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EFFECTIVENESS OF AEROBIC EXERCISES ON COGNITIVE FUNCTIONS IN ELDERLY

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ABSTRACT

Background and Objectives: Cognitive function decreases with aging. In an aging population with increasing incidence of mild cognitive impairment, strategies are needed to slow age-related decline and reduce disease-related cognitive impairment in older adults. So this background of study is to investigate the effects of aerobic exercises on elderly person's cognitive functions. **Methods**: 15 subjects and who have full filled with the inclusion criteria underwent with the aerobic exercises for 9 weeks, 3 days a week for 45 minutes. The assessment is taken at baseline i.e. prior the intervention (pre-test) and at the end of protocol post intervention, measures were taken using Mini Mental State Examination (MMSE) and Montreal Cognitive Assessment (MOCA) test. **Results**: Statistical analysis of the data revealed that the scores from MMSE and MOCA analysis of the pre score and post score intervention shows a significant improvement by using Paired t test analysis. **Conclusion**: Finally, the study concluded that 9 weeks of training program with aerobic exercises has shown better improvement in cognitive function on MOCA and MMSE measurement.

KEYWORDS: Aerobic Training, MMSE, MOCA, Cognition, Elders.

INTRODUCTION

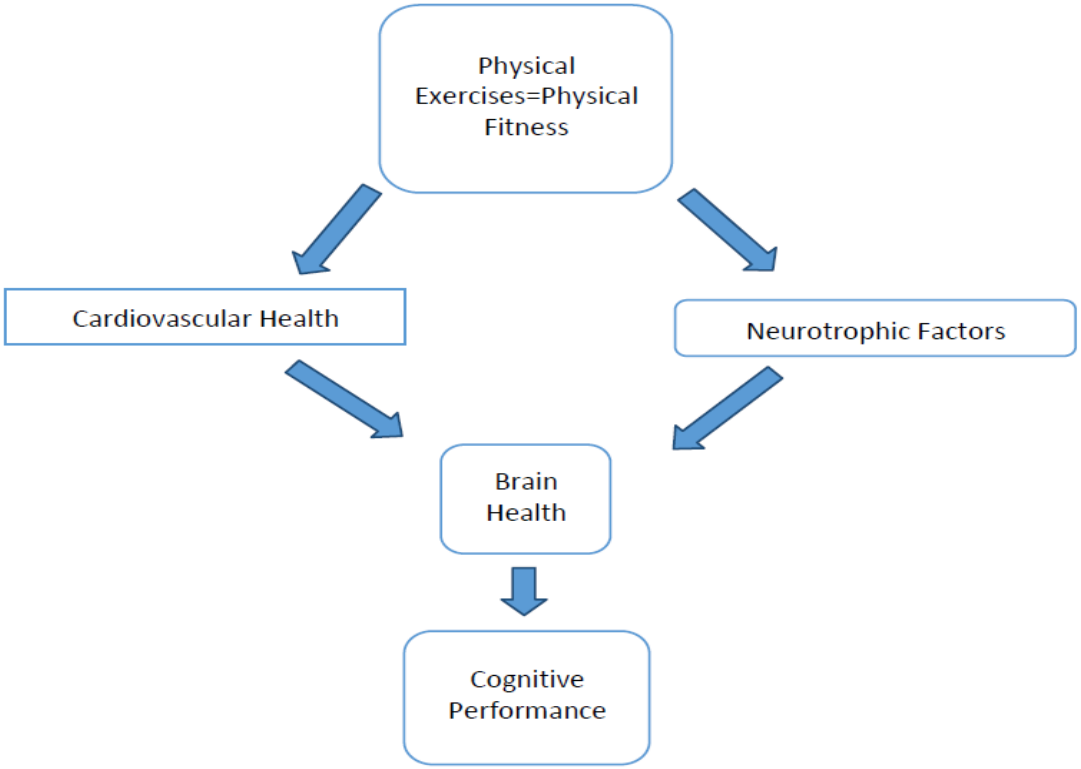
Cognitive function is a broad term which refers to ability to processing of acquired knowledge, manipulation and reasoning of the information perceived by the individual, by means of language, perception, memory, learning, attention and decision making. Normal aging is accompanied by alterations in brain structure and function, and associated with hallmark of cognitive changes. Human brain begins to atrophy in the third decade of life, and there is disproportionate age-related atrophy in the frontal, parietal, and temporal regions.**[1]**

