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EFFECTS OF PROPRIOCEPTIVE NEURO MUSCULAR FACILITATION STRETCHING AND BALLISTIC STRETCHING COMBINED WITH SPORTS SPECIFIC ACTIVITY ON JUMP PERFORMANCE IN BASKETBALL PLAYERS

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ABSTRACT

Introduction: Basketball is a popular sport played worldwide as a recreational and competitive sport of all age group. Flexibility and muscle power of the lower limb is considered to play a vital role in determining an athlete's performance and physical fitness. This study aims at comparing whether ballistic stretching or PNF stretching is effective in improving vertical jump and flexibility aspect with a major focus on muscle group of rectus femoris, hamstrings, iliopsoas, and gastrocnemius which are generally involved in jumping activities. **Methods:** 40 male basket ball players were selected and randomly allocated in to two groups and in this group A received PNF hold relax technique, and group B received ballistic stretching and data analysis was done to find out the effectiveness in both the groups. **Results:** SPSS version 2.0 was used to analyse the data the intra-group analysis clearly showed that Treatment B (BALLISTIC STRETCHIG) is effective than Treatment A (PNF STRETCHING) in terms of improvement in vertical jump test, hip flexion and WBLT both right and left. **Conclusion:** both the groups showed the significant improvements but group B was found to be more superior than group A.

KEYWORDS: Vertical jump, ballistic stretching, PNF hold –relax, jump performance.

INTRODUCTION

Basketball is a popular sport played worldwide as a recreational and competitive sport of all age groups. It is an aerobic-based anaerobic sport of body contact that includes both high-intensity activities such as jumping, sprints, and low-intensity activities such as jogging, and stopping that requires muscle strength.[2]

Due to intense practice and regular games, players have to maintain mobility (flexibility) that can be achieved through stretching. Flexibility and muscle power of the lower limb is considered to play a vital role in determining an athlete's performance and physical fitness.[3]

Flexibility primarily requires muscle and joint performance through the functional range of motion which helps to reduce the risk of injury, delay the onset of muscle soreness, and improvement in performance.[4] Reduction in flexibility will cause reduced functional level and damage to the musculoskeletal system due to overuse. Such damage is very common in the multi-joint muscle which undergo large functional excursion.

Warm up is one of the common instructions prior to any exercises a regular warm-up consist of three components: aerobic exercise, stretching, and a rehearsal of the activity specific movement. There are many evidences that suggest that as the musculo-tendinous unit lengthens there will be increased compliance were the muscle fiber components such as actin and myosin contract over a longer distance thus decreasing in performance parameters like jump performance, sprint, speed, balance, and coordination. This made the players adapt to more dynamic warm techniques like skipping, directional running, shuffling and various high-intensity activity prior to the play.

Stretching is included as pre-exercise warm up in common practice for a wide variety of population. It includes static, dynamic, ballistic, and proprioceptive neuromuscular stretching. Stretching can be defined as the act of applying a tensile force to lengthen muscle and connective tissues to enhance the range of motion of the joint.

There are many studies done on the various stretching techniques that have the main focus on flexibility, the range of motion, peak torques, power and strength, and other variables.

However, there are very few studies done comparing PNF stretching with ballistic stretching. Due to daily intense practice players tend to develop tightness especially in hips, groin and lower back. So this study aims at comparing whether ballistic stretching or PNF stretching is effective in improving vertical jump and flexibility aspect with a major focus on muscle group of rectus femoris, hamstrings, iliopsoas, and gastrocnemius which are generally involved in jumping activities.

VERTICAL JUMP

Jumping and sprinting is a key indicator in basketball. Vertical jump is a classical power test to determine the ability to generate force into the ground at increasing velocity. Samazino et al., suggested that jump height is dependent on 3 factors maximum force, velocity and distance.

PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION STRETCHING

PNF techniques used in stretching is also referred to as facilitative or active stretching, integrated active muscle contraction into stretching maneuvers to facilitate or inhibit muscle activation and increase the likelihood of the muscle to be lengthened remain as relaxed as possible as it stretches.[14]

PNF Hold-Relax techniques is a type of stretching that is being practiced commonly in clinical and sports training. It is because hold-relax and contract-relax techniques appear to make passive elongation of muscle more comfortable than manual stretching.[15]

BALLISTIC STRETCHING

Ballistic stretching is a rapid, forceful intermittent stretch that consists of high speed and high-intensity stretch. It works on the mechanism of quick bouncing movements which create momentum that carries the body segment through the range motion to stretch the shortened structure.[16]

Thus the aim of the present study is to compare the effectiveness of PNF and ballistic stretching on improving the jump performance in basketball players combined with sport-specific activity in the chronic period (regular training program) as they tend to get tighter due to daily practice.

Hence the aim of the study is to determine the effect of PNF stretching and Ballistic stretching on jump performance in basketball players combined with sports specific activity. And the objectives of the study is to determine the effects of PNF stretching along with sports specific activity among the basketball players. To determine the effects of BALLISTIC stretching along with sports specific activity among the basketball players.

METHODOLOGY

❖ **STUDY DESIGN:**

- Experimental.

❖ **STUDY TYPE:**

- Pre and post

❖ **SAMPLING TECHNIQUE:**

- Convenient sampling.

❖ **SAMPLE SIZE:**

- 40 male basketball players.

❖ **DURATION:**

- 4 weeks.

