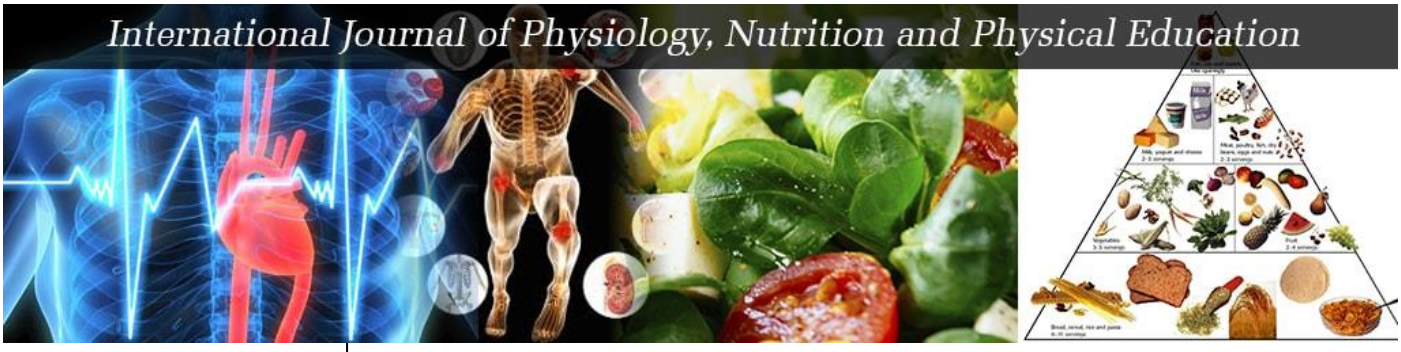

ISSN: 2456-0057
IJPNPE 2022; 7(1): 237-240

www.journalofsports.com
Received: 19-01-2022
Accepted: 22-02-2022

Priyush Kumar UK
Research Scholar,
Department Of Physical Education, University Of Kerala
Thiruvananthapueram, Kerala, India

Dr. Razeena KI
Professor & HOD, Department of Physical Education,
Iqbal College, Peringammala,
Trivandrum, Kerala, India

Corresponding Author:
Priyush Kumar UK
Research Scholar,
Department Of Physical Education, University Of Kerala
Thiruvananthapueram, Kerala, India

Effect of aerobic training on visual attention and Meta-cognition

Priyush Kumar UK and Dr. Razeena KI

DOI: https://doi.org/10.22271/journalofsport.2022.v7.i1d.2471

Abstract
The present study investigated the effect of Aerobic Training on Visual Attention and Meta-cognition. For the purpose of which a 7 week aerobic based exercise intervention was given on a subject population of 16 (n=16) male participants within the age range of 19-23 years randomly divided into two groups (n=8 each). The intervention group was trained in aerobic training in progression for 7 weeks with 3 days a week sessions and 1hrs per session which included Warm-up and Warm-down sessions before and after the beginning of the training intervention respectively, whereas the waitlist control group did their regular activities. To measure their visual attention and Meta-cognition level, TMT- (Trail A) and MAI-1994 with a revised five-point likert-rating scale was used. Data was collected in the beginning (pre training test), after 7 weeks of training (post training test). The intensity of the aerobic training was progressively increased based on the principles of aerobic training by Dr. Hardiyal Singh. The analyses revealed a significant improvement in the Attention level of the experimental group $t(7) = 4.73$, $p < .05$, the mean and SD of the experimental group pre-test was 24.00±1.85 and post-test was 22.00±1.84. In contrast the control group did not show any improvement in their attention level $t(7) = .129$, $p > .05$, the mean and SD of the control group pre-test was 24.37±1.84 and post-test was 24.25±1.98. Similarly a significant difference was also found in the Meta-cognition level of the experimental group $t(7) = -7.514$, $p < .05$, the mean and SD of the experimental group pre-test was 2.81±.84 and post-test was 4.18±.79; and no difference was found in the control group $t(7) = -1.528$, $p > .05$.Hence, It is recommended by the author that 7 week aerobic training programme can increase visual attention level and meta-cognition level of young adults between age ranges of 19-23 years.

