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Effects of active and passive warm-upon oral temperature and cardiovascular responses in healthy subjects

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Abstract

Background: Exercise involves an increase in temperature and metabolic process in cells, there is a 13% increase in metabolic rate as each degree increases. The heart rate and blood pressure responses during exercise are measures of stress on the cardiovascular system.

Objective: To find the efficacy of oral temperature and cardiovascular responses to active and passive warm – up in healthy subjects.

Methodology: An observational study design set up in Meenakshi College of Physiotherapy- Fourty, both male and females were selected by Simple Random sampling.

Procedure: Subjects were asked to ride an unloaded lower extremity bicycle ergometer set at a speed of 60meters/second for 15 minutes. Pre & Post warm- up oral temperature and cardiovascular parameters were recorded. Passive warm- up was done using infrared light to the lumbar area for 15 minutes. Post warm-up readings were recorded. The interval between the two warm-ups were kept at a one week interval.

Results: The standard mean of systolic blood pressure for active warm-up is 6.918 which is higher when compared to the passive warm-up of 3.277. The standard error for active warm-up is 0.5932 which is lower when compared to passive warm-up which is 0.6815. This shows that active warm-up causes a greater rise in systolic blood pressure when compared to passive warm-up. By using independent t- test there is a high significant difference between active and passive warm-up at 0.05 level of significance. The standard mean for diastolic blood pressure for active warm-up is 5.4054 which is higher when compared to the passive warm-up mean of 2.222. The standard error of active warm-up is 0.5527 which is lower when compared to standard error of passive warm-up which is 0.2848. There is a high significant difference between active and passive warm-up at 0.05 level of significance. The standard mean for heart rate in active warm-up is 4.4595 when compared to the passive warm-up mean which is 2.083. The standard error for active warm-up is 0.2499 which is lower when compared to standard error of passive warm-up which is 0.4389. This shows that active warm-up causes a greater rise in heart rate. By using independent sample t- test, it shows a p value of 0.05 level of significance. The standard mean of oral temperature for active warm-up is 9.3243 which is higher when compared to the passive warm-up mean of 7.22. The standard error of active warm-up is 0.2 499 when compared to the standard error of passive warm-up which is 0.4389. There is a p value of 0.05 level of significance which indicates that both groups cause only a slight rise in body temperature.

Conclusion: The study shows that active warm-up causes a significant increase in cardiovascular parameters while passive warm-up did not. This suggests the need for caution when active warm-up is included in treatment program of patients with cardiovascular problems.

Keywords: systolic blood pressure, diastolic blood pressure, rate pressure product, oral temperature

Introduction

The cardiovascular system and the thermoregulatory system are strongly coupled, hence changes in the thermal environment can affect the human thermoregulatory system. This study is aimed to find out the effects of active and passive warm –up to the cardiovascular system. The oral temperature is usually about 0.5 degrees lower than the rectal temperature (Ganong 2001) but not significantly different from it. [8, 9, 10] Hence the oral temperature is a good predictor of the core temperature and could be used to assess the effectiveness of a warm – up.

Objective of Study

- To determine the effect of active and passive warm- up on cardiovascular parameters.
- To emphasize on warm – up techniques.

Hypothesis

- **Null Hypothesis (H0):** Oral temperature and cardiovascular responses will not have a significant influence on active and passive warm up on healthy subjects
- **Alternative Hypothesis (HI):** Oral temperature and cardiovascular responses will have significant influence on active and passive warm up on healthy subjects.

Materials and Methodology

- **Study Design:** Observational study design
- **Study Setting:** Meenakshi College of Physiotherapy – Out Patient Department
- **Sample Size: -** Forty healthy subjects were selected both males and females in the age group of 20 – 30 years.

