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INCIDENCE OF LOW BACK DYSFUNCTIONS IN INDIAN ROWERS

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ABSTRACT
Rowing is a less explored water sport in India, due to lack of the demanding availability of water and the expensive equipment required for the game. This game is a less discussed topics in India with respect to playing and research. It is a high impact sport which includes strenuous activities that may lead to musculoskeletal injuries to the rower athletes. In this study we are primarily focusing on the low back region as it is highly used for the propulsion of the boat in water. The aim of the study is to find the incidence of low back dysfunctions in Indian rowers. This study will help to predict risk factors and know the drawbacks. In this study it was concluded that there is high incidence of low back dysfunction in Indian rowers due to higher magnitude of forces on the lumbar spine.

Keywords – high impact, strenuous activities, low back dysfunctions, magnitude, lumbar spine

INTRODUCTION

Rowing is an Olympic water sport which is recently gaining popularity in India and injuries are common in these athletes.[1] Rowing, a sport whose origins reach back to Ancient Egyptian times is also called as Crew in the United States. It involves using a wooden paddle, known as an oar, to propel a long boat through water at high speeds. A distance of 2000m is competed on water which include both sculling (two oars) and rowing (one oar) at international level. The measure the performance is the race time.[2] There are two categories of Rowing: sweep rowing and sculling.[1]Sweep rowing includes to the use of one oar per rower, which is placed on starboard or port (left and right, respectively, from the perspective of the rower).

Size of the crew varies from 2 to 8. Blades of the oars of the bow side rowers are placed to their left while the stroke side rowers place the blade of the oar to their right. Two symmetrical blades each are handled by the athletes in sculling and can perform as single scull or as double scull with two players. Further categories in the Rowing competition include: **a.** Men: Individual <57 kg, Crew average <70 kg b. Women: Individual <57 kg, Crew average <57 kg

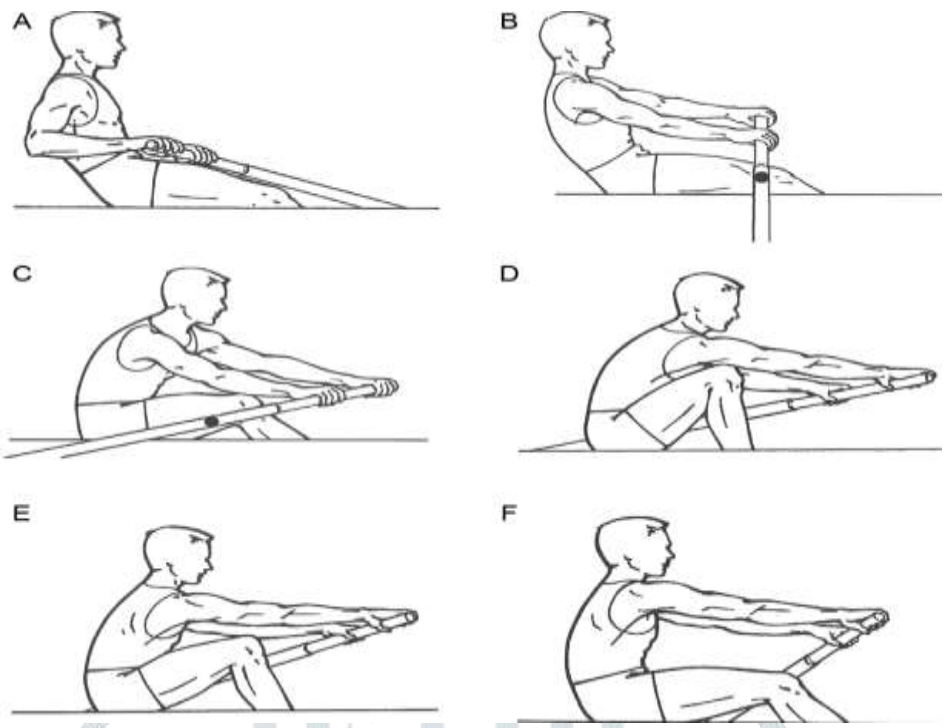


Fig 1- Phases of the rowing stroke include: A-the finish; B-early recovery; C-late recovery; D-the catch; E-early drive; F-late drive.[5]

