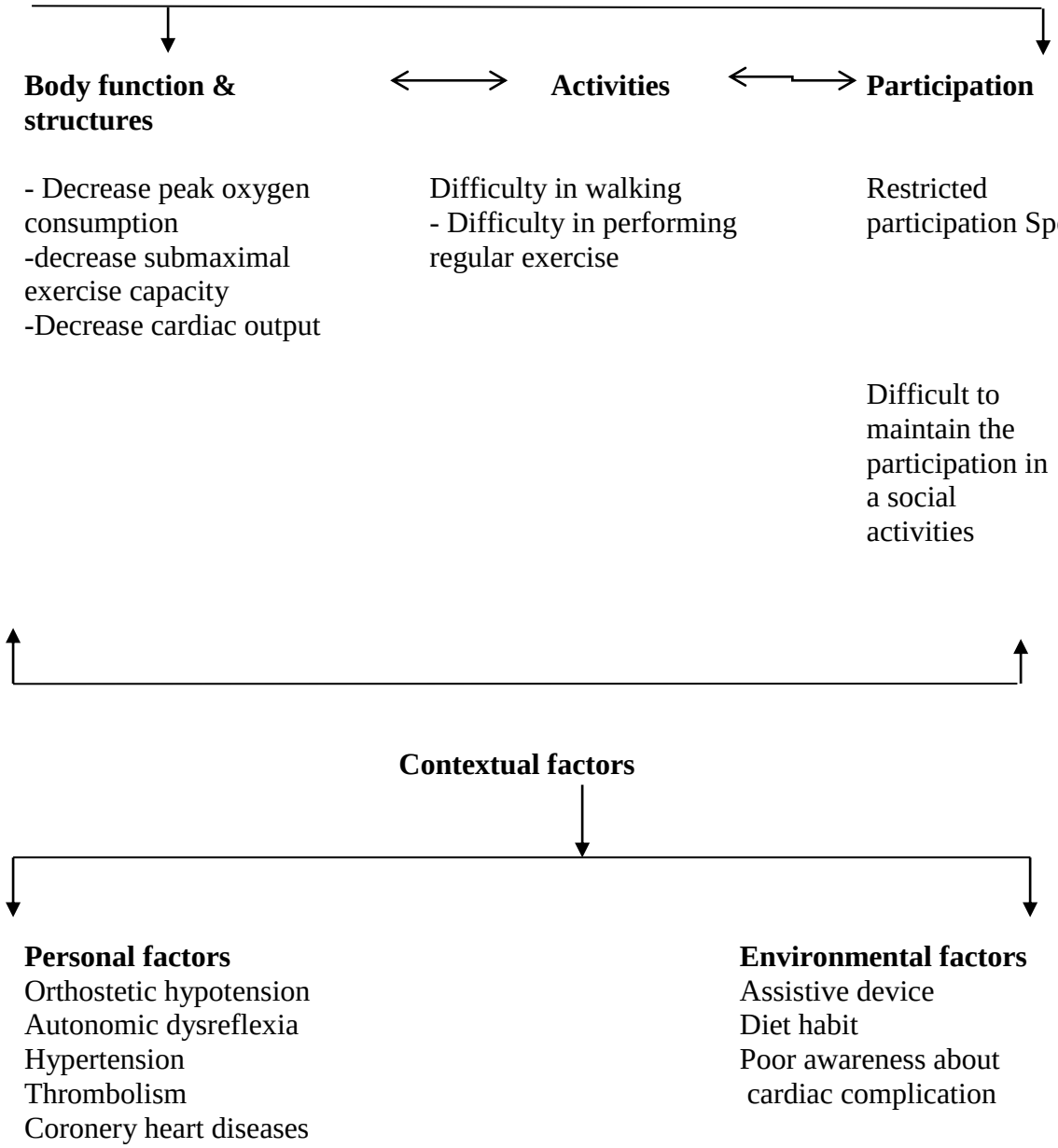
include the 6- and 12-minute wheelchair propulsion tests. In these tests, patients are required to push their wheelchairs as far and as fast as possible in 6 or 12 minutes over flat ground. Variations can be used where the speed of pushing and/or incline are gradually increased. VO2peak can be estimated from the 12-minute wheelchair propulsion test.

Chapter 3 Methodology

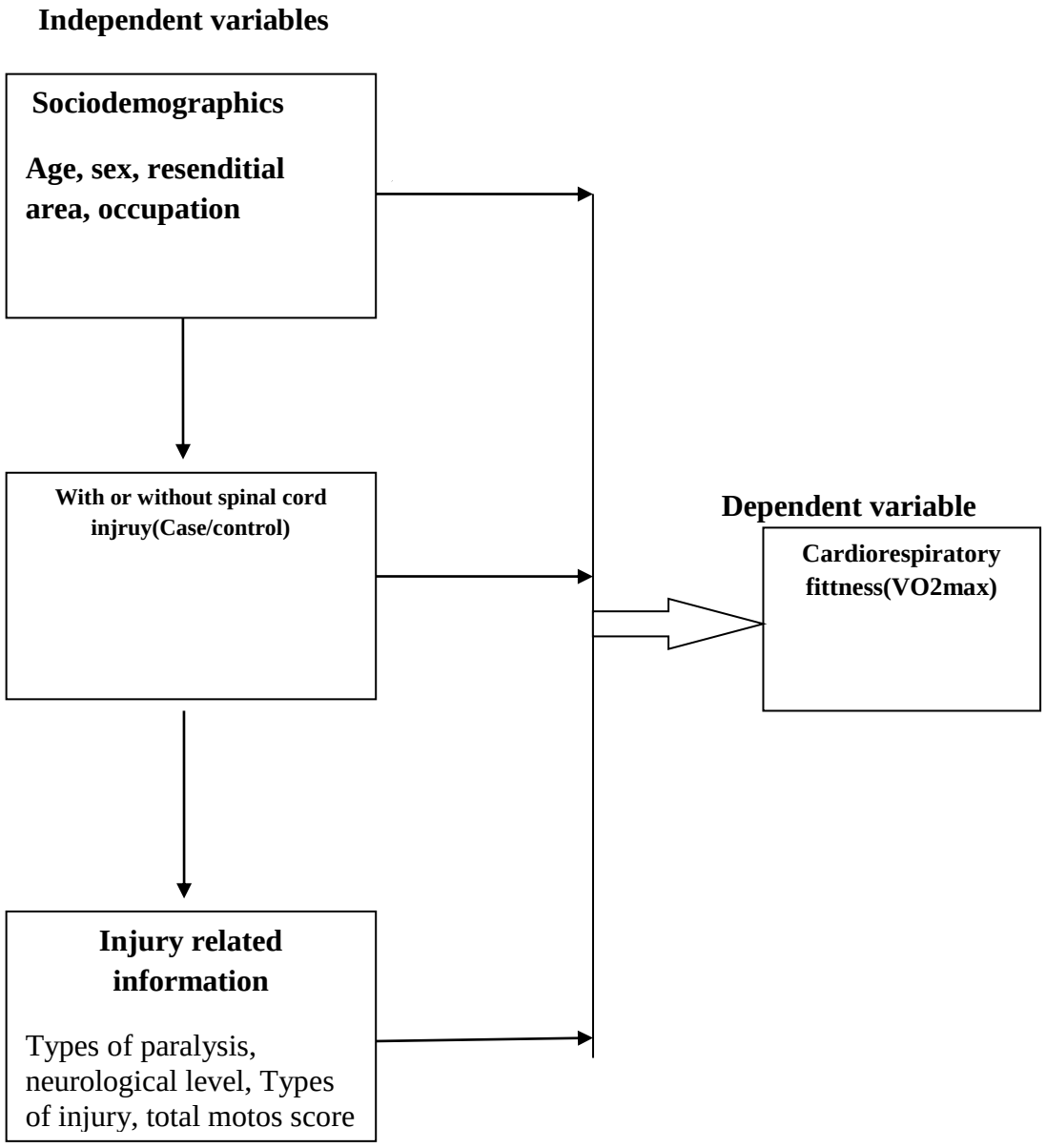
3.1 Conceptual Framework (ICF model)

