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The relationship between development of musculoskeletal disorder and aerobic capacity in health care workers

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Abstract

Background: Healthcare workers have a high prevalence of musculoskeletal disorders, and they are assumed to have physically demanding jobs. Healthcare workers are at high risk of work related musculoskeletal disorders mainly caused by overexertion from lifting and moving patients (i.e., patient handling) Profession. Musculoskeletal disorders are considered to be the most common cause of severe long –term pain and disability. Musculoskeletal disorder and individual aerobic capacity have not been sufficiently investigated. The main aim of this study was to investigate the relationship between individual aerobic capacity and development of musculoskeletal disorder in health care workers.

Objectives of the study: The objective of the study is to determine the relationship between the development of musculoskeletal disorders and aerobic capacity.

Purpose: The purpose of this study is to evaluate the relationship between development of musculoskeletal disorder and aerobic capacity in health care workers.

Methods: This Comparative study was conducted on 130 health care workers (80 women and 50 men) with a mean age of 34 years (standard deviation 6.95). They were divided into 2 groups of 65 each, group 1- subject with musculoskeletal disorder, group 2-subject without musculoskeletal disorder. Informed consent was obtained from all individuals. Aerobic capacity assessed by YMCA 3-minute step test and musculoskeletal disorder assessed by Standardized Nordic Musculoskeletal Questionnaire. Logistic regression was used to analyze the relationship between aerobic capacity and musculoskeletal disorder.

Results: The study result suggest that there is a significant relationship in the scores on YMCA 3 minute step test and standardized Nordic musculoskeletal questionnaire in group 1 subject with musculoskeletal disorder in health care workers. There was no significant relationship in the scores on YMCA 3 minute step test and standardized Nordic musculoskeletal questionnaire in group 2 subject without musculoskeletal disorder in health care workers.

Keywords: Musculoskeletal disorder, aerobic capacity, health care workers

Introduction

Musculoskeletal disorders are injuries or disorder of the muscles, nerves, tendons, joints, cartilage and spinal discs. Work related musculoskeletal disorders are condition in which: The work environment and performance of work contribute significantly to the condition. When a health care worker to do work that is outside of body's capabilities and limitations, is being asked to put his musculoskeletal system at risk. There are three primary ergonomics risk factors:

- High task repletion
- Forceful exertions
- Repetitive or sustained awkward postures.

Musculoskeletal disorders are common among in the health care workers which have high prevalence not only among hard & hurtful jobs but also in health care workers. Musculoskeletal disorders (MSDs) are defined as a group of inflammatory and degenerative conditions that affect muscles, tendons, joints, ligaments, peripheral nerves and the supporting blood vessels.

Musculoskeletal disorders are considered to be the most common cause of severe long-term pain and disability. The most common type of musculoskeletal disorder is low back pain which is considered to be the number one cause of disability among students. Other common Musculoskeletal disorders are include shoulder, neck, knee and wrist pain.

The pathology of musculoskeletal disorder has always been associated with Physical risk factors such as, performing high repetition tasks, static work, exposure to vibration, improve posture while working, which increase the physical loading on the joints and soft tissues leading to injuries However the severity of the injuries depends on various factors such as the frequency, duration and intensity of the physical exposure. Other Physical risk factors such as prolonged sitting, static awkward posture, overhead work and poor control over working patterns are closely related to musculoskeletal disorders. Musculoskeletal conditions significantly limit mobility and dexterity, leading to early retirement from work, lower levels of well – being and reduce ability to participate in society.

Development of musculoskeletal disorders resulting lower the aerobic fitness. The aerobic capacity is the maximum capacity of an individual's body transport and use oxygen during an incremental exercise. It is the product of individual maximal cardiac output and arterial-venous oxygen difference. Aerobic capacity is commonly described by the oxygen maximum or maximal oxygen uptake.

