

EFFECTS OF ICE WITH ACTIVE WARMUP AND ACTIVE WARMUP ALONE ON PERFORMANCE IN FOOTBALL PLAYER

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Abstract

Study objective: To know the effects of ice before active warm up on athletic performance.

Study design: Post test same subject group design.

Study Setting: Central Reserve Police Force (CRPF) Battalion No 31, Okhla, New Delhi.

Subjects: 30 Healthy athletic male football players of age 18-24 years participated in the study.

Measurement: A total number of 30 homogenous subjects were randomly assigned into two groups Group 'A' and 'B', each group consisting of 15 subjects. Group A was given Ice pack before Active warm up and group B was given Active warm up alone. Each warm-up protocol was given at least 48 hours after the previous protocol. After all the warm-up protocols three maximal performance tests viz., single leg vertical jump height, forty yard sprint and Agility shuttle run was done in each subject.

Results: Repeated measure ANOVA with Post Hoc Analysis Bonferroni was used to compare the entire three performance test after the warm-up protocol. The result indicates that there is highly significant difference after active warm-up than the ice pack with active warm-up protocol in single leg vertical jump height, forty yard sprint and agility shuttle run ($P < 0.05$).

Conclusion: The study results showed that ice pack application before the active warm up decreases the athletic performance and thus active warm up alone is better for enhancing the athletic performances.

Keywords: Active warm-up, Single leg vertical jump, Forty yard sprint, Agility shuttle run

1. Introduction

It is important to be properly warmed up prior to training and competition. A warm up involves low intensity exercise (<60% VO_2 max, 65% maximum heart rate) of relatively short duration (<15 minutes). The warm up is a period of preparatory exercise to enhance subsequent competition or training performance¹. There are a number of studies which show the effects of warm up²⁻⁴. Most of these studies have found that warm up do have positive effects on performance. According to Fradkin approximately 60% of the studies found some type of warm up to be superior to no warm-up, approximately 11% found no warm up to be superior and approximately 29% found no significant differences between types of warm up and no warm-up.⁵ Maximal force developed by muscle and their rates of force generation, contraction, relaxation, and power output all gets altered when body temperature varies⁶

Davies *et al* in 1983 have extensively studied the effects of heating on contractile properties of skeletal muscle. It is clear from the research that

increasing the muscle temperature increases the speed of muscle contraction, thereby decreasing both time to peak tension and half relaxation time. The findings of Davies *et al* are consistent irrespective of whether muscle temperature is elevated as a consequence of exercise or passive heating^{8,9}.

Cryotherapy has been associated with both increase and decrease in muscle strength depending on the duration of treatment and timing of measurements. Isometric muscle strength has been found to increase directly after application of ice massage for 5 minutes or less and the proposed mechanism for this response is attributed to nerve excitability and increased psychological motivation to perform.¹⁰ Despite limited scientific evidence supporting the effectiveness, warm-up routines prior to exercise are well accepted in practice. The majority of the effects of warm-up have been attributed to temperature related mechanisms e.g. decrease stiffness, increased nerve conduction rate, altered force velocity relationship, increased anaerobic energy provision and increased thermoregulatory

strain, although non-temperature related mechanisms have been also proposed like elevation of baseline oxygen consumption. It has also been hypothesized that warm up may have a number of psychological effects e.g. Preparedness⁷.

One study observed that the strength of an eccentric contraction was improved with the application of ice, whereas another indicated that ice helped to facilitate concentric but not eccentric strength^{11, 12}. This may be due to an increase in the ability to recruit additional motor neurons during and after cooling¹³. It also appears that higher torque values can be obtained following the application of cold packs than hot packs¹⁴.

Cold appears to have some effect on muscular power also as it has been shown that performance in vertical jumping is decreased following the application of cold^{16, 17}. Another study has quoted the use of Cryotherapy does not seem to affect peak torque but may increase endurance¹⁵.

