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The Relationship between Cardiorespiratory Fitness and Lower Cross Syndrome among Sedentary Individuals- A Correlational Study

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Abstract

Introduction: The American Heart Association (AHA) defined CARDIORESPIRATORY FITNESS as the maximum rate at which oxygen can be utilized by the body during maximal exertion. CRF is categorized as flexibility, body composition, aerobic capacity, and muscular fitness. The Queen's College Step Test is one of many variations of step test procedures usead as submaximal exercise testing for CRF. sedentary lifestyle involves little or no Physical activity. One of the major factors for obesity is sedentary life style. Individuals with a high percentage of body fat tend to have higher fat distribution over the abdominal region and decreased abdominal muscle strength. Lower Crossed Syndrome (LCS) is a characterised by different patterns of muscular weakness (abdominals and gluteus maximus) and tightness (iliopsoas and spinal extensors). A test presumed to characterize abdominal strength is the double leg- lowering (DLL) for lower cross syndrome.

Methodology: 196 partipants divided into 2 groups as per normal and obese according to Asian BMI classification. With job of 6–8 h./d in a sitting posture with aged 19-30 and No history of lumbar disc herniation or trauma were included. Who have active lifestyle and doing regular exercise, Pregnant had Previous back surgery, spinal tumors or infections, or neurological and/or musculoskeletal disorders were excluded. Double leg lowering test for lower cross syndrome and queen's college step test for cardio-respiratory fitness were taken with consent.

Result: Spearmen correlation co-efficient test were used within groups which shows significant correlation of lower cross syndrome and cardio-respiratory fitness ($p < 0.05$).

Conclusion: obese individuals with sedentary lifestyle have correlation of cardiorespiratory fitness with lower cross syndrome due to weak abdominals.

Keywords: sedentary lifestyle, cardiorespiratory fitness, lower cross syndrome, double leg lowering test, queens college step test.

Declaration: Ethical approval was obtained from ethical committee & no financial burden was there on subjects. There was no conflict of interest.

Introduction

The American Heart Association (AHA) defined CARDIORESPIRATORY FITNESS as the maximum rate at which oxygen can be utilized by the body during maximal exertion and is usually given in ml of consumed oxygen per kg of body weight per min. Based on the evidence, health professionals should encourage their patients to improve CRF through regular physical activity.[1,2] CRF is categorized as flexibility, body composition, aerobic capacity, and muscular fitness."[2]. Determination of Cardiorespiratory Fitness in terms of Maximum Oxygen Uptake (Vo2max) is restricted to within the laboratory because of its exhausting and difficult experimental protocol. It is therefore desirable to find a simple procedure for evaluation of Vo2max in population studies, especially in the field and in the absence of a well-equipped laboratory. Among various indirect protocols [3,4]. The Queen's College Step Test is one of many variations of step test procedures usead as submaximal exercise testing, determine Aerobic Fitness.[4] Multiple studies suggested that individuals who participate in large amounts of sedentary behaviour do at the expense of PA and exhibit lower CRF than individuals who do not participate in large amounts of sedentary behaviours [5] . A sedentary lifestyle involves little or no Physical activity. Sedentary behaviours in terms of "low levels of energy expenditure", specifically those activities that expend energy at 1.0–1.5 metabolic equivalent units (METs), A MET is a way to measure body's expenditure of energy: Ratio of working metabolic rate relative to resting metabolic rate [6] . Sedentary behaviour requires assessment of the two different components in its definition*:* Energy expenditure and body posture. Accelerometer measures Energy expenditure [7]. The (GPAQ) was developed in 2002 by the World Health Organisation (WHO) as part of the WHO STEP wise Approach to Chronic Disease Risk Factor Surveillance for PA observation. The GPAQ has been validated against accelerometery[8.] One of the major factors for obesity is sedentary life style [9]