Aerobic capacity reflects individual physical condition in development of musculoskeletal disorders it is assumed that a progressive decline in physical activity. Hence this study aims to determine the relationship between development of musculoskeletal disorders and aerobic capacity in young adults. The aerobic capacity improved by increase oxygen delivery, number of physiological changes improve oxygen delivery. These factors include:- Increased capillary density in the muscle, a greater blood volume with a higher red blood cell count, higher levels of hemoglobin and myoglobin, increased levels of aerobic enzymes, increased size and density of mitochondria, more efficient ATP synthesis and improved blood direction to active muscle.

There is an significant relationship between the aerobic capacity and musculoskeletal disorders, the aerobic capacity is the highest amount of oxygen consumed during maximal exercise in activities that use the large muscle groups in the legs/arms and legs combined.; So any dysfunction present in musculoskeletal structure that will be reduce oxygen consumption of the muscle it resulting decrease the aerobic capacity. Aerobic capacity providing additional information regarding the capacity of the muscle for long term work. The muscle for long term work the muscle is primary site where increase in mitochondrial enzymes improve aerobic endurance capacity.

Methodology

1. Study Design

Comparative Study Design

2. Study Settings

Indo American Hospital Chemmanakary Vaikom, Kottayam
Indo American Hospital, Westgate, Vaikom.
BCF College of physiotherapy, Chemmanakary, Vaikom, Kottayam

3. Sampling Method

Simple random sampling

4. Sample Size

130 Subjects

Selection criteria

Inclusion Criteria

- Age group between 25to 45yrs
- Subjects having neck pain, shoulder pain, elbow pain, wrist / hand pain, upper back pain, lower back pain, hip pain, knee pain ankle/ feet pain
- Both females and males
- Do not included in any fitness program

Exclusion criteria

- Individual with systemic disease
- History of neurological complications
- Recent MI
- Unstable angina
- Uncontrolled arrhythmia
- Severe heart failure
- Electrolyte imbalance
- Hypo/ hypertension
- Uncontrolled metabolic disorder
- History of any injury or trauma to body parts
- Any surgical intervention
- Immunodeficiency syndrome

Materials Used

- Standardized Nordic musculoskeletal questionnaire
- Metronome
- 16 inch high aerobic type step with Risers
- Stop watch
- Chair
- Bottle of water

Study Duration

October 2020 to July 2021

Outcome Measures

It is done by asking the subjects to fill the Standardized Nordic musculoskeletal questionnaire and test the aerobic capacity of the subjects. After scoring, the final measure is calculated which is the sum of all the scores.

1. **Musculoskeletal disorders:** Standardized Nordic musculoskeletal questionnaire.
2. **Aerobic capacity:** YMCA 3 minute step test

Standardized Nordic musculoskeletal questionnaire

The Nordic Musculoskeletal Questionnaire (NMQ) was developed from a project funded by the Nordic Council of Ministers. The aim was to develop and test a standardized questionnaire methodology allowing comparison of low back, neck, shoulder and general complaints for use in epidemiological studies. This is simple general questionnaire, recognized /validated internationally, detects symptoms in the neck, back, shoulders and extremities.it present 28 multiple choice questions, sometimes negative, structured in two well – differentiated parts. The first part, the general one, refers to symptoms in 9 parts of the body (neck, shoulders, elbow, wrists/hands, upper back, lower back/hips/thighs, knees and ankles/feet) during the last 12 months/7 days. The second part, the specific one, refers to symptoms in three parts of the body (neck, shoulders, and lower back) throughout the subjects working life /7 days beforehand. In both cases, complementary information (qualitative variables, sex, age, nationality etc.) of the workers would be helpful, but not

obligatory, to ensure a better evaluation.

YMCA 3 minutes step test

The YMCA 3 minutes step test measures your Aerobic fitness level based on how quickly your heart rate returns to normal

after exercises. The step test provides a submaximal measure of cardio respiratory or endurance fitness and this test require minimal equipment and costs, and if required the test can be self-administered.