Pair, four and eight are the boat classes in sweep rowing. Sculling includes the use of two oars per person. Sculling boats includes the boat classes single, double and quad. Rowing stroke include four main phases: 1. Catch phase 2. Drive phase 3. Finish phase 4. Recovery phase. In the Catch phase (D), with the hips and knees fully flexed the oars are placed into the water. In this compressed state, more amount of potential energy is stored in the legs, back and arms to prepare for the drive phase of the stroke, followed by the legs taking the body back toward the bow. In this phase the force generated by the legs is transferred to the oars. With the legs completely extended and elbows flexed into the body, the Drive phase (E) comes to a close at the Finish phase (A). The Recovery phase (B) starts with movement of the hands away from the body along with forward flexion at the hip and the forward movement of the spine resulting in the movement towards the Catch position. This pattern is repeated for the total time of the race or practice. With the core being the central unit transferring energy from the lower limbs to the oars via the upper limbs, the stroke needs segmental coordination of the entire kinetic chain. Thus approximately 75% aerobic energy and 25% anaerobic energy is required to complete a rowing race. In elite level rowers the maximum oxygen consumption (VO2 max) can be reached up to 70 ml/kg/min.[1]

Determinants of performance, the risk of injury and technique training are all interrelated in rowing. Injuries in this sport mainly result from various risk factors including fitness issues and improper techniques. Rower athletes should have adequate leg extension strength and lumbo-pelvic coordination to produce and transmit power from the legs to the oar handle.[1] Rowing is a physically demanding sport and the movements done at the lumbar spine may lay stress on the lumbar vertebral structures which may compromise the performance of the player.[3] During a study pressure within the intervertebral disk were measured and were related to positions and motions of the spine. The pressure recorded in the intervertebral disk was the second highest when the subject was in a seated position bent forward 20° with a 10 kg weight in each hand. In the catch position the position of a rower is sitting bent forward to 20° or more. Additionally, a competitive rower in season may spend up to 2 hours per day fragmentally in this position. This implied that rowers should encounter higher intervertebral disk pressures and also have a higher incidence of disc pathology. There were three purposes of the study: to qualitatively describe the strength and flexibility of trunk/pelvis muscles in elite lightweight women rowers, to record the incidence of low back pathologies in this specific population, and to recognize obvious correlations between musculoskeletal profiles and incidence of injuries.[4]

Continuous repetitive motion is included in rowing which may lay stress over various anatomic areas constantly depending on the stroke phase. Also, the off-water training for rowing comprises comparable repetitive activities, such as weight lifting, running, stair running, cross-country skiing, rowing in tanks, and using a rowing ergometer. Commonly found injuries in the rowers are due to the overuse. There is significant loading with each rowing stroke was revealed when the kinetic and myoelectric analysis of the lower spine was done.[5] In the rowing sport athletes regularly perform laboratory-based tests on an air-braked rowing ergometer, the Concept II which has examined the reliability of peak power attained during an incremental test to exhaustion with this ergometer.[6]

Rowing game as a competitive sport is a highly aerobic sport requiring proficiency and technical skills, motor coordination, requisite strength, and endurance. The mechanism for injury to the lumbar spine structures may be due to the combination of flexion with compressive loading. Furthermore, along with flexion and compression, sweep rowers also gyrate their trunks. This mixture may place appreciably more stress through the facet joint capsules and ligaments promote damage to discs. In the game of rowing, for the rower athletes, magnitude of the forces on their lumbar spines may also be impacted by the time of day. A large volume of rowing is practiced in the early morning as rowing requires calm water to row in, and to fit in with other daily commitments (work and study). Bending moment is much higher in rowing in the early morning due to the larger loads on the spine which facilitate morning training. Creep may be induced in the soft tissues leading to a decrease in the stiffness of the tissues through the range of motion and an increase in the total range of motion in the lumbar segments due to the repetitive motion of rowing. Mechanoreceptors in spinal ligaments may be desensitized due to the repetitive motion. Instability may also be the ultimate result of this process in rowing.[7]

