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SINGLE BOUT OF AEROBIC AND RESISTANCE EXERCISE ON REACTION TIME AND WORKING MEMORY IN NORMAL SUBJECTS – A RANDOMIZED CONTROL TRIAL

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ABSTRACT

Objectives: To find out the effect of single bout of aerobic and resistance exercise on reaction time and working memory in normal subjects. **Design:** 30 under graduate both gender students were selected randomly using a stratified sampling method and divided into 3 groups of 10 subjects respectively. Subjects were given the working memory task extracted from the modified Sternberg test and the reaction time task. Subjects were tested prior to the exercise and took pre test values. Group 2 was given resistance exercise with multi gym and Group 3 was given aerobic exercise with tread mill walking with proper rest intervals while the Group 1 was kept as control. After the exercise was performed, they were tested again for working memory with differently prepared sheets and reaction time. The exercise given to the subjects were prolonged for 30 minutes. All subjects were given a ten minutes warm up and a cool down exercises. **Result:** Statistical analysis using paired t test showed mean and standard deviation for reaction time for **Group 1**: 0.2290± 3.281, 0.2230±2.983, and 0.2140± 3.688 as pre, post and after 30 minutes respectively with p value ≤ 0.668, 0.350 between pre and post, and pre and after 30 minutes respectively. For **Group 2**: 0.2270± 3.592, 0.2030±4.547, 0.2090± 4.383 as pre, post and after 30 minutes respectively with p value ≤ 0.158, 0.331 between pre and post, and pre and after 30 minutes respectively. For **Group 3**: 0.2150± 3.206, 0.2250±2.915, 0.2140± 3.921 as pre, post and after 30 minutes respectively with p value ≤ 0.472, 0.924 between pre and post, and pre and after 30 minutes respectively. **Conclusion:** There was no statistically significant difference in the effect of single bout aerobic and resistance exercise on reaction time and working memory after single bout of aerobic and resistance exercise in normal subjects.

Keywords: single bout, aerobic exercise, resistance exercise, reaction time, working memory

INTRODUCTION

If you exercise the body, you also exercise the mind. [1] The effect of physical activity on brain and cognition has grown in interest in recent times with an increasing number of reports indicating that chronic participation and single, acute bout of exercise benefit a host of cognitive processes. [2]

In the absence of a rich literature base examining acute resistance exercise and cognition, some understanding of this relationship may be gained through the examination of research on chronic resistance training. Accordingly, the investigation of acute resistance exercise may provide further insight into the overall relation of health behaviours such as physical activity to cognition. [3]

Much of the new research suggests that aerobic exercise can actually promote the growth of new brain cells. This contradicts earlier beliefs that the brain stopped producing new cells relatively early in its development. In one study recent study researchers found that adult mice doubled their number of brain cells in the hippocampus when they had access to running wheels [7]. The hippocampus is a structure in the brain that is vital for memory and learning. A similar study showed that exercising mice had two and half times the growth of new neurons in the dentate gyrus, another area of the brain important in memory. [4-8]

Working memory is the ability to keep information on line for a brief period of time, which is essential for many cognitive tasks such as control of attention and problem solving. Improving working memory capacity leads to better performance on several tasks that require working memory and control of attention and it translates to increased attentiveness in everyday life .[6]

Aerobic exercises clearly improves the speed of recall, and much if the research points to an effect on the quality of mental functioning and the amount of recall. It releases endorphins, the neurotransmitters that relax us into a state of cortical alertness. It decreases the likelihood of depressive symptoms two to one over individuals with little or no physical activity. It also increases the number of capillaries around the neurons of the brain, increasing the supply of blood and oxygen to reach the brain. Finally it results in faster, improved reaction time. [6]

Physical activity improves not only physical fitness but also cognitive functions.[9] Researchers has proposed three reasons why exercise improved fitness and also enhanced cognitive functioning. They proposed that increased transportation of oxygen and glucose to the brain, as well as increased self esteem and decreased physiological distress, would result in improved performance on complex psychological tasks.[10]

Executive attention is thought to be at the heart of working memory.[11]

Resistance exercise and aerobic exercise represent a distinct spectrum of exercise that is characterized by different physiological demands (i.e., cardiovascular,

musculoskeletal, metabolic, etc.). To date, the vast majority of research has investigated changes in cognition after an acute bout of aerobic exercise, whereas only a single study has investigated the effect of acute resistance exercise on cognitive function.[12]

Lack of studies comparing the effect between acute aerobic and resistance exercise on working memory. The purpose of this current study is to expand the acute exercise – cognition database, to include resistance exercise and compare it with aerobic exercise during performance on a working memory task. To evaluate the effect of single bout of aerobic and resistance exercise on working memory and reaction time.

