

## ORIGINAL ARTICLE

## Comparative Effects of Dynamic Stretching and Ice Bag Application on the Physical Performance in Recreational Basketball Players: A Randomized Crossover Study

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### Abstract

**Introduction:** Researchers found that cryotherapy at the ankle joint heightened adjacent muscle activity and reflex amplitude, which facilitated greater force production at the ankle complex. Furthermore, cryotherapy appears to increase musculoarticular stiffness, which has been associated with heightened muscular performance at a joint. **Aim and objective:** the aim of the study is to examine the influence of dynamic stretching and IBA technique on the physical performance. **Methodology:** Total 20 healthy male basketball athletes encompassing two groups participated in the current study. The study consisted of two groups, Group A (ice bag application) and Group B (dynamic stretching). Cold compress was applied over the anterior thigh, posterior thigh, and calf. Subjects were assigned to Group A, and Group B, using Convenience sampling method. Each candidate performed the 5 minutes of jogging before taking intervention. All subjects performed three functional performance tests: Vertical Jump Test, Agility T-test & 20-meter sprint. Each participant attended an orientation session to become familiar with the testing procedures. Subjects were randomly assigned into two groups and exposed to a crossover study design. The experiment was performed on two separate occasions whereby one group received the dynamic stretching in the first session, while the other group uses the cryotherapy first. After 48 hours, (cooling session) on the next occasion, the groups were changed and the second group receives the cryotherapy, while the first group performs dynamic stretching. On both occasions, the dynamic stretching and cryotherapy interventions were the same. Between the sessions, the subjects will not allow to participate in any kind of vigorous physical activity. **Results:** The present study showed an increase in performance of recreational Basketball players by the combination of 5 minutes of warm up plus 6 min of dynamic stretching on the vertical jump height and 20-meter sprint.

### Keywords

Physiotherapy, Dynamic Stretching, Vertical Jump Height

### Introduction

Basketball is a multi-faceted team sport that demands good physical condition to be played successfully. Various writers have suggested that strength, power, agility and speed are important attributes for elite basketball players. As a result, anaerobic testing was found to be more important than aerobic assessment in assessing basketball

playing ability (1). Agility was viewed as a major physiological requirement for basketball. This is because athletes often engage in various sudden changes of direction during the events. Agility capability is decided by the rate of directional change and has been shown to be affected by explosive muscle strength, balance, muscular coordination and flexibility (2).

Most of the sport persons use stretching techniques during warm-up ahead of sporting activity (3). Static stretching helping athletes to maintain and improve joint ROM & flexibility that's why it is a primary part of the warm-up regimen. This benefits sportspersons who want increased level of flexibility. Dynamic warm-up exercises or Dynamic Stretching have been suggested as a replacement for static stretching. There was significantly greater Electromyography (EMG) amplitude in the Dynamic Stretching (DS) compared with the Static Stretching (SS). According to the findings of a clinical investigation, performing dynamic stretching exercises for 6 to 12 minutes after jogging for 5 minutes improved flexibility and vertical jump (VJ) outcomes. From these results, for males who engage in recreational activity, 6 minutes of dynamic stretching of the pelvic girdle and thigh muscular tissues may be the ideal amount to increase VJ performance, flexibility, and muscular endurance (4).

Cryotherapy is the primary mode of treatment for different kinds of sport injuries and also used in the preoperative and postoperative rehabilitation of injured athletes. A typical clinical objective is to obtain a painkiller response in patients with acute & constant pain due to macro-trauma of the musculoskeletal system (5). This is obtained by reducing the relative nociceptor nerve conduction velocity (NCV) that is suggested to be correlated with the depth of the ice application (6). Moreover, cryotherapy reduces the excitability of free nerve endings and peripheral nerve fibers, which increases the pain threshold of a person and induces analgesic effect (7).