Rowing as a sport has a glorious history of competition and has been increasingly popularizing in the recent decades. Competitive rowing itself is as old as several hundred years old. The first races were held in England on the Thames River nearly 300 years ago. Rowing races have existed for >100 years and it is one of the first and earliest sport to be included in the Olympics. Games are also held at the inter collegiate, the club, state and national level. Most researchers have found that injuries in rowing occur mostly through overuse, and can frequently be detected back to an abrupt change in training level or adaptation in technique or equipments. It is also believed that this may be due to the insufficient lactate removal after vigorous training sessions or races, or inappropriate recovery. Poor flexibility, lack of strength and imbalances of the muscles can also contribute.[8]

Forward flexion of the trunk during the rowing stroke needs coordinated lumbar flexion and anterior pelvic tilt illustrated as ‘‘lumbar-pelvic rhythm’’. In this motion the pelvis tilts anteriorly to attain the correct degree of flexion of the trunk at the catch (placement of the oar in the water) and during the drive phase.[9] For most rowers, this game is more than simply a physical activity, it is a form of passion and an artistic expression. Nevertheless, of the motivation to pick up an oar, an ergometer handle, adult rowing has been a metamorphic experience. The mixture of the social aspects of the crew and the team performance, with its high demands on coordination and tactility along with revolutionary equipment, makes it analogously unique with sporting spectrum.[10]

Rowing as a sport is a strength-endurance type of sport and competition performance rely on factors such as aerobic and anaerobic power, physical power, rowing technique and tactics. Hence, a rower needs to develop various abilities and capacities in order to be successful and a valid testing battery of a rower has to include parameters that are highly related to rowing performance.[11] The classic rowing competition is conducted on a 2000m and lasts for 6-7 minutes. During the race, anaerobic alactic and lactic along with aerobic capacities are emphasized to their maximum. Rowers are large and heavy weighed as the weight of their body is supported while they sit in the boat. This game roughly involves 70% of the muscle mass as all the extremities and the trunk necessitate in the propulsion of the boat. Rowing as a sport is a cyclic movement, which includes the work synchronization of both the legs and arms.[12] During the race there is approximately 10-30% of anaerobic contribution while the remaining is the aerobic system. Persistent rowing is also been found to be advantageous for the cardiovascular system. One of the studies noted the myocardial wall thickness, normal systolic function, including high work capacity, in the hearts of senior oarsmen.[8] The players of rowing have a considerably lower risk of obesity than that of the common population, both in college and throughout their lifetime. This game also provides excellent aerobic conditioning and lifelong benefits.[5]

In this study we are trying to find the incidence of low back dysfunction in Indian rowers which will further help to correct the faults and design a preventive measure and rehabilitative protocol. Outcomes measures include Athlete Back Pain Disability Questionnaire used to assess low back pain functional disability of athletes. This includes 12 components in which there are 4 points each. Score is calculated based on the response of the participants.[13] Modified Oswestry Low Back Pain Disability Questionnaire- purpose is to assess pain-related disability in persons with low back pain. It includes 10 components in which there are 6 points each.[14] Modified Modified Schober's Test is used to measure the lumbar range of motion. It is a reliable, valid and convenient method for both therapist and patient as it does not need any fixation and landmarks are easy to palpate.[15]

METHODOLOGY

The study type was survey-based study. Sample size was 45, convenience sampling methods were used and the study duration was 6 months. Study set-up was in Rowing institutes and sports club in and around city. Target population were rower athletes practising since one year. Survey was conducted using Athlete Back Pain Disability Questionnaire and Modified Oswestry Disability Index. Modified Modified Schober's Test was used to assess the lumbar range of motions. The questionnaire was circulated among the rower athletes. Written consent was taken from the participants. The ADQ scale and MODI was distributed to the participants and thoroughly explained. The response of the participants was obtained and statistically analysed.

