ORIGINAL RESEARCH PAPER

Volume-8 | Issue-7 | July - 2019 | PRINT ISSN No. 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

# IMMEDIATE IMPACT OF ROWING IN HAMSTRING FLEXIBILITY IN YOUNG ADULTS

Physiotherapy

**Logeshwari Selvaraj*** M.P.T (Neuro), (Ph. D), Assistant Professor, SOPT, Vistas *Corresponding Author

**Dr. M.S. Sundaram** M.P.T (Sports), Ph.D., Professor, SOPT, Vistas

**Princess Mona P** B.P.T., Student, SOPT, Vistas

## ABSTRACT

**BACKGROUND:** Rowing is one of the effective forms of aerobic exercise which demands high level of technical skill and the ability to generate and sustain more amount of force and power with proper biomechanical knowledge. It is done for upper body and lower body workouts concentrating on all major muscle groups. It plays one of the best exercises in reducing abdominal fat (obesity). Hamstrings tightness is one of the common causes for altered muscle activation. Insufficient Hamstring flexibility leads to improper load to the body in long run if unnoticed.

**MATERIALS AND METHODS:** A quasi experimental study was done for 30 subjects from VISTAS, School of Physiotherapy with the age group between 17-22 and were selected based on inclusion criteria. Rowing machine exercises were asked to perform and then the values of Active Knee Extension Test and the action potential of Medial Hamstrings and Lateral Hamstrings were noted using of electromyography for both right and left leg, further analyzation was done using pre and post-test values.

**RESULT:** There was a significant difference in the Active Knee Extension Test and motor unit action potential of hamstrings with $p<0.05$ in enhancing the hamstring flexibility.

**CONCLUSION:** Hence this study concludes that there is an immediate effect in working out in Rowing Machine in the improvement of hamstring flexibility

## KEYWORDS

Rowing Machine, Hamstring tightness, Electromyography, Active knee extension.

## INTRODUCTION:

Aerobic exercise improves cardiovascular endurance, helps in burning calories, reduces stress and maintains physical fitness of the person. In this modern era advancement in the technology and poor nutritive intake has made the upcoming generation more inactive and less physical fitness level when compared to the past generation. One of the best Aerobic exercises where the whole body is concentrated is Rowing exercises where the upper and lower body workouts is done if proper mechanics is analysed by the therapist during the workouts, works on all major muscles group (Total body workouts).

Rowing performances demands high level of technical skill and the ability to generate and sustain high amounts of force and power.[1] The hip and elbow angular velocity, angular displacement and angular position at the catch do not change throughout the 2000m test,[2] indicating that these are stable features of the rowing techniques even at high level physical exertion. Force and power are important to optimize rowing performance.[3[

Rowing exercise is look like a cyclical sport in Olympic races, approximately 80% of the total energy comes from the aerobic system, but high intensity intermittent efforts are performed at strategic movements of the race.[4,5]

**Rowing in fitness**:

Rowing exercise in rowing machine can helps to burn calories (using of rowing machine burn calories approximately 10%-15% more calories than running or cycling). A rowing machine workout burns an average of 600 calories per hour (it is more efficient that many other home gym machine). Approximately 78 minutes of stationary cycle workout arm involvement is equal to 60 minutes of workout in rowing machine. This not only helps in burning calories but also improves muscle strength and cardio endurance. Structured healthy balanced diet and eating habits along with exercises using a rowing machine consistently is a great way to achieve the fitness goals.

Alterations of exercise such as low impact exercises can be used for the persons with joint problem pain, overweight, healthy geriatrics as high impact workout are more risk than benefits. Persons who cannot perform weight bearing exercise (such as running, walking, hiking etc), can perform Low impact rowing exercise as it as the greater chance for injury prevention and lower risk of tissue injury during exercise which has been also prescribed as strengthening programme for post-operative conditions like after the knee surgery.