Normal age-related changes in executive function include decline in tasks that involve attention-switching (multitasking), difficulty in instrumental activities of daily living, slower response times, reduced speed of information processing, and reduced inhibitory control. Executive functions rely heavily on the frontal cortex, and the volume and function of this brain region declines and Language comprehension, particularly for complex text, is reliant on working memory, which also declines with normal aging.[2]

In fact, brain atrophy in key regions appears to occur prior to detectable cognitive changes. In Mild cognitive disorders, low perfusion appears in the left putamen, globus pallidus, left insula, left posterior cingulate gyrus, right parahyppocampal gyrus and cuneus, etc. Whereas decreased perfusion in local cerebral regions becomes a cause of declined cognitive functions as such, increases in cerebral perfusion through exercise can improve cognitive functions. Exercise enhanced neuroplasticity might help neural circuits spared, or less affected by a disease to compensate for deteriorated circuits and improve other network performance and overall neurological function. Exercise has been shown to appear responsible for significant improvement in learning and memory function, therefore exercise is presented as an effective method to improve brain functions.[3]

The Mini-Mental State Exam (MMSE) is a widely used test of cognitive function among the elderly; it includes tests of orientation, attention, memory, language and visual-spatial skills scored on a scale of 0-30.[4] The Montreal Cognitive Assessment (MoCA) was designed as a rapid screening instrument for mild cognitive dysfunction. It assesses different cognitive domains: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation with score of 30 points.[5]

In the course of normal aging, the human brain begins to lose tissue early in the third decade of life. Average losses are estimated at roughly 15% of the cerebral cortex and 25% of the cerebral white matter between ages 30 and 90, with disproportionately high losses in the frontal, parietal, and temporal cortices. This pattern is closely matched by declines in cognitive performance throughout this period. Colcombe et al. stated aerobic fitness training appears to have an association with reduced brain tissue loss in aging humans.[6]



Flow Chart 1: Physiology of Cognitive Performance in older adults.

Aerobic exercise training has been known to have an important role in improving cognition, cardiovascular fitness and other health outcomes by breaking vicious cycle of physical inactivity and functional decline and the advantages of being simple, convenient, efficient and inexpensive and without severe adverse effects.

R.Martland et al indicate that increased cerebral O2 may be responsible for an enhancement of cognitive function after aerobic training. Physical exercise has been described as an efficient modulator of the health status through increased mitochondrial bioenergetics, adenosine triphosphate (ATP) synthesis, and reduced lipogenesis, reactive oxygen species (ROS) production, endoplasmatic reticulum stress, and proinflammatory cytokine production such as tumor necrosis factor alpha (TNF-α). Physical exercise is able to promote neuroprotection and also it can influence the production of neurotrophic factors providing improvements in brain functionality, through signaling, growth, and cell differentiation.[7]

AIM OF THE STUDY

AIM: To know the effectiveness of Aerobic Exercises on Cognitive Function in Elderly.

OBJECTIVE OF THE STUDY

OBJECTIVE: To Evaluate the effectiveness of Aerobic Exercises on Cognitive Function in Elderly.

MATERIALS AND METHODOLOGY

STUDY SETTING: Outpatient department of Sims College of physiotherapy, Guntur.
STUDY DESIGN: Experimental study.
STUDY DURATION: 1 year.
TREATMENT DURATION: 9 WEEKS (1 session per day, 3 times per week, 45 minutes).
SAMPLING METHOD: Convenient sampling method
SAMPLE SIZE: 15 subjects.

MATERIALS USED

- Stool
- Stationary bicycle
- Stop watch
- Consent form

INCLUSION CRITERIA

1. Age above 55 years
2. Both Male and Female participants who are willing to cooperate.
3. Not objectively cognitive impaired in anyway greater than expected from age alone
4. Adequate Visual and auditory equity

5. Participants MMSE score less than 26

EXCLUSION CRITERIA

1. History of Stroke, Head Injuries
2. Depression, Alzheimer's, Schizophrenia, bipolar disorders
3. Diagnosed or Under Medical Attention Dementia or any neurodegenerative diseases other than age related atrophy
4. Uncontrolled Hypertension
5. Any significant metabolic syndrome or systemic illness

OUTCOME MEASURES

MINI MENTAL STATE EXAM: The Mini-Mental State Exam (MMSE) is a widely used test of cognitive function among the elderly; it includes tests of orientation, attention, memory, language and visual-spatial skills is scored on a scale of 0-30.