The athletes were further assessed for the lumbar ranges with the Modified Modified Schober's test.

Measurement of Lumbar Flexion: The participants were told to take off their shoes and undress, exposing their back from the gluteal fold to the mid-thoracic spine, with the left and right PSIS exposed completely. They were instructed to stand erect, with their gaze horizontally oriented, arms at their sides, and feet 15 cm apart. This position assisted the participants in stabilising their pelvis, keeping their balance, and improving the consistency of their measures. The therapist next showed proper forward bending technique by hanging the arm in front of the body and maintaining the legs straight. The therapist verified that the participants were following the required method after showing them how to do so. The therapist then kneeled behind the standing participants and used her thumb to identify both PSIS. A body marker was used to indicate the inferior margins of the participant's PSIS, and a ruler was utilised to find and mark a midline point on the sacrum (inferior mark). The final mark (superior mark) was placed 15 cm above the midline sacral mark on the lumbar spine (inferior mark). The therapist placed the tape measure between two skin marks, one at the inferior mark and the other at the superior mark, with zero at the inferior mark and 15cm at the superior mark. The measuring tape was pressed against the volunteers' skin as they were asked to bend forward as far as they could while maintaining their knees straight. During the movement, the measuring tape was held on the participant's back but was allowed to unroll to allow for movement. The end of the range of motion (ROM) was noted for each of the spinal motions measured by directing the participants to tell that they could not go any further. The distance between the two markings was measured at the end of the flexion ROM. The range of motion (ROM) was calculated as the difference between 15 cm and the length measured at the end of the motion. "You can return to a comfortable standing position" was the instruction given to the volunteer after each measurement.[15]

Measurement of Lumbar Extension: Lumbar extension was measured using the same landmarks and procedure as the flexion approach. The therapist lined up the measuring tape between the markers with the participants in an upright standing stance, their gaze oriented horizontally, arms at their sides, and feet 15cm apart. "Place the palms of your hands on your buttocks and bend backward as far as you can," the therapist instructed, holding the tape measure firmly against the participant's skin. The new distance between the superior and inferior skin markings was measured using the tape when the subjects bent backward into full lumbar extension, and the change in the distance between the marks was utilised to represent the amount of ROM of lumbar extension. "You can come back to a comfortable standing position" was the instruction given to volunteers after measuring lumbar extension. All skin marks were removed using a spirit swab at the end of data collection.[15]