Knowledge about inter and intra muscular coordination in rowers reports the profile of muscle activities during specific action, and from this information the form and level of muscular activation can improve performance as well as reduce risk of injuries.[6[ In fact world rowing performance is divided into before and after biomechanical analysis, as rowers and coaches began to benefit from structural modification to their boats upon their own initiative.[7,8] Early studies of high speed cinematography showed that rowing efficiency is related to the proximity Z between peak force and the perpendicular position of the paddle with the water, which presents the importance of kinematic analysis and forces acting during movement.[9] In addition to improve muscle strength and tone, resistance training in a rowing machine is a great way to maintain or improving strength, balance and flexibility.[10]

Rowing is a skilful sport and distinct phases to each stroke, which have been combined in an effective manner to ensure maximum power output and acceleration of the boat through the water.[11,12]

Rowing as a four types of phases,[13] it can be summarized they are,
The catch phase
The drive phase
The final phase
The recovery phase

Rower injury rates are low, indeed much lower than the contact sports, however injury still occurs the most common and widely studied problem in rowing is that of low back pain and related lumbar spine injuries.[13] The spine and trunk extensor muscles are play a vital role in the rowing stroke by providing a stable base for transfer of the power generated the arms and legs to the blade, consequently, during the stroke cycle great forces are placed on the flexed lumbar spine.[14,15,16] Repetitive action of the stroke with loading and unloading of the lumbar spine predisposes the rower to low back injury[13].

Traditionally rowing machine had provided a simple data on time taken to row a set distance. More recently many machines have been adopted to allow further parameters to be measured such as stroke length and force data.[17] Such information has been used as a feedback to rowers and coaches to refine and correct faults and weakness in their stroke. One of the study was conducted to measure spinal kinematics of the rowing during a rowing stroke and through a series subsequent studies identified key factors which influence the rowing stroke.[20,22]

**Rowing in whole body workouts:**

**Upper body:**

Rowing machine provide a stellar upper body workouts. Exercise like Trapezius and Rhomboids in upper back, and Latissimus dorsi in lower back, Deltoids in shoulder. The benefits of strong back and shoulder improves posture as well as there is significant reduction in back pain. It enhances Biceps, Triceps, Pectoralis, Rectus Abdominis, Transverse Abdominis, Internal & External Obliques and Erector spinae muscle power which helps to develop a strong core. Maintenance of grip on the oars helps to develop a stronger hand intrinsic & Extrinsic muscles.

**Lower body:**

Rowing exercise is one of the best workout for lower body, in fact rowing exercise is primarily a lower body workout. The main muscles involved are Glutes , Quadriceps in upper front of the thigh, Hamstrings in back of the thigh, calves(Gastrocnemius and Soleus) in back of the lower leg.(Major muscles group). Good rowing posture lets your legs to do the work taking the pressure off your back.

Muscles work depends upon phases of rowing[14]

**The catch phase-** Erector Spinae, Gastrocnemius, Soleus, and Hamstrings.

**Start of drive -** Erector Spinae, Rhomboids, Quadriceps, Gastrocnemius, Soleus, and Hamstrings.

**The drive -** Erector Spinae, Rectus Abdominis, Triceps, Deltoids, Pectoralis, Wrist Flexor and Extensors, Rhomboids, Quadriceps, Glutes, Gastrocnemius, Soleus, and Hamstrings.

**The finial -** Erector Spinae, Wrist Flexor and Extensor, Triceps, Biceps, Deltoids, Pectoralis, Rectus Abdominis, Internal and External Obliques, Quadriceps and Hamstrings

**Kinetics and kinematics of rowing:**

The study of forces that causes a motion or human biomechanical movement.Kinematics include the set of concepts that allow us to describe the displacement (the change in position over time) or motion of a segment without regard to the force that cause movement.

An electromyography detects the electric potential generated by muscle cells, when these cells are electrically or neurologically activated. The signals can be analyzed to detect medial abnormalities, activation level or recruitment order or to analyse the biomechanics of human or animal movement.