2. Methods

A total of 30 male healthy athletic volunteers (N=30) of age 18-24 years participated in the study. Mean values of their age, height, weight, mid thigh girth, and standing vertical reach height were 22.46 ± 1.43 yrs, 168 ± 7.38 Cms, 66.36 ± 8.44 kgs, 54.46 ± 6.06 cms, and 210.83 ± 11.48 cms respectively. Subjects included were of male sex in 18-24 years of age group, playing for an athletic team or had participated in physical activity (Cardio vascular and / or weight training 3 times per week). Subjects with a history of injury to lower extremity within 6 months, Cardiac condition (e.g. hyper tension, coronary artery disease), hyper sensitivity to cold, Diabetic condition excluded from the study

All the subjects were informed about the nature, purpose, and possible risks involved in the study and an informed written consent was taken from them prior to participation. Subjects were randomly assigned into 2 experimental groups A and B on the basis of inclusion and exclusion criteria,

2.1 Study Design: Post- test same subject group experimental design.

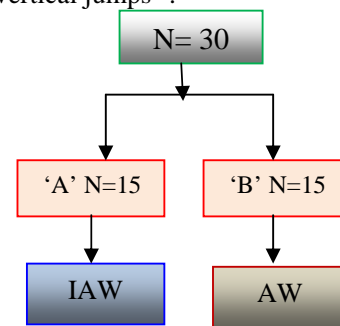
Three Functional performances namely Single-Leg Vertical jump, 40-Yard Sprint Agility shuttle Run were the Dependent Variables and independent variables were the type of cold application and Active Warm-up.

Equipments used in this study included Ice bag, Inch tape, Electronic stopwatch and Ink pad.

2.2 Protocol: A total number of 30 homogenous subjects were randomly assigned into two groups, Group 'A' & 'B' and both group consisted of 15 subjects. The two warm-up protocols were Active warm-up and Ice pack with active warm-up. Each warm-up protocol was given at least 48 hours after the previous protocol.

Ice pack with Active warm-up: The subjects were given Ice bag for 10 minutes²⁰ over the anterior thigh followed by 6.5 minutes of Active warm-up which consisted of 3 minutes jogging, 3 minutes stretching & ten 2-legged vertical jumps¹⁹.

Active warm-up: The subjects were given 6.5 minutes of Active warm-up which consisted of 3 minutes jogging, 3 minutes stretching & ten 2-legged vertical jumps¹⁹.



IAW= Ice Pack with Active warm-up, AW= Active warm-up.

Group A: Ice pack with Active warm-up protocol was given to this group,

Group B: Active warm-up protocol was given to this group,

After the two warm-up protocols three maximal performance tests, single leg vertical jump height, forty yard sprint and Agility shuttle run was done for each subjects.

2.3 Procedure: Participants attended a total of 4 data collection sessions. On the first visit a complete physical fitness was evaluated. Subjects who were suitable for participation in the study were requested to sign consent forms on the first day; each participant attended an orientation session to become familiar with the testing procedures and warm up techniques. Measurements of height, weight, mid thigh girth, and standing vertical reach were taken during the orientation session. The subjects performed 3 practice trials of each of the 3 functional tests to ensure proper technique. Each individual self-selected¹⁹ his preferred leg and this extremity were cooled and tested in the single-leg vertical jump. All the measurements were taken while the participants were wearing T-shirt, short pants, socks, and athletic shoes. The same shoes and clothing were worn for each testing session.

Subjects were given warm up protocol and after each warm up protocol 3 trials of the entire 3 functional performance tests were performed and in that the best functional performance was taken for data analysis.