Fig 1: YMCA 3 mintues step test

Variables

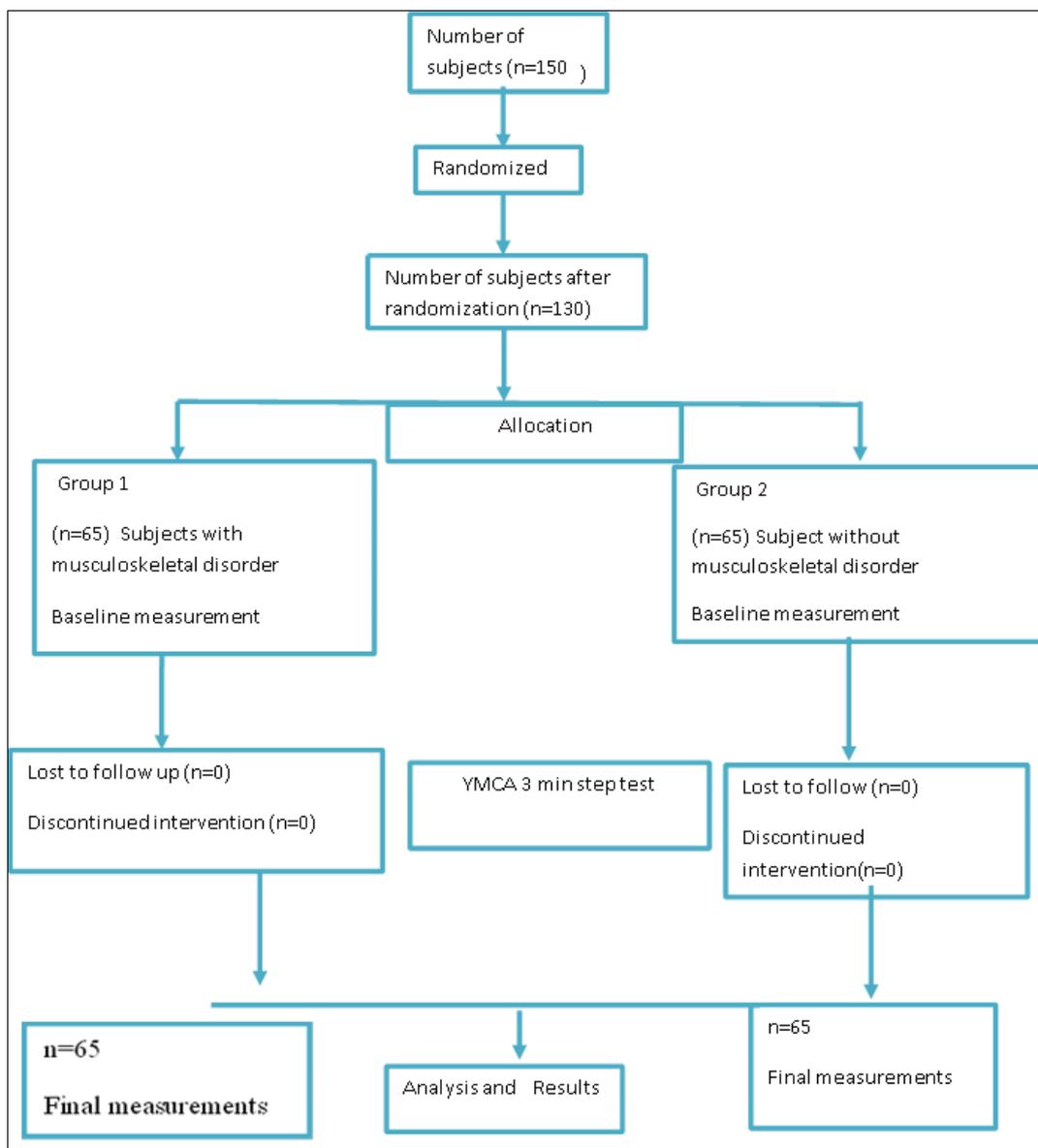
▪ Independent variable are the YMCA 3 mintues step test

and Standardized Nordic musculoskeletal questionnaire.

▪ Dependent variable is the Age.