**Hamstrings muscles on rowing**:

Hamstring tightness is offered as an explanation form low back pain, poor stroke technique, restricted reach on the recovery, and the decline in stroke.[22] The muscular imbalance of quadriceps and hamstrings are resulting in low back pain . knee flexion to extension peak torque ratios and low back injuries in highly active individuals[23]

Hamstrings are the major muscles group to play vital role in hip extension and hip hyper extension. During body forward movements are attain by out body, they need hip extension and then hyper extension. If the lack of hamstring muscle flexibility or hamstrings muscle are tight there is lack of body forward movements.[24] It is an important anti-gravity muscles of the lower limb and its flexibility is important to maintain the normal posture and gait in both adult and children. The lack of hamstrings muscles extensibility creates a decrease of pelvic mobility leads to an invariable biomechanical change in pressure distribution in spine leads to low back pain.[25] Hence, poor hamstrings flexibility has been associated with postural deviation, gait limitation, increased risk of falls, and susceptibility to musculoskeletal injuries like low back ache.[26] Any factor which influences over a hamstrings length which indirectly produces an effect on gait, posture, and musculoskeletal problem. Hence physiotherapist play a vital role in preventing the problem. (k.vadivalan et al)

Some obtained data are novel or associated together and enable a better understanding of the rower movement. The information of the study were discussed to clarify the knowledge, coaches can apply the results summarized here to preventing injuries a planning a specific training. (P.pudlo, A.pinti, and F-X.lepoutre)

Hence it is necessary to analysis the action potential of hamstring during rowing exercise. Improper muscle activation due to improper body position during rowing exercise leads to increase the risk of tissue strain & further lead to mechanical low back pain as well as reduced efficacy of rowing exercise. So we need to know the proper body position (both kinetic and kinematic) during rowing exercise. Hence this study was aimed to know the immediate effect of rowing technique in enhancing hamstring flexibility among young adults.

## MATERIALS AND METHODS

A quasi experimental (pre & post test) study was conducted using convenient sampling technique sample size was calculated and 30 students from SOPT, VISTAS, Thalambur, were enrolled for the study based on inclusion criteria: Active Knee Extension test positive, College students with sedentary life style, Both genders & Age 17-22. Exclusion criteria: non willing participants , Any recent fracture in lower limb or spine, Any recent upper limb or lower limb surgery, Any other neurological, orthopaedic and cardiovascular condition.

**Fig 1: Active knee extension test.**

**PROCEDURE:**

The participants for the study were taken based up on inclusion and exclusion criteria. The subject included for the study were asked to fill the informed consent form, stating that they had a no objection in participating in this intervention and the assessment was taken based the outcome measures.

30 subjects were taken (both gender) based on the inclusion and exclusion criteria. Initially the subject was asked to do ACTIVE KNEE EXTENSION TEST (pre test) to analyse the tightness and flexibility of hamstrings.

Then the subjects were asked to do the workout on rowing machine. During rowing machine workout the action potential of semimembranosus and semitendinosus (hamstrings) was taken using electromyography.

After the completion of procedure the subject were again asked to do active knee extension test to know the flexibility or tightness of hamstrings and values were noted using Goniometer.

**ACTIVE KNEE EXTENSION TEST:**

Ask the patient to lying down(supine) on the couch, and instructed them to maintain the hip and knee flex to 90 degree and ask the patient to extend the knee as much as possible without any discomfort. Therapist record the value or angle with the help of goniometer pre and post. The teat done in the both the legs.

**EMG recording:**

The subject was asked to sit on the rowing machine and do to the rowing exercise, at the same time EMG record of the muscle activity should be done in the hamstring muscles. Therapist notes the EMG value of pre and post. EMG recording was done in the both the legs.

**Data Analysis and Interpretation:**

All statistical analysis were performed on IBM compactible micro computer using statistical package for the social sciences (SPSS 20.0)

The significance was set at alpha=0.005 level paired-t test was used to compare the pre and post values of Active Knee Extension Test and motor unit action potential of hamstrings.

