



Research Article

## COMPARISON OF VO2 MAX BETWEEN CHRONIC NECK PAIN AND NORMAL INDIVIDUALS USING QUEEN'S COLLEGE STEP TEST

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Chronic neck pain, Maximal oxygen capacity, Vo2 max, Trapezius.

### ABSTRACT

**Background:** Chronic neck pain is a condition increasing in general and occupational groups. environmental and personal factors influence onset and progress neck pain. Patients with chronic neck pain often report disability and decrease in their functional activities.

**Objective:** To compare VO2max between normal and chronic neck pain individuals.

**Materials and Methods:** study design- experimental study on 30 chronic neck pain and 30 normal individuals between age group 20-40 years. Materials:-bench for step test height 41.3cms, metronome, stopwatch.

**Results:** There was significant decrease in vo2 max values between chronic neck pain and normal individuals using unpaired t-test (p value<0.0001).

**Conclusion:** the study concluded that there is decrease in maximal oxygen carrying capacity of chronic neck pain individuals compared to normal.

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### INTRODUCTION

The neck anatomy is a well engineered structure of bones , nerves ,muscles ligaments and tendons. The neck begins at the base of the skull through a series of seven vertebral segments to connect to thoracic spine(upper back).The cervical spine is comprised of seven vertebrae C1,C2,C3,C4,C5,C6,C7.At each level vertebrae protect their segments of spinal cord and work with muscles ,tendons ,ligaments and joints to provide combination of support, structure and flexibility of the neck. With its complex and intricate construct and the stresses and forces that can be placed on it through a trauma or even just daily activities the cervical spine is at risk for developing painful conditions.

Neck pain is common among individuals. Neck pain can be developed suddenly from an injury or develop slowly over time such as poor posture or wear and tear. Some of the causes of neck pain are as follows<sup>1</sup>:-

- Degenerative disc diseases
- Neck strain
- Herniated disc
- Pinched nerve
- Poor posture

Neck pain occurring may be of two types Acute neck pain or Chronic neck pain. Acute neck pain occurs suddenly from an injury or a stress.

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Most of the times it will resolve itself within seven-ten days. Chronic neck pain is a long lasting neck pain lasting longer than three months.<sup>2</sup>

Chronic neck pain is a condition increasing in general and occupational groups, environmental and personal factors influence onset and progress neck pain. Patients with chronic neck pain often report disability and decrease in their functional activities. Lack of physical activities leads to maintenance of chronic episodes.<sup>1</sup>

Maximum oxygen consumption (vo2max) measure of body's capacity to use oxygen. Maximum amount of oxygen consumed per minute when individual has reached maximum effort. Milliliters of oxygen per kilogram of body weight per minute (ml/kg per minute).It is dependent on the transport of oxygen, the oxygen binding capacity of blood, cardiac function ,oxygen extraction capabilities and muscular oxidative potential. Maximum oxygen consumption is considered as 'Gold Standard' of cardio pulmonary and muscle cell fitness. The two methods of VO2 assessments<sup>3</sup>

- Direct :-VO2 max is measured directly by Benedict Rosh apparatus
- Indirect:-VO2 max is measured indirectly by sub maximal and maximal tests.

Sub maximal tests include 6min walk test,3 min walk test, Queens College step test, Haward step test. Maximal test include shuttle test-run and walk test, Cycle ergometry, Treadmill.

Musculoskeletal pain is one of the leading cause for affecting the physical activities of the individual. Previous studies have

been done showing decrease in the maximal oxygen consumption in patients with musculoskeletal pain.<sup>4</sup> It has been shown that it leads to affect their health related parameters<sup>1</sup>

Step testing is convenient for both indoor and outdoor settings and for use with either one person or multiple people. Step tests come in many types and perhaps one of the most popular is the Queens College step test. Queens’s college step test is an established method to evaluate cardio – respiratory fitness. Stepping test is one of the most widely used field test for estimating VO<sub>2</sub>max. Stepping requires no elaborate or expensive equipment no calibration and can be easily administered.<sup>5</sup> The reliability of step test range from (r=0.78 to r=0.95)<sup>6</sup>. Previous study done show that queen’s college step test is a valid test for measuring vo<sub>2</sub> max when compared to six-minute walk test.<sup>7</sup>

**MATERIALS AND METHODOLOGY**

**Study Design**

- Type of study :-Experimental study
- Duration of study:-1 year
- Place of study :-College opd

**Sample design**

- Sampling size :- 30 control, 30 chronic neck pain
- Sampling population:- Control group chronic neck pain individuals.
- Type of sampling:-Convenient sampling

**Inclusion criteria**

- 20-40 year old
- Chronic intermittent neck pain more than 3 months
- BMI normal.
- People who are co-operative and aware about their condition.

**Exclusion criteria**

- Patients who have any other musculoskeletal pain
- Acute constant neck pain
- Early diagnosed degenerative changes.
- Lumbar pathology.
- Undergoing physiotherapy treatment within 3-6 months.
- Neurological injuries.
- Recent trauma and fractures, spinal surgery.
- Regular physical exercise practioner.
- Psychological illness.
- Without any co-morbidities
- No addiction
- Smokers.

**Materials used**

- Bench for step test 41.3cms (16.25inch) high
- Stop watch
- Metronome
- Weight machine
- Sphygmomanometer
- Measuring tape

**Procedure**

60 Subjects were selected on the basis of inclusion and exclusion criteria. 30 subjects were normal individuals, 30 were individuals with chronic neck pain. Prior to starting the study a written consent form were taken from the participants.. A demonstration of the test were shown to the subjects. Then they were given information of the study and procedure were made understand to them.