Inclusion Criteria
- Subjects in the age group of 20 – 30 years [1, 7]
- Both male and females are taken for the study

Exclusion Criteria
- Subjects who have contraindications to infrared radiation [4, 7]
- Musculoskeletal disorders affecting lower extremities that will prevent the subject from using the cycle ergometer [1, 4, 7, 9].
- Cardiovascular disorders such as angina, arrhythmias, rheumatic heart disease that will precipitate when the heart is stressed. [1, 4, 7, 9]

Materials or Tools Required
- Bicycle ergometer – a lower extremity bicycle ergometer of the Vyking Company set at a speed of 60 meters/ second for 15 minutes.
- Infrared lamp – a Medi Gold Infrared lamp is used which is manufactured by surgical enterprises.
- Clinical thermometer – SMIC GOLD Clinical thermometer is used to measure the subject's oral temperature [1, 8, 14].
- Sphygmomanometer – a mercury in glass sphygmomanometer manufactured by the ACCOSON Company [1, 8, 14, 27].
- Lithman's stethoscope [1, 8, 14].

Procedure

Forty normal subjects of college students were selected from Meenakshi College of Physiotherapy to participate in the study. All the subjects were also asked to avoid activities such as ingestion of cold or hot fluid, gum chewing, smoking and mouth breathing that may affect their oral temperature (Ganong, 2001) before coming for the tests. The subjects were rested for five minutes before the heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and oral temperature (OT) were recorded in the sitting position. The rate pressure product (RPP) was also recorded to measure the oxygen consumption.

RPP is calculated using the formula: -

RPP = HR x SBP (Mc Ardle et al 1996) [1]

Active warm – up was achieved by asking the subjects to ride an unloaded lower extremity bicycle ergometer set at a speed of 60 meters/second for 15 minutes [1].

Post warm- up oral temperature and cardiovascular parameters of the subjects were recorded soon after the warm –up. The interval between the two warm – ups was kept at a one-week interval.

In passive warm – up, infrared light was applied to the lumbar area for 15 minutes. Following this the post warm- up parameters are recorded.

Statistical Analysis

Descriptive Statistics of Systolic Blood Pressure

Table 1

Group	Mean	Standard Deviation	Standard Error
Active Warm-Up	6.918	3.608	0.5932
Passive Warm - Up	3.277	4.089	0.6815

Independent Sample t – Test

Table 2

Group	t Value	Degrees of Freedom	Mean Difference	p- Value
Active Vs Passive Warm- Up	4.037	71	3.64	.000

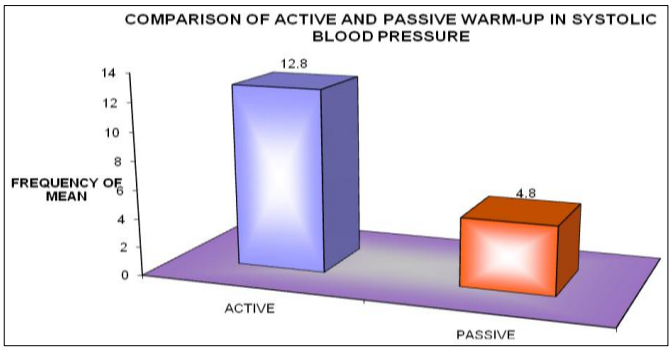

Fig 1

The descriptive statistics of systolic blood pressure has been tabulated above. The standard mean for active warm –up is 6.918 which is higher when compared to the passive warm –up mean of 3.277.The standard error for active warm-up is 0.5932, which is lower when compared to the standard error of passive warm-up, which is 0.6815. This shows that active warm –up causes a greater rise in the systolic blood pressure when compared to the passive warm – up. By using independent sample t- test we have also arrived at a highly significant difference between active and passive warm – up at 0.05 level of significance. So we conclude that the group which has a higher mean (active warm – up) is more effective.

