Effect of Different Warm Up Protocol on Exercise Performance

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Abstract- *This study examines the effects of different warm up protocols on exercise performance among untrained young individuals. METHOD:A total of 100 medical and paramedical students (18-30 years) were selected by simple random sampling and were enrolled in the study. They performed active warm up(stretching, slow jogging and cycle ergomentry), passive warm up (strentching, massage and hot pack) and no warm up protocols (rest period for 15 mins). After this the vitals were recorded and then the subject started walking on treadmill at the constant speed on 5 km/hour and until the RPE reached 15(somewhat hard). Immediately after terminating exercise vital parameters were taken and then after 3 minute, 5 minutes and 7 minutes. Also the duration of treadmill walking was recorded. RESULTS: The exercise duration was analyzed by using repeated measure ANOVA and the recovery parameters were compared by using paired t- test. All the tests are compared at confidence interval of 95%. CONCLUSION: Warm up is essential before any type of exercise. Passive warm up increases the exercise duration more than active warm up. The recovery period is shorter in active warm up procedure as compare to passive and no warm up. The recovery period of heart rate is not known as it did not come back to resting level at 7 minutes.*

Keywords- Active warm up, passive warm up, rate of perceived exertion, treadmill walking, blood pressure.

I. INTRODUCTION

Warm up has been defined as the activity that rises the total body temperature as well as the temperature of the muscles to prepare the body for vigorous exercise. The warm up period prepares the cardiovascular system, respiratory system, nervous system and the musculoskeletal system by gradually increasing the demand on those systems so that they are able to accommodate the demands of more strenuous activity.1,2 Warm up will improve performance by affecting musculoskeletal system by training the Speed of muscular contraction and strength of muscle contraction. Benefits in speed and strength of muscle contraction are result of an increase in enzyme activity in warmer muscle fibers. Warm up produces a gradual increase in blood flow due to the vascular shunt mechanism via:

1. Vasoconstriction of the arterioles/ precapillary sphincters to organs and therefore increasing blood flow to muscles and decreasing blood flow to organs.
2. Vasodilatation of muscle arterioles/ precapillay sphincters, increasing blood flow delivery to working muscles.

A proper warm up provide many benefits due to elevated temperatures associated with it. The likelihood of injury is reduced. Athletic performance can be improved. The warm up increases muscle efficiency, reduces potential for muscle pulls, improves reaction time and improves the speed of movement of muscled and ligaments. Proper warm up can also help reduce the severity of post-exercise muscle soreness. The higher temperatures and increased blood flow resulting from warm up are important for delivery of oxygen to the muscles and for prevention of build-up of unwanted waste products which can lead to muscle soreness.3

II. INTENSITY AND DURATION OF WARM UP

It is difficult to recommend specific intensity and duration of warm up for every person, but most research in this area suggests an increase in body and muscle temperature of approximately one to two degrees Fahrenheit to be adequate. The higher the environmental temperature and the greater the amount of clothing, the sooner the desired body temperature is attained2, 3.

III. BACKGROUND OF THE STUDY

There are different ways to warm up: 1) Active warm up and 2) Passive warm up. In active warm up the muscle and body temperature rises because of the active muscle contraction e.g. jogging, walking, low intensity cycling etc. In passive warm up temperature is increased by external means like massage, hot shower, heating pads, steam baths2, 4.

Enormous researches are done on the effect of warm up on athlete or endurance trained individuals. Troyce J. Solley(2006) through their study “The acute effects of active warm up and passive warm up on passive tension,” reported no significant difference on the energy absorbed or peak

stiffness after active warm up and passive warm up.5 An early study by Andzal(1976), Genovely and Stanford(1982) reported that a high level of warm up improved sport performance significantly more than did a low level of warm up and no warm up at all.6 Mitchell and Huston however did not find any difference between high level, low level and no warm up in sport performance.