Keywords: aerobic training, visual attention, meta-cognition

Introduction
In order to have energetic, healthy and fruitful life, human beings need to maintain good or optimal physical and mental health, for which various types of physical activities play a foremost important role. Any activity that results in energy expenditure above the resting level can be categorised under the term physical activity (US Department of Health and Human Services, Centres for Disease Control and Prevention, National Centre for Chronic Disease Prevention and Fitness, President's Council on Physical Fitness, 1998). Maintaining a physically active lifestyle is not only associated with maintaining a positive health, but also benefits in greater development of brain's functions, especially cognitive functions (Carral and Perez, 2007; Ruscheweyh *et al*., 2011) [8, 19]. For maintaining optimal health and fitness it is recommended that individuals should engage in low or Moderate-intensity exercise training for ≥30 min/day for ≥5 days/week or High intensity training for ≥20 min/day for ≥3 days/week or can also combine both (Garber *et al*., 2011) [14]. The low and Moderate-intensity exercise literally means exercising at sub-maximal loads (workload), for which the energy is supplied by the Aerobic system. So, it is also known as aerobic activities or exercises. Specifically speaking, any activity which requires the presence of oxygen for execution of movements can be termed as an aerobic activity. The aerobic system in order to create ATP (Adenosine tri-phosphate) uses oxygen along with fats, carbohydrates and proteins. ATP is a heterogeneous organic compound which provides energy to drive much process in living cells (Knowles JR; 1980) [15]. Low to moderate intensity exercise are categorised under aerobic exercises (Plowman and Smith; 2007) [18]. Aerobic activities results in increased metabolic demand for oxygen by the body, which results in increased blood flow, increased capillary density,

increased size and density of mitochondria, increased fat metabolism and thermoregulation.

Evidences suggest that aerobic exercise training improves blood flow to brain regions and improves cardio respiratory fitness (Tomoto *et al*., 2021) [24].

Visual Attention and Meta-cognition are two important aspect of Cognition (cognition is the mental processes of gaining knowledge and understanding by means of experiences and thoughts). Where Attention is the cognitive process of selectively focusing on relevant information excluding other irrelevant information's (Anderson JR, 2004) [4] in which visual attention is selectively processing visual information through prioritization of an area within the visual field (Dosher and Lu, 2013) [12] and Meta-cognition is being aware of one's own thoughts and understanding the mechanism behind them (Metcalfe and Shimamura, 1994) [17]. In an individual's life Attention and Meta-cognition plays an important role starting from doing their daily chores to complex sporting activities.

Influence of Aerobic Activities on Different Brain Regions

Aerobic activity is considered as a powerful stimulant for improving an individual's mental health and also aids in generating structural changes in the brain regions (frontal, parietal, temporal, occipital etc.) (Thomas *et al*., 2012) [26]. Earliest studies conducted on animals have found that physical activity produces specific changes in the brain regions which are different from that produced by learning or new experiences (Black *et al*., 1990). Recent studies carried out using humans as subjects undoubtedly provides enough evidence that physical activities of any kind exerts powerful effect on brain (Thomas *et al*., 2012) [26], in which studies have shown that hippocampus is one of the brain regions sensitive to the effect of physical activity intervention especially to aerobic activities (Cotman *et al*., 2007) [11]. There is also evidence of greater changes (increase or decrease) in Grey and White matter (Maass *et al*., 2015; Burzynska *et al*., 2017) [16, 6]. Human research has shown that physical exercise intervention especially aerobic interventions exert great impact on attention (Verstynen *et al*., 2012; Cardoso and Taufik, 2016; Chaire *et al*., 2020) [29, 7, 10] and meta-cognition (Alvarez-Bueno C *et al*., 2016, 2017) [3].

Materials and Methods

A total of 16 male subjects (N=16) were shortlisted from two local residential association of in Trivandrum district; the subjects were selected on the basis of the following criteria's, i.e. should be physically fit, between the age range of 19-23 years and should not have any cardio vascular related problem. The data regarding their health and other things were collected from their parents before the commencing of the training. The author requested the parents also to be a present at the time of the training; the subjects and their parents were briefed in details about the aim, objectives and nature of the study. The subjects were divided into two groups randomly, Group-I (intervention group) and Group-II (waitlist control group). The pre-test/post-test control group design was used (randomised controlled trial) as the research design.