ICF model for the cardiovascular fitness of patient with Spinal cord injury:

(Spinal Cord injury)



Conceptual Framework (Independent and dependent variable)



3.2 Study Objectives

3.2.1Main objective:

- To compare the level of cardiovascular fitness of patient with spinal cord injury at CRP with normal population

3.2.2 Specific objective:

- To measure the cardiovascular fitness in respective of VO2max
- To compare the cardiovascular fitness with non SCI people
- To measure walking speed of patient with SCI and non SCI population
- To measure the BMI of person with and without SCI

3.3 study design

This study aimed to compare the level of cardiovascular fitness of patient with spinal cord injury at CRP with normal population. To complete this purpose case control study design was selected for this study.

3.4 Study population

All the Spinal cord injured patients who admitted in CRP during the study.

3.5 Study site

The study area was Spinal Cord Injury (SCI) unit of the Centre for the Rehabilitation of the Paralysed (CRP), Savar, Dhaka.

3.6 Study period

February 18 to May 2018

3.7 Sample size

Total 50 participants, 25 cases and 25 control group

3.8 Inclusion and Exclusion Criteria

Inclusion Criteria for case

- SCI patients who receive treatment from CRP
- Able to walk with or without device at least two minutes

- Injured before minimum 3month and maximum 36 month ago
- Age range 15 to 60

Exclusion criteria for case

- Patient with known cardiovascular diseases
- Unable walk for two minutes
- Injured less than 3 month or more than 36 months

Inclusion Criteria for control

- Participants without spinal cord injury
- Similar age with a case participants
- Without any difficulties in walking

3.9 Sampling procedure

Sampling procedure was convenience sampling procedure. Conveniently 25 SCI patients were selected during the study period who receive treatment from CRP. In this technique it was easy to collect data from the sample within limited time.

Control group were selected purposively from normal population with similar age group around the CRP.

3.10 Data collection instrument

For data collection a self-administrative questionnaire was used to find out Socio-demographic information.

To Asses cardiovascular fitness VO2max:

Resting heart rate was measured by FIT BIT ultra, sensor watch. Participants were instructed to rest for two minute and then heart rate was measure.

Maximum heart rate was calculate by HR max=220-Age equation.

Than, VO2 max = 15 x (HRmax ÷ HRrest) calculation was used to measured the VO2max , UTH, N. et al. (2004).

Two minute walk test:

The 2MWT was performed over a 50-ft (15.2-m) out-and-back course. Participants were instructed to walk as fast as they could until asked to stop. They were also told not to worry if they had to slo down or rest, but that if they stopped they should start walking again as soon as they felt ready to do so. When 1 minute had elapsed, they were told "You are doing well; you have 1 minute left." Participants stopped walking at 2 minutes, and the distance covered was documented(Bohannon et al., 2014).

10 meter walk test:

Participants were instructed to walk as fast as they could until asked to stop in a 10 Meter walking line. Total duration was measured in second(Peters, Fritz, & Krotish, 2013)

To asses Perceived Exertion (RPE):

The Borg Rating of Perceived Exertion (RPE) is a way of measuring physical activity intensity level. Perceived exertion is how hard you feel like your body is working(Scherr et al., 2013).

3.11 Procedure of data collection

Data was be collected by the researcher himself. The questionnaire form was be completed or filled up in front of the researcher.

3.12 Ethical consideration

Ethical issues were followed by World Health Organization (WHO) and Bangladesh Medical and Research council (BMRC). At first to conduct study, the

formal research project proposal was submitted to Bangladesh Health Professions Institute Institutional Review Board (IRB). After that permission for data collection was obtained from the Spinal Cord Injury (SCI) unit of CRP, Savar. Data collection was started and complete within the allocated time frame. All data was reviewed in strict secure and maintain confidentiality. The assessment files were strictly secured and it was not open in front others without researcher.

Chapter IV Result

The aim of this study was to compare the cardiovascular fitness of people with spinal cord injury with normal population with same age.

Demographic characteristic:

There were two groups in this study, one was case who has spinal cord injury and another was control who doesn't have spinal cord injury.

In gender distribution all participants in both case and control group was female.

Age distribution:

In age distribution most of the participants was young adult in both case and control group. Mean age of the participants was 28±5years. Majority of participants was within 25 to 30 years old age group.