A recent evaluation of related literature has found that cold water immersion of the foot and ankle complex results in highest reduction in skin temperature, sensory NCV and motor NCV compared with ice bag application (IBA) and ice massage technique. The sensitivity of neuromuscular function to temperature is well established. The temperature of the muscular tissue can influence elective motor control. (8)

The ice application over the ankle and foot complex accelerates the activity of near-by muscular tissue and the amplitude of deep tendon reflexes, thus it is easier to produce excessive amounts of muscular power. In addition, cryotherapy seems to increase musculo-articular stiffness, which leads to increased muscle activity and force production at the joint. The findings suggest that the use of a 15-minute cold compress on upper arm can considerably increase muscular force production, although, the hot water fermentation has not resulted in a change in force generation (9).

Rationale of the study: Although, various research has proved that increase in the physical performance of athletes via dynamic stretching and IBA in separate studies. However, there is lack of literature to study the

quantified effects of dynamic stretching versus IBA in basketball players.

Our null hypothesis was- Pre and post intervention measures do not significantly differ in both batches upon components of

physical performance and

Our alternative hypothesis was- The pre and post intervention measures show a clear difference in both batches upon components of physical performance.

### Aim & Objective

To study the differential effects of dynamic stretching and the pre-cooling (IBA) on components of physical fitness.

### Material & Methods

Twenty physically fit male basketball athletes, consisting of TWO groups, participated in this research trial. Prior to joining the first session of trial, each & every athlete signed an informed consent form authorized by Jamia Millia Islamia University, human subjects committee, New Delhi. The study was composed of TWO groups, Group A (ice bag application) and Group B (dynamic stretching). Crushed Ice Bags were applied over the Quadriceps muscles, Hamstring Muscles and calf muscle group. Using the convenience sampling technique, people were divided into Group A and Group B. Male collegiate athletes with no lower extremity trauma and impairment participating occasionally in a college team sport on the field, especially basketball. The number of contestants were calculated using Software G. Power 3.15 using data of changes in vertical jump height. In this study, the impact of dynamic and static stretching on vertical jump performance was evaluated, and it was determined that 13 individuals were required due to the 2.38 effect size, 0.05 alpha level, and 0.95 power (1- beta) value. But we will take the sample size 20 for increasing the power.

We included the study subjects who never had any kind of surgical procedure to the knee joint or any disabling knee injury, Doesn't have any kind of movement system impairment of the knee joint, Who will be willing to participate on a voluntary basis?, Who has not suffered an injury to the lower limbs in the last six months? University students playing basketball recreationally, between the ages of eighteen and twenty-four, only males eligible for this study, Free from deformation (No Alignment Impairment e.g. acquired or congenital).

We excluded who participate in any kind of Regular Strength training program in last three months prior to this study, taking anabolic steroids, Artificial protein supplements and performance enhancing substances (PES) or any chemical Ergogenic Aids, the individual who does not meet the inclusion requirements, Any kind of Metabolic disorders like Diabetes, thyroid dysfunction & High Blood Pressure etc. It was a pre-test- post-test experimental crossover design. Our dependent variables were-20 Meter Sprint Agility, T test, Vertical jump height

and independent variables were 06-minute dynamic stretching, 05-minute ice bag application

Various instruments were used in data collection of study include Field measuring tape, Digital (Racer) stopwatch, Field cone, Stadiometer, Weight machine, Ink-pad & chart papers, Markers, Inch tape, Towels and Crushed Ice Bags. The Jamia Millia Islamia University Institutional Review Board gave the study its approval, and all participants have obtained their informed consent. The athletes be dressed in T-shirts, short pants, ankle socks and sports shoes. Each candidate has done the Five minutes jogging before intervention of the study. All participants carried out three anaerobic fitness drills: Twenty meter Dash, Vertical Jump Test and Agility Performance T-test.