The intervention group was trained in aerobic training in progression for 7 weeks with 3 days a week sessions and 1hrs per session which included Warm-up and Warm-down sessions before and after the beginning of the training intervention respectively. During the first two week the intervention group (Group-1) did brisk walking and the rest of the weeks did slow Continues running as the training intervention. The waitlist control group (Group-2) did their regular day-to-day activities; the author had no control over the daily playing habits of the subjects. The training plan of the Intervention group is mentioned below. The intensity was monitored using commercially available heart rate monitors which were correlated before the commencing of the study using test-retest method (the heart rate was counted manually then correlated with the readings of the heart rate monitor). The formula used for measuring WHR (working heart rate); 220-Age=MHR (Max. heart rate) WHR=MHR-RHR; where the subjects were asked to measure the RHR (resting heart rate) early morning after waking up in the presence of their parents. Intensity was calculated WHR multiplied by earlier decided intensity (65%, 70% etc.) + RHR (eg: 220-12=208-70=138; 138×65%=89.7+70=159, so 159 bpm is the decided heart rate for that session). The aerobic training intensity was decided after referring to the book of Dr. Hardayal Singh (science of sports training).

The aerobic training intensity was decided after referring to the book of Dr. Hardayal Singh (science of sports training).

Week	Days	Time	Intensity
I	Monday	20 min.	65%
	Wednesday	20 min.	70%
	Friday	20 min.	75%
II	Monday	22 min.	65%
	Wednesday	22 min.	70%
	Friday	22 min.	75%
III	Monday	24 min.	65%
	Wednesday	24 min.	70%
	Friday	24 min.	75%
IV	Monday	26 min	65%
	Wednesday	26 min.	70%
	Friday	26 min.	75%
V	Monday	28 min	65%
	Wednesday	28 min.	70%
	Friday	28 min.	75%
VI	Monday	30 min.	65%
	Wednesday	30 min.	70%
	Friday	30 min.	75%
VII	Monday	35 min.	65%
	Wednesday	35 min.	70%
	Friday	35 min.	75%

Tools Used

In Visual attention was measured using Trail Marking Test (TMT trial-A). The Trail Making Test is a visual attention and task switching neuropsychological test; the test can provide information on visual search speed, scanning, processing speed, mental flexibility, and executive functioning. It is divided into two parts (Arnett and Seth, 1995) [1]. Ralph Reitan introduced the test in 1944; the test requires a subject to connect a sequence of 25 consecutive targets on a sheet of paper, the subject has to connect the dots in a sequence and the total time to complete the test is recorded (Tombaugh, 2004) [25].

Meta-cognition was measured using Meta-cognition Awareness inventory (MAI). The MAI was originally constructed by Schraw and Dennison in 1994, MAI constitutes of 52 questions which are originally scored in a true/false scale, but the scoring followed in this study is from the updated MAI with the likert-scale (Terlecki and McMohan, 2018) [23], further the total score from the inventory is divided by 52 creating a scale that ranges from 1 to 5 (Tosum and Senocak, 2013) [27]. The data was computed using SPSS 21.0 and the statistical intervention used was 'T' test, Mean and S.D.

Result

Table 1: Mean, SD, T and P value of Experimental and Control group on Attention and Meta-Cognition, before and after 8 weeks of Training

Attention		Mean	SD	T	P
Experimental group	Pre-test	24.00	1.85	4.73	.002
	Post-test	22.00	1.30		
Control Group	Pre-test	24.37	1.84	.129	.901
	Post-test	24.25	1.98		
Meta-Cognition Experimental group	Pre-test	2.81	.84	-7.514	.000
	Post-test	4.18	.79		
Control Group	Pre-test	2.87	.95	-1.528	.170
	Post-test	3.00	.84		

The analyses revealed a significant improvement in the Attention level of the experimental group $t(7) = 4.73$, $p < .05$, the mean and SD of the experimental group pre-test was 24.00±1.85 and post-test was 22.00±1.84. In contrast the control group did not show any improvement in their attention level $t(7) = .129$, $p > .05$, the mean and SD of the control group pre-test was 24.37±1.84 and post-test was 24.25±1.98. Similarly a significant difference was also found in the Meta-cognition level of the experimental group $t(7) = -7.514$, $p < .05$, the mean and SD of the experimental group pre-test was 2.81±.84 and post-test was 4.18±.79; and no difference was found in the control group $t(7) = -1.528$, $p > .05$, the mean and SD of the control group pre-test was 2.87±.95 and post-test was 3.00±.84.