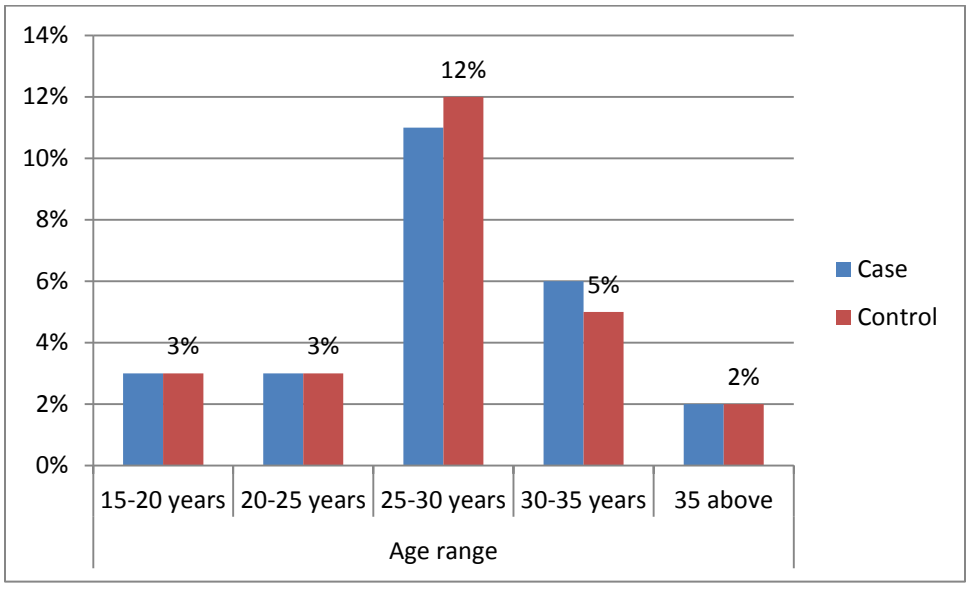


Figure 1: Age Distribution of the participants

Monthly income: Average monthly income of the participants was 20400±9122.74 BDT. Most of the participants income range was from 15000 to 30000 BDT. Most income generating age group was 30 to 35 years

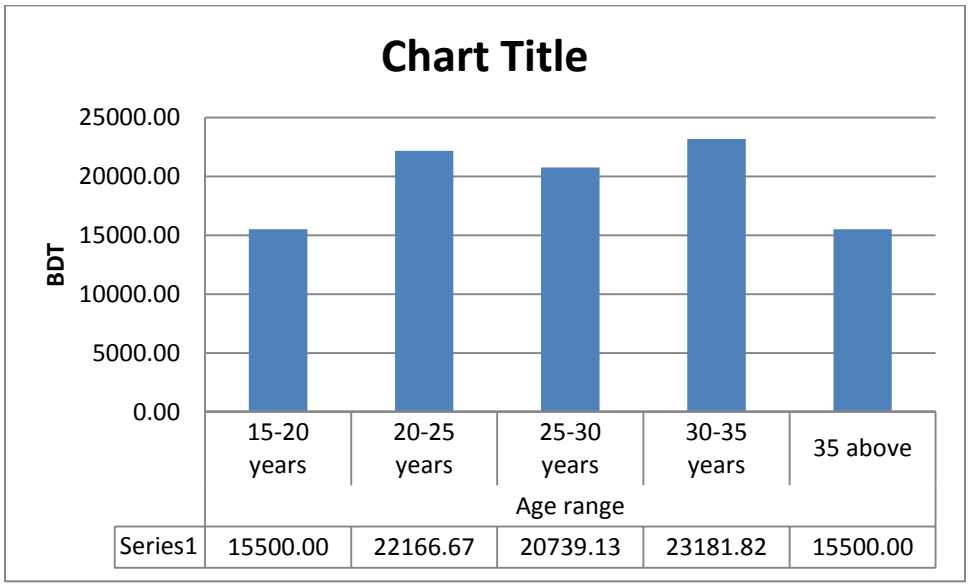


Figure 2: Age income relationship

Educational status:

In educational status discrepancy was followed between case and control group. In case group 84% sample educational status was up to higher secondary level. In case of control group 80% sample was within bachelor or above.

Educational Status	Case	Control
Illiterate	12%	4%
Literate	16%	8%
Primary	24%	4%
HSC	12%	0%
HSC	20%	0%
Bachelor	16%	80%
Masters or above	0%	4%
Total	100%	100%

Table 1: Educational status of the participants

Residential area:

In case group most of the sample was live in rural area(60%), and in control group most of the was live in urban area (64%)

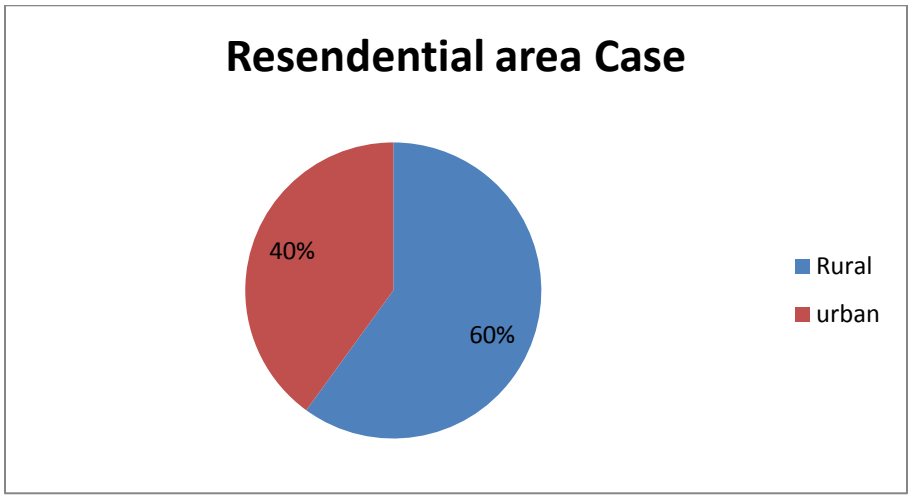


Figure 3: residential area of case

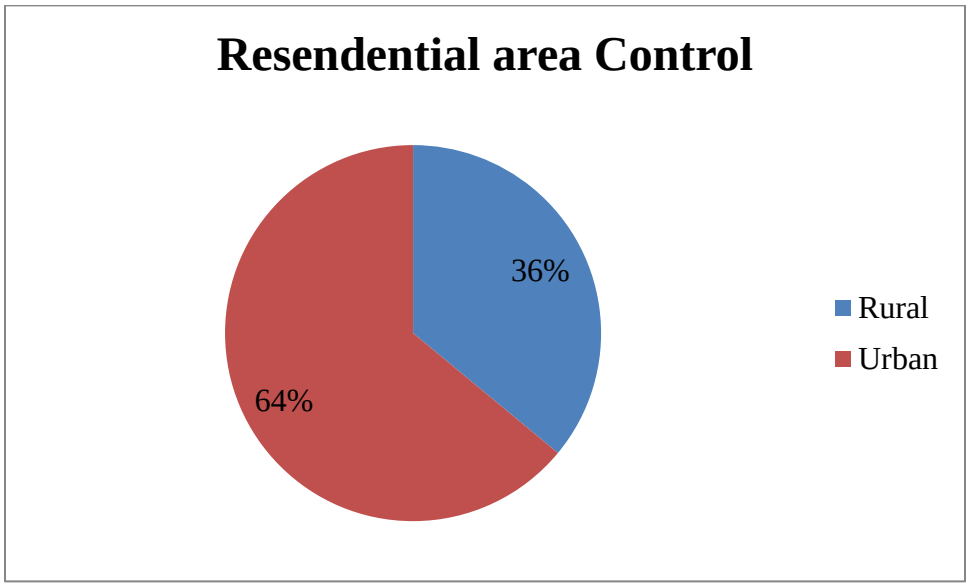


Figure 4: residential area of control

Type of paralysis

In types of paralysis within case group representative sample portion was paraplegic (68%) and rest of them was tetraplegic.