An orientation session was provided to each contestant so they could become comfortable with the exam mechanics. The orientation session will include the completion of measurements for height, weight, and history. The Candidates were randomized into two groups and participate in this crossover research method. The investigation was conducted on two distinct sessions where A-Group performed dynamic stretching in the first session while B-Group obtained the pre-cooling in first session. After the wash-out period of forty eight hours (two days), on next session, the interventions were changed and A-Group get Pre-cooling and B-Group perform dynamic warm-up techniques. In both cases, the dynamic warm-up stretching and Pre-cooling interventions were similar. In between two occasions, contestants will not allow for any kind of exertional physical exercise.

The candidates carried out three practical practice tests of each of the three functional tests to learn the correct approach. Before and after each dynamic warm-up and pre-cooling interventions candidates completed 3 trials of the 20 meter Dash, Agility Performance T-Test and vertical jump height test. Three functional tests were carried out with an interval of 15 seconds between each test. There was a one-minute break prior to the player conducted the trials. The stretching time will be measured by a portable chronometer. The muscle groups were stretched in an arbitrary or random order.

Dynamic warm-up stretching regimen: - Without delay following the warm-up routine, each candidate assumed the erect standing position and start performing Dynamic Stretching regime under the supervision and commanding sports physiotherapist. The proper techniques were introduced to the candidates, who received verbal feedback during the execution of each Dynamic Stretching Exercise. The drills were conducted in sequence for total Six minutes. The dynamic warm up drills were accomplished in a sequence of low to high intensity, with a 15 seconds relaxing time after every set. The study involved all three muscle groups, namely hamstrings, quadriceps and calf muscles. Each muscle group was

dynamically stretched for one minute bilaterally hence two minutes for each group in total Six minutes.

Pre-Cooling or Ice bag application (IBA): - Every one ice bag contained 1.36 kg (03 lb) of crushed ice in a 3.79L (01 gal) plastic bag. Twenty participants were sitting tall and the ice pack was placed to the front of the thigh, back of the thigh and posterior part of the leg (calf muscles) for the duration of five minutes.

#### Criterion Measure

**Vertical Jump Height:** Depicted in academic studies on basketball, The vertical jump test (VJT) is traditional and extremely used jump test and it has already been used to Evaluate the anaerobic fitness according to playing position (10). Before and after each condition, candidates made three VJ counter-movement attempts with a 15-second rest period in between. To finish the VJ tests, subjects stand on the floor with their feet shoulder width apart and their hands on their pelvic girdle. A quick-descent squat was permitted before the quick vertical jump, and no steps were taken. Candidates jump with both feet simultaneously and land in the same position. The maximum VJ height in centimeters of the three tests will be used as the final considerable VJ value (11).

**Speed:** A 20-metre sprint from a stationary position was carried out on the basketball court or other court and duration will measured with the help of handheld stopwatch, two volunteers situated on both starting and finishing line. Participants will allow three trials, and the best performance (highest value) was recorded. This distance was selected because it is a little shorter than the length of a basketball court. The twenty-meter dash test has depicted high levels of reliability in physical active men (correlation coefficient of 0.91 between test and retest) and does not need any practice session beforehand. Performance of this test was also significantly correlated to playing time in NCAA Division I male basketball players ( $r = 0.62$ ).

**Agility:** Trainers and researchers extensively used Agility T-test, The T agility test is a suitable agility test for basketball as it uses most of the basic movements performed. In fact, the subjects were instructed to run from a standing point in a straight line to a pylon 9 meter away. Subsequently, they had to move to the left side (side shuffle) without crossing their feet on another cone located 4.5m apart. After touching this cone, they side shuffled to their right to a third cone placed 9 m away, side shuffled back to the middle cone, and ran backward to where they had started. The highest value of 3 attempts was recorded. Participants will randomly assign to two experimental groups using a simple randomization method: -Group A: - DS: 05 minutes of active warm-up or jogging at self-selected speed followed by 6 minutes of dynamic stretching. Group B: - IBA: 5 minutes Ice Bag Application only.