Obesity has increased worldwide; The WHO broadly defines obesity as "Abnormal or excessive fat accumulation in adipose tissue, to the extent that health is impaired." The prevalence of overweight and obesity is increasing in both industrialized and developing world constituting a global epidemic [9]. The diagnosis of obesity is often based on BMI, calculated as weight in kilograms divided by height in meters squared (kg/ m2) [10]. e increases in both body fat and lean tissue cause increments in BMI, relationships between body weight and health are conventionally expressed in terms of BMI rather than body fat[11]. Individuals with a high percentage of body fat tend to have higher fat distribution over the abdominal region and decreased abdominal muscle strength. Lower Crossed Syndrome (LCS) is a musculoskeletal condition characterised by different patterns of muscular weakness (abdominals and gluteus maximus) and tightness (iliopsoas and spinal extensors) that connect the dorsal and ventral sides of the body. Low-cross syndrome can arise as a result of a variety of situations, including chronic, recurrent

running acts. Inaction can have a negative impact on the body's mechanics, such as immobilization, disuse, or chronic postural pain, as may long periods of sitting and poor posture at the workplace[12]. A test presumed to characterize abdominal strength is the double leg-lowering (DLL) for lower cross syndrome .The DLLT manoeuvre has been shown to provide a considerable challenge to the abdominal muscles[13].The DLLT assesses the ability of muscles to stabilize the pelvis in a posterior-tilted position against an external load imparted by the lower extremities as they are lowered from a vertical starting positions [14.] The aim of the study is to find the correlation between lower cross syndrome and CRF. With hypothesis to evaluate the correlation of lower cross syndrome with CRF in sedentary obese individuals.

Methodology

Study design: cross sectional co-relational study

Sample size: 196 people with sedentary lifestyle

Sources of data: Smt Shantaguri Rasiklal Shah(Rangwala) College of Physiotherapy

Duration of study: the total duration was two months

Data collection: convenient sampling

Materials Used in Study

- Pen/paper
- Weigh scale (Omron HN 283 weigh scale)
- Stadiometer (Escala portable height measurement)
- Plinth
- Goniometer
- 16.25 steeper
- Pulse oximeter (contec[tm] pulse oximeter)
- Calculator
- Assessment format
- Consent form
- Patient profoma

Inclusion

6–8 h./d in a sitting posture[15]

(aged 19-30)

No history of lumbar disc herniation or trauma[16]

All genders

Sedentary healthy individuals

BMI: 18-30

Exclusion

Has active lifestyle and doing regular exercise Pregnant[16]

Previous back surgery, spinal tumors or infections, or neurological and/or musculoskeletal disorders [16]

Outcome measure

1. Double leg lowering test (mmt of lower abs) [13,14]
2. Queen's college step test

Double leg lowering test (mmt of lower abs) [13,14]

Administered to evaluate the flexibility and strength of the lower abdominal muscles, the Double Leg Lowering Test was a functional assessment. The patient position is in supine lying & the test was performed on the patient accordingly. Therapist position beside the patient on the test side. Patient's starting position should be 90* hip flexion along with posterior pelvic tilt then slowly ask the patient to bring both the lower limb towards the plinth when anterior pelvic tilt occurs, we measure that angle and keep it in criteria of lower abs MMT. Controlled, under which the subject attempted to prevent anterior pelvic tilting by force-fully contracting the abdominal muscles to maintain flat back were the instructions given to patients[17]. A pressure biofeedback unit was kept under the lower back. Subjects then performed a posterior pelvic tilt and baseline pressure was set at 40 mmHg[18,19]. They maintained this position while slowly lowering the legs to horizontal. A decrease in pressure might suggest inability to maintain posterior

pelvic tilt. Strength was graded on the ability to keep the lower back flat on the surface; the angle at which the back arched was noted and correlated with the grading system.[20] Angle ratings are 90 Very poor 75 Poor 60 Below average 45 Average 30 Above average 15 Good 0 Excellent.

Queen's college step test [4]

The queen's college step test is use to determine aerobic fitness. Equipment required: 16.25inches step, stopwatch, heart rate monitor. Pre-test: Explain the test procedures to the subject. Prepare forms and record basic information such as age, height, body weight, gender, test conditions. Check step height and set metronome. Procedure: The Queen's College Step Test is one of many variations of step test procedures, used to determine aerobic fitness The participant was asked to step up and down on a platform of height 41.3cm (16.25inches) at a rate of 22 steps per minute The participants were asked to step using a four-step cadence, 'up-up-down-down' for 3 minutes. The participant stopped immediately on completion of the test the heart beats were counted for 15 seconds from 5-20 seconds of recovery. This 15second reading was multiplied by 4 to give the beats per minute (bpm). Men: VO2max (ml/kg/min) = 111.33 - (0.42 x heart rate (bpm)) Women: VO2max (ml/kg/min) = 65.81 - (0.1847 x heart rate (bpm).

