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EFFECTIVENESS OF NORDIC HAMSTRING EXERCISE VS DYNAMIC SOFT TISSUE MOBILIZATION IN IMPROVING HAMSTRING MUSCLE FLEXIBILITY AMONG YOUNG MALE CRICKETERS

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ABSTRACT

Purpose: The purpose of the study was to find the effectiveness of Nordic Hamstring Exercise vs Dynamic Soft Tissue Mobilization on improving hamstring muscle flexibility among young male cricketers. **Methods:** In this study there were 170 subjects. The subjects were divided into two groups by convenient sampling method. The subjects in the Group A (n= 85) received Nordic hamstring exercises while the subjects in Group B (n=85) received dynamic soft tissue mobilization. Intervention was given ton participants for 3 sessions a week for 5 weeks. Sit and Reach Test for Flexibility were used to assess the intervention's effectiveness. **Results:** Independent 't' test was used to compare the mean significance difference between continuous variables. Paired 't' test was used to assess the statistical significance difference between pre and post scores. Statistical analysis of this data revealed that, both groups significantly improved in flexibility when compared within the groups, but when compared between the groups, the Nordic Hamstring Exercise group improved better than the Dynamic Soft Tissue Mobilization group. **Conclusion:** According to the results of the present study, the five weeks of interventions of both the Nordic Hamstring Exercise and Dynamic Soft Tissue Mobilization groups, Nordic Hamstring Exercise group has shown significant effect when compared to Dynamic Soft Tissue Mobilization group in improving Hamstring Muscle Flexibility.

KEYWORDS: Nordic Hamstring Exercise, Dynamic Soft Tissue Mobilization.

INTRODUCTION

Cricket is a global sport traditionally popular in the commonwealth nations but now being played in 105 member countries of the international cricket council. Cricket is the world's second -most popular spectator sport after football and has captivated people of every age, sex, background and ability for more than 400 years. A bat-and-ball game with complex rules, cricket involves physical fitness, skill, and strategy.[1,2]

Sport and exercise contribute to both the physical and mental health of an individual. While the social benefits of sport, such as gain of fitness, reducing risk of disease, recreation, development of self-confidence and high selfesteem.[3]

Cricket is a dynamic sport that involves many abstract skills and movements. To enhance these skills and movements, many people ensure that their bodies are kept fit and strong.

There are three unique aspects of the game [bowling, batting and fielding] which are associated with the risk of injury.[4] The increase in injury risk is of particular concern at younger levels, as research has shown that adolescent cricket injury risk is higher than that in adult cricketers.[5]

In a longitudinal study of the nature of injuries to cricketers, lower limb injuries accounted for nearly half of injuries [49.8%] and primarily include injuries to the hamstring.[6,7] Hamstring strain has emerged from being one of many common injuries a decade ago to being the most common injury in the sport. These hamstring strains have a seasonal incidence of 8.7 injuries per 100 players per season.[8,9,10]

Hamstring is a group of muscle on the posterior aspect of the thigh consists of biceps femoris, semitendinosus and semimembranosus. Being an antigravity muscle, hamstring muscle aid in maintain body posture, holding

position of pelvis and performing trunk movements in relation to lower extremity.[11,12]

Direct or assisted participation of hamstrings is inevitable in activities like running, jumping and changing speed. Any decrease in the flexibility of hamstrings or tightness can cause hamstring injuries which are the most common type of injury among the athletes and have a slow recovery rate, make health expenditures high and also decrease the performance level of the athlete. In contact sports the prevalence of the hamstring tightness is very high.[13,14,15]

Flexibility is considered as essential element of normal biomechanical functioning in sports. The literature reports a number of associated benefits of flexibility including improved athletic performance, reduced risk of injury, prevention or reduction of post exercise soreness and improved coordination.[16]

Nordic hamstring exercise (NHE) is an eccentric training of the hamstrings which can both lower the risk of hamstring strain and improve muscle performance. Fitness parameter like, muscle flexibility is important for injury prevention.[17]

The hamstring muscle is important in both preventing injuries and increasing performance (Al Attar, Soomra, et, al, 2017) Hamstring injuries are one of the most common injuries in almost all team an individual sports involving the lower body (Bennell, et, al, 1996).[18,19]