10. Study Procedure

Flow Chart Showing Methodology



The population included 130 subjects full filling both inclusion and exclusion criteria. Subjects with musculoskeletal disorder group 1 (n=65) and group 2 Subjects without musculoskeletal disorder (n=65) were randomly selected from BCF college of physiotherapy, Chemmanakary, Vaikom, Kottayam. BCF College of nursing, chemmanakary, vaikom, kottayam Indo American hospital, chemmanakary, vaikom. Indo American hospital, Westgate vaikom. Informed consent was obtained from each subject prior to participation. A description about the procedures was given to the subjects before commencing the study. A total no of 130 subjects was divided into two groups by random sampling method, Group 1{n=65} & Group 2{n=65}.

Group 1: Subjects with musculoskeletal disorder

Sixty-five subjects randomly selected from willing participants formed group 1.

Group 2- control group

Sixty-five subjects randomly selected from the willing participants formed the group 2.

A questionnaire is used to collect demographic data. The participants were assessed by the following:-

1. Standardized Nordic musculoskeletal questionnaire

The questionnaire includes image of human body - the back, which is divided in to a 9 anatomical regions. It is a binary response questionnaire with yes/ no indicate the presence & absence of Participants will be ask to indicate whether they have an episode of pain/ discomfort in any of the body parts mentioned in the questionnaire in past 12 months (period prevalence), and the past 7 days (point prevalence). Information on the severity of MSDs in the past 12 months (if MSDs affected their normal daily activities) is obtained.

The total no of 130 subjects will be selected on the basis of Nordic musculoskeletal questionnaire and divided in to two groups i.e. aerobic capacity of subjects with musculoskeletal disorders will be taken as Group - 1 and aerobic capacity of subjects without musculoskeletal disorders will be taken as Group -2.

YMCA 3 minutes step test is used to measure the aerobic capacity in those individuals who are selected for the study.

2. YMCA 3 - minutes Step test

Pretest: Explain the test procedure to the subjects, perform screening of health risks and obtain informed consent. Prepare forms and record basic information such as age, gender test conditions. Procedure: Begin by demonstrating the alternating stepping cadence to the subjects.

In the time with the beat step one foot up on the bench (1st beat) step up with the second foot (2nd beat) step down with one foot (3rd beat) & step down with the other foot (4th beat) Allow the subjects to practice the stepping to the metronome cadence.

For males: Set at 96 beats per minute (4 click = one step cycle) for a stepping rate of 24 steps per minute.

For females: Set at 88 beats per minute (4 click =one step cycle) for a stepping rate of 22 steps per minute.

Inform Participants about the time as it passes. That is 30 seconds remaining. Remind participant to sit down quickly at the end of the test.

When the participant sit down, immediately place fingers (not the thumb) firmly on the radial artery get the rhythm and start

counting 1 minute after the test is completed. Measure the no of beats for 1 minute fully. The 1 minute count reflects the heart recovery rate.