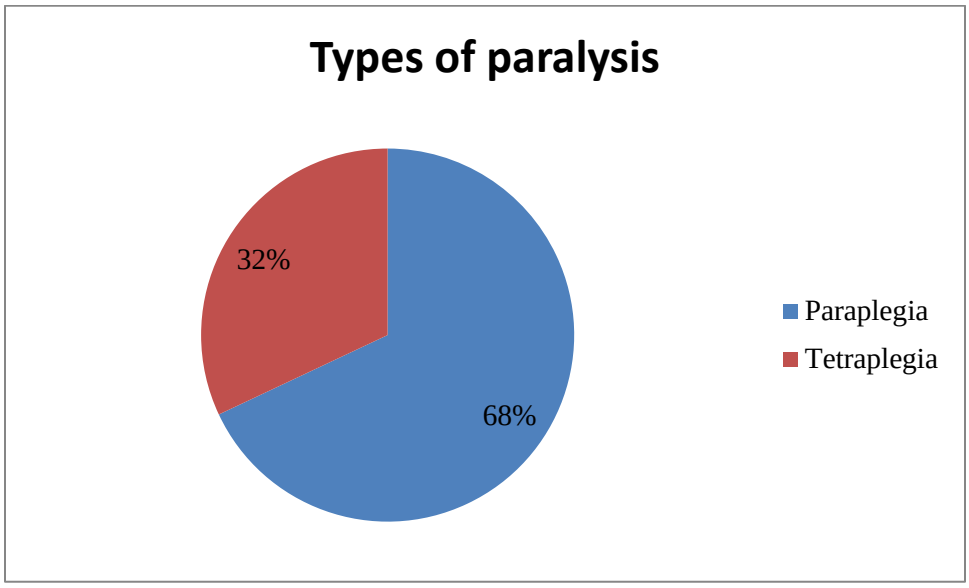


Figure 5: types of injury

Types of injury:

In type of injury most of the participants was Incomplete D(80%), Incomplete B and C was 20%. There was no Complete A within the participants

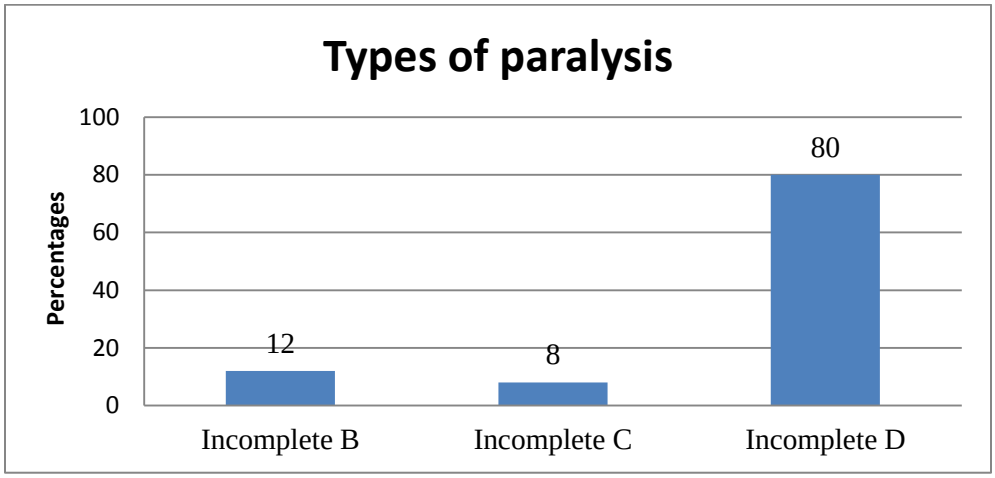


Figure 6: ASIA of injury

Neurological Level of injury:

In neurological level of distribution in lumber area L1, L2 & L3 sample portion were level 44%, (n-25%), cervical region 44%, and thorasic region 12%.

Neurological level of injury	Frequency	Percent
C3	1	4.0
C4	3	12.0
C5	1	4.0
C6	2	8.0
C7	4	16.0
T8	1	4.0
T12	2	8.0
L1	3	12.0
L2	4	16.0
L3	4	16.0
Total	25	100.0

Table 2: Distribution of neurological level

Total motor score:

Motor score was calculated from summation of total key muscle of upper and lower limbs. Average motor score of the case group were 72± 17, (n-25). Maximum motor score was 98 within 100 score and minimum score were 34.

Length of injury:

Average length of injury of the participants was 8 months± 11 months. Minimum and maximum length of injury was 3 months and 36 months. In length of injury representative portion was in 3 month, 48% (n-25).

Use of assistive device:

Most of the cases of people spinal cord injury were used different types of assistive device during walking test 60%, n-25. Within then 36% (n-25) use more than one types of assistive device. Most commonly used assistive device was toe pick up which was 32% (n-25).

Participant's height weight and BMI:

Participant's height was measure in Meter and weight was calculated by Kilogram (KG). Mean height of participants in case group was 1.67 M±.08, and control group 1.66 M±.12. Mean difference among them was .008M.

Mean body weight of case group was 56.7 kg±7.9 and control group was 67.853kg±7.52. Mean difference among them was 11.14 kg. In body mass index mean difference among both groups was 4.43 kg/m□

Case/control		Height in M	Body weight in KG	BMI kg/m□
Case	**Mean**	1.676	56.704	20.1688
	N	25	25	25
	Std. Deviation	0.08451	7.98407	3.24989
Control	**Mean**	1.6676	67.852	24.6032
	N	25	25	25
	Std. Deviation	0.1283	7.52878	3.3246
Sig. (2-tailed)		.000	.000	**.000**

Table 3: BMI distribution with case/control

In independent sample t test among both group shows having spinal cord injury have significant impact (p<.05) on BMI of the participants.