Hamstring injuries, one of the most common sports injuries in the lower extremity, account for more than 12x of all sports injuries. The fact that only a single muscle region is more than 12x in the total injury rate has increased the number of studies, hamstring muscles are often neglected muscle groups in training, hamstring flexibility has been shown to play a major role in increasing or decreasing the risk of hamstring strain injury(timmins et, al, 2016).[20,21]

Various contraction methods are necessary to increase hamstring flexibility. The most important of these eccentric contractions occur in daily motor activities and are generally responsible for twoimportant features of movement. Eccentric contractions allow mechanical energy to dissipate during deceleration. (konow and Roberts et, al, 2015).[22] Eccentric contractions also allow the conversion of kinetic energy into elastic energy of tendons (hopperler et, al, 2014). Eccentric movements during maximal voluntary isokinetic exercise generally result in lower muscle activity than concentric movements but the maximum strength are significantly higher.[23]

Nordic hamstring exercise is a hamstring training method known to increase eccentric strength and flexibility which can be performed in the field as well and can be performed without the need of extra equipment. The Nordic hamstring exercise is understood to be an eccentric exercise that is performed on knees with ankles held/ strapped with subjects lowering their upper body towards a prone position, as slowly as possible. This training method has been known to increase eccentric hamstring strength and flexibility more effectively than traditional hamstring exercises.[24,25,26,27]

A hierarchical dynamic soft tissue mobilization (DSTM) was developed to treat athletes with muscle tightness and associated soft tissue problems. Dynamic soft tissue mobilization (DSTM) was developed with the aim of increasing muscle length. It utilizes a combined technique of classic massage followed by a dynamic component, where the limb is moved through its range. Determining specific area of tightness, where the treatment is concentrated, proceeds the dynamic component.[28]

Dynamic soft tissue mobilization follows a relatively recent development in manual therapy techniques in that it combines, with the therapist delivered manual treatment, a number of different features, such as passive joint and soft tissue positioning and movements and active movements involving either concentric or eccentric muscle activity. Invariably linked with and preceding these manual therapy techniques is a precise and careful manual examination that relies on the therapists perception of the tissue's compliance and response to manual provocation, including any induced muscle reactivity.[29]

NEED FOR THE STUDY

Cricket is a popular global sport although a noncontact sport, overuse and impact injuries are common since players engage in wide range of physical activities, including running, throwing, batting, bowling, catching, and diving. Flexibility in hamstrings muscle group is necessary for the hip and knee movements as well as in many functional activities. Literature reported that Nordic hamstring exercise reduced number of injury rates after pre-season training among athletes. But there are controversies on improvement in hamstring muscle strength. Several studies reported neither an improvement in muscle strength nor a reduction in injury rates. Several researchers have studied to check effectiveness of various stretching procedure to increase hamstring flexibility. Most studies have proved the effectiveness of individual muscle stretching technique. Among these techniques, dynamic soft tissue mobilization has been proved to produce a very significant improvement in increasing hamstring flexibility.

Therefore, this study is designed to investigate the effect of Nordic hamstring exercise and dynamic soft tissue mobilization in improving the parameter like hamstring flexibilityamong young male cricketers.

AIM OF THE STUDY

The aim of the study was to assess the Effectiveness of Nordic Hamstring Exercise and Dynamic Soft Tissue Mobilization in improving Hamstring Muscle Flexibility among young male cricketers.

OBJECTIVES OF THE STUDY

1. To determine the Effectiveness of Nordic Hamstring Exercises in improving Hamstring Muscle Flexibility among young male cricketers.
2. To determine the Effectiveness of Dynamic Soft Tissue Mobilization in improving Hamstring Muscle Flexibility among young male cricketers.
3. To compare the Effectiveness of Nordic Hamstring Exercise and Dynamic Soft Tissue Mobilization in improving Hamstring Muscle flexibility among young male cricketers.

HYPOTHESIS

RESEARCH HYPOTHESIS (H)

Nordic Hamstring Exercise is more Effective than Dynamic Soft Tissue Mobilization in improving Hamstring Muscle Flexibility than among young male cricketers.

ALTERNATIVE HYPOTHESIS (H_1)

Dynamic Soft Tissue Mobilization is more effective than Nordic Hamstring Exercise in improving Hamstring Muscle Flexibility among young male cricketers.

NULL HYPOTHESIS (H_0)

There is no significant difference between Nordic Hamstring Exercise and Dynamic Soft Tissue Mobilization in improving Hamstring Muscle Flexibility among young male cricketers.