YMCA 3 mint step test procedure



Fig 2: Starting position



Fig 3: Step 1



Fig 4: Step 2

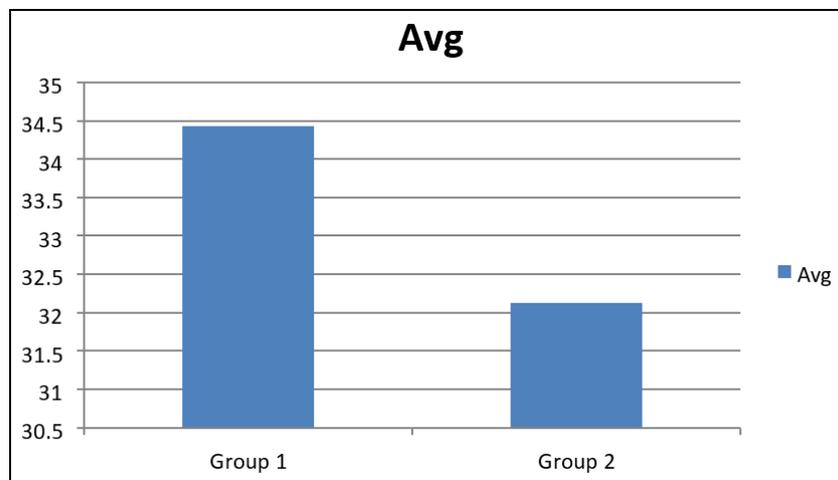


Fig 5: Step 3



Fig 6: Step 4

Statical analysis

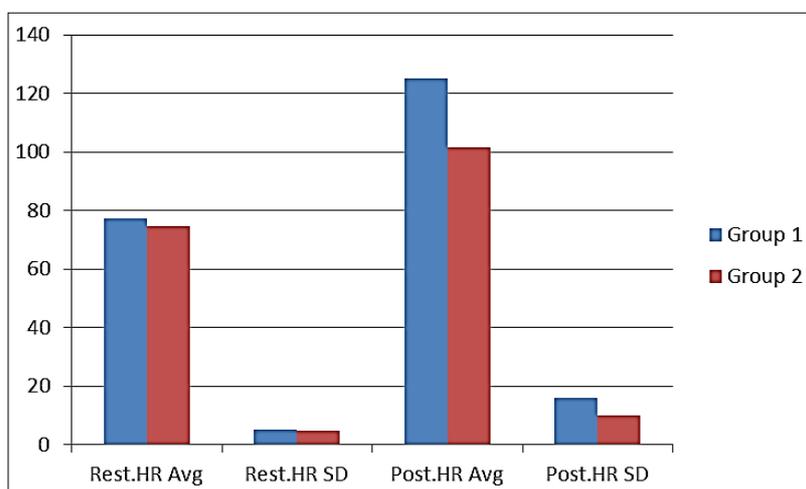


Graph 1: Age distribution by graphical representation

Statical Analysis using t tests in YMCA 3mint step test Table 2. Comparison of Resting Heart rate and post Heart rate in Group 1 and Group 2

Table 1: Comparison of Resting Heart rate and post Heart rate in Group 1 and Group 2

Group	Rest. HR mean	SD	Post-HR mean	SD
Group 1	77.35	5.20	125.06	15.95
Group 2	74.83	4.69	101.67	9.90



Graph 2: Graphical representation of Rest.HR and Post HR of Group 1 & 2

Table 2: Mean S.D and t-value to compare Rest. HR of YMCA 3Mint step test between Group 1 and Group 2

Test	Mean	SD	Mean Change	n	t	df	table value	p-value
Rest. HR	77.35	5.20	2.523	130	2.90	128	1.65	< 0.0043
Post. HR	74.83	4.69						

The mean column displays the mean REST - HR of Group 1 and Group 2 of YMCA 3 mint step test scores among health care workers. SD is the standard deviations of the YMCA 3mint step test scores in REST – HR of Group 1 and Group 2 respectively. Mean change 2.523 units is the difference between REST –HR (77.35 units& 74.83 units).Since the t-value, 2.90 units is greater than the table value 2.624 units, $p < 0.0043$, there is a significant difference existing REST - HR of Group 1 and Group 2 of YMCA 3 mint step test scores among health care workers. There is significant relationship between aerobic capacity and musculoskeletal disorder.

Table 3: Mean S.D and t-value to compare POST. HR of YMCA 3Mint step test between Group 1 and Group 2

Test	Mean	SD	Mean Change	n	t	df	Table Value	p-value
Rest. HR	25.06	5.95	23.38	130	10.03	128	2.624	<0.0003
Post. HR	101.67	9.90						

The mean column displays the mean POST - HR of Group 1 and Group 2 of YMCA 3 minutes step test scores among health care workers. SD is the standard deviations of the YMCA 3mint step test scores in POST –HR of Group 1 and Group 2 respectively. Mean change 23.38 units is the difference between POST–HR (125.06 units & 101.67 units). Since the t-value, 10.03 units is greater than the table value 2.624 units, $p < 0.0003$, there is a significant difference existing POST - HR of Group 1 and Group 2 of YMCA 3 mint step test scores among health care workers. There is significant relationship between aerobic capacity and musculoskeletal disorder.