Active warm up: The active warm-up consisted of 3 minutes of light jogging (65 % maximum heart rate by using heart rate monitor)¹ followed by 3 minutes of stretching. Two minutes were allowed for general active stretching, which consisted of the butterfly stretch for the inner thigh and groin, seated hamstring stretch, seated spinal twist for lower back and gluteal muscles, and standing calf stretch for gastrocnemius and soleus muscle groups. One minute was given for quadriceps stretching, which consisted of both side-lying and standing quadriceps stretches lasting 30 seconds each. All other stretches were performed bilaterally, with 15 seconds allotted for each side. Stretching was followed by ten times 2-legged vertical jumps. The 2-legged vertical jumps were performed with a counterforce movement using both arms, and participants were instructed to jump as high as possible. The total time for the entire warm-up routine was approximately 6.5 minutes¹⁹.

Ice bag application with active warm-up: Each ice bag comprised 3 lb (1.36 kg) of crushed ice in a 1-gal (3.79-L) plastic bag¹⁹ Subject was in high sitting position and the ice bag was applied on anterior thigh for 10 minutes with a compression wrap followed by 6.5 minutes of active warm up.

Functional Tests: Three tests of functional performance, single-leg vertical jump, agility shuttle run, and 40-yd sprint, were performed after each warm up protocol for each subject. A total of 48 hours rest period²² was given to each subject between each warm up protocol for the recovery of previous warm up and functional performance test. A 1-minute rest period was allowed between each functional performance tests. Three trials of each functional performance test were performed, with a 30-second rest period between each trial. The best score from the 3 trials for each functional performance test was used for data analysis¹⁹.

1. Single-leg vertical jump: The single-leg vertical jump was performed by the treated extremity. Each participant, with blue ink on his middle fingertip, stood with the treated-extremity side of his body next to the wall marked in increments by inch tape. Each subject was instructed to place the opposite arm behind his back while raising the arm nearest to the wall vertically over his head and to stand only on the leg closest to the wall. Using a countermovement,

the participant jumped vertically as high as possible and touched the wall with his middle fingertip at the apex of his jump. The difference between the heights of the subjects' jumped and their standing reach height was recorded in centimeters as the trail score. Before each trail, we encouraged subjects to give maximal effort and jump when ready. No encouragement or knowledge of results during or after test trails was given to participant¹⁹.

2. 40-yard sprints. The 40-yd (36.5m) sprint began with the subjects in a forward lunge position with the treated leg forward. Again for the test, time was started when we said, "go" and stopped when the subject's foot touched the end line. We measured elapsed time by hand, using a stopwatch accurate to 0.1 second. Here also we instructed subjects to perform each test as fast as possible and no encouragement or knowledge of results during or after test trails was given to participant. During each testing session, they performed three trials of the test¹⁹.

3. Agility shuttle run: The shuttle run²³ consisted of four 6.1-m sprints (24.4 m total). Subjects sprinted 6.1 m, stopped, turned around, immediately sprinted back to the starting line, and then repeated the Process. They changed the direction three times. The shuttle run reproduced the acceleration and deceleration forces experienced during high-intensity athletics. For test, time was started when we said, "go" and stopped when the subject's foot touched the end line. I measured elapsed time by hand, using a stopwatch accurate to 0.1 second. I instructed subjects to perform each test as fast as possible and no encouragement or knowledge of results during or after test trails was given to participant. During each testing session, they performed three trials of the test¹⁹.

3. Result

The data analysis was done by using SPSS-15 software system. Demographic data of subjects including age, height, weight, mid thigh girth and standing vertical reach height were descriptively summarized. The dependent variables were analyzed using repeated measure ANOVA for within group comparison. Post Hoc paired comparison was done using Bonferroni correction. A prior alpha level $P = < 0.05$ was set as significance for all comparison.

Mean values of their age, height (cm), weight (kg), mid-thigh girth(cm), and standing vertical reach height(cm) were 22.46 ± 1.43 , 168 ± 7.38 , 66.36 ± 8.44 , 54.46 ± 6.06 , and 210.83 ± 11.48 . respectively.