MATERIALS AND METHODS

STUDY DESIGN: This study is a Prospective Study Design.

ETHICAL CLEARANCE: The study protocol was approved by the ethical committee of GSL Medical College and General Hospital (Annexure-I), the investigator explained the purpose of the study and given the patient information sheet. The participants were requested to provide their consent to participate in the study (Annexure-II). All the participants signed the informed consent and the rights of the included participants have been secured.

STUDY POPULATION: Young male cricketers.

STUDY SETTING: The study was conducted in the Cricket ground of GSL MEDICAL COLLEGE, Rajamahendravaram, and SAAP Vijayawada, Andhra Pradesh, India.

STUDY DURATION: The Study was conducted during the period of one year.

TREATMENT DURATION: Both the groups received intervention ofthree sessions per week forfive weeks.

STUDY SAMPLING METHOD: Convenient Sampling.

SAMPLE SIZE: A total number of 175 cricket players who are willing to participate in the study were included in this study, all the recruited participants were explained about the study. After obtaining informed consent form and meeting criteria, a total of 170 subjects were allocated in to two groups equally by convenient sampling.

GROUP A: NORDIC HAMSTRING EXERCISE (85 subjects)

GROUP B: DYNAMIC SOFT TISSUE MOBILIZATION (85subjects)

GROUPS	NO. OF PARTICIPANTS	TREATMENT
GROUP A	85	NORDIC HAMSTRING EXERCISES
GROUP B	85	DYNAMIC SOFT TISSUE MOBILIZATION.

MATERIALS USED

- Table
- Measuring tape
- Marker
- Sit and reach scale

INCLUSION CRITERIA

- Subjects in age group 15 - 29 years male cricketers.
- Pre – diagnosed hamstring tightness with sit and reach test having value less than 18 cm.
- Subjects playing regularly for more than 3 years.

EXCLUSION CRITERIA

- Sustained recent fractures.
- Ligament injuries.
- Muscle cramps.
- Recent surgeries.
- Impairments in musculoskeletal system.
- Known cardiovascular and neurological disorders.

STUDY TOOLS AND OUTCOME MEASURES

Sit and Reach Test – will be used to assess flexibility of hamstring muscle.

SIT and REACH TEST[30,31]

Sit and reach test will be used to assess the flexibility of the hamstring muscle. Participants will be asked to perform a short warm up stretch prior to the test. Participant will be asked to remove their shoes and instructions will be given to sit with the soles of the feet

flat against the flexo-meter at the 23 cm mark. Inner edges of the soles are placed within 2 cm of measuring scale. With extended knees, participant will be placing both hands super-imposed with tips of the middle finger at 23 cm mark. A command "reach forward with both hands as far as possible" will be given and asked to hold the position for approximately 2 seconds. The subjects will be instructed to keep both hands super-imposed and in contact with the measuring scale. Best of two trials will be recorded, and adequate rest period will be given between each trial.

INTERVENTION

All the training sessions will be preceded by a general warm up session of 10 minutes. Warm up included whole body self-stretches, spot joggings, neck rotation, arm rotation, hip rotation, and push-ups. A cool down period of 10 minutes will be provided after the exercise training. Cool down phase included whole body self-stretches and gentle walking.

NORDIC HAMSTRING EXERCISE[24]

Subject will be in kneeling position on the mat, head and neck in neutral position by the side (or) front of the chest, back and hip straight, knees in 90^0 flexion and ankles well stabilised by therapist. therapist positioned behind the subject by stabilizing the ankles. Subject's legs will be held stable by the therapist or the other partner. Subject was asked to lean forward slowly with a steady speed while trying to resist the forward fall by using the hamstring muscle as long as possible. When the balance to resist the forward fall is lost then he falls on his arms and let the chest touch the ground push backward immediately to reduce the contraction of hamstring. I the first week use 2 sets with 5 repetitions and then increase the number of sets to 3 and repetitions gradually every week according to the protocol.

WEEK	SESSIONS	SETS	REPITITIONS/SET
1	1	2	5R/ set
2	2	2	6R/ set
3	3	3	6R/set in 1st session, 7R/set in 2nd session, 8R/set in 3rd session.
4	3	3	8R/set in 1st session, 9R/set in 2nd session, 10R/set in 3rd session
5	3	3	12R/set in 1st session, 10R/set in 2nd session, 8R/set in 3rd session

Fig No. 1: Initial Position of Nordic Hamstring Exercises.