In correlation with age there is no significant correlation (p<.05) among age and BMI of the participants.

BMI category:

In BMI categorical distribution among both groups in case group 32% participants had underweight and 62% were normal weight (n-25),and in control category 50% had normal weight and 45% had class 1 obesity (n-25). Chi-squire test shows that there is strong association (p<.05) between case and control group with types of BMI.

	Case/control				
BMI	**Case**		**Control**		**Chi-square**
classification	**Count**	**%**	**Count**	**%**	
under weight	8	32.0%	0	0.0%	**.001**
Normal	15	60.0%	12	50.0%	
pre obesity	2	8.0%	11	45.8%	
obesity class 1	0	0.0%	1	4.2%	

N-25

Table 4: BMI category distribution with case/control

Heart rate:

Heart rate of the participants was measured in there time. Resting heart rate was calculated before the walk test and after two minute rest in sitting position. Than heart rate was measured after two minute of walking and consequently after two minute rest. Maximum heart rate was measured by 220 minus present age. Mean resting heart rate

was 74.7±12 beat/min, maximum heart rate 191±5.4beat/ min; heart rate after two minutes walking 93±19 beat/minute, and heart rate after two minute rest was 75±8.5 beat/min. Mean difference among case and control group was in resting heart rate 0.95, maximum heart rate 0.11, after two minute walking 23.8 and heart rate after two minute rest 5.39 beat per minutes.

Case/controll		Resting heart rate beat/min	Maximum heart ratebeat/min	heart rate after 2 min walking beat/min	Heart rate after 2 min beat/min
Case	Mean	74.7200	191.9200	93.8800	75.2000
	N	25	25	25	25
	Std. Deviation	12.70013	5.39228	19.04232	8.53424
Control	Mean	73.7600	192.0400	117.6800	80.6000
	N	25	25	25	25
	Std. Deviation	7.72054	5.25579	15.75786	22.40164
	Sig Value	.ooo	.0003	.006	.005

Table 5: Heart rate distribution with case/control

Independent sample t test among case and control group shows having spinal cord injury have significant impact ($p<.05$) on heart rate after two minute walking. There is no significant association with resting heart rate, maximum heart rate and heart rate after two minute rest.

Walking parameter:

Patient was performing two walking test two minute walk test two minute walk test and 10 meter walk test.

In case group Mean distance cover in two minutes was 98.18±64.1 M and control group 222.92±22.1M, mean difference 124.74M.

In 10 meter walk test mean duration was 14.65±18.42 sec in case group and 5.06±.65sec, mean difference among them was 9.592 sec. In Speed measurement mean speed was 1.4m/sec and in control .5m/sec.

Case/ Control		Distance in M cover in 2 min	Duration in sec for 10 meter
Case	Mean	98.1800	14.6520
	N	25	25
	Std. Deviation	64.10682	18.42408
	Speed		1.4m/sec
Control	Mean	222.9200	5.0600
	N	25	25
	Std. Deviation	22.10566	.65064
	Speed		0.5 m/sec
	Sig. (2-tailed)	**.000**	**.012**

Table 6: Walking parameter with case/control group

Independent sample t test among case and control group shows having spinal cord injury have significant impact ($p<.05$) on both two minute walk test and 10 meter walk test.

Respiratory volume:

Mean peak expiratory flow in case group was 391±58 CC and in control group was 397±95CC. Mean difference among them was 5.83CC. In force expiratory volume in 1 min mean value in case group was 2.21 L/Min and in control group 2.26L/min. Mean difference among them was .025 L/Min.

Case/controll		Peak expiratory flow CC	FEV1 L/min
Case	Mean	391.6000	2.2412
	N	25	25
	Std. Deviation	58.39521	.66235
Control	Mean	397.4400	2.2664
	N	25	25
	Std. Deviation	95.09385	.56560

Table 7: Respiratory volume distribution with case/control

There is no significant association of (p>.05) spinal cord injury with two minute walk test and 10M walk test.

SCIM value:

In spinal cord injury independence measure (SCIM) value mean score was 29.76±7.36. In age range 20 to25 age group had the highest SCIM mean score, 32. In neurological level mean score was highest in C6 (38) and L3 (36). In type injury and types of paralysis mean SCIM score was high in tetraplegic , 31.88 and Incomplete B, 32.25 patient. One way ANOVA test shows there is association exist between types of injury ($p<.05$) and SCIM score. There is no association between SCIM score with type of paralysis or age range ($p>.05$).

		SCIM mobility score Mean	
Mean		29.76	Sig value
Std. Deviation		7.367	
Age range	15-20 years	22.67	
	20-25 years	32.00	.327
	25-30 years	31.27	
	30-35 years	31.17	
	35 above	24.50	
Neurological level of injury	C3	36.00	
	C4	24.00	
	C5	33.00	
	C6	38.00	
	C7	33.25	
	L1	22.00	
	L2	30.00	
	L3	36.00	
	T12	21.00	
	T8	22.00	
Type of paralysis	Tetraplegia	31.88	
	Paraplegia	28.76	.335
Types of injury	Incomplete B	20.00	**.001**
	Incomplete C	19.50	
	Incomplete D	32.25	

Table 8: SCIM score distribution with case/control

Fitness (Vo2max) score:

In Vo2max there are very low dissimilarities among case and control group, mean difference .14. Mean Vo2 max score of case group was 39.34 ml/kg/min ±5.25 and control group 39.48±4.52.

	vo2max ml/kg/min		
Case/control	Mean	N	Std. Deviation
Case	39.3467	25	5.25045
Control	39.4868	25	4.52516
Sig. (2-tailed)	.920		

Table 9: VO2max distribution with case/control

Independent sample t test among case and control group shows having spinal cord injury have non-significant impact (p>.05) on fitness, VO2 max .

In correlation with fitness VO2 max has strong negative correlation with (r=-.94) with resting heart rate and weak correlation (n-50) with age of the participants, BMI, peak expiratory flow.

