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Effect of Aerobic Exercise versus Resistance Exercise Training on Cognitive Function in Young Adults: A Comparative Study

Dharti Trivedi[1], Jalpa Parikh[2]

[1]MPT in Neurology, Ahmadabad Institute of Medical Sciences

[2]MPT neurology, PhD scholar, Gujarat University, Ahmadabad Institute of Medical Sciences
drt.tvd20196[at]gmail.com

Abstract: ***Background: Cognition is the act of process of knowing, including awareness, reasoning, judgments, intuition and memory. Exercise seems a simple and widely practiced behaviour that activates molecular and cellular signalling process involved in various central nervous system processes. Aerobic and resistance exercises seem to be effective in improving cognitive function in adults and elderly. Aim: The aim of this study was to compare the effects of aerobic and resistance exercise training on cognitive functions. Method: Fifty-eight individuals participated and underwent aerobic exercise and resistance exercise training. Exercise training protocol consisted of twelve sessions of 45 minutes,3 days per week for 4 weeks. Executive functions were measured by the Stroop Test and trail making test. Results: Result of the study found improvement of cognition in aerobic exercise group as well as resistance exercise group in young healthy individuals. Conclusion: The present study concluded that both Aerobic exercise and Resistance exercise training were similarly effective on improving cognition in young individuals.***

Keywords: Aerobic exercise, resistance exercise, cognitive function, young healthy individuals, Trail making test, Stoop test.

1. Introduction

Cognition is the act of process of knowing, including awareness, reasoning, judgements, intuition and memory. It is conceived of as a general term that includes perception, attention, thinking and memory [1].Aerobic exercise has shown to increase heart rate levels and, therefore, to increase arousal levels [2] and activation of a specific cortical area [3]. These areas are responsible for cognitive function. [4] Resistance exercise has shown to increase heart rate levels as well as the concentration of several hormones that were correlated with cognitive improvements. [5]So it is equitable to compare the effect of aerobic exercise versus resistance exercise on cognitive functions. Beginning in the twenties and continuing throughout the rest of life, there is a gradual deterioration in the functioning of the brain, which is responsible for such disease like dementia, Alzheimer's disease etc.[6] A reduction in specific cognitive abilities, such as processing speed, executive functions and episodic memory, is seen in healthy individuals during the aging process, due to neuro anatomical changes. Other factors such as obesity, stress, smoking, alcohol and prolong mobile usage are affect sustained attention and other cognitive functions in young adults.[7-12]

2. Literature Survey

Many studies are available on Aerobic exercise which improves cognition in elderly. In 2018, freja Gheysen et al studied on 'Physical activity to improve cognition in older adults: can physical activity programs enriched with cognitive challenges enhance the effects. A systematic review and meta-analysis' concluded that Physical Activity programs for older adults could integrate challenging cognitive exercises to improve cognitive health.. [14], as well as studies are available on Resistance exercise training improving cognitive function in middle aged woman and healthy older adults etc.[15,16] But there are less study done on showing comparative effect of Aerobic exercise training versus Resistance exercise training on cognition in healthy young adults. Hence, the aim of current study is to find out which exercise is more effective on cognition in healthy young adults.

3. Methodology

Present study is an experimental study. Ethical approval for the study was taken from the institutional ethical committee. The study was conducted in various outpatient departments and health centres of Ahmadabad and Himatnagar.

- **Population:** Healthy young males and females with age of 18 to 40 years.
- **Study Duration:** Data was collected over a period of 4 months.
- **Sample Size:** Total 58 samples were selected based on inclusion and exclusion criteria.
- **Sampling:** Convenience sampling

Inclusion Criteria:
Individuals in between the age of 18 to 40 years, both males and females and individuals willing to participate were included in the study.

Exclusion Criteria:
Individual who were Smokers, People who were doing regular workout, Individuals with neurological or psychiatric disease, individuals having prescribed medications that might alter cognitive function,who had Head injury or long-term hospitalization in the previous three months, Abnormal cardiac signs or symptoms and Individual with fracture in previous 3 months were excluded in the study.