❖ **STUDY SETTING:**

- Jawaharlal Nehru Stadium, Periyamet, Chennai.

❖ **SAMPLE SELECTION:**

- **INCLUSION CRITERIA:**
  - Gender: Male.
  - Age group: 18 to25.
  - Playing basketball actively for at least 1 to 2 years
  - Individuals who are willing to participate.
  - Individuals with no past or recent injuries.
  - Individuals with normal BMI.
- **EXCLUSION CRITERIA:**
  - History of acute or chronic injury.
  - Concussion at least 3 months before enrolment.
  - Not willing to participate due to personal and professional reasons.
  - Recent surgery or injury, any recent fractures or injury.
  - Subjects were excluded if they have/had any respiratory pathology, any Impairment.

PROCEDURE

Individuals were explained about the procedure and were selected according to the inclusion and exclusion criteria. A written Informed consent was obtained from all the subjects who are willing to participate in the study 40 participants were divided randomly into two groups with 20 participants in each group Among them group A participants were assigned to follow PNF stretching exercises and group B participants were assigned to follow BALLISTIC stretching exercises. Each subject participated in this stretching protocol for three times a week for four consecutive weeks.

After assessment both the group individuals were asked to complete a general warm up of jogging for 5 minutes followed by 15 minutes of basket ball play (5 minutes of full court sprint layup and 10 minutes of shooting).

PRE TEST

➢ These groups are assessed for vertical jump test to measure the jump performance and range of motion for hip flexion, knee extension and ankle dorsi-flexion to measure the flexibility.

POST TEST

➢ After giving 4 weeks of stretching program to both the groups again vertical jump test and range of motion of the hip knee and ankle is measured.

VERTICAL JUMP TEST

- Initially participants standing reach was recorded by asking them to stand beside the wall markings and asked to extend his dominant arm over head without lifting heels off the ground
- This height was measured
- Then the participants were asked to perform preliminary movement by rapidly flexing the knees before launching the body vertically.
- Participants performed three jumps and average of the 3 trails was recorded.

HIP FLEXION TEST

- Participants were made to lie in supine position.
- Pelvic movement was restricted by strapping the contra-lateral limb firmly using straps.
- Then the participants flexed the hip as far as possible with knee in flexion until firm end feel is felt.
- Hip angle was measured using universal goniometer with axis over the greater trochanter and movable arm over the lateral midline of femur with lateral epicondyle as reference and immovable arm over the lateral midline of pelvis.
- Same procedure repeated for next limb.

ACTIVE KNEE EXTENSION TEST

- Participants were made to lie in supine position and left hip flexion is maintained in 0degree by securing the limb with Velcro straps.
- Then the test limb is flexed hip to 90degree maintained with a help of foot stool and foot in neutral position knee at 90 degree flexion a standard universal goniometer was used were the immovable arm aligned along the thigh, axis over the lateral femoral condyle and movable arm in the direction of lateral malleoli.
- From this position without any prior warm up subjects were asked to extend the knee until they felt a strong resistance holding this position readings were noted down.
- Same procedure repeated for next limb.

WEIGHT BEARING LUNGE TEST

- Participants performed three trials of the WBLT by knee to wall principle.
- Measuring tape was placed over the floor and participants were asked to place the heel firmly over the floor and flexing their knee to wall.
- Opposite limb (non-test) limb is placed behind the test limb to maintain the stability and balance was maintained by allowing contact with the wall using two fingers from each hand.
- Participants then lunged forward until their knee touches the wall and the test limb was moved away from the wall in 1cm increments until they were unable to keep their heel on the floor or touch the wall with knee.
- The distance from the great toe to the wall is measured as reaching maximum dorsi-flexion.
- Same procedure repeated for next limb.

EXERCISE PROTOCOL
Group A-PNF STRETCHING
Hold-Relax Technique For

i. Hamstring,
ii. Iliopsoas,
iii. Rectus Femoris,
iv. Gastrocnemius.

Group B-BALLISTIC STRETCHING: (60 beats per minute using metrronome)

i. Sit and reach.
ii. Lunge knee bent.
iii. Standing heel cord with extended knee.
iv. Standing heel cord with flexed knee.

GROUP-A: PNF HOLD-RELAX STRETCHING GENERAL PROTOCOL

- Passive extension of the muscle without causing pain and maintained for 30seconds
- Followed by isometric contraction of the muscle for 6 seconds.
- 15 seconds of relaxation time.
- Followed by 15 seconds of maximum extension into new range.
- REPETITIONS: 3sets of 15 stretches per each muscle groups with 15 seconds rest between each stretching.

HAMSTRING MUSCLE

- The hamstring group was stretched with the subject in a supine position with arms to their side.
- The researcher then grasped the ankle and raised the leg straight to the point of mild discomfort and maintained this position for 30 seconds.
- After this point, the subject was asked to perform a maximum voluntary isometric contraction of the hamstring concentrically, against the researcher's resistance for 6 seconds
- Then the individual is asked to relax for about 15 seconds.
- Then the researcher take the joint to the new range and hold it for 15 seconds.
- Repeat the same procedure on the opposite side.