Single leg vertical jump height (cm): Repeated measure ANOVA showed that there was highly significant differences between two warm-up protocols for single leg vertical jump height with $F = 12.21, P = 0.00$. Active warm-up showed better performance than ice pack with active warm-up in two warm-up protocols. The post hoc analysis with Bonferroni correction showed that there was significant difference in the Single leg

vertical jump height performance. Comparison between Ice pack with active warm-up and Active warm-up showed that active warm performance was better than ice pack with active warm-up, $p=0.001 < 0.05$

Forty yard sprint (second): Repeated measure ANOVA showed that there was highly significant differences between two warm-up protocols for forty yard sprint with $F = 20.14, P = 0.00$

Variables	Ice+Active warm up Means \pm S.D N=30	Active warm up Means \pm S.D N=30	Repeated MANOVA		Post hoc Analysis Bonferroni
			F	P	IC+AW vs. AW
VJH(cm)	27.06 \pm 3.87	28.63 \pm 3.24	12.21	0.00	0.001
40YdSP(S)	5.41 \pm 0.20	5.30 \pm 0.21	20.14	0.00	0.000
AGSR(S)	6.98 \pm 0.17	6.87 \pm 0.19	19.92	0.00	0.000

Table No.1: SLVJH (cm) = Single leg Vertical jump height (Centimeters), 40 Yd SP(S) = Forty Yard Sprint (Seconds) AGSR(S) = Agility shuttle run (Seconds), AW= Active Warm up, IC+AW= Ice pack with Active Warm up,

Active warm-up showed better performance than ice pack with active warm-up in two warm-up protocols. The post hoc analysis with Bonferroni correction showed that there was significant difference in the forty yard sprint performance. Comparison between Ice pack with active warm-up and Active warm-up showed that active warm performance was better than ice pack with active warm-up, $p=0.000 < 0.05$

Agility shuttle run (second): Repeated measure ANOVA showed that there was highly significant differences between two warm-up protocols for Agility shuttle run with $F = 19.92, P = 0.00$. Active warm-up showed better performance than ice pack with active warm-up in two warm-up protocols. The post hoc analysis with Bonferroni correction showed that there was significant difference in the Agility shuttle run performance. Comparison between Ice pack with active warm-up and Active warm-up showed that Active warm performance was better than ice pack with active warm-up, $p=0.000 < 0.05$

than the ice pack with active warm-up protocols. Forty yard sprint and Agility shuttle run test are time dependent variables. The subjects who took less time to cover the target were considered the best performers. The subjects who were given Active warm-up alone took less time to complete the target, so the active warm-up protocol was better than the ice pack with active warm-up protocols.

The majority of the effects of warm up have been attributed to temperature-related and non-temperature-related physiological mechanisms. However psychological mechanisms have also been proposed (e.g. increased preparedness). Non temperature-related and psychological mechanism is common for both the groups but temperature related mechanism varies from group to group due to different warm-up protocols.

Proposed temperature related mechanisms include decreased stiffness, increased nerve-conduction rate, altered force-velocity relationship, increased anaerobic energy provision and increased thermoregulatory strain.

Our results are consistent with Asmussen and Boje²⁴ who concluded that “a higher temperature in the working organism facilitates the performance of work”. Since then, the effects of warm up have largely been attributed to temperature-related mechanisms, decrease in muscle and joint stiffness¹⁸ and an increase in nerve conduction rate¹⁹.

