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EFFECT OF SUPERFICIAL HEAT AND COLD IN PEAK SPEED ATTAINMENT OF CYCLIST – A COMPARATIVE STUDY

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Background and Need for Study

Physical activity by far provides the greatest demand for muscular performance. Performance is the key that is expected out of a sports person and the best performer has his cutting edge with his co-performers.

A best performer is a boon for the team and for the Nation as well and to achieve this creditable position some may even use 'unlawful and injurious ways' such as doping to attain their goal. So it is important that legal and ethical ways of improving performance has to be developed.

The present study is designed to elaborate some of the ways of improving performance of a cyclist. Cycle is an important mode of transport over centuries. Cycling has also evolved as a sporting event, which has its own traditional importance.

Cycling as a sport has various categories like short distance cycling, long distance cycling, cross-country cycling, velodrome-cycling etc and depending upon the distance and speed at which the event should be performed different muscle fibers may take active part like for short spurt activity the fast twitch fibers and for long distance the slow twitch may work and different muscle groups may work depending upon performance level and one prime muscle for cycling is the quadriceps group of muscles. Quadriceps provides the power in cycling and is also the muscle most often injured in cycling.

Enhancing the activity of quadriceps may in turn enhance the performance of the cyclist.

All the muscles are influenced by external factors which alter their properties; the most traditional external factors which are used to influence muscle are superficial heat and cold. There are historical evidences where heat has been used to reduce pain and improve elasticity of muscles and evidences are seen in recent studies that cold improves muscle strength. The skin is endowed with both cold & warmth receptors. There are far more cold receptors than warmth receptors; therefore peripheral detection of temperature mainly concerns detecting cool & cold instead of warm temperature.

The extensive use of cold and superficial heat in medicine and physical therapy has produced volumes of research on the immediate effect of cold & superficial heat.

Heat application improves cell function, increase local blood flow, aids removal of waste products, reduces pain, increases elasticity of muscle, prevent microtrauma etc and cold application reduces inflammation, pain, muscle spasm etc. And it has been shown by **Helen Mc gown** that muscle strength increases and eventually exceeds pretreatment level and maintained remarkably high level for upto 180 minutes. All these evidences are in relation to the properties of muscle. But there have been very few evidences on the effect of superficial heat and cold on muscle performance.

The present study aims to find out whether this variation in temperature, which alters the physiological properties, has an effect on performance (peak speed attainment) of a cyclist.

Statement of Problem

This study was undertaken

a) To determine whether superficial heat and cold have any statistically significant difference in peak speed attainment of cyclist.
b) To determine whether there exists any statistically significant difference between application of superficial heat and cold in peak speed attainment of cyclist.

Aims & Objective of the Study

1. To find out whether superficial heat applied on quadriceps has effect on peak speed attainment in cyclist.
2. To find out whether cryoapplication has effect on peak speed attainment in cyclist.
3. To compare the effect of both (superficial heat & cold) is peak speed attainment in cyclist.

Null Hypothesis
There is no significant effect of pre-application of superficial heat on peak speed attainment.
There is no significant effect of pre-application of cryotherapy on peak speed attainment.
There is no significant difference between pre-application of superficial heat & cold on peak speed attainment in cyclist.

Design & Methodology
Study Approach & Design
This is an experimental study with descriptive analytical comparison of superficial heat and cold in a group of male subjects (age ranging from 18-25 years).

The subjects are studied in three different settings. Here superficial heat and cold are attributed, as **cause factor** and they are the **independent variable.** The peak speed attainment is attributed as **effect factor** or **dependent variable.** Both constitute the data to be analysed.

Data was collected from the results of the experiment. All precautions were taken to reduce any source of constant or random errors as much as possible.

Population for Study
The population from study is normal healthy college going students between the age group of 18-25 years.
Sample Size **:** 60
Sampling Technique **:** Non – probability purposive sampling.

Selection Criteria
Exclusion Criteria
Subjects were excluded if they were found
- Not fit assessed via PAR-Q test
- Any unhealed injury to the bone and soft tissues especially pertained to the lower limb.
- Subjects with recent intake of steroids or any ergogenic aids. (less than 6 months)
- Subject with recent intake of analgesics or under going drug therapy.
- Subject contra indicated to superficial heat and cold.
- Subjects with sensory deficit.
- Subject who has under gone recent strenuous activity.
- Subject who are not medically fit.
- Do not have good comprehension.
- Not willing to participate in the study.
- Do not meet inclusion criteria.

Inclusion Criteria
Subject are included if they were found
- Fit assessed with PAR-Q test.
- Subjects familiar with bicycling.
- Do not meet the exclusion criteria.

Tools for Data Collection
- Bicycle ergometer.
- A questionnaire (PAR-Q) for the selection of subjects.