MATERIALS AND METHOD

Study design:

A Randomized Control Trial.

Group 1: Subjects not performing both aerobic and resistance exercises.

Group 2: Subjects performing whole body resistance exercise for 30 minutes.

Group 3: Subjects performing aerobic exercise on treadmill for 30 minutes.

Subjects:

Number of subjects:-30 (3 groups each having 10 subjects), Students of the Sumandeep Vidyapeeth University.

Inclusion criteria:

- Age: 19-25 years
- Sex: Both Male and Female
- Students who have raw knowledge about aerobic and resistance exercise.

Exclusion criteria:

- Musculoskeletal condition
- Neurological condition
- Psychiatric illness
- Cardio respiratory conditions
- Aerobic performers and regular exercisers.

Procedure:

30 numbers of subjects were recruited from Sumandeep Vidyapeeth who were fulfilling the inclusion criteria of age 19 – 25 years, both male and female and whom have raw idea about aerobic and resistance exercise. Students with musculoskeletal condition, neurological condition, psychiatric illness, cardio respiratory conditions, and regular aerobic performers and sports persons were excluded.

30 subjects divided into 3 groups, 10 each through stratified random sampling method. Experimental group 1 was given resistance exercise with multi gym. Experimental group 2 was given aerobic exercise with treadmill whereas the other was kept as control group. The exercise duration was kept for 30 minutes with 2 rest intervals of each 3 minutes and additional 10 minutes of warm - up and cool – down. Single session was carried out. Subjects were given the Modified Stanford Working Memory Task and the reaction time was tested prior to the session. After the exercise was performed they were tested again for working memory with differently prepared sheets and reaction time. The tasks were repeated 30 minutes after the session. Then data were documented for results.

Data analysis:

Data was analysed by using paired and independent‘t’ test with the help of Statistical Package for Social Sciences (SPSS) version 11.0 for windows and p≤ 0.05 was kept as highly significant.

RESULTS:

TABLE 1.1: Results for Reaction Time

Group	Values taken on	No.of subjects	Mean	Standard deviation	Standard deviation (between groups)	‘t’ value	Significance (2-tailed)
control group	pre test	10	.2290	3.281	4.274	.444	.668
	Post test	10	.2230	2.983			
	After 30 min	10	.2140	3.688	4.813	.986	.350
Aerobic group	pre test	10	.2270	3.592	4.926	1.541	.158
	Post test	10	.2030	4.547			
	After 30 min	10	.2090	4.383	5.534	1.029	.331
Resisted group	pre test	10	.2150	3.206	4.216	.750	.472
	Post test	10	.2250	2.915			
	After 30 min	10	.2140	3.921	3.213	.098	.924

TABLE 1.2: Results for Reaction Time between groups immediately and after 30 minutes

Group	No of subjects	Mean		Standard deviation		Significance (2-tailed)	
		Immediately	After 30 minutes	Immediately	After 30 minutes	Immediately	After 30 minutes
Control group	20	-1.000	3.000	4.216	5.056	.410	.917
Resisted group		6.000	1.000	4.274	3.213	.339	.713
Aerobic group		2.600	1.200	4.812	5.572	.092	.612