Increase in temperature has the potential to improve performance especially strength and power related tasks. There was more increase in anterior thigh muscle temperature after active warm-up than ice pack with active warm-up, so

4. Discussion

A total number of 30 homogenous subjects were randomly assigned into two groups, Group ‘A’ and ‘B’ each group consisted of 15 subjects. Group A was given Ice pack before Active warm up and group B was given only Active warm up. Purpose of this study was to see the effects of ice on three maximal performance test, Single leg vertical jump height, Forty yard sprint and Agility shuttle run. Our results indicated that ice application before active warm up decreases the athletic performance. Single leg vertical jump height performance was better in active warm-up

an increase in muscle temperature may affect the performance via decrease in the viscous resistance of muscle. Mild warming has also been reported to reduce the passive resistance of the human metacarpal joint by 20%²⁵. It has also been suggested that performance changes following warm up may result from increased oxygen delivery to the muscles via a right ward shift in the oxyhaemoglobin dissociation curve and vasodilatation of muscle blood vessels²⁷. Furthermore, an elevated temperature also stimulates vasodilatation of blood vessels and increases muscle blood flow²⁸. An increase in muscle temperature may also contribute to improved performance by augmenting the function of the nervous system. Karvonen²⁶ has demonstrated that increased temperature improves central nervous system function and increases the transmission speed of nervous impulses.

Single leg vertical jump height was less in Ice pack with Active warm-up protocol than the other warm up protocols which are consistent with the findings of the Bergh and Ekblom because there is a positive relationship between the muscle temperature and the height of vertical jump²⁹. Bergh and Ekblom best demonstrated this relationship finding that the height of the jump decreases with a decrease in muscle temperature at a rate of 4.2% x degree C⁻¹²⁹. Decreases in CMJ height could also be attributed to changes in dynamic strength following the application of cold. Ruiz *et al.* contended ice caused a significant decrease in both concentric and eccentric quadriceps strength immediately following a 25 minute ice application^[12]

Ruiz *et al*¹² and Howard *et al*³⁰ investigated the use of ice immersion and strength and concluded that strength is impaired at higher movement velocities which are required during athletic activity. The results of our study were also consistent with Greicar's examination of agility using a carioca test and found immediately following the treatment that time was increased to complete Agility shuttle run. The more functional, T-test for agility demonstrated an increase of 10.8% immediately following treatment³¹.

Cross *et al.* also found a significant increase in shuttle run times from 6.54s to 6.71s immediately following a 20 minute 13° Celsius treatment leading to the conclusion that cold applied to the lower leg and ankle does, indeed have a detrimental effect on agility performance immediately following treatment. Therefore, it

appeared that agility was affected immediately following cold application³².

Speed, a component of agility, has not been studied in great detail. Bergh & Ekblom²⁹ are the pioneer researchers who attempted to quantify the effects of muscle temperature on speed. They found sprint performance measured on a bicycle ergometer was significantly reduced with a decreased muscle temperature. Along with changes in strength, the decreased agility and speed performance in our study can be attributed to increased joint and tissue stiffness. Cold application to connective tissue results in increased stiffness and decreased extensibility as temperatures decrease (Hunter and Williams.³³

Functional performance decrements may also be related to the stretch-reflex phenomenon. As noted by Davies & Young⁸ the impaired ability of the muscle spindle to trigger the stretch-reflex may have decreased the amount of elastic potential which could be produced during the eccentric loading phase of muscular contraction. It was evident by the work of Bergh & Ekblom²⁹ that muscular contraction, speed and the capacity to generate force are reduced by cold.

Future research may be done by increasing number of subjects. Since passive warm up involves raising muscle or core temperature by some external means and Active warm-up utilizes exercise, comparison between the two can be done to check athletes' performance. Thigh Skin fold thickness measurement can be taken because the skin fold thickness varies among individuals. The temperature of the treated part can be monitored so that we can find out how changes in temperature are proportional to changes in performance. Further the effects of temperature on physical performance of the whole lower limb could be studied. Delayed effects of these three warm up protocols can also be checked in future studies.

From this study it is evident that Active warm-up can be used to enhance the immediate performance of the Athletes., Moreover the research findings do add to the knowledge base of athletic trainers and others sports medicine professionals who should be aware of three different types of warm-up on maximum physical performance.

4. Conclusion

The study results show that ice pack application before the active warm up decreases the athletic performances and thus active warm up is better for enhancing the athletic performances.

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