MONTREAL COGNITIVE ASSESSMENT: The Montreal Cognitive Assessment (MoCA) was designed as a rapid screening instrument for mild cognitive dysfunction assesses different cognitive domains: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation is scored on scale 30 points.

PROCEDURE

The study and method of testing was well explained to all participant, to prevent fear and apprehension, after obtaining informed consent from them individually, 15 subjects were recruited based on inclusion criteria and exclusion criteria who were of age above 55 years will be taken for this study. All the subjects were assessed for their cognitive function by mini mental state examination (MMSE) and Montreal cognitive assessment (MOCA) test before the treatment and the date is recorded on the first day of the study as Pre test score and then participants were given aerobic exercises.

The aerobic exercises consist of three sub sections, the session begun with 10 minutes of warm-ups followed by 30 minutes of interval training and ended with 5 min of cool down exercises. The principle of interval training was to alternate between the periods of exercise and active recovery.

The warm ups were given for 10 minutes which consists of slow walking or brisk walking without any speed factor, participant can walk on own speed on a flat surface with shoes on. The interval training is given for 30 minutes which consists of stationary bicycling. The cool down exercises are same as that of warms up exercises that is slow walking or brisk walking, which are performed for 5 minutes. The exercise intensity was being set for 65% -75% of the intensity for the maximum heart rate. The exercises were given for three times a week for nine weeks.[8]

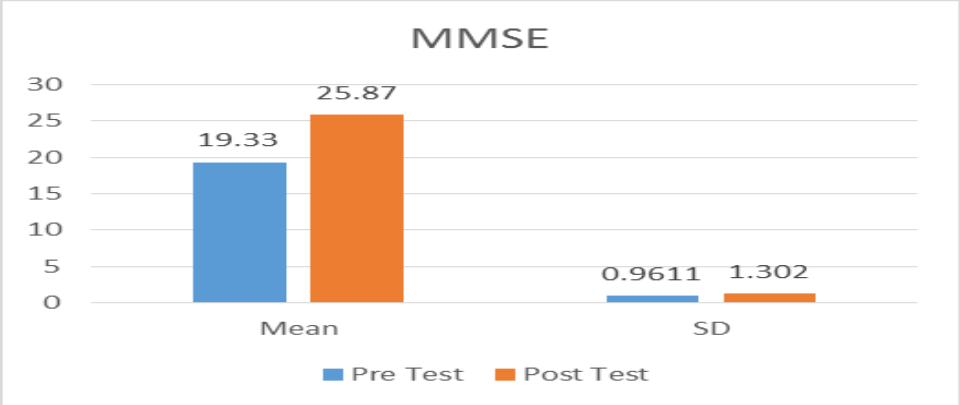
At the end of the 9th week after the completion of treatment protocol, the subjects were again assessed for cognitive function using mini mental state examination and montreal cognitive assessment test and the data has to be recorded and analysed for outcome results.

STATISTICAL ANALYSIS AND RESULTS

Statistical analysis was performed using MS excel. The demographic data like standard deviation and mean difference percentage were calculated and presented. Paired t- test was performed. The analysis was carried out using statistical tests, for the outcomes measures Mini Mental State Exam and Montreal Cognitive Assessment. The statistical significance was set at P< 0.05 with 94% confidence intervals.

Table 1: Analysis of Pre and Post-test mean values of MMSE (Mini Mental State Exam).

MMSE	Mean	N	Std.Deviation	T value	P value	Inference
Pre test	19.33	15	0.9611	-13.780	<0.0001	Highly significant
Post test	25.87	15	1.3020			