Comfortable standing position

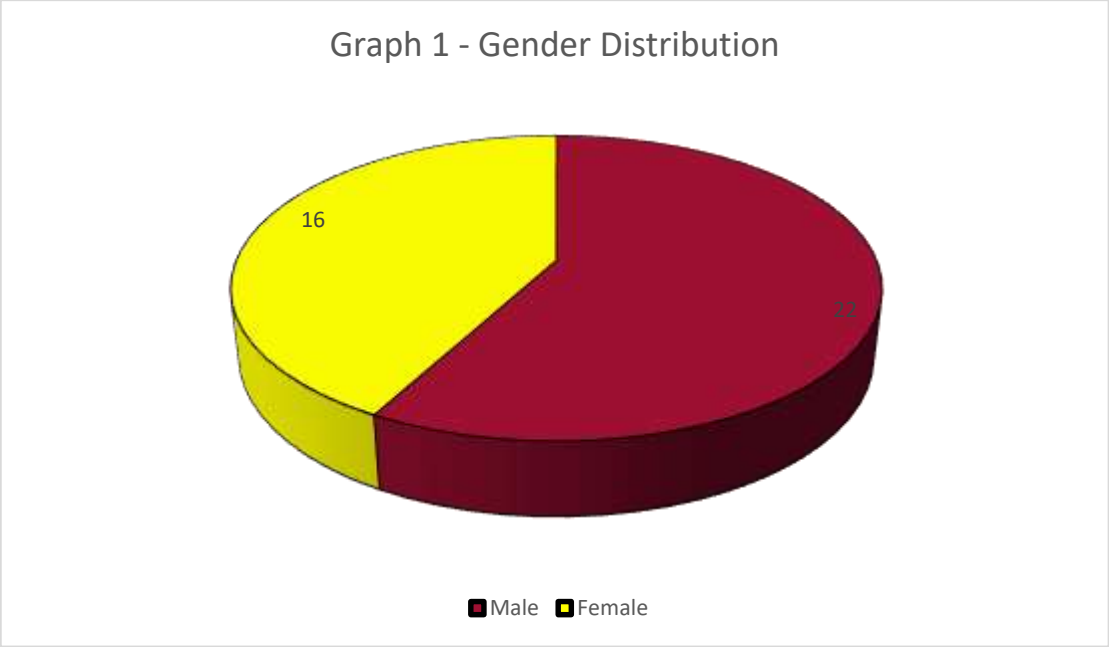
Measurement of MMST flexion

Measurement of MMST extension

RESULT AND ANALYSIS

Table no 1 – Gender distribution

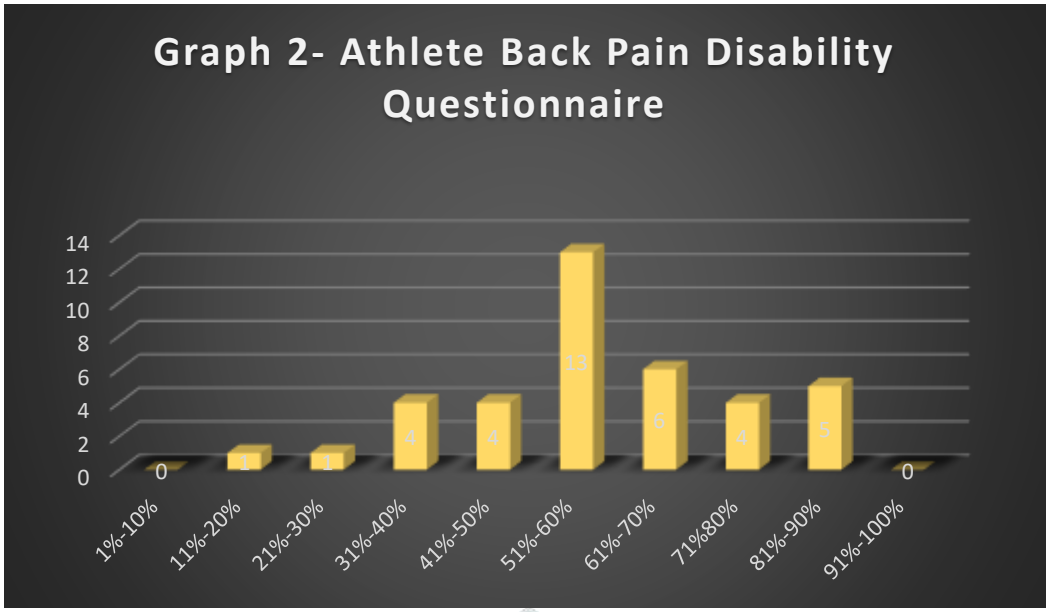
Gender	No of players
Male	22
Female	16



Interpretation - Graph 1 indicates that out of 38 players 22 were male and 16 were females.