TABLE 2.1: Results for Working Memory

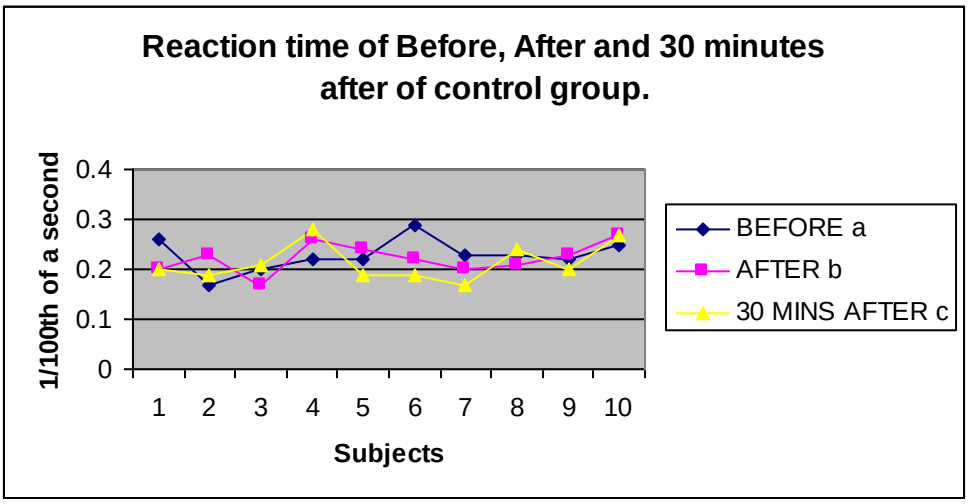
Group	Values taken on	No.of subjects	Mean	Standard deviation	Standard deviation (between groups)	't' value	Significance (2-tailed)
control group	pre test	10	32.0000	6.4636	7.8626	.282	.785
	Post test	10	31.3000	4.2939			
	After 30 min	10	28.7000	6.2725	6.9610	1.499	.168
Aerobic group	pre test	10	27.6000	5.4610	5.8119	-.544	.600
	Post test	10	28.6000	5.0155			
	After 30 min	10	29.3000	3.4976	5.7745	-.931	.376
Resisted group	pre test	10	27.4000	6.5524	6.7667	.794	.447
	Post test	10	25.7000	5.1651			
	After 30 min	10	30.1000	6.1183	7.1500	-1.194	.263

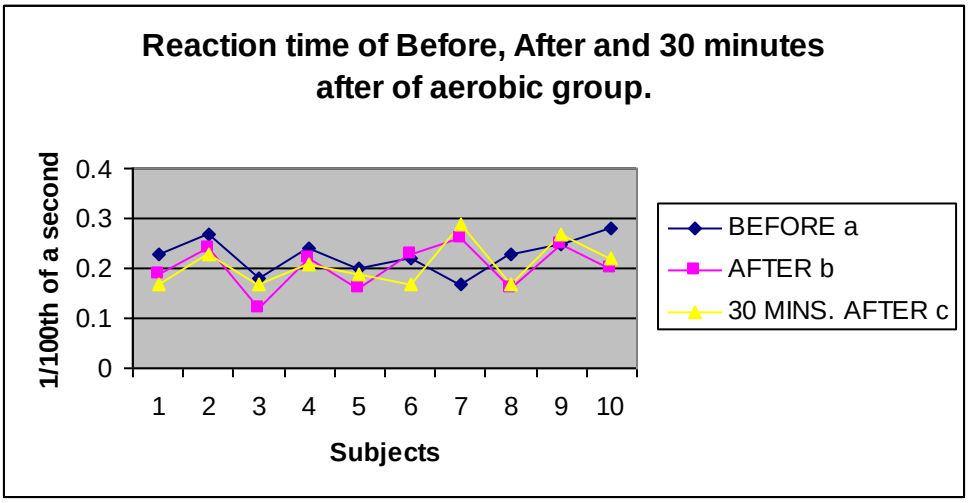
TABLE 2.2: Results for Working Memory between groups immediately and after 30 minutes