**Table-1 : Immediate Impact Of Rowing In Hamstring Flexibility In Young Adults (left Leg)**

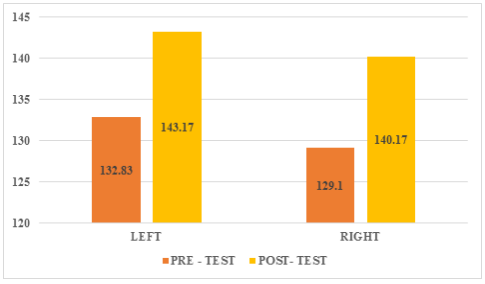
| Outcome Measure | Mean | Std. Dev | t Value | p Value |
|---|---|---|---|---|
| AKE (Pre & Post test values) | 10.33 | 27.47 | 10.79 | .000 |

| | | | | |
|---|---|---|---|---|
| Hamstrings Medial (Pre & Post test values) | 36.26 | 6.00 | 14.79 | .000 |
| Hamstrings Lateral (Pre & Post test values) | 34.94 | 5.12 | 15.43 | .000 |

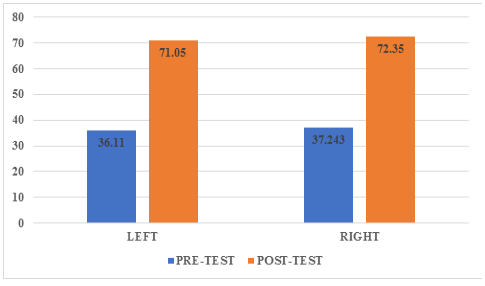
**Table-2 : Immediate Impact Of Rowing In Hamstring Flexibility In Young Adults (right Leg)**

| Outcome Measure | Mean | Std. Dev | t Value | p Value |
|---|---|---|---|---|
| AKE (Pre & Post test values) | 11.17 | 1.3 | 9.78 | .000 |
| Hamstrings Medial (Pre & Post test values) | 28.68 | 6.15 | 11.53 | .000 |
| Hamstrings Lateral (Pre & Post test values) | 35.15 | 4.85 | 15.93 | .000 |

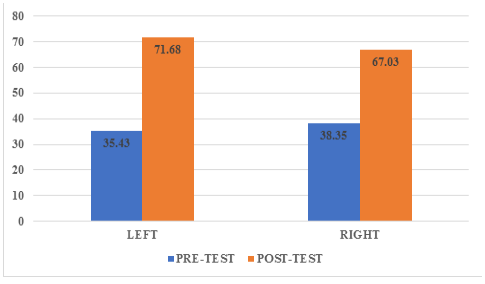
**Graph-1: Immediate Impact Of Rowing In Hamstring Flexibility In Young Adults In Active Knee Extension**




**Graph-2: Immediate Impact Of Rowing In Muap Of Medial Hamistrings In Young Adults**




**Graph-3: Immediate Impact Of Rowing In Muap Of Latral Hamistrings In Young Adults**




**RESULTS** :

- Table1: shows the immediate impact of rowing in hamstring flexibility in young adults – left leg, the post-test values of Active knee extension 143.17 ± 7.25 & MuAP of Medial hamstrings 71.05 ± 12.12 & Lateral Hamstrings 71.68 ± 10.42
- Table 2: shows the immediate impact of rowing in hamstring flexibility in young adults – right leg, the post-test values of Active knee extension 140.17 ± 6.23 & MuAP of Medial hamstrings 72.35 ± 12.83 & Lateral Hamstrings 67.03 ± 13.35
- Graph-1: shows the Immediate impact of rowing in Hamstring flexibility in young adults in active knee extension the mean post-test values of left leg 143.17 ± 7.25 & right leg 140.17 ± 6.23
- Graph-2: shows the Immediate impact of rowing in MuAP of Medial Hamstrings in young adults the mean post-test values of left leg 71.05 ± 12.12 & right leg 72.35 ± 12.83
- Graph-3: shows the Immediate impact of rowing in MuAP of lateral hamstrings in young adults the mean post-test values of left leg 71.68 ± 10.42 & right leg 67.03 ± 13.35
- The inter group analysis of this current study shows that there is significantly activate hamstrings muscle fibers in rowing machine to reduce hamstring tightness.

**DISCUSSION:**

This study was done to observe the immediate effect of rowing in Hamstring flexibility and to know the action potential of Hamstrings muscles (medial & Lateral groups). Hamstring flexibility has an indirect cause for musculoskeletal problems, posture, gait etc.