Table 5: Mean S.D and t-value to compare Rest. HR and POST-HR of Group 1 using t-test

Group	Mean	S.D	Difference in Mean	n	t	df	table value	p-value
Group 1 REST-HR	77.35	5.203	47.71	65	-23.5	64	1.669	<0.0001
Group1 POST-HR	125.06	15.95						

The Mean column in the t- test table displays the mean REST-HR and POST HR scores in the Group 1. The standard deviation column displays the standard deviation of the scores of REST – HR and POST-HR of Group 1. The difference (47.71units) shows the difference between mean in REST – HR and POST-HR of Groups1 (77.35 units & 125.06units). Since the *t-value* -23.5 units is less than the table value 2.467 units, $p < 0.0001$ value, there is significant difference in REST – HR and POST -HR of YMCA 3 mint step test scores in Group 1. So, we can consider the heart increased by the exercise.

Table 6: Mean S.D and t-value to compare Rest. HR and POST-HR of Group 2 using t-test

Group	Mean	S.D	Difference in mean	n	t	df	table value	p-value
Group 1	74.83	4.69	26.84	65	-25	64	1.669	<0.0002
Group 2	101.67	9.90						

The Mean column in the t- test table displays the mean REST-HR and POST HR scores in the Group 2. The standard deviation column displays the standard deviation of the scores of REST – HR and POST-HR of Group 2. The difference (26.84units) shows the difference between mean in REST – HR and POST-HR of Groups1 (74.83 units & 101.67units). Since the t-value -25.5 units is less than the table value 2.467 units, $p < 0.0002$, there is significant difference in REST – HR and POST -HR of YMCA 3 mint step test scores in Group 2. So, we can consider the heart increased by the exercise.

Results

Group 1 and Group 2 Rest-Hr Evaluation of YMCA 3 Mint Step Test

By comparing the REST-HR of Group 1 (subjects with musculoskeletal disorder)Group 2 (subjects without musculoskeletal disorder) YMCA 3 MINT STEP TEST scores in health care workers in the Mean change 2.523 is the difference of REST-HR between Group1 and Group2 (77.35units & 74.830 units). Since the *t-value*, 1.656 units is less than the table value (*table value* 2.624 units), $p < 0.004$, there is a significant difference existing REST-HR between Group1 and Group 2. This proves the effect of musculoskeletal disorder increase the heart rate.

Group 1 and Group 2 post-hr evaluation of YMCA 3 mint step test

By comparing the POST-HR of Group 1 (subjects with musculoskeletal disorder) Group 2 (subjects without musculoskeletal disorder) YMCA 3 MINT STEP TEST scores in health care workers in the Mean change 23.38 is the difference of REST-HR between Group1 and Group2 (125.061units & 101.676units). Since the t-value, 1.656 units is less than the table value (*table value* 2.624 units), $p < 7.7E-18$, there is a significant difference existing REST-HR between Group1 and Group 2. This proves the effect of musculoskeletal disorder increase the heart rate

So we have seen that there is significant change in YMCA 3mint step test score among the health care workers in group1 (subjects with musculoskeletal disorder) and group2(subjects without musculoskeletal disorder)

Hence, it can be concluded that there is an association between the aerobic capacity and musculoskeletal disorder and are most probably found in health care workers.

Discussion

The study aimed to prove the relationship between development of musculoskeletal disorder and aerobic capacity in health care workers. Every second participants (51.8%) reported pain in the neck shoulders, lower back pain for more than 30 days during, the last 12 months. The study result suggest that there is a significant relationship in the scores on YMCA 3 minutes step test and standardized Nordic musculoskeletal questionnaire in group 1 subjects with musculoskeletal disorder in health care workers. There was no significant relationship in the scores on YMCA 3 minutes step test and standardized Nordic musculoskeletal questionnaire in group 2 subject without musculoskeletal disorder in health care workers.