Descriptive Statistics of Diastolic Blood Pressure

Table 3

Group	Mean	Standard Deviation	Standard Error
Active Warm-Up	5.4054	3.3620	0.5527
Passive Warm- Up	2.222	1.7090	0.2848

Independent Sample t – Test

Table 4

Group	t – Value	Degrees of Freedom	Mean Difference	p - Value
Active Vs Passive Warm - Up	5. 08	71	3.18	0.000

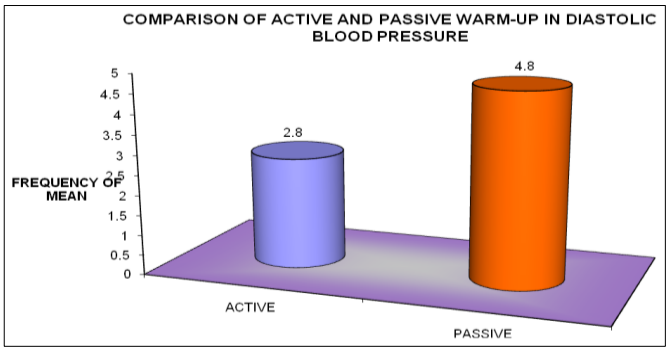

Fig 2

The descriptive statistics of diastolic blood pressure has been tabulated above. The standard mean for active warm –up is 5.4054 which is higher when compared to the passive warm – up mean of 2.222.The standard error of active warm- up is 0.5527, which is lower when compared to the standard error of passive warm-up, which is 0.2848. This shows that active warm –up causes a greater rise in the diastolic blood pressure when compared to the passive warm – up. By using independent sample t- test we have also arrived at a highly significant difference between active and passive warm – up at 0.05 level of significance. So we conclude that the group which has higher mean (active warm – up) is more effective.

Descriptive Statistics of Heart Rate

Table 5

Group	Mean	Standard Deviation	Standard Error
Active Warm-Up	4.4595	1.520	0.2499
Passive Warm - Up	2.083	2.6336	0.4389

Independent Sample t – Test

Table 6

Group	t Value	Degrees of Freedom	Mean Difference	p-Value
Active Vs Passive Warm- Up	4.737	71	2.376	.000

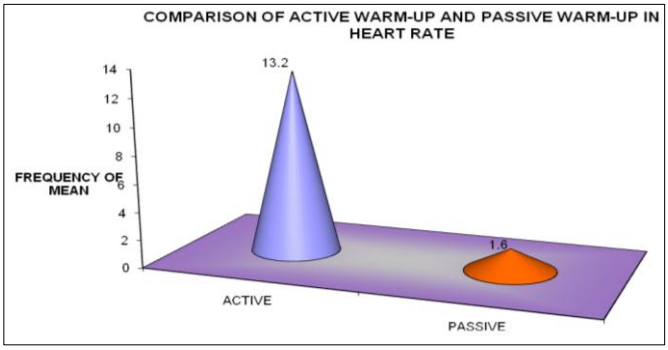

Fig 3

The descriptive statistics of heart rate has been tabulated above. The standard mean for active warm –up is 4.4595 which is higher when compared to the passive warm –up mean of 2.083.The standard error for active warm-up is 0.2499, which is lower when compared to the standard error of passive warm-up, which is 0.4389. This shows that active warm –up causes a greater rise in the heart rate when compared to the passive warm – up. By using independent sample t- test we have also arrived at a highly significant difference between active and passive warm – up at 0.05 level of significance. So we conclude that the group which has higher mean (active warm – up) is more effective.

Descriptive Statistics of Oral Temperature

Table 7

Group	Mean	Standard Deviation	Standard Error
Active Warm-Up	9.3243	55. 3675	9.1024
Passive Warm - Up	7.22	0.2953	4.922

Independent Sample t – Test

Table 8

Group	t Value	Degrees of Freedom	Mean Difference	p- Value
Active Vs Passive Warm- Up	1.002	71	9.252	.320

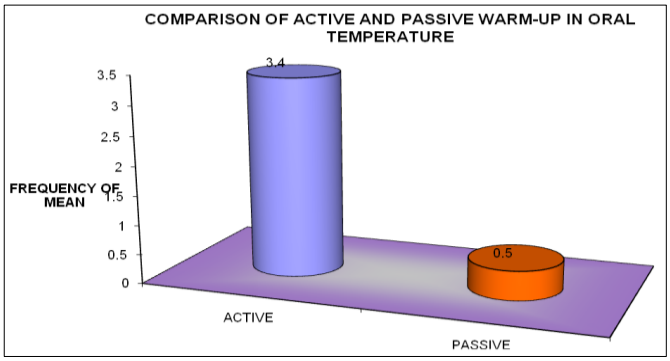

Fig 4

The descriptive statistics of oral temperature has been tabulated above. The standard mean for active warm –up is 9.3243 which is higher when compared to the passive warm –up mean of 7.22.The standard error of active warm-up is 0.2499, which is lower when compared to the standard error of passive warm-up, which is 0.4389. This shows that active warm –up causes a greater rise in the oral temperature when compared to the passive warm – up. By using independent sample t- test we have also arrived at a slightly significant difference between active and passive warm – up at 0.05 level of significance.