Discussion

The purpose of this study was to assess the effect of aerobic training on visual attention and meta-cognition. 16 subjects were randomly selected and divided into two groups (Control n=8 and experimental n=8). Their age ranged from 10 – 13 years. To measure their visual attention and Meta-cognition level, TMT- (Trail A) and MAI-1994 with a revised five-point likert-rating scale was used. Data was collected in the beginning (pre training test), after 5 weeks of training (post training test). The experimental group underwent aerobic training thrice a week for seven weeks. The intensity was progressively increased based on the principles of aerobic training (Science of sports training, Hardayal Singh, 1991) [21]. The information regarding Visual attention was collected using TMT (Trial A) and Meta-cognition was collected using MAI-1994. The findings of the study suggests that a 7-weeks Aerobic training can significantly increase the Attention level and Meta-cognition level of children's between age range of 19-23 years. This may be due to the fact that aerobic activities has a variety of effects on the brain; It raises heart rate, which causes more oxygen to be delivered to the brain; It promotes the release of hormones, which create an ideal environment for brain cell growth; Exercise also promotes brain plasticity by stimulating the formation of new connections between cells in a variety of critical cortical areas of the brain (Ding Q et al, 2006) [13].

Conclusion

It is recommended by the author that aerobic training programme can increase visual attention level and meta-cognition level of young adults between age ranges of 19-23 years. If subjects of age range 19-23 are benefiting in increasing their visual attention through aerobic training then all type of people can benefit from it, as this is the age when most of the mental abilities have developed to a certain level, but it needs to be proved by conducting some more researches using a varied population and gender, and on people in different type of working environment and social class. Further the author feels that some more cognitively challenging activities can also be added along with the aerobic training in order to magnify the impact of the training.

Compliance with ethical standards

Funding

The author received No funding

Conflict of interest

The author declares that there is no conflict of interest.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Reference

1. Arnett James A, Seth S Labovitz. "Effect of physical layout in performance of the Trail Making Test". Psychological Assessment. 1995;7(2):220-221. doi:10.1037/1040-3590.7.2.220.
2. Álvarez-Bueno C, Pesce C, Cavero-Redondo I, Sánchez-López M, Martínez-Hortelano JA, Martínez-Vizcaíno V. The Effect of Physical Activity Interventions on Children's Cognition and Metacognition: A Systematic Review and Meta-Analysis. Journal of the American Academy of Child and Adolescent Psychiatry. 2017;56(9):729-738. https://doi.org/10.1016/j.jaac.2017.06.012
3. Alvarez-Bueno Celia, Pesce Caterina, Cavero-Redondo Ivan, Sánchez-López Mairena, Pardo-Guijarro María, Martinez Vizcaino Vicente. Association of physical activity with cognition, metacognition and academic performance in children and adolescents: A protocol for systematic review and meta-analysis. BMJ Open. 2016;6:10. 1136/bmjopen-2016-011065.
4. Anderson JR. Cognitive Psychology and Its Implications (6th ed.). Worth Publishers. 2004, 519. ISBN 978-0-7167-0110-1.
5. Black JE, Isaacs KR, Anderson BJ, Alcantara AA, Greenough WT. Learning causes synaptogenesis, whereas motor activity causes angiogenesis, in cerebellar cortex of adult rats. Proc. Natl. Acad. Sci. U.S.A. 1990;87:5568-5572. 10.1073/pnas.87.14.5568.
6. Burzynska AZ, Finc K, Taylor BK, Knecht AM, Kramer AF. The Dancing Brain: Structural and Functional Signatures of Expert Dance Training. Frontiers in human neuroscience. 2017;11:566. https://doi.org/10.3389/fnhum.2017.00566.