Table no 2- Athlete Back Pain Disability Questionnaire

ADQ	Mean	SD
	56.9	±16.8



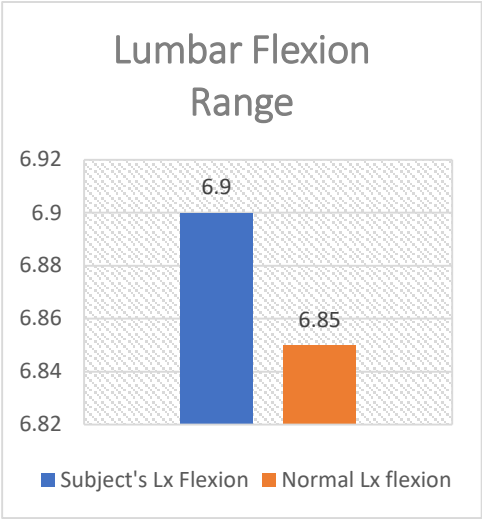
Interpretation- Graph 2 indicates the distribution of the participants according to their pain disability on Athlete Back Pain Disability Questionnaire. Out of 38 players maximum of 13 participants experienced pain disability in the range of 51% to 60%. Followed by 6 participants who experienced pain disability in the range of 61% to 70%.

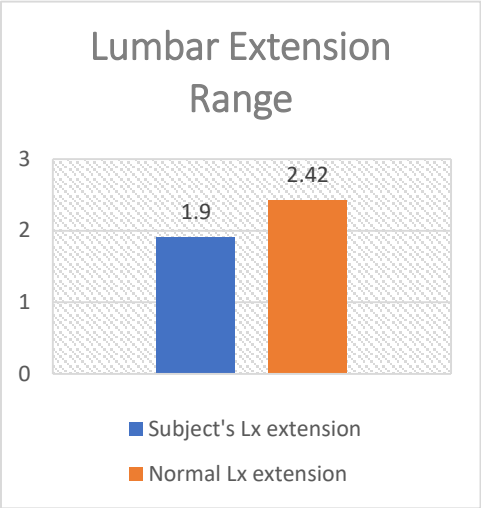
Table no 3(a)- Modified Modified Schober's Test

MMST		
	Mean	SD
Flexion	6.9	±1.1
Extension	1.9	±0.8

Table no 3(b)- Modified Modified Schober's Test

Modified Modified Schober's Test			
Lumbar Flexion of subjects	Range of Normal Lumbar Flexion	Lumbar Extension of subjects	Range of Normal Lumbar Extension
6.9 ± 1.1	≥6.85 ± 1.18	1.9 ± 0.8	≥ 2.42 ± 0.74