Description of the Tools & Equipments
Bicycle Ergometer
It is normal exercise equipment and this is used in this study to record the peak speed attainment of the subjects.
The working mechanism is that when the subject starts to pedal the muscular energy is used to rotate the flywheel and the speed at which the flywheel rotates is recorded with a **Speedometer.**

Hot / Cold Packs: This are packs made of silica gel and they can retain warmth / cold for a period of time.

Hot Packs

These packs are immersed in thermostatically controlled unit filled with water at a temperature range of 71^0C to 79^0C for about 45 minutes before application to the subjects.

Cold Packs

There are stored in the freezing compartment for about 6-8 hours prior to application to the subjects.

Procedure For Data Collection

The data collected from each subject are

- Peak speed attainment without applying superficial heat or cold (PRE-TEST)
- Peak speed attainment after application of superficial heat (POST – TEST)
- Peak speed attainment after cryoapplication (POST – TEST)

Peak Speed Attainment: (Pre-Test):

The subjects are given clear instructions and asked to sit on the Bicycle ergometer and to start pedaling as fast as possible for 30 seconds and the peak speed is recorded from the speedometer. Like wise, three trails are conducted at different days to avoid any after effects of the previous attempt.

Peak Speed Attainment after Application of Superficial Heat

The subject is given brief description about the application of hot packs and made to lie in supine. Hot pack is applied over the quadriceps of both limbs for about 20 minutes and then the subject is asked to sit on the bicycle ergometer and to pedal as fast as possible for 30 seconds and the peak speed is recorded as indicated by the speedometer. Like wise three trails are conducted in different days.

Peak Speed Attainment after Cryoapplication:

The subject is given brief description about cryoapplication and then made to lie supine and cold pack is applied over the quadriceps muscle of both the limbs for about 20 minutes and the subject is asked to sit on the bicycle ergometer and to pedal as fast as possible for about 30 seconds and the peak speed is recorded as indicated by the speedometer. Like wise three trials are taken on different days.

Statistical Methodology

The Data obtained were tabulated and analysed using descriptive and inferential statistical methods. To assess the variables mean and standard deviation were used.

Mean $X = \frac{\sum x}{n}$

x = Given variable

$\sum x$ Summation of all variable

n= No. of samples

Standard Deviation (S.D) $= \sqrt{\frac{1}{n}(\sum x^2 - \frac{(\sum x)^2}{n}}$

The scores were statistically analysed by paired ‘t’ test. ‘t’ test is applied to data pertaining to two groups of individuals (samples), which have been exposed to different experimental conditions or treatment.

If the ‘t’-value calculated from such data exceeds a pre-assigned critical value (level of 5%, 1%, 0.1%) the difference between the two groups is said to be significant and attribute to the differences in the particular conditions or the treatment applied.

The ‘t’-test is widely applied to the recorded data for comparing observations in pair and un pair experiment as well as in comparing in mean of a given samples with that of a standard.

The only caution in using ‘t’-test in to ensured that the observation have been drawn from a normal population.

The formula used is

$$t = \frac{|\overline{d}|}{s/\sqrt{n}}$$

$\overline{d}$ = difference of mean
s= standard Deviation
n=Sample size

The t-value is calculated using SPSS computer software and the value is compared with standard tabulated value to find the level of significance.

Comparison Between Pre – Test &Post- Test (Superficial Heat) In Peak Speed Attainment

TABLE - 1
POST – TEST (SUPERFICIAL HEAT)

TRIAL	MEAN KM/HR	S.D
1	44.20	3.77
2	44.87	3.51
3	44.80	7.30
AVERAGE	44.6233	2.9744

TABLE - 2PRE - TEST

TRIAL	MEAN KM/HR	S.D
1	48.48	4.08
2	48.43	4.04
3	48.57	3.55
AVERAGE	48.933	3.4284

TABLE –3

	MEAN KM/HR	S.D	t- VALUE	P- VALUE
PRE- TEST	44.6233	2.9794	15.850	P<0.001***
POST- TEST	48.4933	3.4284		

*** * * - Very highly significant**

S. D - Standard Deviation

Interpretation
There was a significant (P < 0.001) increase in peak speed after application of superficial heat.

COMPARISON BETWEEN PRE – TEST &POST- TEST (COLD) IN PEAK SPEED ATTAINMENT

TABLE - 4
POST – TEST (COLD)

TRIAL	MEAN KM/HR	S.D
1	44.20	3.77
2	44.87	3.51
3	44.80	7.30
AVERAGE	44.6233	2.9744

TABLE - 5PRE - TEST

TRIAL	MEAN KM/HR	S.D
1	50.92	4.04
2	51.73	4.08
3	50.95	4.68
AVERAGE	51.2	3.6835

TABLE – 6

	MEAN KM/HR	S.D	t - VALUE	P - VALUE
PRE- TEST	44.6233	2.9794	21.379	P<0.001***
POST- TEST (COLD)	51.2	3.6835		

*** * * - Very highly significant**

S. D - Standard Deviation

Interpretation:
There was a significant (P < 0.001) increase in peak speed after application of cold.