Materials

1) Consent form
2) Assessment form
3) Pen
4) Weighing machine
5) Stadiometer

6) Stopwatch
7) Weight cuff

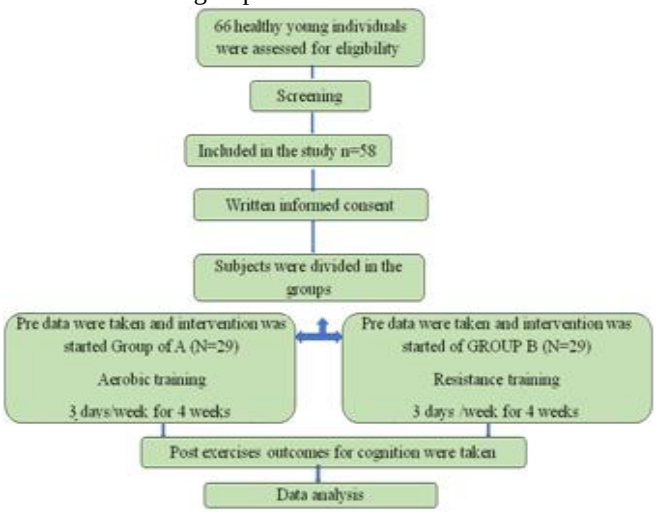
8) Dumbbell
9) Treadmill

Outcome Measures

1) Stoop test
2) Trail making test

Procedure

Healthy young individuals who fulfilled the inclusion and exclusion criteria were taken up for the study by convenience sampling. The whole procedure of the study was explained to all the subjects A written informed consent of the all the subjects was taken prior to the study and divided into two groups .Pre-and post test outcomes were taken for both the groups.



Group A: Aerobic Exercise Training [17]

The total duration of the training session was given for 45 minutes.

Warm Up Period: Included stretching and low intensity exercises such as neck movements, shoulder circles, trunk movements and marching for 10 minutes.

Training Session

Frequency: 3 days per week on nonconsecutive days.

Intensity: The continuous aerobic training exercise was performed on treadmill at 40-60% of maximum HR for 4 weeks for 30 minutes. Maximum heart rate was calculated by using the formula:

HR max =220 - AGE

TIME: 30 minutes

Cool Down Period: After the training session cool down period was given was given for 5 minutes which included large group muscle stretching i.e. hamstring, calf, quadriceps, biceps and triceps.

Group B Resistance Exercise Training [17]
The total duration of the training session was given for 45 minutes. 1RM was calculated isotonically for muscle group such as elbow flexors, elbow extensors, knee flexors, knee extensors and hip abductors.

Warm Up Period:
Stretching and low intensity exercises of 10 minutes were given in each training session prior to training.

Training Session:
Frequency: 3 times per week on nonconsecutive days.
Intensity: The resistance training was given with free weight and dumbbells for three alternate days in a week at a 60-70% of 1 RM consisting of 2-4 sets of 8 -12 repetitions with rest period of 2 minutes after each set. Each repetitions of exercise included a slow controlled movement (2 seconds up and 4 seconds down), one full inspiration and expiration, and no breath holding (Valsalva maneuver).

Progression:
In 1st week 60% of 1RM with 8 repetitions of 2 sets were given.
In 2nd week 65% of 1RM with 9 repetitions of 2 sets were given.
In 3rd week 70% of 1RM with 10 repetitions of 3 sets were given.
In 4th week 70% of 1RM with 11 repetitions of 3 sets were given.
The **rest period** was **2 minutes** between each set.

Five different types of exercises like biceps curls, triceps extension, side leg rises, and knee extension were included.

TIME: **30 minutes**

Cool down period: After the training session cool down was given for **5 minutes** which included large group of muscle stretching i.e. **hamstrings, calf**, **quadriceps**, **biceps**, **and triceps**.

4. Result

Statistical analysis was done using SPSS version 20.0 and Microsoft excel version. Prior to the statistical test data were screened for normal distribution. Outcome measures were taken before intervention and after completion of intervention at the end of 4 weeks. Level of significance was kept at 5% with confidence interval at 95%.