ILIOPSOAS MUSCLE

- The iliopsoas (hip flexors) were stretched with the subject in a supine position.
- The subject lie on a tall bench with the thigh hanging down off the end of the bench. The opposite thigh was raised toward the side of torso. The lower thigh was allowed to drop toward the floor with knee flexed at 90 degree until the point of mild discomfort and maintained this position for 30 seconds.
- After this point, the subject was asked to perform a maximum voluntary isometric contraction of the hip flexors concentrically, against the researcher's resistance for 6 seconds
- Then the individual is asked to relax for about 15 seconds.
- Then the researcher take the joint to the new range and hold it for 15 seconds.
- Repeat the same procedure on the opposite side.

RECTUS FEMORIS MUSCLE

- Individual in a prone position.
- The researcher lifted the knee and pushed the ankle down toward the hip till the individual felt the point of discomfort and maintained this position for 30 seconds
- After this point, the subject was asked to perform a maximum voluntary isometric contraction of the rectus femoris concentrically, against the researcher's resistance for 6 seconds
- Then the individual is asked to relax for about 15 seconds.
- Then the researcher take the joint to the new range and hold it for 15 seconds.
- Repeat the same procedure on the opposite side.

GASTROCNEMIUS MUSCLE

- Individuals were made to sit in long sitting with back supported.
- The researcher passively stretched the muscle until the point of discomfort and maintained this position for 30 seconds.
- After this point, the subject was asked to perform a maximum voluntary isometric contraction of the concentrically, against the researcher's resistance by pressing the foot against the researcher's hand for 6 seconds.
- Then the individual is asked to relax for about 15 seconds.
- Then the researcher take the joint to the new range and hold it for 15 seconds.
- Repeat the same procedure on the opposite side.

GROUP B

GENERAL PROTOCOL

A metronome was set to 60 beats per minute and the subjects were asked to bounce to the beat.

1. SIT AND REACH

- Subjects were asked to sit with their legs straight and feet upright.
- Distance between the feet should not be not more than 6 inches.
- Subjects bend from the waist until the felt tightness but not pain and bounced according to the beat back and forth.
- Repeat the same procedure on the opposite side

LUNGE KNEE BENT

- Subjects were standing and were instructed to take a long step forward.
- The front knee was directly in line with the ankle.
- Other knee resting on the floor.
- Without changing the position subjects lowered the front of the hip downward in back and forth movement according to the beat.
- Repeat the same procedure on the opposite side.

3. STANDING HEEL CORD—KNEE EXTENDED

- Subjects stood facing the wall with non-test leg with slight bent at the knee.
- Subjects kept the test leg behind straight and allowed their weight to push back the heel down with heel flat and toes pointed.
- Ask the individuals to keep both the heels flat on the floor and press the hips towards the wall.
- Without changing the position, subjects lowered the pushed the hip forward in back and forth movement according to the beat without eliciting pain.
- Repeat the same procedure on the opposite side.

4. STANDING HEEL CORD—KNEE FLEXED

- Subjects stood facing the wall with non-test leg with slight bent at the knee.
- Subjects kept the test leg behind with knee bent slightly and allowed their weight to push back the heel down with heel flat and toes pointed.
- Ask the individuals to keep both the heels flat on the floor and press the hips towards the wall.
- Without changing the position, subjects lowered the pushed the hip forward in back and forth movement according to the beat without eliciting pain.
- Repeat the same procedure on the opposite side.

SS

DATA ANALYSIS

All the statistical analysis were performed by using IBM SPSS for Window version 20.

- **DESCRIPTIVE STATISTICS**
- Mean & Standard deviation for Continuous variables like Vertical jump test values and Hip Flexion test, AKET and WBLT values.
- **INFERENTIAL STATISTICS**
- Intra Group Analysis – Paired Samples t-test
- Inter Group Analysis – Independent Samples t-test.

Since the p-value (<0.0001) of the test statistic is less than 0.05, we reject the null hypothesis at 5% level of significance. In addition the Intra-group analysis (Paired t-test) showed that both the treatments are effective in terms of all the measures Vertical jump test **values**, hip flexion test values, AKET Values, and WBLT values on both right and left side. However, the Inter-group analysis (Independent t-test) showed that there is no significant difference between two treatments in terms of changes in Right and Left AKET. However, the inter-group analysis clearly showed that Treatment B (BALLISTIC STRETCHIG) is effective than Treatment A (PNF STRETCHING) in terms of improvement in vertical jump test, hip flexion and WBLT both right and left.