Several measures are used to test the muscle length but active knee extension test is more reliable test as it involves less motion on lumbar spine as well as pelvis. Active knee extension test has been considered by some to be gold standard for hamstring flexibility assessment. In this test, locating the end point of motion is reliable as we use the strict upper body stabilization of adjacent joints, so the knee extension is active and subjects were instructed not to force the leg past the point of initial mild resistance, we believe the motion in the hip of tested extremity, while the sacroiliac joints are eliminated[22]

This study reported the muscle activity levels and patterns of the major thigh muscles during training section of on- water rowing. Only the start phase (Maximal intensity) showed difference in muscular activity. During an all-out 500m section a decrease in power and stroke rate was found. These mechanical changes were not associated with changes in muscle activation pattern. During the leg drive the muscle activation of quadriceps were unchanged, while the activity of hamstrings muscles deceased during all-out 500m.[7]

Because of the tested lifts are performed with the intention of stressing the hamstrings, it is important to note that the muscle activity was maximized for the BF during the RDL, and glute-ham raise. The concentric action from the ST and SM was highest in the glute-harm raise, whereas the eccentric action from the ST and SM was highest in RDL; therefore the current findings suggest the athletes and coaches who seek to maximize involvement of different regions of the hamstrings musculature should consider a specific exercise.[28]

To our knowledge, no such study is conducted to observe the impact of extended sitting on flexibility in educational setups, especially in young and healthy, asymptomatic university students, the important finding was an alarming high rate of hamstring tightness among most of students, and a significant positive correlation found among extended sitting hours and hamstring tightness, but it is consistent with the finding of study conducted by Adar who claims that hamstring tightness increases with the increasing age

The hamstring tightness has a tendency to increases with sitting duration and also modification of sedentary life style (lack of physical activates), it can lead to muscles weakness, different researchers studied that long-term strength training can improve muscle strength.[22]

Another study claims that maximum flexibility is found in the mid-twenties for both male and females, contrary to this claim, we found significant reduction in hamstring flexibility in young population in their twenties, one main for this prolonged sitting hours and modification of sedentary life styles of students.[23]

During rowing machine exercise, it consists of four phase, both upper and lower body muscles are activated in rowing exercise, but throughout the four phase lower body major muscles are a activated efficiently like calves, hamstrings, and gastronomies[17].

Rowing machine are also very good to do upper and lower body workouts, helping the built muscles strength and its endurance capacity. So its maintain the physical fitness and proper muscle properties, as well as its maintain the ROM of joints.

**LIMITATIONS:**

- Small sample size.
- Young Adults were only considered
- Duration of the study was shorter.
- Only specific lower limb muscle was considered for the study
- Other muscles activity was not included.

**RECOMMENDATION:**

- Targeting larger population.
- Long term effect of rowing exercise in various age group and population
- Specific action potential of specific muscles involved in rowing for both upper body and lower body work outs can be considered.

## CONCLUSION:

The current study concludes that there is a significant improvement in hamstring flexibility and in enhancing the muscle action potential after rowing exercise in young adults with hamstring tightness.