Data were analyzed using SPSS 21.0 version. Shapiro-Wilk was used to evaluate the normality of outcomes and the

distribution of all variables was found to be normal. The candidates received the two procedures in a different order following a two days washout period. Group 1 received a Pre-cooling first followed by a dynamic warm-up and Group 2 a dynamic warm-up followed by a Pre-cooling. Baseline scores between the 2 groups were compared using independent t-test. Effect of each intervention was assessed using paired t-test. Difference between the 2 interventions was assessed using independent t-test. Further independent t-test was used to compare the order of interventions. Level of significance was set as  $p < 0.05$ .

## Results

Twenty subjects were included in this study to compare the effects of dynamic warm up technique and ice Pre-cooling on the athletic performance in recreational basketball athletes. The participants randomly were segregated into 02 groups, Group-1 ( $n=10$ ) and Group-2 ( $n=10$ ). Mean $\pm$ SD of age, weight, height and Body Mass Index (BMI) of the subjects were  $20.60 \pm 2.13$  years,  $62.0 \pm 8.03$  kg,  $175.80 \pm 6.04$  cm and  $20.06 \pm 2.13$  kg/m<sup>2</sup> respectively. Comparative measurement of reference criteria between the Ice Bag Application and Dynamic Stretching group were done using independent t-test to prove the homogeneity between the groups. In the statistics we don't find significant difference in Vertical jump, Agility T-test and 20-meter Sprint in between two groups. [Table-1](#).

Paired t test was used to compare the physical performance variables at the baseline and Post-test measures after dynamic stretching. There was a significant difference in the vertical jump and 20-meter sprint scores as shown in [Table 2](#).

Paired t test was used to compare the physical performance variables at the baseline and Post-test measures after Ice Bag Application. There was a significant difference in the vertical jump as shown in [Table 3](#).

Independent T test I used to compare the effect of order of interventions on criterion measures. [Table 4](#). Group order effect that has been found to be insignificant in terms of these three variables. [Table 5](#)

**Vertical Jump:** Independent t-test displayed no significance difference for the baseline values of vertical jump between the groups receiving IBA and DS at  $t(38) = -1.8$ ,  $p = 0.079$ . Paired t-test used to assess the effect of each intervention showed significance difference in vertical jump scores following Dynamic Stretching at  $t(19) = -4.73$ ,  $p < 0.01$ , as well as application of Ice Bag at  $t(19) = -4.55$ ,  $p < 0.001$ .

**Agility T-Test:** Independent t-test displayed no significance difference for the baseline values of Agility t-test between the groups receiving IBA and DS at  $t(38) = .64$ ,  $p = 0.52$ . Paired t-test used to assess the effect of each intervention showed no significance difference in Agility t-test scores following Dynamic Stretching at  $t(19) = 0.16$ ,

$p < 0.001$ , as well as application of Ice Bag Application at  $t(19) = -0.22$ ,  $p < 0.001$ .

**20 Meter Sprint:** Independent t-test displayed no significance difference for the baseline values of 20-meter sprint between the groups receiving IBA and DS at  $t(38) = -1.27$ ,  $p = 0.21$ . Paired t-test used to assess the effect of each intervention showed significance difference in 20-meter sprint scores following Dynamic Stretching at  $t(19) = 0.18$ ,  $p < 0.001$  and shown no significance difference after application of Ice Bag at  $t(19) = -0.38$ ,  $p < 0.001$ .

## Discussion

The present study is the only research to in the investigator's knowledge that examined compares the consequences of dynamic warm-up technique (DS) and Pre-cooling Technique (IBA) on the athletic performance of collegiate recreational basketball playing youngsters. Many studies on dynamic Warm-Up and Pre-Cooling technique have been done by other researchers; nevertheless, each study separately demonstrates the impact of dynamic warm-up stretching and pre-cooling technique. To date, few clinical trials have been conducted to compare the effectiveness of such methods. Although, dynamic stretching was generally used as a pre-event warm-up protocol. The goal of our research was to differentiate the effectiveness of the dynamic warm-up and Pre-cooling technique on athletic performance in collegiate basketball sportspersons.