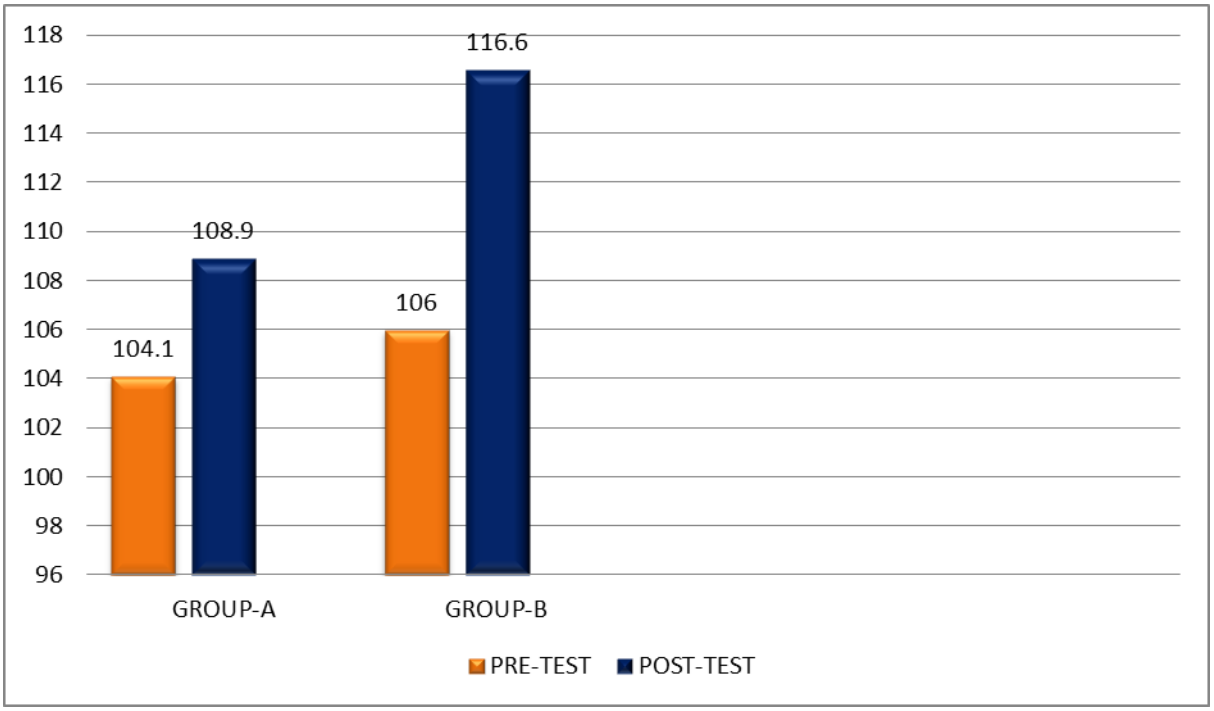
GROUP-A: PNF STRETCHING

GROUP-A-PNF STRETCHING							
OUTCOME MEASURE		MEAN		STANDARD DEVIATIONS		t-VALUE	P VALUE
					POST		
VERTICAL JUMP		46.535	52.63	6.014	5.879	18.1422	
HIP	RIGHT	103.85	108.65	8.23	6.76	4.4853	
	LEFT	104.1	108.9	8.56	6.95	4.2833	
KNEE	RIGHT	32.5	29.7	7.71	7.66	5.1301	0.000
	LEFT	32.8	29.6	7.29	7.74	5.2496	
ANKLE	RIGHT	17.075	19.875	2.587	2.564	8.4524	
	LEFT	17.2	19.75	3.689	2.74	7.5411	