Within case and control group separately VO2max has weak correlation with motor score, age of the participants, BMI, peak expiratory flow, distance cover in two minute and duration needed in 10 meter waking.

		vo2max Mean ml/kg/min	Sig
Age range	15-20 years	40.48	.582
	20-25 years	**40.84**	
	25-30 years	39.56	
	30-35 years	39.03	
	35 above	35.94	
Type of paralysis	No paralysis	39.49	.594
	Tetraplegia	40.80	
	Paraplegia	38.66	
	NO injury	39.49	
Types of injury	Complete A	0	**.022**
	Incomplete B	31.45	
	Incomplete C	39.44	
	Incomplete D	40.52	
BMI classification	under weight	41.79	.243
	Normal	39.52	
	pre obesity	38.06	
	obesity class 1	39.04	

Table 10: VO2max distribution with demographic characteristics

One way ANOVA shows VO2max differ significantly ($p<.05$) with types of injury and Incomplete B category patient have significantly low VO2max score among them. It doesn't differ significantly with age range, types of paralysis or types of BMI

		Case/control	
		Case vo2max ml/kg/min Mean	Control vo2max ml/kg/min Mean
Age range	15-20 years	41.44	39.52
	20-25 years	36.49	**45.18**
	25-30 years	**39.96**	39.20
	30-35 years	39.25	38.76
	35 above	37.42	34.45

Table 11: Age range and VO2 max distribution among case/control

In age range highest mean VO2 max in case group was 25 to 30 years and control group was 20 to 25 years.

		vo2max Mean
		39.49
	C3	41.91
	C4	42.11
	C5	43.85
	C6	44.10
Neurological level of injury	C7	38.39
	L1	35.02
	L2	39.32
	L3	37.78
	T12	37.97
	T8	40.42

Table 12: BMI category distribution among neurological level

VO2max mean score greater in thorasic and lower cervical rather than lumber region.

Chapter V Discussion

The aim of this study was to compare the cardiovascular fitness of people with spinal cord injury with normal population with same age. There was more than one factor that had association with cardiovascular fitness of people with spinal cord injury.

Demographic characteristics:

In age distribution mean age of the participants was 28 years and majority age group were 25 to 30 years. In one of the Previous studies it was found that average age for SCI patients was 33 years (Wyndaele, M. and Wyndaele,J.J.,2006). It was very accurate to this study, Another study also showed mean age for SCI patients was 33.5 years (Devivi and Philip, 1985). Two studies in Bangladesh also support that age rage(Islam, Hafez, & Akter, 2011), (Hoque, Grangeon, & Reed, 1999) .

Injury related characteristics:

Researcher didn't include any female participants in this study due to scarcity of female particular criteria. Ratio of the female participants is also low within the SCI population(Islam et al., 2011).

Within control group representative portion was paraplegic 68%, it is supported by (Islam et al., 2011). Majority portion was Incomplete D. It is due to In complete D patient have most of the chance of motor recovery and regaining gait ability(Scivoletto & Di Donna, 2009).

In neurological level of lesion sample also shows similarities with (Islam et al., 2011) that upper lumber and lower thorasic is the common injury region.

Cardiovascular fitness:

This study shows highest VO2max mean value in case group is in 25 to 30 year and in control 20 to 25 year. Wilmore and Costill (2005) shows norm value for VO2max male in different age group. According to them from 20-29 it is 43-52 ml/kg/min**.** In this study it was 36 to 39 in case group and 39 to 35 in control group. In this study researches also didn't found any association between age groups and changes in VO2 max. Researched also didn't found any impact of being case or control on VO2max. This may be due to changes in VO2max after spinal cord injury depend on extending of lower limb paralysis (Harvey 2008). In this study participant were selected from who have ability to walk. This may create impact on VO2max level.

There is limited study regarding relationship between physical fitness and injury related status of patient with spinal cord injury. This study shows VO2max have negative correlation with resting heart rate of the participants. This is due to VO2max was calculated from body weight and maximum heart rate and maximum heart was measured by resting heart rate, UTH, N. et al. (2004). This may also contribute poor relationship with motor score, age of the participants, BMI, peak expiratory flow, distance cover in two minute and duration needed in 10 meter waking.

Cardiovascular fitness differ significantly with types of ASIA of patient and AIS B patient have lowest VO2 max score among them. It also differ with neurological level. Mean VO2 max higher in thoracic rather than lumber region. Janssen et al., 1996 showed it differ with neurological level and BMI.

Researcher didn't found any significant relationship with types of injury and VO2 max . According to (Hicks et al., 2011) it has no significant relationship with types of injury but (Janssen et al., 1996) found its relationship with VO2 max.

5.1 Limitation of the study:

The aim of this study was to compare the cardiovascular fitness VO2max of SCI population with normal population. Despite of researcher willingness and effort still there is some limitation of this study.

- This study was used based on all 25cases and 25 control to compare the level of cardiovascular fitness VO2max of SCI patients, which is not large enough to make a general comment regarding SCI patients.
- This study didn't include any female respondent.
- Age group of the participants wasn't broad enough for all age range
- Researcher only included patient who have walking ability. Wheelchair user or other types of patient was excluded

CHAPTER –VI: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This study found no significant relationship between case and control groups with fitness of VO2max. Significant association found between VO2max and types of injury and it also differ with neurological level of injury. Researcher didn't found any positive co relationship of VO2max with BMI, AGE, and walking distance and speed. Average VO2max score was lower in both case and control group.

In the rehabilitation of spinal cord injury patients it is very important to maintain fitness level of SCI patients. It has a impact on patient activity of daily living and functional level.

Researcher only included patient with walking ability in this study. So it can be said that cardiovascular fitness (VO2max) doesn't differ with SCI people who can walk with or without support.

6.2 Recommendation

This was a case control study with limited sample size in a control environment. No wheel chair user was included in this study. Further study with larger sample size in community environment can be done to find out the actual relationsip between Vo2max and spinal cord injury

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VARBAL CONSENT STATMENT

Assalamu alaikun/nomosker, my name is *Kazi Imadadul Hoque*, I am conducting a research project (dissertation) study which included in our course curriculum of Bangladesh health professions institute (BHPI). The title of the study is 'Assessing cardiovascular fitness of patients with spinal cord injury at CRP, Bangladesh compare with normal population'. I would like to know about some personal and other related question about your spinal cord lesion. This will take approximately 20 to 30 minutes.

I would like to inform you that this is purely academic study and will not be used for any other purpose. The researcher is not directly related with this musculoskeletal area, so 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 insured that the sources of information remains anonymous.

Your participation in this study is voluntary and you may withdraw yourself at any time during this study without any consequence. You also have a right not to answer a particular question that you do not like or do not want to answer during interview.

If you have any query about the study or your right as a participant you may contact with me and / or Muhammad Millat Hossain Assistant Professor, Rehabilitation Science. Course Coordinator, Department of physiotherapy.