COMPARISON BETWEEN SUPERFICIAL HEAT & COLD IN PEAK SPEED ATTAINMENT

TABLE - 7
COLD

TRIAL	MEAN KM/HR	S.D
1	48.48	4.08
2	48.43	4.04
3	48.57	3.55
AVERAGE	48.4933	3.4284

TABLE – 8 SUPERFICIAL HEAT

TRIAL	MEAN KM/HR	S.D
1	50.92	4.04
2	51.73	4.08
3	50.95	4.68
AVERAGE	51.2	3.6835

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TABLE – 9

	MEAN KM/HR	S.D	t - VALUE	P - VALUE
PRE- TEST	48.4933	3.4284	12.335	P < 0.001***
POST- TEST (COLD)	51.2	3.6835		

*** * * - Very highly significant**
S. D - Standard Deviation
Interpretation
There was a significant (P < 0.001) increase in peak speed after application of cold packs when compared to the peak speed attained after application of superficial heat.

Discussion
The present study was designed to show & compare the effects to local application of superficial heat and cold to the quadriceps muscle on the peak speed attainment of cyclist.

From Analysis of Table 3 it is evident that the peak speed attainment after application of superficial heat was significantly (P<0.001) better than the pre-application status in all the three trials.

Prior studies have also shown similar results for example the study done by **Kari Kauren & Heikki Vanharta (1997)[4]** infers that motor performance of hand was increased after application of superficial heat, which was expressed as reaction time. Speed of movement and Tapping Speed.

The probable reason would be
- Gradual increase in muscle strength and endurance after application of superficial heat[6].
- Decreased possibility of strain injuries[17].
- Improved co-ordination of the antagonist muscle[14].
- Increase nerve conduction velocity[37].

From analysis of Table-6 it was found that the peak speed attainment after cryo-application was significantly (P<0.001) better than pre-cold status in all the three trials.

This may due to
- Increased muscle strength[10].
- Expanded blood flow to the area, which disproportionately increases the excitability of the muscle[10].
- Elimination of masking reflex[9].
- Decreasing the power produced by the antagonist and power absorbed by agonist[5].
- Increasing pain threshold[11].
- Facilitating muscle contraction[11].
- Local vasoconstriction of the skin and possibly a vasodilatation of the skeletal muscles[3].

Analysis of Table-9 shows that the peak speed attainment after application of cold was significantly (P<0.001) better than application of superficial heat.

This could be due to greater increase of muscle strength[10]. Which is regulated by the sympathetic nervous system? Stimulation of sympathetic nervous system occurs will local cryo-application resulting in local vasoconstriction of the skin and possibly of vasodilatation of the skeletal muscle[3]. Thus the sympathetic nervous system influences changes in the skeletal muscles, which in turn forms a regulatory mechanism for the increase in muscle strength.

An increase in pain threshold is also seen after application of cold packs, cryo therapy reduces pain by acting as a counter irritant[16].

Gammon G.D. & Starr .I (1941) [18] suggested that cold is more effective counter irritant than heat, studies by **Cerotic and associates (1993)[14]** looked at the effects of superficial heat and cold on the pain threshold in the hands of 30 patients with Rheumatoid arthritis.

A warm bath (38^0C) was applied for 10 minutes to 15 patients. The other 15 patients received ice massage (1 to 3 minutes) to the fourth proximal. Interphalangeal. Joint of the right hand. Pain threshold was measured at baseline and post treatment. Both heat and cold application resulted in a pain threshold increases immediately following treatment. However the group received ice massage demonstrated an increase pain threshold at 10 and 30 minutes following treatment.

The other physiological factors supporting the result are eliminating masking reflex[9], decreasing power produced by the antagonist[5], facilitating muscle contraction[11], which has been discussed and supported by many authors.

Conclusion

1. Application of superficial heat before cycling significantly ($P<0.001$) increases peak speed attainment.
2. Cryo- application before cycling significantly ($P<0.001$) increases peak speed attainment.
3. The peak speed attainment is increased significantly ($P<0.001$) with cryo-application when compared to superficial heat application prior to cycling.

Recommendations

- The same study can be done in field conditions.
- EMG changes can be incorporated to evaluate muscle activity, which may be significant in research.
- Biofeedback can be used as a method of motivation to the subjects to attain their peak speed.

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