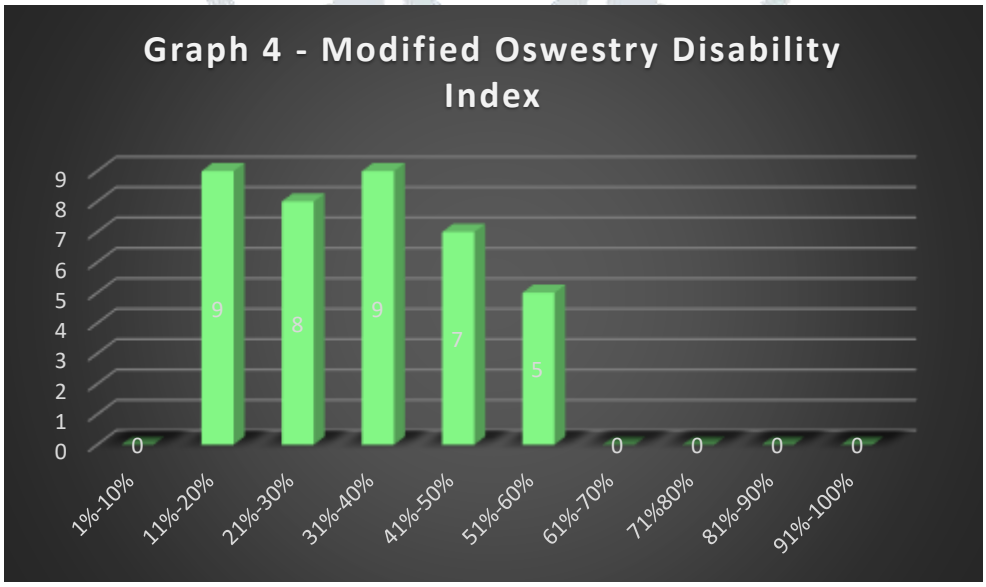




Interpretation - Graph 3(b) indicates the flexion and extension ranges of motion of the participants according to the Modified Modified Schober's Test. Among them the mean of flexion in the players was found to be 6.9 with standard deviation ±1.1 which states that the flexion range of motion among the rowers is increased. The mean of extension was 1.9 with standard deviation ±0.8 which states that the extension range of motion among the rowers is decreased.

Table No 4 – Modified Oswestry Disability Index

	Mean	SD
MODI	33.5	±12.6



Interpretation - Graph 4 indicates the distribution of participants according to their pain disability on the Modified Oswestry Disability Index. Among the total 38 participants 9 of them experienced pain disability in the range of 31% to 40% and other maximum 9 experienced pain disability in the range of 11% to 20%.

DISCUSSION

Rowing is an Olympic water sport that has recently gained popularity in India, and these sportsmen are prone to injury.[1] Rowing is a high-impact sport that incorporates demanding movements that can cause musculoskeletal problems in rowers. We've concentrated on the low back region in this study because it's crucial for boat propulsion in the water. As a result, research on the incidence of low back dysfunction in athletes was needed in order to identify risk factors and drawbacks. The aim of the study was to determine the incidence of low back dysfunction in Indian rowers.

In this study, pain disability rates in professional rowing players were analysed. In the results of the present study, it was found that large proportion of rowing players experienced low back dysfunctions. Also, the athletes complained of more low back pain and discomfort during periods when training and workout sessions were higher along with excessive competition load. A study was conducted in New Zealand by Newlands C et.al in 2015 on international level rowers which stated that low back pain is common in rowers.[3] In this study, the lumbar flexion range of motion is found to be more than the normal, while the lumbar extension ranges are reduced. Hyperflexion of the lumbar spine, whether intermittent or continuous, may put enough mechanical stress on noncontractile tissue to excite pain receptors in the musculoskeletal system of the low back. According to Nachemson's research, a seated leaned forward posture can result in rather large interdiscal pressures. The intervertebral disc contains little or no space between the vertebrae. As a result, the shape of the object must be sufficiently deformed to exert stress on an innervated structure. When a person estimates that a rower can spend up to 2 hours per day in a rowing machine a situation that could jeopardise the structural integrity of her lower back, it's easy to see why there's 80% chances to have low back pain. 75% of the samples that participated were found to have hyperflexion of lumbar spine.[4] Low back pain was marked to be more frequent in endurance sports that precisely load the low back during training and competition.[16] It was explained as pain, ache or discomfort in the lower back or lumbar region with or without referral to the buttocks or legs that has been experienced for more than 1 week and/or interrupted or barged in at least one training session.[3] Extreme flexibility in extension in some sports is required where there is high load on the spine (gymnastics, wrestling, and weightlifting). A study was previously done which stated that a large training volume during the past year and previous episodes with back dysfunction are risk factors for low back pain.[17]

Rowing game as a competitive sport is a highly aerobic sport requiring proficiency and technical skills, motor coordination, requisite strength, and endurance. The mechanism for injury to the lumbar spine structures may be due to the combination of flexion with compressive loading. Furthermore, along with flexion and compression, sweep rowers also gyrate their trunks. Ducan A Reid et.al. conducted a study in New Zealand to find the factors contributing in low back pain in rowers which states that the mixture of flexion, extension and rotation may place appreciably more stress through the facet joint capsules and ligaments promote damage to discs.[7]