Therefore the purpose of this study was to examine the effects of active warm up, passive warm up and no warm up on the time to perceived exertion with treadmill exercise. The objectives were to find which method is better to prolong the duration of exercise, the recovery period after exercise and the effects of warm up on vital parameters.

IV. BACKGROUND OF THE STUDY

A cross over study design was adopted in order to limit sample bias. Thus the study included the same subjects for all three procedures with same exercise protocol following equal warm up period. Therefore the null hypothesis H0 was that there will be no significant difference in exercise duration and cardiovascular response following active, passive and no warm up procedures. As there may be difference in physiological response following different warm up procedures therefore the alternative hypothesis (H1) was that there will be significant difference in exercise duration and cardiovascular response following active, passive and no warm up procedures.

A total of 100 medical and paramedical college students of Pimpri area were selected by simple random sampling method were enrolled in the study. Untrained individuals aging from 18- 30 years(males and females) were included in the study. The individuals with any respiratory, cardiac, neurological, systemic disorders, recent musculoskeletal injuries and any sensory deficits were excluded from the study.

The procedure of evaluation and execution involved the use of these materials. They were subjected to calibrate every 4 months.

1. Moist pack
2. Digital blood pressure monitor
3. Motorized Treadmill with digital adjustment of speed
4. Static cycle ergometer
5. Plinth, chair, pillow
6. Talcum powder for massage.
7. Borg's rate of perceived exertion scale on the cardboard of 3 ft length and 2 ft width with proper color coding.

After going through the basic assessment the subjects were given sequence of the procedure randomly to avoid learning bias. All the subjects were given the dates of the 3 procedure and the dates were noted. Between any 2 procedures there was 3-5 days of rest period for wash out period.The subject attended 3 sessions of testing.

1) Active warm up
2) Passive warm up
3) No warm up

Before any warm up protocol the resting RPE was taken. It was emphasize that RPE should be 6 to 7 that is no exertion at all or extremely light, when the training was not done.

Active warm up procedure comprised of active stretching of quadriceps, hamstrings, calf and back extensors(3 times for 15-20 seconds with 10 seconds rest), slow jogging(4 minutes) on treadmill and low intensity ergometer cycling(4 minutes at 3km/hr). During warm up it was ensured that the RPE did not exceed 11 that is light.

Passive warm up procedure comprised of passive stretching of quadriceps , hamstrings, calf and back extensors(3 times for 15-20 seconds and 10 seconds rest), massage consisted of effleurage(1 minute), kneading(20- 30 seconds), stroking(20-30 seconds) and petrissage(30 seconds)and hydrocollator packs(at 750 for 8 minutes). Subjects were asked to report any discomfort during the procedure. Massage was begun with the effleurage and ended with the effleurage.These all procedures were applied on bilateral quadriceps, hamstrings, calves and back extensors for 10 minutes. All the procedures were performed by same therapist.

No warm up procedure consisted of subjects sitting for 15 minutes in a quiet room before treadmill exercise. Subjects was not allowed to do any activity and were asked to rest in position whichever comfortable for them.2

After this the subjects started to exercise on treadmill at the constant speed on 5 km/hour and until the RPE reached 15(somewhat hard). When subject felt 15 on RPE, at that time the exercise was stopped and the duration was noted. Patients were asked to report any discomfort like joint or muscle pain, chest pain or any other discomfort. Immediately after terminating exercise subjects were given comfortable sitting position in the chair and vital parameters were taken immediately and then after 3 minute, 5 minutes and 7 minutes. Also the duration of treadmill walking was recorded.

V. BACK STATISTICAL ANALYSISGROUND OF THE STUDY

As the sample were same in all 3 different types of procedure, the exercise duration was analyzed by using repeated measure ANOVA and the recovery parameters were compared by using paired t- test.

All the statistical tests are compared at confidence interval of 95%.

Table 1. comparison of treadmill walking duration after different warm up protocols and effect of different warm ups on heart rate, respiratory rate, and blood pressure.