Table 1: Mean Age of the Participants in Each Group

	Number of Participants	Mean Age
Group A	29	25.5±7.83
Group B	29	24.17±5.73

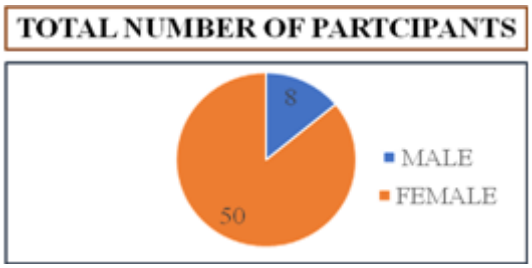


Table 2: Mean Differences in Stroop A Score for Group A Table

Pre Treatment		Post Treatment		P Value
Mean	SD	Mean	SD	0.0001
9.04	±1.87	7.78	±1.49	

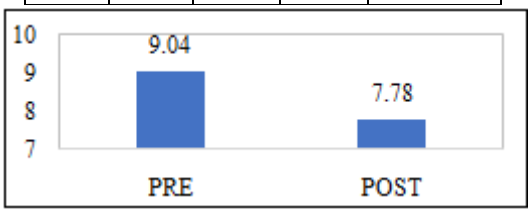


Table 3: Mean Differences in Stroop B Score for Group A

Pre Treatment		Post Treatment		P Value
MEAN	SD	MEAN	SD	0.0001
26.39	±8.27	20.48	±4.77	

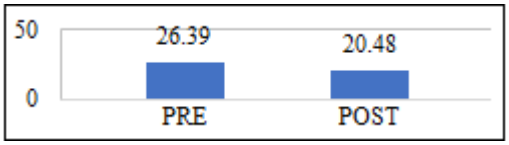


Table 4: Mean Differences in Trail Making Test A Score for Group A

Pre Treatment		Post Treatment		P Value
Mean	SD	Mean	SD	0.0001
25.94	±7.54	20.18	±6.52	

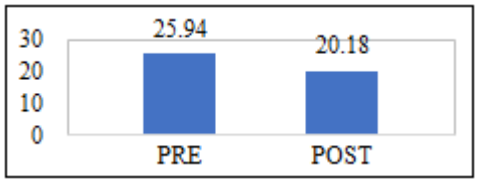


Table 5: Mean Differences in Trail Making Test B Score for Group A

Pre Treatment		Post Treatment		P Value
Mean	SD	Mean	SD	0.0001
41.24	±10.89	31.73	±8.84	

Table 6: Mean Differences In Stroop A Score For Group B

Pre Treatment		Post Treatment		P Value
Mean	SD	Mean	SD	0.0001
8.10	±0.99	7.30	±0.88	

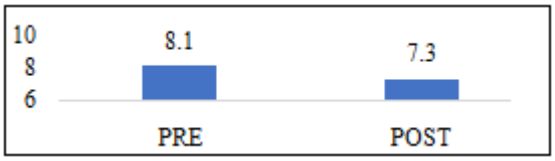


Table 7: Mean Differences In Stroop B Score For Group B

Pre Treatment		Post Treatment		P Value
Mean	SD	Mean	SD	0.0001
25.43	±6.06	20.80	±4.70	

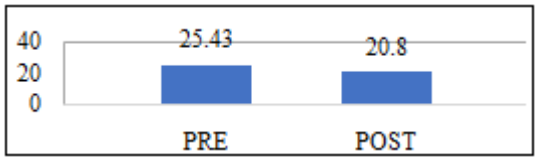


Table 8: Mean Differences in TMT A Score for Group B

Pre Treatment		Post Treatment		P Value
Mean	SD	Mean	SD	0.0001
24.36	±7.16	17.99	±4.19	

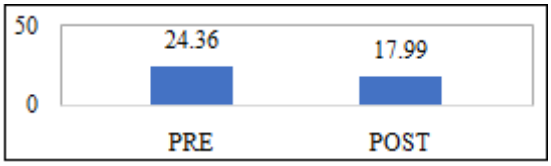


Table 9: Mean Differences in TMT B Score for Group B

Pre Treatment		Post Treatment		P Value
MEAN	SD	MEAN	SD	0.0001
45.34	±15.91			

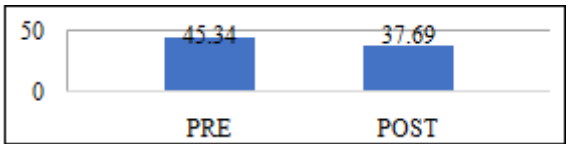


Table 10: Mean Differences in Stroop A Score Between Group A and B

Pre Treatment		Post Treatment		U Value	P Value
Mean	SD	Mean	SD	365.00	0.388
7.78	±1.49	7.30	±0.88		