I am ---------- giving my consent

Signature----------Date

Data collector sign---------- Date

Witness sign---------- Date

সম্মতি পত্র

আমি কাজী ইমদাদুল হক, এম এস সি ইন রিহ্যাব সাইন্স, দ্বিতীয় বর্ষ আমার শিক্ষার অংশ হিসাবে একটি গবেষণা পরিচালিত করছি যার বিষয় হল "মেরুরজ্জুতে আঘাতপ্রাপ্ত ব্যাক্তিদের হৃদযন্ত্রের কাজ করার উপযোগিতা"।

আমি আপনার কিছু ব্যক্তিগত এবং প্রাসঙ্গিক সমস্যা যেমন বর্তমান অবস্থা সম্পর্কিত কিছু প্রশ্ন করব। এর জন্য ৫–১০ মিনিট সময় প্রয়োজন হতে পারে। আপনাকে গবেষনার অংশ হিসাবে কিছু দৈহিক পরিশ্রমের কাজে অংশ নিতে হবে যা লিপিবদ্ধ করা হবে। আমি আপনাকে জানাতে চাচ্ছি যে এই গবেষণাটি শিক্ষা প্রয়োজনে ব্যাবরীত হবে এবং কোনভাবেই আপনার বর্তমান কিংবা ভবিষ্যতের জন্য ক্ষতিকর নয় । এই গবেষণা টি পক্ষাগাতগ্রতস্থদের পুনর্বাসন কেন্দ্র (সি আর পি) চিকিৎসার সাথে সম্পর্কিত নয় ফলে আপনার চিকিৎসার কার্যক্রমের কোন ব্যাঘাত ঘটবেনা। এছাড়াও বর্তমান কিংবা ভবিষ্যতে এই গবেষণাপত্রটি প্রকাশিত হলেও আপনার নাম পরিচয় প্রকাশ করা হবে না।

এই গবেষণায় আপনার অংশগ্রহন সম্পূর্ণ ঐচ্ছিক এবং এই গবেষণা চলাকআলীন সময়ের যেকোনো পর্যায়ে আপনি কোনপ্রকার বাধা বিগ্ন ছাড়া আপনার সম্মতি প্রত্তাহার করতে পারবেন। এই সাক্ষাৎকারের সকল প্রশ্নের উত্তর দিতে বাধ্য নন।

আপনার যদি কোন প্রশ্ন থাকে তবে মাস্ট্রার্স ইন রিহ্যাবিলিটেশন সাইন্স বিভাগ, বাংলাদেশ হেলথ প্রফেসন্স ইন্সিটিটিউট ,সি আর পি এর সাথে যোগাযোগ করতে পারবেন।

আমি ---------- এই গবেষণায় অনশগ্রহনে আমার সম্মতি জ্ঞাপন করলাম।

স্বাক্ষর/টিপ সই ----------তারিখ

তথ্য সংগ্রহকারীর নাম ও স্বাক্ষর---------- তারিখ

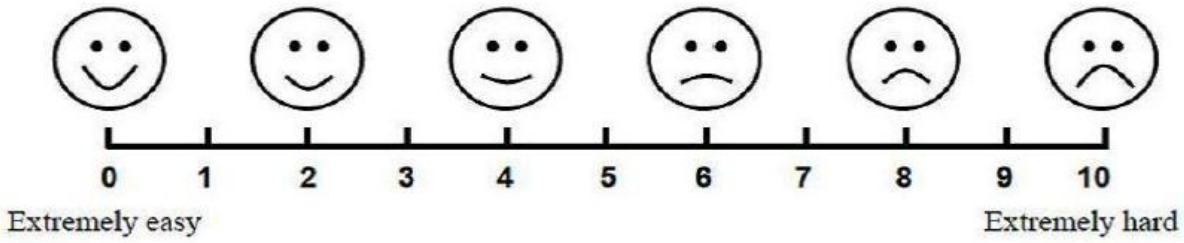
সাক্ষী স্বাক্ষর/টিপ সই ---------- তারিখ

Questionnaire

Section 1: Demographic Questions

QN	Questions and filters	Responses	Code
	Patient ID		
	Date……/……../…….	Time…….am/pm	
101.	Age (in year):	|__|__| yrs	
102.	Sex:	Female …….. Male ……..	01 02
103.	Marital status:	Married…….……..… Unmarried……..…… Divorced……..……..……... Widow…….……..	01 02 03 04
104.	Religion	Islam …….…… Hinduism…….. Christianity...…….…… Buddhist…… Other (Specify):_____	01 02 03 04
105.	Educational status	Illiterate…… …….. Literate…….. …….. Primary……...….... Secondary school certificate (SSC) -- Higher secondary certificate (HSC)… Bachelor ……... Masters or above……. Other (Specify): _____	01 02 03 04 05 06 07 08
106.	Residential area	Rural……. Urban…….	01 02
107.	Average monthly family income	_____(*Taka*)	
	Injury related information		
108	Type of paralysis	Tetraplegia Paraplegia	01 02
109	Length of injury	……days	
110	Types of injury	Complete A Incomplete B Incomplete C Incomplete D	01 02 03 04
111	Neurological level		
112	Total motor score		
113	Assistive Device use during testing	Wheelchair Elbow crutch	01 02

		Back slab Toe pick up AFO KAFO others	03 04 05 06 07
114	Do you use any drug related with cardiovascular problem	Yes No	
	Fitness related Question		
115	Patient height	……..m	
116	Patient body weight	……..Kg	
117	BMI		
118	Air temperature during examination	…….C	
119	Humidity during examination	…….	
120	Resting Heart rate	……..beat/min	
121	Maximum Heart rate	……..beat/min	
122	Ending heart rate	……..beat/min	
123	Heart rate 2 in after completing	……..beat/min	
124	Distance cover in 2 min	……M	
125	Duration need in 10 meter	…….sec	
126	Maximum Level of exertion after walking/wheeling		
127	Perceived		
128	Peak expiratory flow	……..CC	
129	FEV1		
130	SCIM mobility score		



SCIM-SPINAL CORD INDEPENDENCE MEASURE

1. Mobility in Bed and Action to Prevent Pressure Sores
0. Needs assistance in all activities: turning upper body in bed, turning lower body in bed, sitting up in bed, doing push-ups in wheelchair,
with or without adaptive devices, but not with electric aids
2. Performs one of the activities without assistance
4. Performs two or three of the activities without assistance
6. Performs all the bed mobility and pressure release activities independently

2. Transfers: bed-wheelchair (locking wheelchair, lifting footrests, removing and adjusting arm rests, transferring, lifting feet).
0. Requires total assistance
1. Needs partial assistance and/or supervision, and/or adaptive devices (e.g., sliding board)
2. Independent (or does not require wheelchair)