Procedure of warm up	N	Treadmill walking Duration (mean±SD)	Heart rate (mean ± SD)	Respiratory rate (mean ± SD)	Systolic BP (mean ± SD)	Diastolic BP (mean ± SD)
1(passive warm up)	83	16.15±8.012	-3.229±7.075	-0.4096±1.781	-0.3735±5.219	2.012±11.13
2(active warm up)	83	14±6.029	6.289±9.229	3.349±14.66	-6.807±12.66	-1.036±5.756
3(no warm up)	83	12.44±5.965	-1.651±4.432	-0.6386±1.812	0.759±6.068	1.024±4.59
ANOVA		22.109	48.482	5.777	19.727	3.287
P value		<0.001	<0.001	0.004	<0.001	0.04

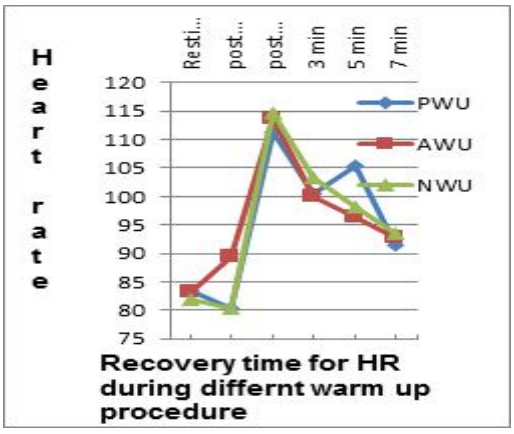

Figure 1. Graph 1: Recovery of heart rate following treadmill walking.

Graph 1 a marked difference in heart rate at rest and at 7 min in all three procedures.

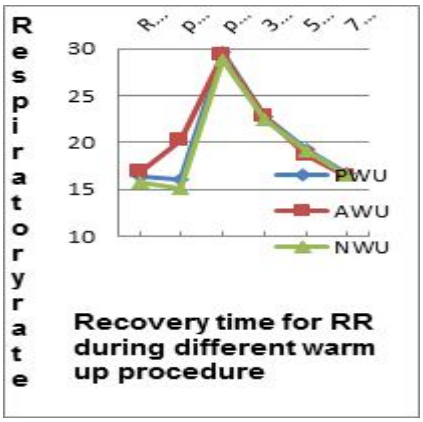

Figure 2. Graph 2: Recovery of respiratory rate following treadmill walking

Graph 2 shows that respiratory rate after 7 min came near to resting level for all 3 procedures but there is no statistically significant difference between resting and 7 min post treadmill respiratory rate for no warm up.

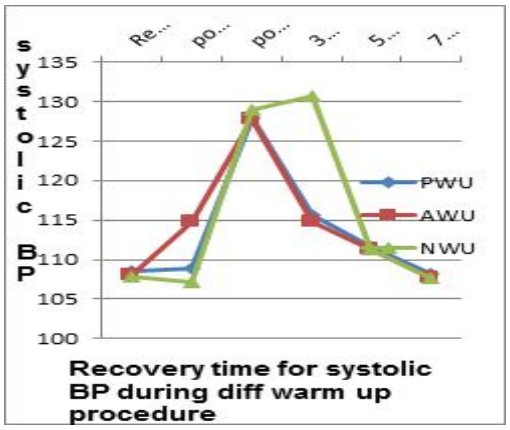

Figure 3. Graph 3: Recovery of systolic blood pressure following treadmill walking

Graph 3 shows that at 7 min systolic blood pressure comes back to resting level in all 3 procedures.