## REFERENCES:


1. M. simoes et al, XXIV – ISBS symposium 2006, Salzburg – Austria : a kinematic analysis of rowing performance during a 2000m ergometer test.
2. Hartmann et al, international journal of sports medicine, 14 suppl 1, s42-45 : peak force, velocity, and power during five and ten maximal rowing ergometer strokes by world class female and male rowers.
3. Lamb,d.h. et al, American journal of sports medicine, 17(3), 367-73 : a kinematic comparison of ergometer and on-water rowing.
4. Ingham et al, 2002, European journal of applied physiology, 88(3), 243-6 : determinants of 2000m rowing ergometer performance in elite rowers.
5. Megergor, a.h. et al, 2005, medicine and science in sports and exercise, 37(6), 1014-20 : spinal kinematics in elite oars women during a routine physiological step test.
6. Bianca miarka et al, 2018, journal physical education and sports, 18(1) Art 25, pp. 193-202 ; biomechanics of rowing kinematic, kinetic and electromyography aspect.
7. Smith, r.m et al, 1995, journal of sports science, 13(5),377-385 : discriminant analysis of biomechanical difference between novice, good and elite rowers.
8. Calentano, f. et al, 1971, bulletin of the Italian society of experimental biology, 47(7), 185-87 : the biomechanics of rowing II, efficiency of the progression.
9. Mahler,d. et al, 1985, international journal of sports medicine, 6(04), 229-233 : physiological changes in rowing performance associated with training in colligate women rowers.
10. Attenborough, a.s. et al, 2012, journal of sports science, 30(5), 449-458 : effect of gender and stroke rate on joint power characteristic of the upper extremity during simulated rowing.
11. Buckeridge, e.m. et al, 2012, medicine and science in sports and exercise, 44(11), 2147-2153 : kinematic asymmetries of the lower limb during ergometer rowing.
12. Cerne,t. 2013, human movement science,32(4), 691-707 : difference between elite, juniors and non rowers in kinematic and kinetic parameters during rowing.
13. Rebecca r. steer et al, 2006, journal of sports science and medicine,5, 52-59 : a comparison of kinematics and performance measure of two rowing ergometer.
14. Redgrave, s. 1995 : complete book of rowing, partridge press.
15. Bull, a.m.j. et al, 2000, clinical biomechanics, 15, 772-776 : measuring a spinal motion in rowers, the use of an electromagnetic device.
16. Holt,p.j.e. et al, 2003, international journal of sports medicine, 24, 597-602 : kinematics of spinal motion during prolonged rowing.
17. Budget, r.g. 1989, clinical sports medicine, 1, 56-61 : illness and injury in international oarsmen.
18. Bernstein, l.a. et al 2002, British journal of sports medicine,36, 108-112 : an ergonomical comparison of rowing machine design, possible implication for safety.
19. Caldwell, j.s. et al 2003, clinical biomechanics,18, 704-711 : the effective of repetitive motion on lumbar flexion and erector spinae muscle activity in rowers.
20. Mcgregor, a.h. 2004, international journal sports medicine,, 25, 1-6 : a comparison of rowing technique at different strokes rates-a description of sequencing, force production and kinematics.
21. O-sullivan, f. et al 2003, clinical biomechanics 18, 488-493 : modeling multivariate biomechanical measurements of spine during a rowing exercise.
22. K. Vadivelan et al 2015, international of physiotherapy volume 2(2), 459-464 : influence of two different sitting postures on hamstrings muscle flexibility in school going children.
23. Abdolali banaeifar et al 2013, international journal of sports studies,3(12), 1307-131 : the correlation of sit and reach test and the hip joints goniometer angle in terms of measuring the hamstrings muscle length in krajs primary school students.
24. Gawas varuna et al 2011, Indian journal of physiotherapy and occupational therapy, 5(2), 162-168 : hamstrings index in school children- A cross sectional study in Belgaum city.
25. Mayora-vega, Rev.int.med.science.act.fis.deporte.ISSN:1577-0354 : Validity of sit and reach with plantar flexion test in children aged 10-12 years.
26. C.M. Norris et al 2006, journal of body work and movement therapies 10,122-126 : correlation between hamstring muscle length and pelvic tilt range during forward bending in healthy individuals.
27. A. Guevel et al 2011, international journal of sports medicine, 32, 109-116 : thigh muscles activation in elite rowers during on water rowing.
28. Shazlin shaharudin et al, 2013 journal of medical and engineering, volume 4, no.4 : muscle synergy of collegiate rowers during 6 min maximal rowing on fixed and slides ergometer.
29. Neil fleming et al 2014 journal of sports science : a comparison of electromyography and stroke kinematics during ergometer and on water rowing.
30. Ante panjkota et al 2016, 7th WSEAS international conference on automation and information, Croatia ; correlation of EMG activity and kinematic in case of ergometer rowing
31. Matt j. mcallister et al 2014, journal of strength and conditioning, volume 6 : muscle activation during various hamstrings exercise.