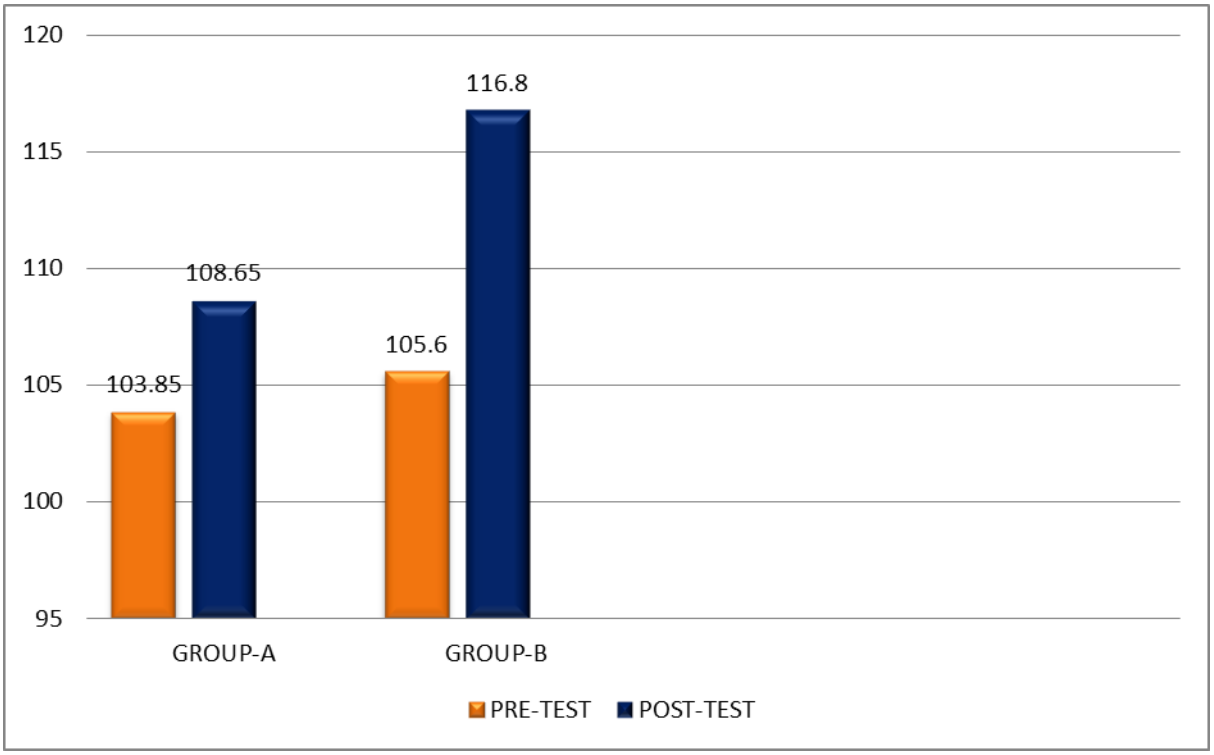
GROUP-B: BALLISTIC STRETCHING

GROUP-B-BALLISTICS STRETCHING							
OUTCOME MEASURE		MEAN		STANDARD DEVIATIONS		t-VALUE	P VALUE
					POST		
VERTICAL JUMP		46.505	60.865	9.326	11.456	9.9246	
HIP	RIGHT	105.6	116.8	9.25	4.63	6.4292	
	LEFT	106	116.6	9.37	4.6	6.0806	
KNEE	RIGHT	38.75	34.5	6.51	7.81	5.2215	0.000
	LEFT	39	34.6	5.96	7.77	5.5738	
ANKLE	RIGHT	17.275	22.15	3.168	2.434	11.1273	
	LEFT	17.85	22.225	3.188	2.5	8.0971	