Result

Table 1: Spearman Correlation Coefficient

	Group 1		Group 2	
Statistic	Variable X	Variable Y	Variable X	Variable Y
Mean	75	30.199	30	47
Biased Variance	22.12	10.470	9.23	17.3
Biased Standard Deviation	8.36	20.9	22.8	10.2
Covariance	50.71		48.9	
Correlation	0.923		0.939	
Determination	-0.918		-0.873	
T- Test	3.65		3.48	
p- value (2 sided)	0.02801		0.0341	

95% CI of Correlation	0.12437813639494,	0.478469943076747
Degrees of freedom	99	99
Number of Observations	99	97

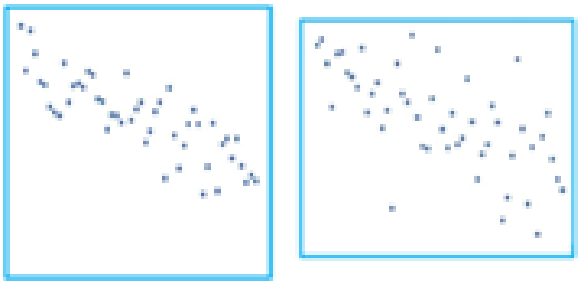

Figure 1: Spearman rank coeffeciant co-relation in group 1 interpretation: fairly strong negative relantionship

	90		75		60		45		30		15		0	
	O-1	O-2	O-1	O-2	O-1	O-2	O-1	O-2	O-1	O-2	O-1	O-2	O-1	O-2
VP	10	0	10	0	7	0	0	0	0	0	0	0	0	0
P	6.6	0	16.6	3.3	3.3	0	0	0	0	0	0	0	0	0
F	6.6	0	3.3	3.3	13.3	0	3.3	0	0	3.3	0	0	0	0
G	6.6	0	0	3.3	0	6.6	3.3	0	0	6.6	0	0	0	0
E	3.3	3.3	3.3	6.6	0	6.6	0	3.3	0	0	0	0	0	0
S	3.3	3.3	0	6.6	0	13.3	0	20	0	10	0	0	0	0

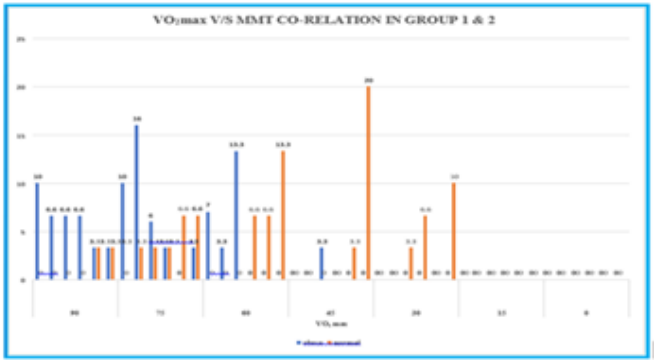

Figure 2: Spearman rank coeffeciant co-relation in group 2 interpretation: fairly moderate negative relationship

Discussion

The present study was aimed to find correlation of cardiorespiratory fitness with lower cross syndrome in sedentary individuals. This study examined the sedentary lifestyle by GPAQ, MMT of abdominals by double leg lowering test and aerobic fitness by Queens's college step test. The other parameter is HR. Participants are divided into 2 groups respectively. In that, G1 group includes Normal Individuals and G2 group includes Overweight and Obese individuals according to the Asian BMI classification. Weight and height are measured. GPAQ scale is use to check whether their lifestyle is sedentary or not. After that double leg lowering test is performed to check strength of the abdominals in the people who have sedentary lifestyle. Then, step test was performed to check VO_2max in the individuals who have weak abdominals and who have sedentary lifestyle.

Weak abdominals affects the respiratory function which ultimately leads to reduction of VO_2max. VO_2max is directly proportional to strength of the abdominal muscles.