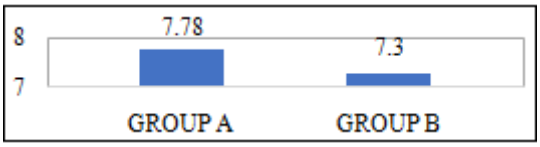


Table 11: Mean Differences in Stroop B Score between Group A and B

Pre Treatment		Post Treatment		U Value	P Value
Mean	SD	Mean	SD	389	0.624
20.48	±4.77	20.80	±4.70		

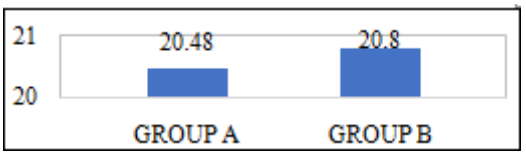


Table 12: Mean Differences In Trail Making Test A Score In Between Group A And B

Pre Treatment		Post Treatment		U Value	P Value
Mean	SD	Mean	SD	394.00	0.680
20.18	±17.99	17.99	±4.19		

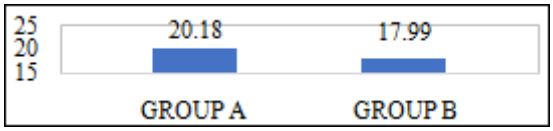
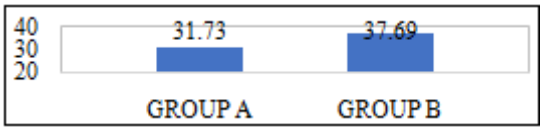


Table 13: Mean Differences in Trail Making Test B Score between Group A and B

Pre Treatment		Post Treatment		U Value	P Value
Mean	SD	Mean	SD	315.00	0.101
31.73	±8.845	37.69	±12.90		



5. Discussion

Result of the study found improvement of cognition in aerobic exercise group as well as resistance exercise group in young healthy individuals**.** There was significant difference in cognition within aerobic exercise group (p vulue-0.0001 which is <0.05) and resistance exercise (p value-0.0001 which is s0.05) group analysis whereas no significant difference was present in between aerobic versus resistance exercise group analysis.

Improvement in Aerobic exercise can be explained by physiological mechanism that increased performance corresponded with increased activation in the left **dorsolateral prefrontal cortex** and alteration in **serum levels of BDNF (brain derived neurotrophic factor)**. BDNF is found in the central nervous system and functions in areas associated with cognitive processes, such as the prefrontal cortex, striatum, hippocampus, cortex, septum neurons, cerebellum and motor neurons. which can be responsible to improve cognitive performance.[18] **Graffin** et al in 2011 reported that both acute and five-week exercise interventions improved cognitive performance as assessed by the Stroop test and altered serum levels of brain derived neurotrophic factor (BDNF).[19]

Group B (Resistance exercise) also showed significant improvement in Stoop test and trail making test which can be due to increase in insulin like growth factor (IGF-1). IGF-1 is one the most important hormones for growth and development in humans and associated with aging in the brain. It has shown to prevent loss of brain tissue and increase concentrations of (BDNF) brain derived growth factor and vascular endothelial growth factor(VEGF).BDNF is found in the central nervous system and functions in areas associated with cognitive processes, such as the prefrontal cortex, striatum , hippocampus, cortex , septum neurons , cerebellum and motor neurons, studies have found that IGF-1 enhances synaptic, plasticity and neuronal survival, which can improve cognitive performance.[18]

Hence, both Aerobic exercise training and Resistance exercise training reveals similar effect on cognition in healthy young individuals.

6. Conclusion

The present study concluded that both Aerobic exercise and Resistance exercise training are similarly effective on improving cognition in young individuals.

7. Clinical Implication

Both aerobic exercise and resistance exercise training can be used to improve cognitive functions in neurological cognitive deficits in clinical practices.

8. Future Research

Future study is recommended to study the comparative effect of aerobic exercise and resistance exercise in different neurological conditions with cognitive deficits and also with different cognitive measures.

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Author Profile

Dr. Dharti Bhavankumar Trivedi, MPT in Neurology.

Dr. Jalpa Parikh, MPT neurology, PhD scholar. She is Lecturer, AIMS since 5 years; Worked in Wadia hospital, Mumbai 4 years.