Fig No. 2: Subject Performing Nordic Hamstring Exercises.

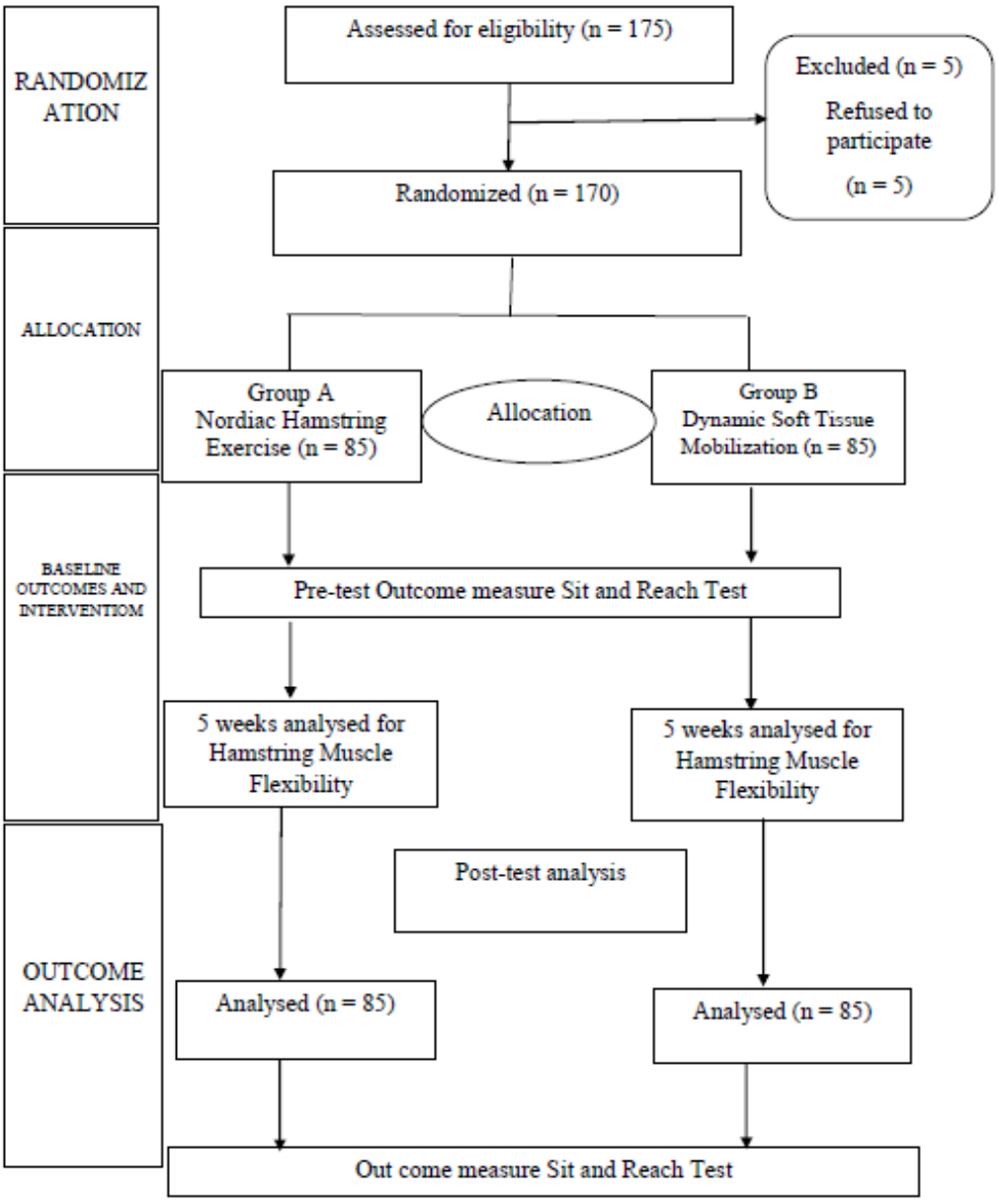
Fig No. 3: Final Position of Nordic Hamstring Exercises.