Pain and discomfort were studied using the Athlete back pain disability Questionnaire. Most athletes favour physically demanding hobbies, thus any limitations in these activities should be assessed in terms of low back pain induced impairment. Athletes' main concerns were sport-related issues (stretching exercises, resistance exercises, technical skills, back ROM, and changing direction).[13] A study done in Iran by Noormohammadpour P et.al. proved that this scale is used to monitor the low back pain in athletes.[4]

The Modified Modified Schober's test was used to assess the lumbar flexion and lumbar extension range of motion of the participants. The procedure of this test does not require any fixation and landmarks are easy to palpate, it is a trustworthy, valid, and convenient method for both therapist and patient. The normative value for flexion is -6.85±1.18cm and that for extension is -2.42±0.74cm.[15]

Total 45 subjects participated in this study among which 7 of them did not have low back pain hence were excluded. 38 out of 45 had severe low back pain and discomfort hence were further assessed using the Athlete back pain disability Questionnaire and the Modified Oswestry Disability Questionnaire. These 38 were also assessed for the lumbar flexion and lumbar extension range of motion using the Modified Modified Schober's test. Among the 38 participants 22 were male and 16 were female subjects.

In this study, according to the Athlete back pain disability Questionnaire out of 38 players maximum of 13 participants experienced pain disability in the range of 51% to 60%. Followed by 6 participants who experienced pain disability in the range of 61% to 70%. Out of the remaining 5 of the participants have pain disability in the range of 81% to 90%. Other 4 are in the range of 71% to 80% along with 4 participants with pain disability in the range of 41% to 50%. Followed by 4 of the participants have pain disability in the range of 31% to 40%. Further, 1 of the remaining participants have 21% to 30% and other 1 participant have 11% to 20% of pain and disability. The mean of the results of this questionnaire is found to be 56.9 with the standard deviation of ±16.8.

According to the Modified Oswestry Disability Index. Among the total 38 participants 9 of them experienced pain disability in the range of 31% to 40% and other maximum 9 experienced pain disability in the range of 11% to 20%. Out of the remaining 5 of the participants had pain disability in the range of 51% to 60% and 7 participants had pain disability in the range of 41% to 50%. Further, 8 of the remaining participants had pain disability in the range of 21% to 30%. The mean of the results of this questionnaire is found to be 33.5 with the standard deviation of ±12.6. Tensile stresses on the intervertebral disc's outer annulus have been reported to increase significantly above 50 percent flexion. A mechanism for injury to the lumbar spine structures has been identified as the combination of flexion and compressive force. Sweep rowers rotate their trunks in addition to flexion and compression. This combination can put a lot of strain on the facet joint capsules and ligaments, as well as facilitate disc injury.[7]

The subjects were also assessed with the Modified Modified Schober's Test. In which the mean of flexion in the players was found to be 6.9 with standard deviation of ±1.1 and the mean of extension was 1.9 with standard deviation ±0.8.

During periods of increased training and workout sessions, as well as an increased competition load, the athletes reported of more low back pain and stiffness. This suggests that there is correlation between low back pain and the specific loading patterns of rowing. Other studies have concluded that no considerable number of players had quit the sport due to the pain and dysfunction but had few individual cases in the previous seasons. The rowers have the maximum frequency of missed the training sessions because of low back dysfunctions. This could suggest that symptoms were more severe among the rowers, but it is also possible that low back pain reduces the rowing movement. In the individual sport of cross-country skiing, the athlete can decrease the intensity of the practice session.[16]

Specific muscle activity has recently been recommended as a way to improve lumbar spine stability. The relevance of the transversus abdominus and internal oblique abdominus groups has been studied by Richardson and Jull and O'Sullivan et al. The multifidus muscles contract together. These are the muscles that have the ability to control how much movement there is in the lumbar spine. As a result, activation of the lumbar segments may be beneficial. In rowing, it's effective for preventing low back strain in the population.[7]

CONCLUSION

The study concluded that there is high incidence of low back dysfunction in Indian rowers due to higher magnitude of forces on the lumbar spine.

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