Prior to study the subject were asked to not have any heavy meal.

The subject were shown a demonstration of the test to be performed.

Before starting the test the blood pressure, respiratory rate and pulse rate were calculated.

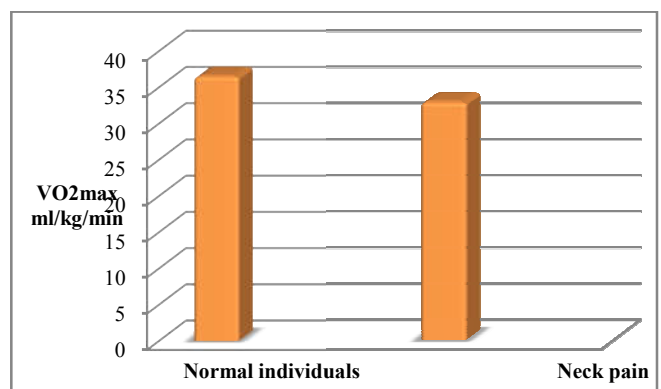
- The subject was asked to step up and down the step for 3 minutes. As the subject steps up and down a metronome is maintained
- Subject steps up and down on a 16.25INCH stool.
- A cadence of 24beats/min will be maintained for the female individuals and 22 beats/min for male individuals.
- After 3minutesof exercise recovery pulse rate was taken for 15 seconds i.e from 5<sup>th</sup> to 20<sup>th</sup> second.
- The data will be analyzed
- From the resultant value comparison of vo<sub>2</sub> max is then done

**Outcome Measure:** Thus with the observed readings the following formula is used for calculation of vo<sub>2</sub> max.(ml/kg/min)

- Women :65.81- (0.1847\*HR)
- Men :111.33-(0.42\*HR)
- From the resultant value comparison of vo<sub>2</sub> max is then done

**TABLES AND RESULTS**

**Table 1** Comparison of vo<sub>2</sub> max values in normal and chronic neck pain individuals



Vo2max	Mean	P value	Significance
Normal individuals	36.53	0.0001	Significant
Chronic Neck pain	32.93		

\*p<0.05

**Inference:-**The above graph shows significant difference in vo2 max values of normal individuals and chronic neck pain individuals ( $p < 0.05$ )

## DISCUSSION

In our study we had selected 60 Subjects comprising of two groups i.e. 1<sup>st</sup> group of 30 subjects comprising of normal individuals and 2<sup>nd</sup> group comprising of chronic neck pain individuals of age group 20-40 years was taken. Subjects were taken considering the inclusion and exclusion criteria. Pulse rate of the subjects was taken before the test. The subjects were then asked to perform the Queen's college step test for 3mins. After the test was done post pulse rate was taken for 15 sec and vo2 max value according to the formula was calculated. Maximum oxygen consumption (vo2max) is measure of body's capacity to use oxygen. It is the maximum amount of oxygen consumed per minute when individual has reached their maximum effort.<sup>3</sup> The factors affecting vo2 max are mitochondrial contents, pulmonary arterial diffusion capacity, oxygen transfer capability by blood vessels and individual muscular characteristics<sup>16</sup>.

Table 1. and graph 1. shows a significant difference in vo2 max values of normal individuals and chronic neck pain individuals. In our study individuals with chronic neck pain showed decrease in maximal oxygen carrying capacity. Queen's college step test requires activation of postural muscles. The probable reason could be chronic neck pain leads to weakness and decrease in endurance of postural muscles and impaired regulation of circulation.<sup>16</sup> Fatigued muscles can also affect the VO2 max.<sup>17</sup> It has been explained that anaerobic glycolysis predominates when muscles fatigue for supply of energy.<sup>18</sup>

This anaerobic glycolysis causes formation of lactic acid in the muscles. This intramuscular lactic acid and glutamate cause reduction in oxyhaemoglobin of neck muscle. As a result there is decrease in oxygen carrying capacity of blood leading to decrease in VO2max.<sup>18</sup>

Again it has been seen that trapezius muscle undergoes energy crisis and metabolic insufficiency in chronic neck pain. There is reduction in aerobic capacity of the muscles leads to insufficient recovery of oxygenation of postural muscles causing decrease in VO2max.<sup>19</sup>

Metabolic adaptations in skeletal muscles increase the mitochondrial enzyme activity causing increase in vo2 max. This mitochondrial enzyme activity can be limited by amount of lactate produced within the muscles. Since it is already high in fatigued muscles, i.e postural neck muscles, there is limitation in energy and efficiency of neck muscles. Higher load on neck, repeated for a longer time causes tissue damage and pain. These changes results in reduced capacity and muscle strength. This causes decrease in endurance of the muscles.<sup>20</sup> This reduced endurance causes decrease in VO2max which is required for Sub maximal exercise testing.<sup>20</sup> Changes in level of physical activity are seen in chronic neck pain individuals<sup>13</sup>. Thus these individuals require more oxygen consumption to do the same activity as compared to normal individuals since their maximal oxygen capacity in muscles is very low.

## CONCLUSION

Our study showed that the maximal oxygen capacity (VO2Max) of chronic neck pain individuals is reduced as compared with normal individuals.

## Limitations

- We did not assess other postural muscles.
- Since it was unaccustomed activity it might have affected the results of our study.

**Conflicts of Interests:-** None

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