DYNAMIC SOFT TISSUE MOBILIZATION[28]

The DSTM was divided into hierarchical progressions and here the subject is in the prone lying position and few deep longitudinal strokes are applied to the entire muscle group and the area of tightness is located. When the specific area of tightness of hamstring is located, the further treatment is limited to this target area. For dynamic intervention, the subject is in supine lying position with the knee and hip flexed to 90^0 and all the dynamic techniques are applied in a distal to proximal direction. Deep longitudinal strokes are applied to the area of hamstring tightness and the leg is passively moved to a position in which the hamstring is in lengthened position. Five strokes are applied to the area and shaking of the limb is performed for 20 seconds at the completion of this technique. Then the area of hamstring is reassessed for reduction in muscle tightness. If any improvement in the flexibility is indicated, then the next progressive dynamic technique is applied. The same sequence is applied for the next dynamic technique in which the subject is asked to actively extend his leg, so that reciprocal inhibition of the hamstring can be achieved. In the final technique, the subject is asked to eccentrically work the hamstring muscle group to the end rom and the therapist performs five deep distal to proximal longitudinal strokes over the area of muscle tightness at hamstrings.

Fig no. 4: Identification of The Area of Muscle Tightness.

Fig No.5: Therapist Perfoming Dynamic Soft Tissue Mobilization.



STASTISTICAL ANALYSIS

All statistical analysis was done by using SPSS software version 21.0 and Microsoft excel-2007.

Descriptive data was presented in the form of +/- standard deviation andmeandifference percentages were calculated and presented.

Within the groups: Paired "t" test was used to compare the levels of pre and post test scores (non-parametric or para metric accordingly). It was used to assess the statistical difference within thegroups for Sit and Reach Test.

Between the groups: unpaired t test was used to compare the statistical difference between meansof two independent group for Sit and Reach Test For all statistical analysis, $p<0.05$ was considered as statistically significant.

RESULTS

The results of the study were analysed in terms of increased Hamstring Flexibility through Sit and Reach Test. The consort flow chart of the study showed the study organization terms of subjects screening, random allocation and analysis following the intervention.

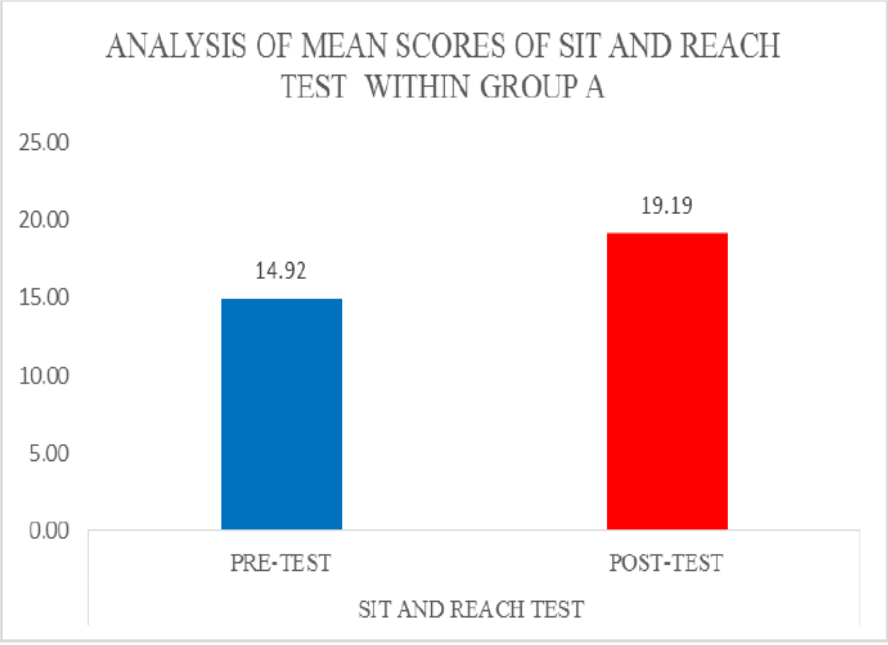
A total of 170 subjects were screened for eligibility and are included in the study trail. All the subjects who met the inclusion criteria have undergone base line assessment and included subjects were randomised into two equal groups consisting of 85 subjects each. In this study 85 participants completed training in Group A and 85 participants completed training in Group B.

Comparison was done both within the Groups as well as in between the two Groups. So as to evaluate the Intra Group and Inter Group Effectiveness of Nordic Hamstring Exercise and Dynamic Soft Tissue Mobilization techniques which are under consideration in the present day.