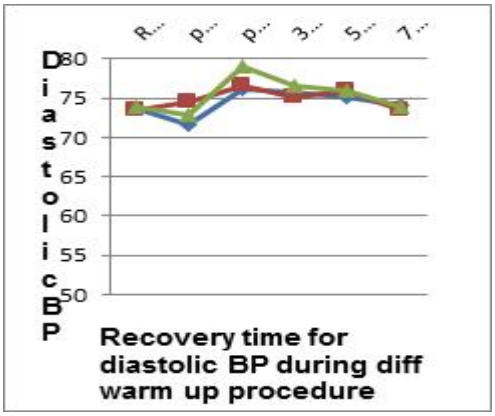

Figure 4. Graph 4: Recovery of diastolic blood pressure following treadmill walking

Graph 4 shows that diastolic blood pressure came back to resting level in passive and active warm up while in no warm up it came to near resting level but there is no statistically significant difference between resting and 7 min post treadmill diastolic blood pressure.

VI. DISCUSSION

Statistical analysis reveals that the treadmill walking duration is more after warm up as compare no warm up. Furthermore after passive warm up the treadmill walking duration was more than active warm up. Active warm up increased the vital parameters more than passive and no warm up. While recovery period was shorter in active warm up and passive warm up as compare to no warm up. There was no much difference in recovery period of all vital parameters between active and passive warm up except in respiratory rate. Systolic blood pressure, diastolic blood pressure and respiratory rate came back to resting level at 7 minutes while heart rate didn't come to resting level at 7 minute.

After active warm up procedures heart rate was increased. While there was decrease in heart rate after passive and no warm up. There was no significant difference in heart rate between passive and no warm up. The reason behind increase in heart rate following active warm up could be because of its exertive nature.3 As Active warm up consisted of active stretching, cycling and treadmill walking which was more exertive than no warm up (15 min rest) and passive warm up.

The other important vital parameter is respiratory rate. The respiratory rate was increased during active warm up but there was no significant difference in respiratory rate following passive and no warm up. The reason behind increase in respiratory rate could be the same as heart rate. As RPE was more at the end of active warm up as compare to no warm up and passive warm up which suggest that active warm up is much more exertive than passive and no warm up.

There was significant increase in systolic BP following active warm up while there was a mild increase following passive warm up and mild decrease following no warm up but in both the condition the differences were not significant. The increase in systolic BP following active warm up is because of initially exercise induced vasoconstriction. The other reason could be the sympathetic stimulation following any light, moderate or severe intensity exercises which lead to increase in systolic blood pressure.

The diastolic BP was increased after active warm up while it was decreased following passive and no warm up. The reason behind increasing diastolic BP could be the sympathetic stimulation and vasoconstriction initially which lead to increase in peripheral resistance. This results in increase in diastolic blood pressure. There was a significant decrease in diastolic BP in passive warm up, it could be because of massage and hot packs cause vasodilatation. Following that there in reduction in peripheral vascular resistance which results in decrease in diastolic BP following passive warm up. During no warm up patient was completely relaxed which causes sympathetic inhibition lead to decrease in diastolic BP.

Respiratory rate was also increased after treadmill walking in all procedures, but it came back to resting level at 5 minutes following active warm up and at 7 minutes following passive warm up. It didn't come back to resting level till 7 minutes in the case of no warm up which suggests no warm up take more time to recover the respiratory.

Therefore the null hypothesis 'there is no significant difference in all three warm up procedure' is rejected and alternative hypothesis is accepted. So there is significant difference in exercise duration and cardiovascular responses following active, passive and no warm up procedure.

Passive warm up can be given to bedridden patients following trauma, post surgery, fractures, neurological conditions, systemic diseases or pregnant women, obese individuals, patients with respiratory disorders which will help in improving their performance. As the result suggested the passive warm up extends the exercise duration almost 2 minutes more in which patients can walk 166m more. This distance is not significant for the normal healthy individual but It will give significant improvement in long term

VII. CONCLUSION

This study concludes that warm up is essential before any type of exercise. Passive warm up and active warm up lengthen the treadmill walking duration as compare to no warm up. Passive warm up increases the exercise duration more than active warm up. The recovery period is shorter in active warm up procedure as compare to passive and no warm up.

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