There is an significant relationship between the aerobic capacity and musculoskeletal disorder, the aerobic capacity is the highest amount of oxygen consumed during maximal exercise activities that use the large muscle groups in the legs /arms and both lower and upper extremities combined. So any

dysfunction present in musculoskeletal structures that will be reduce the oxygen consumption of the muscle it resulting decrease the aerobic capacity. Aerobic capacity providing additional information regarding the capacity of the muscle for long term work. The long term work the muscle is the primary site where increase in mitochondrial enzymes improve aerobic endurance capacity. In our study include standardized Nordic musculoskeletal questionnaire (NMQ) and YMCA 3 minutes step test. The Nordic musculoskeletal questionnaire was developed from a project funded by the Nordic council of minister. The aim was to develop and tests a standardized questionnaire methodology allowing comparison of low back, neck, shoulder and general complaints for use in epidemiological studies. YMCA 3 minutes step test is standardized tool for assess aerobic capacity of individual. The tool using widely for the study: submaximal test, require low cost and supervision.

To understand the relationship between aerobic capacity and musculoskeletal disorder. High load repeated over time may lead to tissue damage inflammation of the musculoskeletal tissue, and pain. These changes may result in reduced capacity and in this context reduce the pain – dependent strength. An adaptation of the musculoskeletal tissue presupposes a mechanical exposure and recovery that are customized to the individual. Individuals with low muscular strength use a greater proportion of their maximum capacity than individual with greater strength to perform the same work and will reach an assumed level of risk for tissue damage and pain faster. The same model may illustrate the mechanism involved in the association between the level of aerobic capacity and musculoskeletal pain. The ability to manage work demanding a high energy metabolism may be determined by the aerobic capacity. The model only fit our results for health care workers. With a lower aerobic capacity. We also found a significant association between self – reported physical activity and musculoskeletal pain in the health care workers. Previous research had shown that self - reported physical activity and measure aerobic capacity were correlated but hat the correlation was low or moderate these result were supported by our data. Another possible explanation is that the levels of aerobic capacity and strength were the central factors associate with musculoskeletal pain rather than physical activity. The authors suggested that for the prevention of pain, physical activity should be performed at an intensity and at a duration that contribute to an increased aerobic capacity.

Exercise programs at the work place initiated to reduce musculoskeletal pain showed mixed results. Exercise, activity modification, ergonomic advice reduce symptoms for all health care workers with musculoskeletal pain, but the results from our study may help identify the groups to be focused upon. Our results indicate that activities promoting individual capacity may reduce musculoskeletal pain for health care workers.

Aerobic capacity is the maximum capacity of an individuals body transport and use oxygen during an incremental exercise, it reflects individual physical condition. The development of musculoskeletal disorder, it is assumed that a progressive decline in physical activity it affects maximal aerobic capacity; creating a real vicious cycle in which inactivity leads to aerobic deconditioning. The aerobic capacity is the highest amount of oxygen consumed during maximal exercise in activities that use the large muscle groups in the human body so any dysfunction present in musculoskeletal structures that will be reduce the oxygen

consumption of the muscle it resulting decrease the aerobic capacity. Aerobic capacity providing additional information regarding the capacity of the muscle for long term work. The muscle for long term work the muscle is the primary site where increase in mitochondrial enzymes improve aerobic endurance capacity.

Limitations

- Height, weight and BMI not consider this study the generalization of the finding of this study is not possible
- Due to Covid -19 pandemic and lockdown issues makes adequate routine checkup difficulty and travelling issues.

Conclusion

There is a significant relationship between the aerobic capacity and musculoskeletal disorder, the aerobic capacity is the highest amount of oxygen consumed during maximal exercise in activities that use the large muscle groups in the human body so any dysfunction present in musculoskeletal structures that will be reduce the oxygen consumption of the muscle it resulting decrease the aerobic capacity. Aerobic capacity providing additional information regarding the capacity of the muscle for long term work. The muscle for long term work the muscle is the primary site where increase in mitochondrial enzymes improve aerobic endurance capacity.

Through one year study, assume that there is an association between the aerobic capacity and musculoskeletal disorder and are most probably found in health care workers this observation is supported by statical analysis. Based on the outcome of the study, it can be concluded that the development of musculoskeletal disorder reduce aerobic capacity in health care workers.

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