GRAPHS

Table 1: Analysis of Mean Scores of Sit and Reach Test Within The Group A.

GROUP A		Mean	Std. Deviation	*P* VALUE	INFERENCE
SIT AND REACH TEST	PRE-TEST	14.92	1.727	0.001	SIGNIFICANT
	POST-TEST	19.19	1.680		

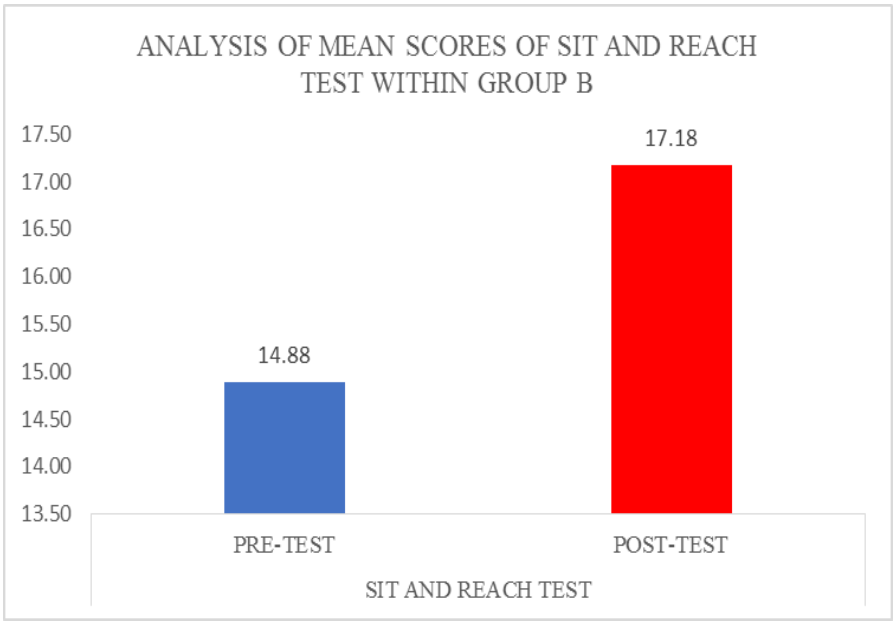


GRAPH – 1.

RESULTS: The above table and graph shows that the Mean Scores of Sit and Reach Test changes from Pre-Test to Post-Test within Group A were found to be statistically significant ($p<0.005$).

Table 2: Analysis of Mean Scores of Sit and Reach Test Within The Group B.

GROUP B		Mean	Std. Deviation	*P* VALUE	INFERENCE
SIT AND REACH TEST	PRE-TEST	14.88	1.796	0.0001	SIGNIFICANT
	POST-TEST	17.18	1.840		

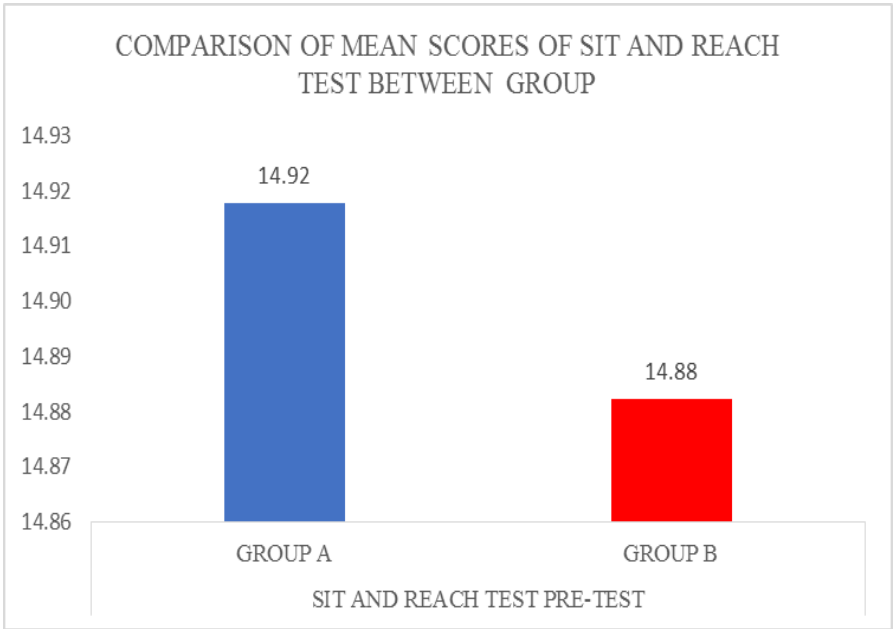


GRAPH – 2.