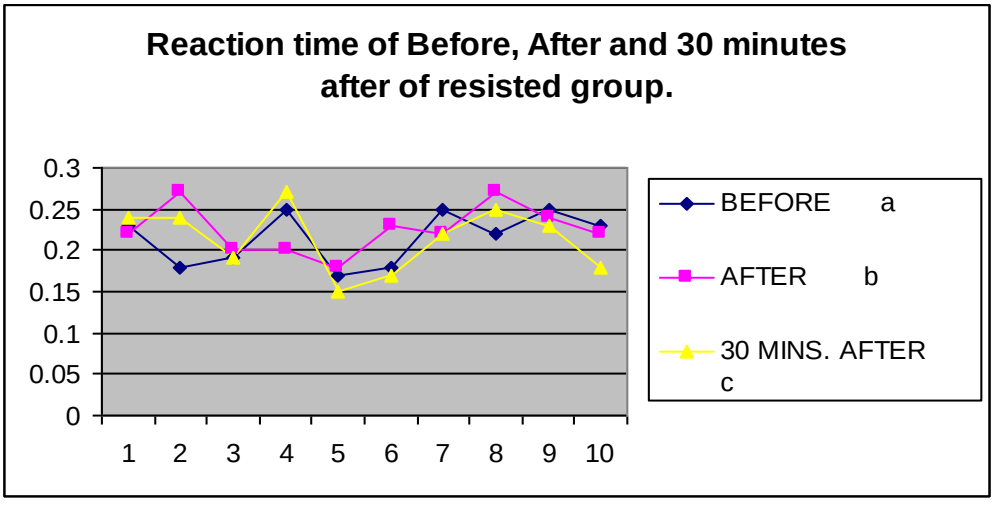
Group	No of subjects	Mean		Standard deviation		Significance (2-tailed)	
		Immediately	After 30 minutes	Immediately	After 30 minutes	Immediately	After 30 minutes
Control group	20	-.7000	1.7000	7.8606	5.7745	.589	.097
Resisted group		1.000	-3.3000	5.8119	6.9610	.764	.073
Aerobic group		-1.7000	2.7000	6.7667	7.1500	.351	.735

The results show no significance between the results of both reaction time and working memory between Pre-exercise, Immediate Post-exercise and 30 minutes Post-exercise in all the three groups i.e. control, aerobic and resisted groups. i.e., there is no effect of single bout of aerobic and resisted exercise on reaction time and working memory.