The lesser the strength of abdominals, the lesser the VO_2max

This study result shows that people who have lower cross syndrome, sedentary lifestyle and whose BMI is greater than 23, their VO_2max is decreased. Greater body mass index and sedentary lifestyle makes respiratory function impaired because weak abdominals affect the function of diaphragm. That's why higher the BMI, more the sedentary lifestyle, more the weakness of abdominal, lesser the VO_2max. Simoes et al.2010 reported that Respiratory muscle strength is lower in sedentary individuals, and lacking pulmonary function is associated with sedentary lifestyle[21]. Watanabe K et al reported that obesity accentuates exercise intolerance and lowers aerobic capacity[22].

VO_2max is a measure of the functional limit of the cardiorespiratory system and the single most valid index of maximal exercise capacity. VO_2max has been expressed either in absolute value, i.e., in litre per

minute (l/min) or as relative values, i.e., ml per kg of body weight per minute (ml/kg/min), ml per kg of lean body mass (ml/kg LBM/min) or litres per unit of body surface area per minute (l/m2/min). The absolute value of VO2 max is one of the best indices of an individual's cardiorespiratory fitness to transport oxygen to working muscles [23].

Previous researchers have concluded that the DLLT is a more challenging test for the abdominal muscles than the abdominal curl [24, 25,26].

Priyanka Sahu reported that Muscular imbalance is one of the most common causes of low back discomfort in young people. Pelvic crossed syndrome (LCS) is a muscle imbalance characterised by tight hip flexors, lower back muscles, and abdominals, as well as gluteus maximus muscle weakness, all of which affect the biomechanical force distribution in the lower back region, potentially contributing to chronic low back pain. Data on the prevalence of LCS in young persons of both genders is scarce. As a result, the goal of this research was to find out the prevalence of tight and weak structures in both males and females, as well as the occurrence of Lower crossed syndrome in young people[27,28,29].

Sunita basavaraj kalyanshetti reported that In medical students, obesity is increasing due to lack of physical activity, more of sedentary lifestyle and increase in energy dense food consumption. Obesity is associated with decrease in physical fitness and increased risk of cardiovascular disease[38.]

Generally normal person who comes under normal BMI range, have high VO_2max as compare to people who are overweight and obese. Lesser the weight, higher the VO_2max and higher the weight, lesser the VO_2max

High body mass leads the weakness of the abdominal muscles which ultimately affects respiratory function because of reduced VO_2max Person who comes under higher BMI range, there are high number of chances that he/she have weak abdominals. Weak abdominals lead to decrease in VO_2max

Laxmi et al reported that VO2max was significantly less in obese group as compared with no obese group in both the genders. The correlation factor for the association of BMI and VO_2max was negative and it was statistically significant. In obese individuals, there is increase in type 2 muscle fibres and decrease in type 2 muscle fibres which may have effect on reduced o2 uptake[30].

Hasmukh Shah et al reported that Body mass index was negatively association with VO2 max in males (r = -026) and in females (r = -0.16). VO2 max decreased in both gender with high body mass index but statistically not significant. While fat mass was also negatively association with VO2max in males (r = -0.37) and in females (r = 0.11). Total body fat percentage played a key role for reduction of VO2max in both genders. Significant negative association was found between the VO2max and total body fat percentage, in males (r = 0.39) and in females (r =-0.330)[31.]

Chaterjee et al reported significantly higher value of peak heart rate Queen's College Test in obese group which indicates greater cardiac load among them [32].

Limitations

- The study is limited with respect to the affection of the gender i.e. The study cannot conclude that who is more affected whether male or female because study comprised more number of females as compared to males.
- The study is limited because we have less number of people to include them in research.
- The study is limited it is not possible to take

Pulmonary function test of every individual.

- The study is limited because we don't have Bioelectrical impedance instrument to measure body fat mass.
- The study is limited because we haven't checked every parameters of CRF i.e., Flexibility, muscular, neurodynamic we just able to check aerobic fitness.

Future Scope

We can take Pulmonary function test of every individual for accuracy of cardiorespiratory fitness.

Clinical Implication

This study suggests that by strengthening exercise of adominal muscles we can improve aerobic capacity which ultimately improve Cardiorespiratory Fitness.

Conclusion

The present study concluded that people having sedentary lifestyle and fall under obese and overweight criteria have weak abdominal strength compare to normal individuals according to correlation of double leg lowering test with step test , so obese & overweight have lower cardiorespiratory fitness. So lesser the abdominal strength lesser the cardiorespiratory fitness.

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