RESULTS: The above table and graph shows that the Mean Scores of Sit and Reach Test changes from Pre-Test to Post-Test within Group B were found to be statistically significant (p<0.005).

Table 3: Comparison of Mean Scores of Sit and Reach Test In Between The Groups Pre – Test.

GROUPS		Mean	Std. Deviation	*P* VALUE	INFERENCE
SIT AND REACH TEST PRETEST	GROUP A	14.92	1.727	0.896	INSIGNIFICANT
	GROUP B	14.88	1.796		

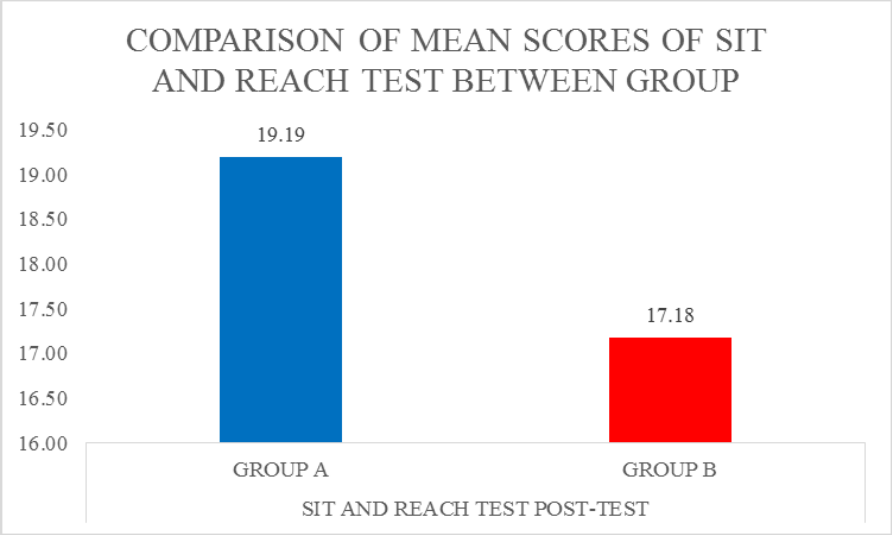


GRAPH – 3.

RESULTS: The above table and graph shows the Pre-Test measurement of Sit And Reach Test scores in between the Groups. The Mean Scores in Group A and B were found to be Statistically Insignificant.

Table 4: Comparison of Mean Scores of Sit and Reach Test In Between The Groups Post – Test.

GROUPS		Mean	Std. Deviation	*P* VALUE	INFERENCE
SIT AND REACH TEST POST-TEST	GROUP A	19.19	1.680	0.0001	SIGNIFICANT
	GROUP B	17.18	1.840		



GRAPH- 4.

RESULTS: The above table and graph shows the Post-Test measurement of Sit And Reach Test Scores in between the Groups. The Mean Scores in Group A and B were found to be Statistically Significant.

DISCUSSION

The main purpose of the study was to evaluate the Effectiveness of Nordic Hamstring Exercise and Dynamic Soft Tissue Mobilization on improvement of Hamstring Muscle Flexibility in young male cricketers. In this study, subjects were assessed for Hamstring Muscle Flexibility using the outcome measure Sit And Reach Test. 170 subjects were divided into two Groups and Group A (n=85) received Nordic Hamstring Exercises and Group B (n=85) received Dynamic Soft Tissue Mobilization. Who underwent five weeks exercise training program. Assessment was done before and after five week program.

By the end of the fifth week intervention protocol the subjects of Group A who received Nordic Hamstring Exercise had significantly improved results in Hamstring Muscle Flexibility which showed changes in outcome measure Sit And Reach Test composite Mean Score (p=0.001). Group B who received Dynamic Soft Tissue Mobilization also showed significant results in Sit And Reach Test Composite Mean Score (p=0.001).

The results of the study implied that there is a statistically significant in both Nordic Hamstring Exercise and Dynamic Soft Tissue Mobilization to effectively bring changes in outcome measure Sit and Reach Test in young male cricketers.