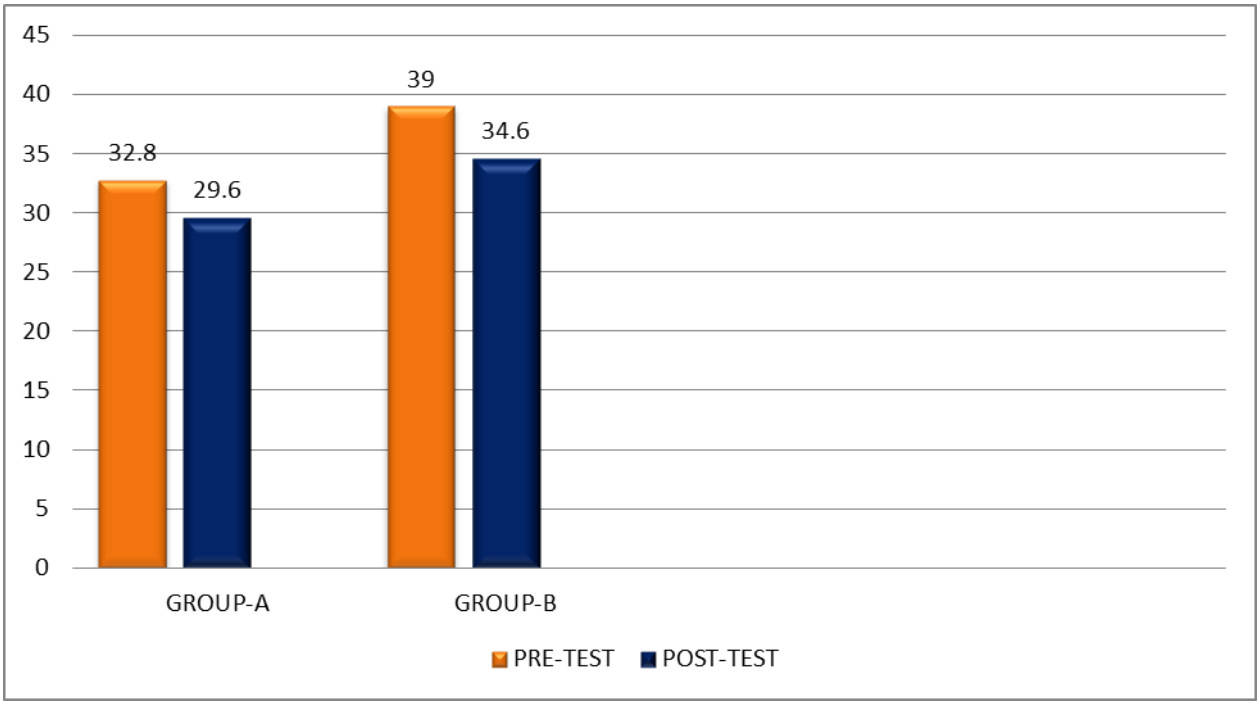
GRAPHICAL REPRESENTATION



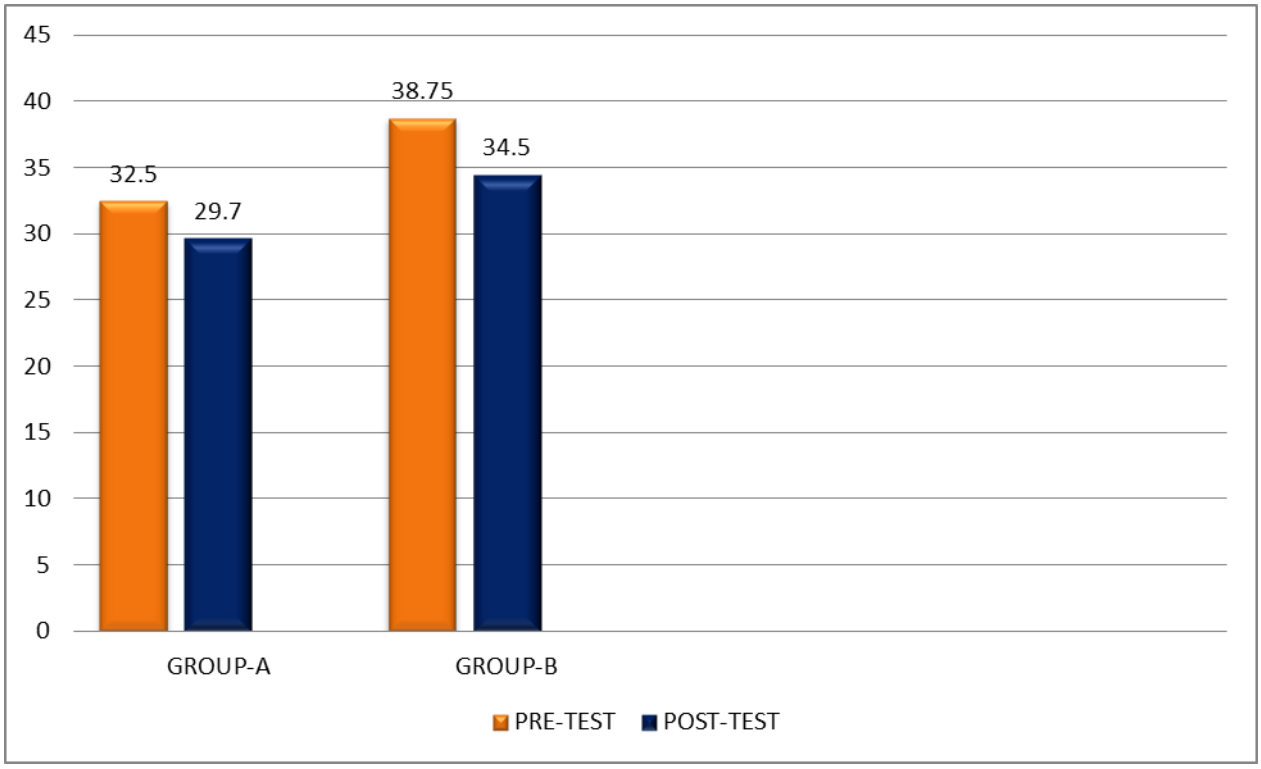
GRAPH 1: SHOWS THE DATA REPRESENTATION OF PRE AND POST TEST MEAN VALUES OF HIP FLEXION TEST (LEFT LEG): GROUP-A AND GROUP-B



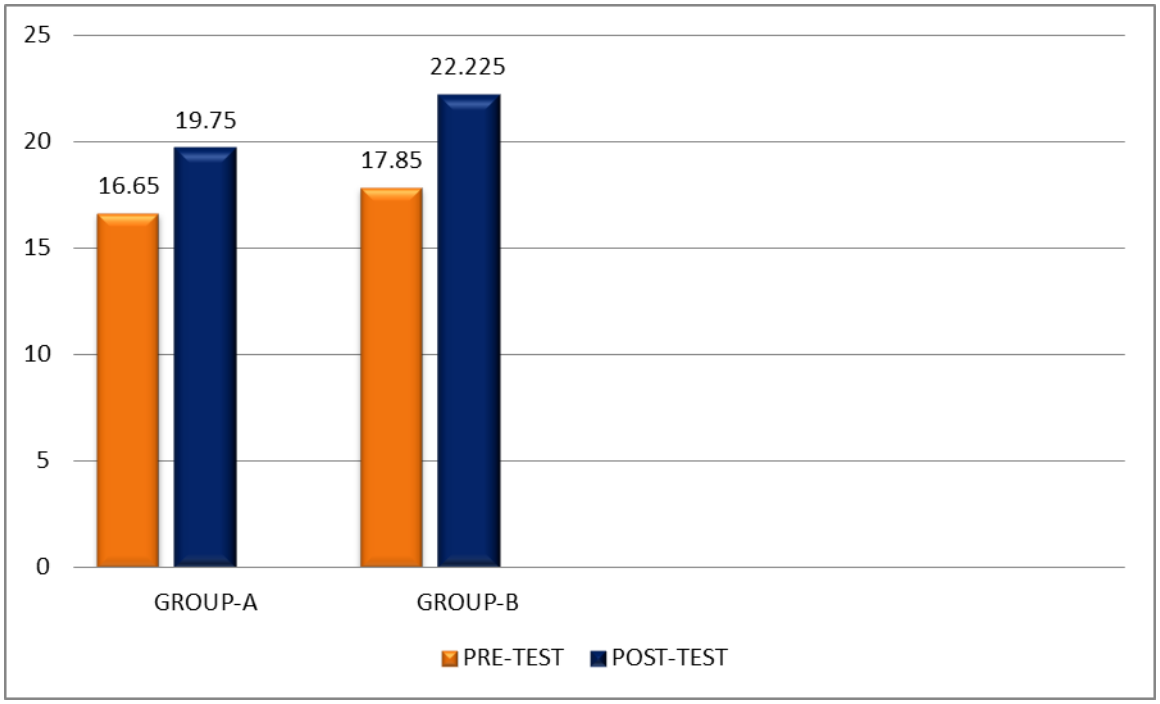
GRAPH 2: SHOWS THE DATA REPRESENTATION OF PRE AND POST TEST MEAN VALUES OF HIP FLEXION TEST (RIGHT LEG): Group-A and Group-B