Discussion

The primary objective of this study was to evaluate and compare the oral temperature responses of apparently healthy college students to active and passive warm-up thereby evaluating the effectiveness of 15 minutes of both the warm up techniques. In this study 40 healthy college students were selected in the age group of 20 – 30 years of age [1, 8, 9, 10]. They were subjected to 15 minutes of active warm- up of cycle ergometer. This was followed by 15 minutes of passive warm –up which required the exposure to infrared radiation of 15 minutes. The heart rate, blood pressure, oral temperature and rate pressure product were recorded before and after the warm –up techniques. There was an increased cardiovascular response to active warm up when compared to passive warm – up [1, 6, 8, 16]. Adegoke, B.O.A., Ogwumike, Maruf had investigated and compared the effects of active and passive warm –up on oral temperature and cardiovascular parameters of 40 apparently healthy undergraduates. Results showed that there was no significant difference between pre and post-passive warm- up on oral temperature of the subjects. In contrast, significant differences were observed between the pre and post active warm –up cardiovascular parameters. This article supports my study by showing significant increase in heart rate, systolic blood pressure and rate pressure product following active warm-up. In my study the statistics was calculated using independent t- test. Statistical analysis of systolic blood pressure showed a highly significant difference between active and passive at 0.05 level of significance indicating that the active warm –up is more effective.

Statistical analysis of the diastolic blood pressure also showed a 0.005 level of significance. By using independent sample t-test there was a highly significant difference between active and passive warm- up, thereby concluding that active warm-up is more effective. Statistical analysis of the oral temperature showed a slightly significant difference between active and passive warm – up at 0.05 level of significance. Therefore it shows that both groups causes only a slight rise in the body temperature. Osamu Shido, Naotoshi Sugimoto, Minoru Tanabe and Sotaro Sakuradadid a study on 20 healthy volunteers. They were asked to stay in a temperature controlled room for 4 hours. The heat exposure was given for 9 – 10 consecutive days. Body mass and rectal temperature was measured before and after the heat exposure. The effects of heat acclimation and time of day on all parameters measured were evaluated by two – way ANOVA.[11] Significant changes in thermoregulatory and cardiovascular parameters were seen. The probable physiological mechanism during a warm – up session could be the breakdown of hemoglobin for the delivery of oxygen to working muscles. The release of oxygen from myoglobin is increased. Blood flow to the muscles is increased thereby reducing the muscle viscosity and improving mechanical efficiency. In conclusion this study showed that active warm – up caused a significant increase in cardiovascular parameters while passive warm – up did not. This suggested the need for caution when active warm –up is included in the treatment programmes of patients with cardiovascular problems. So passive warm –up may be a safer [1, 6, 7, 9, 16].

Limitations

- The study was conducted in subjects within the age group 20- 30 years, which is a normal age group.
- The study used only normotensive subjects.

Recommendations

- This study can be investigated in moderate risk patients such as obesity, hypertension.
- Further studies could compare the effects of different duration of warm-ups on axillary, oral and rectal temperature.

Conclusion

In conclusion this study showed that there was only a slight significant difference between the oral temperature responses of apparently healthy college students to active and passive warm-up thereby suggesting that both types of warm-up were effective. However, the finding that active warm-up resulted in significant increase in cardiovascular parameters while passive warm-up did not, suggested the need of caution when active warm-up as simple as stationary bicycle riding is included in the treatment programmes of patients with cardiovascular problems. In such patients, passive warm-up maybe safer and readily substituted.

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