Independent t-test was used to assess the baseline data of all the variables and pre post intervention scores were analyzed with the help of the paired t-test. There was no significance difference in the scores of all three variables between IBA and DS groups at the baseline level and after interventions. Vertical jump performance was elevated after DS as well as IBA and significance difference was seen. Agility t-test results shown decreased performance after DS but increased performance after IBA, but results was not significant. 20-meter sprint test findings demonstrate the increased scores in DS group with significance difference in the values and decreased test results scores after IBA and during the results of the analysis of this study no significant difference was found in the scores of all assessed variables between the group orders. Thus, group orders have no effects upon the results of the study.

The decline in anaerobic and aerobic fitness following the use of passive static stretching is supported by data from several research (3 & 12). A research article depicted that static stretching (performed actively or passively) has an adverse effect on the twenty-meter running time. Jump and sprint performance significantly decline after static stretching compared to dynamic stretching, supporting evidence from many trials that elaborate improved performance on muscular strength and power following a dynamic stretching regimen (13).



In earlier research, it has been suggested that dynamic warm-up routine be used as the major technique for warm-up prior to anaerobic fitness drills (14). This study's findings are consistent with this advice about agility performance. This research recommended using a dynamic warm-up strategy to maximize agility in the Agility T-test. The present study's findings discovered that dynamic stretching produced the highest effects in high-intensity exercise and strength.

Warm-up, using dynamic stretching, help to elicit the highest physical performance in terms of agility, speed and power. Active Static stretching has been shown to adversely affect agility test outcomes. Combining dynamic and static stretching has been found to dilute the effects of dynamic stretching followed by static stretching. These results support that static muscular flexibility exercises reduced the impact of a regular warm-up on jumping test outcomes.

The majority of warming-related impacts have been assumed to be more temperature-related than non-temperature-related physiological mechanisms. But there have also been suggested psychological explanations (e.g. better preparation). Although both groups share non-temperature-related and psychological processes, due to various warm-up procedures, temperature-related mechanisms vary between groups. Reduced stiffness, accelerated nerve conduction velocity, changed force-velocity ratio, elevated anaerobic energy supply, and marked-up thermoregulatory burden are some of the temperature-related impacts that have been proposed.

Hyperthermia has the quality to increase performance specially in power and strength related drills. The temperature of the quadriceps muscle group increased more after dynamic stretching than after application of an ice bag with aggressive warming up, Increased muscle temperature can affect performance as it reduces the viscous resistance of the muscular tissue. A twenty percent reduction in passive resistance of human metacarpophalangeal joints has also been recorded following modest heating. A rightward shift in the oxyhemoglobin dissociation curve and vasodilatation of muscle arteries have both been found to be associated with changes in performance during warm-up. The temperature also boosts the vasodilatation of the blood vessels and increases the blood circulation of the muscles. In addition, elevated body temperature also stimulates vasodilatation of blood vessels, increasing blood flow to muscles. Elevated muscle temperature also contributes to increased performance by improving nervous system function. Hyperthermia of muscular tissues improves central nervous system (CNS) functioning and accelerate the speed of nerve impulse transmission.

Leg muscles pre-cooling exhibited stronger ergogenic benefits on physical performance than upper or whole-body cooling, and the type of pre-cooling determined how much heat stress was decreased during intermittent sprint

cycling (15). It was also evident that the performance of each measure of functional performance gradually improved over time after the cold tub immersion techniques (16). The ergogenic benefits of effective pre-cooling techniques in warm team sport conditions are particularly pronounced during sub-maximal training sessions (17).

This study determines the results of a dynamic Warm-Up and Pre-cooling (IBA) upon anaerobic fitness in occasionally playing collegiate basketball sportspersons aged 18-26 years. Dynamic stretching improved his vertical jump height and his twenty-meter dash test performance. However, only the vertical jump performance improved after the application of the ice pack. Dynamic stretching can be used to improve physical performance for any player.