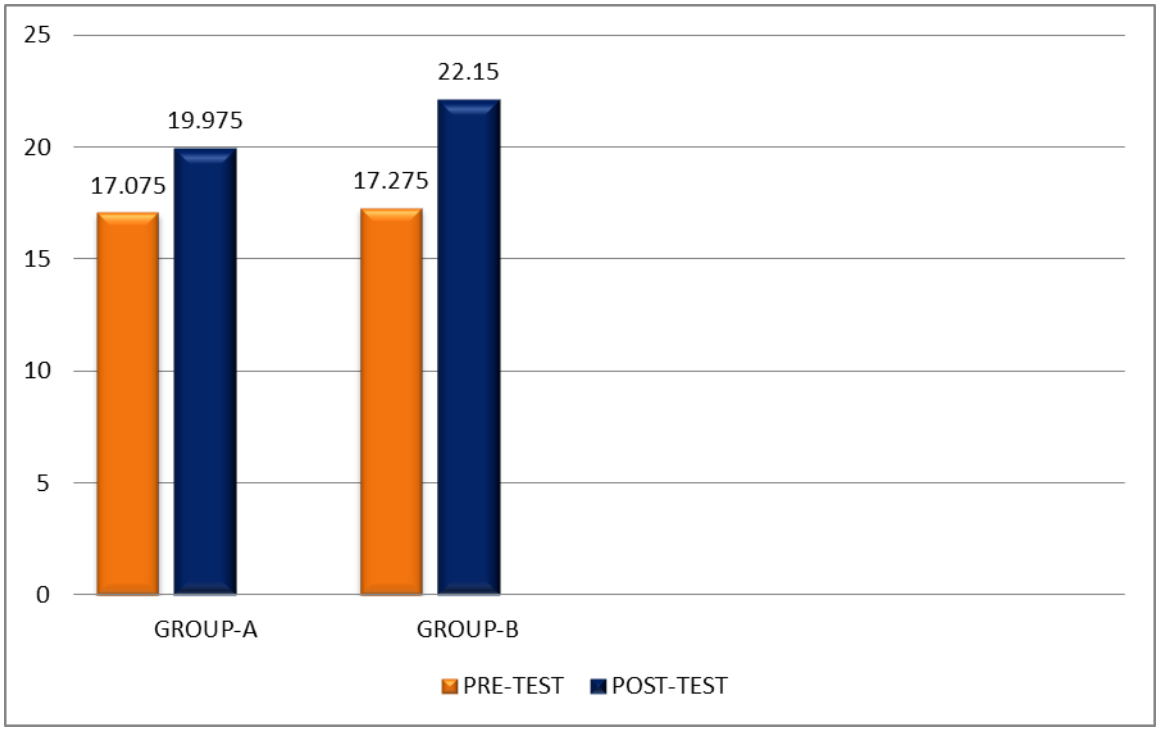
GRAPH 3: SHOWS THE DATA REPRESENTATION OF PRE AND POST TEST MEAN VALUES OF ACTIVE KNEE EXTENSION TEST (LEFT LEG): Group-A and Group-B



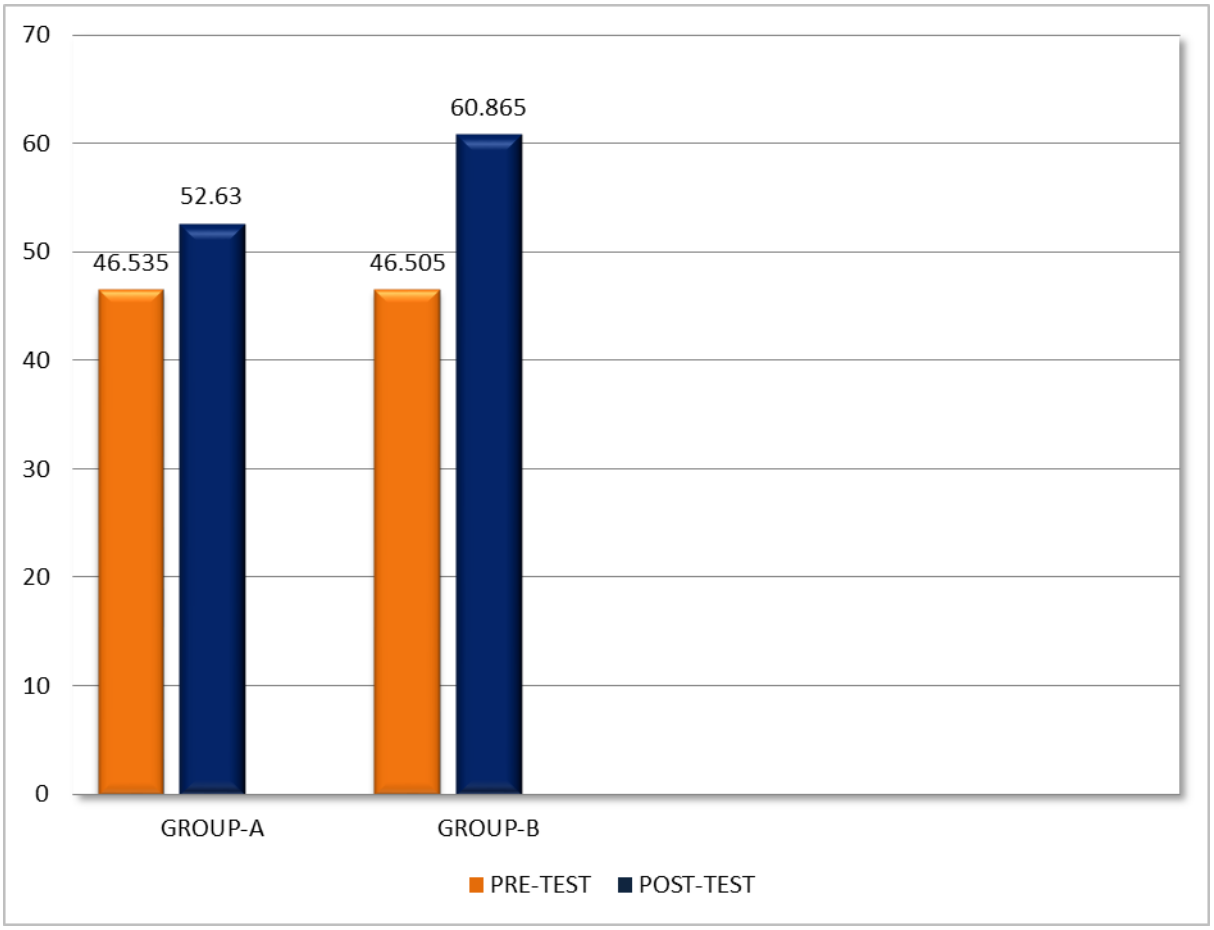
GRAPH 4: SHOWS THE DATA REPRESENTATION OF PRE AND POST TEST MEAN VALUES OF ACTIVE KNEE EXTENSION TEST (RIGT LEG): Group-A and Group-B