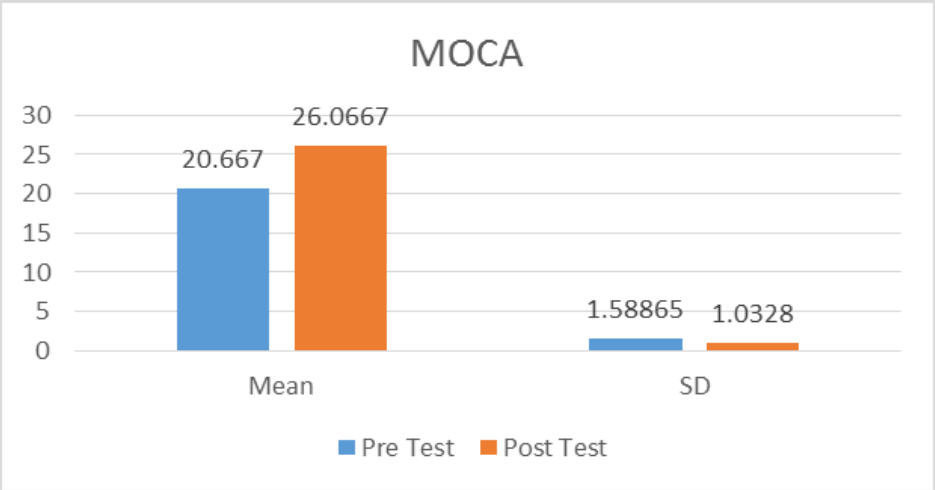


Graph 1: Mini Mental State Exam.

Results: The above table and graph shows mean values changes within the group from pre and post test in mini mental state examination were found to be statistically significant ($p<0.0001$).

Table 2: Analysis of Pre and Post-test mean values of MOCA (Montreal Cognitive Assessment).

MOCA	Mean	N	Std.Deviation	T value	P value	inference
Pre test	20.667	15	1.58865	-14.895	<0.0001	Highly significant
Post test	26.0667	15	1.03280			



Graph 2: Montreal Cognitive Assessment.

Results: The above table and graph shows mean values changes within the group from pre and post test in moca were found to be statistically significant ($p<0.0001$).

DISCUSSION

15 Participants of age 55 above with cognitive impairment of mild level based on MMSE and MOCA were recruited in this study who fulfilled the inclusion criteria. Informed consent will be obtained from all the subjects. Participants were initially assessed by MOCA and MMSE are baseline evaluation on 1st day of treatment, each participant were undergoing aerobic exercises, which includes 10 minutes of warm-ups followed by 30 minutes of interval training with exercises intensity was been set for 65% -75% of the intensity for the maximum heart rate and ended with 5 min of cool down exercise for three times a week for nine weeks.

This study shows that, there was a significant improvement of cognitive ability on MMSE measurement after the aerobic intervention, that is Mean value of MMSE Data is increased from 19.9333 to 26.87 with p value of 0.00 which is highly significance on Paired t test statistical Analysis and the mean value ofMOCA Data is increased from 20.667 to 26.0667 withp value of 0.00 on Paired t test statistical Analysis.

The results from this study, which shows improvement in cognitive ability were assumed to accept that exercises induces brain neural plasticity and neural protection, which were similar to the research done by Cotman and Berchtold et al stated that the exact mechanisms how exercises improve cognitive function were unclear, but they assume that it is likely by the multiple physiological mechanisms which lead to preservation and improvement in brain health and function.[9]

Jonasson et at 2017, were they found aerobic exercise superior to the conventional treatment in a comparative study including 58 participants. And similar to the work done byGill et al 2016, were they found exercise group shows better cognitive improvement on MMSE and MOCA measurement.[10]

by a cognitive score, compared to individuals assigned to stretching and toning control training This study shows the influence of aerobic exercise on cognitive performance, and brain structures derived using Freesurfer. We observed that sedentary older adults randomly assigned to aerobic exercise exhibited a broad improvement in cognitive performance, reflected.[11]

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Mahncke et al stated that elderly subjects with normal cognitive function had enhancement of memory following an intensive, plasticity-based computer training program. Physical exercise promotes positive neuroplasticity, increases cognitive reserve and higher

neuronal connection density, and results in improved cognitive function.[13,14]

In the present study, based on the results of many previous studies indicating that exercise and physical activities positively affects elderly persons. It has been said that in senescence, cognitive functions rapidly decrease as ages increase and that whereas the atrophy of the frontal lobe and the prefrontal lobe is a prominent characteristics of brain function declines in the process of aging, exercise activates the functions of the frontal lobe, in particular, the prefrontal lobe and the hippocampus. For this reason, exercise is presented as an effective method to improve brain functions.[15-19]

In the present study, aerobic exercises using fixed cycles for nine weeks improved the elderly persons' cognitive functions. These results can be reference data for exercise methods for improving elderly persons' cognitive functions and will be helpful in preventing declines in elderly persons' cognitive functions.[20]

Exercise is a preferred non-pharmacotherapy treatment option due to its wide range of positive effects, fewer side effects, and low economic burden.

CONCLUSION

Individuals in this study participated in 9 weeks' intervention period of aerobic exercises. After the intervention, the study showed that aerobic exercises have shown better improvement in cognitive function on MoCA and MMSE measurement.

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