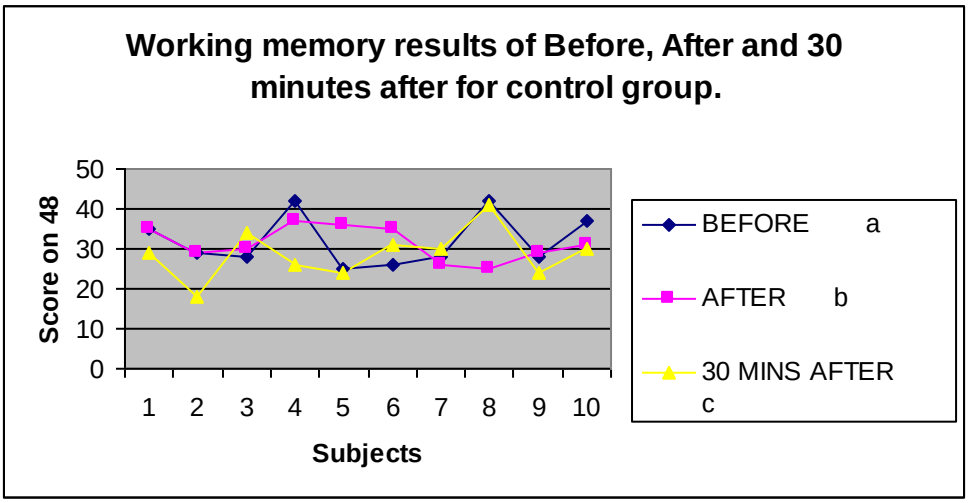
A. Graphs for reaction time

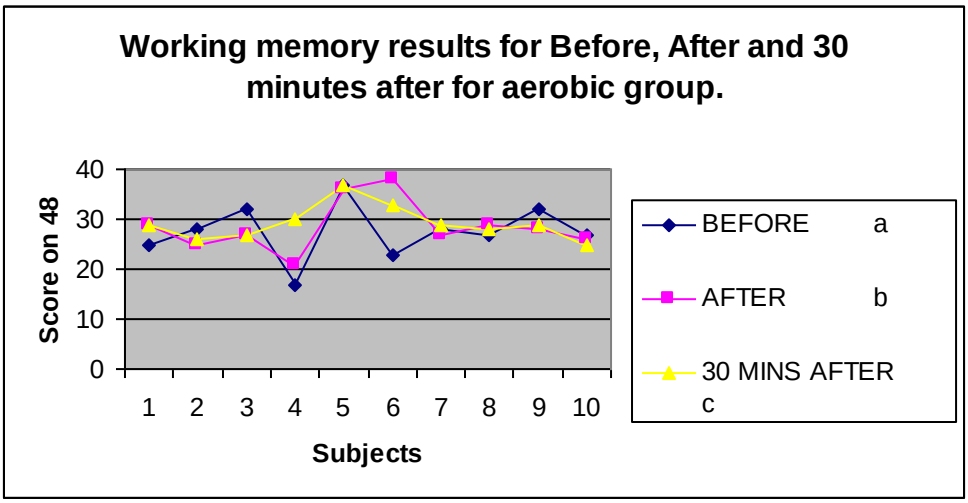


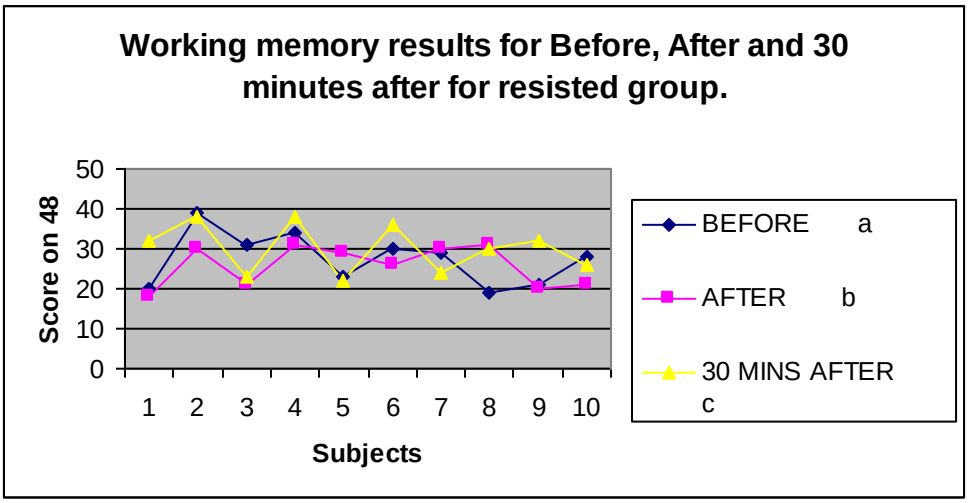




B. Graphs for working memory







DISCUSSION

For centuries, people have been intrigued with the brain and in finding a way to tap into its vast potential. It seems, though, that each new discovery brings more questions than answers.

Literature review shows a great deal of evidence regarding the reaction times following all exercise conditions and were seen to be shorter when compared to the baseline condition. Ozyemisci-Taskiran. O, Gunendi Z et al in their study concluded that a single bout of cycling exercise significantly improves pre-motor fraction of reaction time in healthy young sedentary subjects.[13]

Considering that resistance exercise exerts a very different metabolic response compared with aerobic exercise, manifested by lower oxygen consumption despite higher levels of muscular exertion, and lower levels of systemic blood flow, it may be possible that resistance exercise affects cerebral blood flow differently compared with aerobic exercise.

Pontifex MB, Hillman CH et al (2009) studied influence of acute bouts of aerobic versus resistance exercise on the executive control of working memory and they concluded that acute exercise-induced changes in cognition are disproportionately related to executive control and may be specific to the aerobic exercise domain but according to my study we did not get a significant difference in the results of working memory between resisted and aerobic groups. Although within the groups we get certain degree of improvement but when the groups are compared as a whole the results are not significant.[3]

The reason for such results could be because the study was concise and the sample size was only 30.The results may even vary with difference in the intellectual level of various subjects. The concentration level of the subjects as well as the environment in which they performed the exercises and the tasks could also be considered as a major factor affecting the results. Their results might have varied even due to differences in the physical activities in their day to day lives.

The time at which they performed the tasks would also affect the results as the subjects are fresher in the mornings.

The working memory task and reaction time task could have been made more precise. The weight given to the subjects in the resisted group was kept constant for all but the weight could have been varied by measuring their repetition maximum.

It is very pleasing and giving immense pleasure to say this study gives very much advancing ideas about the relationship between the exercise domains with cognitive function. This study can be explored in so many aspects including the various forms of exercise related with higher mental function. It is giving extended inputs to study the expanding horizons of various forms of exercise on cognitive functioning.

CONCLUSION

There was no statistically significant difference in the effect of single bout aerobic and resistance exercise on reaction time and working memory after single bout of aerobic and resistance exercise in normal subjects.

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