### Conclusion

The current study shown that combining a 5-minute warm-up with a 6-minute dynamic stretching session improved the performance of recreational basketball players in terms of vertical jump height and 20-meter sprint.

### Limitation of the study

Small sample size is the limitation of our study.

### Authors Contribution

All authors contributed equally.

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**Tables**

**TABLE1 COMPARISON OF BASELINE VARIABLES BETWEEN IBA AND DS GROUPS**

Variables	IBA Mean(SD)n =20	DS Mean(SD)n =20	t-value	Independent-test (p-value)
<b>VJH(inch)</b>	16.71(2.20)	18.04(2.44)	1.80	<b>.079</b>
<b>T-test(sec)</b>	11.73(.49)	11.62(.62)	.644	<b>.523</b>
<b>20msprint(sec)</b>	3.28(.31)	3.39(.25)	1.273	<b>.211</b>

*VJH- vertical jump height, T-test- agility t-test, 20m- 20 Meter sprint, IBA- Ice Bag Application, DS-Dynamic Stretching, SD- Standard Deviation, Level of significance (p< 0.05)*

**TABLE 2 COMPARISON OF VARIABLES WITHIN DYNAMIC STRETCHING GROUP WITH THE PAIRED T-TEST**

Variables	Premean(SD) n =20	Postmean(SD) n =20	t-value	p-value
<b>VerticalJump(inch)</b>	18.04(2.44)	18.35(2.40)	-4.73	<b>&lt;.001*</b>
<b>AgilityT-Test(sec)</b>	11.62(.62)	11.65(.79)	0.16	<b>0.745</b>
<b>20meterDash(sec)</b>	3.39(.25)	3.29(.29)	0.188	<b>0.017*</b>

*SD-Standard Deviation, p< 0.05, \*=significance difference*

**TABLE 3 COMPARISON OF VARIABLES WITHIN ICE BAG APPLICATION GROUP WITH HELP OF PAIRED T-TEST**

Variables	Premean(SD)	Postmean(SD)	t-value	p-value
<b>VerticalJump(inch)</b>	16.71(2.20)	17.27(2.21)	4.55	<b>&lt;0.001*</b>
<b>AgilityT-Test(sec)</b>	11.73(.49)	11.71(.86)	.228	<b>.900</b>
<b>20meterDash(sec)</b>	<b>3.28(.31)</b>	<b>3.29(.32)</b>	<b>.388</b>	<b>.778</b>

**TABLE4 COMPARISON OF THE POST INTERVENTION VARIABLES BETWEEN IBA AND DS GROUPS WITH THE HELP OF INDEPENDENT T-TEST**

Variables	IBA Mean(SD)n =20	DS Mean(SD)n =20	t-value	Independent t-test(p-value)
<b>VJH(inch)</b>	17.27(2.21)	18.35(2.36)	1.49	<b>.724</b>
<b>T-test(sec)</b>	11.71(.86)	11.65(.79)	.247	<b>.262</b>
<b>20mSprint(sec)</b>	3.29(.31)	3.29(.29)	.051	<b>.097</b>

*IBA-icebagapplication, DS-dynamicstretching, VJH-verticaljumheight, T-test-Agilityt test, 20m-20meter sprint.*

**TABLE5 COMPARING THE ORDER OF INTERVENTIONS**

Variables	GpOr01 Mean(SD)	GpOr02 Mean(SD)	t-value	Independent t-test(p-value)
<b>VJH(inch)</b>	17.68(2.29)	17.94(2.40)	.349	<b>.729</b>
<b>T-test(sec)</b>	11.76(.89)	11.60(.75)	.592	<b>.557</b>
<b>20mSprint(sec)</b>	3.37(.32)	3.21(.26)	1.756	<b>.087</b>

*VJH- vertical jump height, T-test- Agility T-test, SD- standard deviation, Gp Or- Group Order, GroupOrder01 = IBA –DS, GroupOrder02 =DS–IBA.*