7. Cardoso Cassilhas, Ricardo, Tufik, Sergio, De Mello, Marco. Physical exercise, neuroplasticity, spatial learning and memory. Cellular and molecular life sciences: CMLS. 2016;73:10. 1007/s00018-015-2102-0.
8. Carral JMC, Pérez CA. Effects of high-intensity combined training on women over 65. Gerontology. 2007;53(6):340-346. https://doi.org/10.1159/000104098.
9. Cassilhas RC, Viana VA, Grassmann V, Santos RT, Santos RF, Tufik S *et al*. The impact of resistance exercise on the cognitive function of the elderly. Medicine and science in sports and exercise. 2007;39(8):1401-1407. https://doi.org/10.1249/mss.0b013e318060111f.
10. Chaire Alondra, Becke Andreas, Duzel Emrah. Effects of Physical Exercise on Working Memory and Attention-Related Neural Oscillations. Frontiers in Neuroscience. 14. 239. 10.3389/fnins.2020.00239.
11. Cotman CW, Berchtold NC, Christie LA. Exercise builds brain health: key roles of growth factor cascades and inflammation. Trends in neurosciences. 2007;30(9):464-472. https://doi.org/10.1016/j.tins.2007.06.011.
12. Dosher BA, Lu ZL. Mechanisms of visual attention. In C. Chubb, B. A. Dosher, Z.-L. Lu, & R. M. Shiffrin (Eds.), Human information processing: Vision, memory, and attention, 2013, pp. 149-164. American Psychological Association. https://doi.org/10.1037/14135-010.
13. Ding Q, Vaynman S, Akhavan Maziar M, Ying Z, Gomez-Pinilla F. Insulin-like growth factor I interfaces with brain-derived neurotropic factor-mediated synaptic plasticity to modulate aspects of exercise-induced cognitive function. Neuroscience. 2006;140:823-33. 10.1016/j.neuroscience.2006.02.084.
14. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, *et al*. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. Medicine and science in sports and exercise. 2011;43(7): 1334-1359. https://doi.org/10.1249/MSS.0b013e318213fefb.
15. Knowles JR. Enzyme-catalyzed phosphoryl transfer reactions. Annual review of biochemistry. 1980;49:877-919. https://doi.org/10.1146/annurev.bi.49.070180.004305.
16. Maass A, Berron D, Libby LA, Ranganath C, Düzel E. Functional subregions of the human entorhinal cortex. eLife, 2015, 4, e06426. https://doi.org/10.7554/eLife.06426.
17. Metcalfe J, Shimamura AP (Eds.). Metacognition: Knowing about knowing. The MIT Press, 1994. https://doi.org/10.7551/mitpress/4561.001.0001.
18. Plowman Sharon, Smith Denise. Anaerobic Metabolism during Exercise Exercise physiology for health, fitness, and performance. Sports-Specific Rehabilitation, 2007; 39-63. 10.1016/B978-044306642-9.50006-X.
19. Ruscheweyh R, Willemer C, Krüger K, Duning T, Warnecke T, Sommer J, *et al*. Physical activity and memory functions: an interventional study. Neurobiology of aging. 2011;32(7):1304-1319. https://doi.org/10.1016/j.neurobiolaging.2009.08.001.
20. Schraw G, Dennison RS. Assessing metacognitive awareness. Contemporary Educational Psychology. 1994;19(4):460-475. https://doi.org/10.1006/ceps.1994.1033.
21. Singh Hardayal. "Science of sports training". D.V.S. publications, Girinagar, Kaikaji, New Delhi-110019 (India), 1991.
22. Smith JC, Nielson KA, Woodard JL, Seidenberg M, Verber MD, Durgerian S, *et al*. Does physical activity influence semantic memory activation in amnestic mild cognitive impairment?. Psychiatry research. 2011;193(1): 60-62. https://doi.org/10.1016/j.pscychresns.2011.04.001.
23. Terlecki M, McMahon A. A call for metacognitive intervention: Improvements due to curricular programming and training. Journal of Leadership Education, 2018, 17(4). doi:10.12806/V17/I4/R8.
24. Tomoto T, Liu J, Tseng BY, Pasha EP, Cardim D, Tarumi T, *et al*. One-Year Aerobic Exercise Reduced Carotid Arterial Stiffness and Increased Cerebral Blood Flow in Amnestic Mild Cognitive Impairment. Journal of Alzheimer's disease: JAD. 2021;80(2):841-853. https://doi.org/10.3233/JAD-201456.
25. Tom N. Tombaugh, Trail Making Test A and B: Normative data stratified by age and education, Archives of Clinical Neuropsychology, Volume 19, Issue 2, March 2004, 203-214. https://doi.org/10.1016/S0887-6177(03)00039-8.
26. Thomas Adam, Dennis Andrea, Bandettini Peter, Johansen-Berg Heidi. The Effects of Aerobic Activity on Brain Structure. Frontiers in psychology. 2012;3:86. 10.3389/fpsyg.2012.00086.
27. Tosun Cemal, Senocak Erdal. The Effects of Problem-Based Learning on Metacognitive Awareness and Attitudes toward Chemistry of Prospective Teachers with Different Academic Backgrounds. Australian Journal of Teacher Education, 2013, 38. 10.14221/ajte.2013v38n3.2.
28. US Department of Health and Human Services, Centres for Disease Control and Prevention, National Centre for Chronic Disease Prevention and Fitness, President's Council on Physical Fitness, 1998. https://www.cdc.gov.in/nccdphp/srg/index.htm.
29. Verstynen TD, Lynch B, Miller DL, Voss MW, Prakash RS, Chaddock L, *et al*. Caudate nucleus volume mediates the link between cardiorespiratory fitness and cognitive flexibility in older adults. J Aging Res. 2012, 939285. doi:10.1155/2012/939285.