Multiple cricket playing nations have documented the occurrence of cricket injuries over several seasons and all have demonstrated an increase in injuries over recent times with the introduction of twenty20 cricket and increase in matches played per year (Orchard 2011 et al).[32] International cricket injury reports suggest that pace blowers are most at risk of incurring an injury. Hamstring strain injuries in cricket account for 8-11.1 of all injuries (Frost and Chalners, 2014).[33] Hamstring strain injuries are common in cricket as it is a high intensity sport. Risk factors include hamstring muscle weakness, previous hamstring injury lac of hamstring flexibility and biomechanical abnormalities. Hamstring strength imbalances can be of particular problem for cricket players. In particular pace bowlers due to asymmetrical demands of fast bowling and throwing. Addressing strength imbalances in improving eccentric hamstring strength have been proposed as a key component of hamstring strain injury prevention.[34]

The Nordic Hamstring Exercise particular could provide cricket players a feasible and effective way to reduce the risk of sustaining a Hamstring Strain Injury and reducing the number of Hamstring Strain injuries occurring in cricket throughout the world.[22]

Furthermore, the improvement in results of Group A is supported by the study done by (Morgan D et al), who explained the mechanism behind the improvement of Hamstring Muscle Flexibility via Nordic Hamstring Exercise. They stated that significant difference in flexibility might be due to the change in optimum length of the hamstring muscle fibres following repeated eccentric contractions result in change in length of the sarcomere and a shift in the optimum angle. It is proposed that there will be an acute shift in length immediately after the eccentric exercise and a second shift in the length after repeated training sessions. Acute shift is thought to occur from increased compliance and disrupted sarcomeres. Brockett et al proposed that during active lengthening, myofilaments are stretched and some sarcomereswill be over stretched they will become progressively weaker until the myofilaments no longer overlap. But when this eccentriccontractions are repeated over time more sarcomeres will be converted from weaker to stronger and they will not re integrate at the end of each contraction.[35]

Christian sebelien PT et al 2017 suggested another theory in there studythat eccentric contraction can cause increase in passive tension of the muscle which might be the reason for improvement in flexibility after Nordic Hamstring Exercise. Nordic Hamstring Exercises specially targeted at eccentric training of the hamstring musculature may have resulted in decreased in the numbers of Hamstring Strains which helps in improving Hamstring Muscle Flexibility.

This study also showed an improvement in the Hamstring Muscle Flexibility in Group-B who received Dynamic Soft Tissue Mobilization, where the general techniques applied to non-specific areas delivered when muscles were placed in a shortened, resting, or neutral position unlike these generalised techniques, Dynamic Soft Tissue Mobilization is a specific structure technique in which the therapist identifies a target area of muscle tightness and focuses the treatment on that specific area whilst moving it longitudinally under different muscle contraction parameters.[28]

Sachin Maghade et al 2018 who stated that Dynamic Soft Tissue Mobilization Technique releases the scar tissue adhesion to allow the full lengthening of the muscle and to regain flexibility to functional use. In this study it is proved that DSTM has an immediate, significant effect on hamstring length DSTM may mechanically sheer out the cross links and break down scar tissue, remobilising the fascia back to its gel like state. Once the fascia is in the more like state, soft tissue compliance increases allowing for greater Range Of Motion.[36]

The mean scores and pre - test and post - test values showed that both Nordic Hamstring Exercise and Dynamic Soft Tissue mobilization intervention programs were beneficial in improving hamstring muscle flexibility.

From the finding of this study, it can be recommended that the Nordic Hamstring Exercise may be opted by the strength and conditioning trainers and cricket coaches in coaching centers as an adjuvant program for young male cricket players to add in their regular training sessions.

LIMITATIONS

- Less treatment sessions per week.
- Only age group are included in the study.
- Lack of follow up in the present day.
- Lack of control Group.

RECOMMENDATIONS FOR FURTHER RESEARCH

The length of the study can be extended by either 8 or 12 weeks for better results.

CONCLUSION

In conclusion, 5 weeks interventions of both the Nordic Hamstring Exercise and Dynamic Soft Tissue Mobilization groups, Nordic Hamstring Exercise group has shown significant effect when compared to Dynamic Soft Tissue Mobilization in Improving Hamstring Muscle Flexibility in Young Male Cricketers.

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