3 . Transfers: wheelchair-toilet-tub (if uses toilet wheelchair: transfers to and from; if uses regular wheelchair: locking wheelchair,
lifting footrests,removing and adjusting armrests, transferring, lifting feet)
0. Requires total assistance
1. Needs partial assistance and/or supervision, and/or adaptive devices (e.g., grab-bars)
2. Independent (or does not require wheelchair)

Mobility (indoors and outdoors, on even surface)

4. Mobility Indoors
0. Requires total assistance
1. Needs electric wheelchair or partial assistance to operate manual wheelchair
2. Moves independently in manual wheelchair
3. Requires supervision while walking (with or without devices)
4. Walks with a walking frame or crutches (swing)
5. Walks with crutches or two canes (reciprocal walking)
6. Walks with one cane
7. Needs leg orthosis only
8. Walks without walking aids

5 . Mobility for Moderate Distances (10-100 meters)
0. Requires total assistance
1. Needs electric wheelchair or partial assistance to operate manual wheelchair
2. Moves independently in manual wheelchair
3. Requires supervision while walking (with or without devices)
4. Walks with a walking frame or crutches (swing)
5. Walks with crutches or two canes (reciprocal walking)
6. Walks with one cane
7. Needs leg orthosis only
8. Walks without walking aids

6. Mobility Outdoors (more than 100 meters)
0. Requires total assistance
1. Needs electric wheelchair or partial assistance to operate manual wheelchair
2. Moves independently in manual wheelchair
3. Requires supervision while walking (with or without devices)
4. Walks with a walking frame or crutches (swing)
5. Walks with crutches or two canes (reciprocal waking)
6. Walks with one cane
7. Needs leg orthosis only
8. Walks without walking aids

7 . Stair Management
0. Unable to ascend or descend stairs

1. Ascends and descends at least 3 steps with support or supervision of another person
2. Ascends and descends at least 3 steps with support of handrail and/or crutch or cane
3. Ascends and descends at least 3 steps without any support or supervision

8. Transfers: wheelchair-car (approaching car, locking wheelchair, removing arm and footrests, transferring to and from car, bringing
wheelchair into and out of car)
0. Requires total assistance
1. Needs partial assistance and/or supervision and/or adaptive devices
2. Transfers independent; does not require adaptive devices (or does not require wheelchair)

09. Transfers: ground-wheelchair
0. Requires assistance
1. Transfers independent with or without adaptive devices (or does not require wheelchair)

Total score- 40

Achieved score-

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

Ref.

Date: 03/06/2018

CRP-BHPI/IRB/06/18/210

To
Kazi Imdadul Hoque
Part II, M.Sc. in Rehabilitation Science
Session: 2016-17, Student ID: 181160059
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Subject: Approval of the thesis proposal- "Comparing the level of cardiovascular fitness for patients with spinal cord injury at CRP and normal population in Bangladesh"

Dear kazi Imdadul Hoque,

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	Dissertation Proposal
2	Questionnaire (English version)
3	Information sheet & consent form.

Since the study involves answering a questionnaire that take about 20-30 minutes, have no likelihood of any harm to the participants and have possibilities of benefit both for the providers and receivers. The members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 9.00 AM on 6th May, 2017 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

Permission Letter

Date:

To

The Head of medical services wing,

Department of physiotherapy

CRP, Chapain, Savar, Dhaka-1343

Subject: Application for permission of data collection for master's thesis

Dear Sir,

With due respect, I am Kazi Imdadul Hoque, student of part-II M.Sc in Rehabilitation Science at Bangladesh Health Professional Institute (BHPI). As per course curriculum, I need to complete a thesis for completion of my Masters program. Hence, I have to conduct a thesis entitled, "Measuring the level of cardiovascular fitness for patients with spinal cord injury at CRP, Bangladesh" under honorable supervisor **Md. Fazlul Karim Patwary**. As my research includes spinal cord injury patients, I would like you to grant me the permission to use the information among patients. The purpose of the study is to assess cardiovascular fitness of spinal cord injury among patients attended at CRP. Related information will be collected from the patients attending in CRP.

Data collection will require the patients and a small space of CRP. Data collectors will receive informed consents from all participants. Ethical approval is received from the Institutional Review Board (IRB) of Bangladesh Health Profession's Institute (BHPI).

Sincerely yours,

_____

Yours sincerely

Kazi Imdadul Hoque

Part-II, M.Sc in Rehabilitation Program

BHPI, CRP, Savar, Dhaka

Ref to Dr. Kamal, Registrar, for NFA. 29/5/18 15-1915

Permission Letter

Date:23/05/2018

To

The Head of department,

Department of physiotherapy

CRP, Chapain, Savar, Dhaka-1343

Subject: Application for permission of data collection for master's thesis

Dear Sir,

With due respect, I am Kazi Imdadul Hoque, student of part-II M.Sc in Rehabilitation Science at Bangladesh Health Professional Institute (BHPI). As per course curriculum, I need to complete a thesis for completion of my Masters program. Hence, I have to conduct a thesis entitled, "Measuring the level of cardiovascular fitness for patients with spinal cord injury at CRP, Bangladesh" under honorable supervisor **Md. Fazlul Karim Patwary**. As my research includes spinal cord injury patients, I would like you to grant me the permission to use the information among patients. The purpose of the study is to assess cardiovascular fitness of spinal cord injury among patients attended at CRP. Related information will be collected from the patients attending in CRP.

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Sincerely yours,

Kazi Imdadul Hoque

Yours sincerely

Kazi Imdadul Hoque

Part-II, M.Sc in Rehabilitation Program

BHPI, CRP, Savar, Dhaka

Approved

29/05/18

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

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

Ref. CRP-BHPI/MRS/04/18/0111

Date: 04/04/18

To Whom It May Concern

This is to certify that kazi Imdadul Hoque, a student of M.Sc in Rehabilitation Science at Bangladesh Health Professional Institute (BHPI) under the faculty of Medicine; University of Dhaka has to conduct a research for fulfillment of her Master's degree. His research title is "Measuring the level of cardiovascular fitness for patients with spinal cord injury at CRP, Bangladesh" which is a self funded study. The research proposal has been approved by Institutional Review Board (IRB) of this institute. To accomplish research objectives, he will collect data from CRP. We request you to provide him necessary support from your department / organization.

I wish his for every success in order to accomplish his research.

Best regards,

Millat Hossain

Muhammad Millat Hossain
Assistant Professor, Bangladesh Health Professional Institute (BHPI)
Project & Course coordinator, M.Sc in Rehabilitation Science
BHPI, CRP, Savar, Dhaka-1343, Bangladesh.