GRAPH 5: SHOWS THE DATA REPRESENTATION OF PRE AND POST TEST MEAN VALUES OF WEIGHT BEARING LUNGE TEST (LEFT LEG): Group-A and Group-B



GRAPH 6: SHOWS THE DATA REPRESENTATION OF PRE AND POST TEST MEAN VALUES OF WEIGHT BEARING LUNGE TEST (RIGT LEG): Group-A and Group-B



GRAPH 7: SHOWS THE DATA REPRESENTATION OF PRE AND POST TEST MEAN VALUES OF VERTICAL JUMP TEST): Group-A and Group-B

DISCUSSION

The present study was done to assess the effects of PNF and Ballistic stretching on jump performance in basketball players combined with sport-specific activity.

PNF Hold-Relax stretching is therapist assisted stretching whereas ballistics is a form of self-stretching which can be done by the players.

In basketball jumping quickly and maximally is important for the athletes to generate a quick burst of movements resulting in a maximal jump. Few studies support that jump performance returned to baseline when no physical activity was performed. while in the present study athletes performed a sport-specific activity like sprint layup and shooting to maintain the effect of stretching.

Specificity of stretching to sport movement is supported by Fletcher and Jones who reported that a warm up with stretches increase in coordination and balance.

One of the study by Andrea Konrad et al showed an increase in the range of motion with ballistics stretching but not significant adaptation is measured in structural parameters.

PNF works under four mechanism that improves the range of motion which are autogenic inhibition, reciprocal inhibition, stress relaxation, and gate control theory.

Church et al concluded that after PNF stretching activity jump performance reduced but no change was seen in the static stretching protocol.

This study showed an increase in jump performance after PNF stretching and ballistic stretching results were similar to the study done by Young and Behm, in rugby players who reported an increase in the vertical jump when stretching was combined with sport-specific activity such as sprints.

Our results indicate that ballistic stretching is effective as PNF stretching for increasing flexibility. One study has been reported as ballistics stretching is contraindicated as it causes a greater risk of injury and delayed onset of muscle soreness but they are not supported with any scientific evidence that they cause injury and some evidence report that ballistic stretching results in less soreness than static stretching.

The improvement on jump performance can be attributed to warm up consisting of a combination of sport specific activity and stretching which is similar to the study by Mandy et al who reported 3 cms of increase in vertical jump after ballistic stretching following 20 minutes of basketball play.

Unick et al stated that there will be no reduction in jump performance followed by ballistic stretching but Nelson et al stated in his study that during knee flexion and extension the muscle strength had been reduced and it did not impair the jump performance irrespective of age, gender and training.

Young and Elliot in their study found that there was a reduction in drop jump performance but no change after PNF stretching.

PNF is a stretching technique utilized to improve both the active and passive range of motion as it has a positive effect on muscle activity (Funk et al.,).

Mahmoud Raouf et al., concluded that short time PNF stretching protocols at warm-up level before any activity benefits stretching advantages and flexibility without muscle strength decrease Our flexibility results showed significant increase in flexibility after 4 weeks of PNF and ballistic stretching with the same effect on hamstring flexibility as stated by Nikita Joshi comparing the effect of ballistic and PNF hold-relax stretching on hamstring flexibility.

It is interesting that in our study both ballistic and PNF stretching has a significant effect on vertical jump and flexibility of hip, knee, and ankle but ballistic stretching showed a more significant increase in vertical jump and flexibility of hip and ankle whereas flexibility of hamstring was similar in both stretching techniques. Hence both factors of strength and flexibility which are important in basketball can be improved by applying short time of ballistic and PNF stretching in warm level is recommended to basketball players.

LIMITATION

- Study was done only on male population.
- Sample size is small.
- Subject blinding was not implemented in this study.
- Research is done only on a particular age group.

RECOMMENDATIONS

- Future studies can be aimed at using a larger sample size with varying age group.
- Long term follow ups can be done.

CONCLUSION

Hence the evidence is sufficient to conclude that both **BALLISTIC** and **PNF** stretching are almost similar in terms of its effectiveness in significantly improving the AKET measures but **BALLISTIC** stretching is found to be more effective in improving other measure like vertical jump, hip flexion and WBLT than **PNF** stretching.

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