JK SCIENCE pISSN: 0972-1177

ORIGINAL ARTICLE

Intelligence, Stress and Cognitive Functions Assessment after three months Practice of Moderate Intensity Physical Exercise

Mohita Singh[1], Sunil Sachdev[2], Dev Raj[3]

Abstract

Background : Aerobic exercises produce lasting effect on higher brain functions and promote positive changes in one's mental health, intelligence, cognitive functions like memory, attention and ability to develop better strategies to cope with stressful encounters. Present study was designed to explore the role of three months practice of aerobic exercise on intelligence level, cognitive functions and stress parameters. **Material and Method**: The study was conducted on 50 subjects for three months duration to assess stress reactivity in subjects with varying level of general intelligence (GI) and emotional intelligence (EI). The effect moderate intensity physical exercise (MIPE) was assessed on GI, EI, stress parameters, cognitive functions and the data obtained was compared with basal values recorded using standard scales. **Result:** There was significant improvement in IQ and cognitive functions after three months practice of MIPE. Acute stress, chronic stress as well as stress related parameters showed significant improvement post exercise intervention. **Conclusion:** MIPE improved individual's level of GI, reduced stress parameter values and improved memory and attention concentration span.

Key Words

General Intelligence, Emotional Intelligence, Cognitive Functions, Stress Response, Physical Exercise

Introduction

Human intelligence is the intellectual prowess of humans which is marked by high cognition, motivation and self-awareness. [1] There are four basic levels of emotional intelligence namely awareness of emotions developed in early childhood; mental processing of emotions and the ability to incorporate emotional experiences into general awareness; to understand and reason about emotions including how and why they develop; and to manage and regulate emotions. [2] Stress can be acute time limited stress (involve short term challenges), brief naturalistic stress (an event that is normal but nevertheless challenging), stressful event sequence (that continue to yield stress into the immediate future), chronic stress (exposure to long term stressor), and distant stress (that is not immediate). [3]

Department of Physiology[1, 2] , Department of Community Medicine[3]
Government Medical College Jammu
Correspondence to: Dr Mohita Singh, Department of Physiology, Government Medical College Jammu
Manuscript Received: 17.01. 2022; **Revision Accepted**: 4.3. 2022;
Published Online First: 10 Oct, 2022
Open Access at: https://journal.jkscience.org

Cite this article as: Singh M, Sachdev S, Raj D. Intelligence, Stress and Cognitive Functions Assessment after three months Practice of Moderate Intensity Physical Exercise . JK Science 2022;24(4):221-224

Moderate to vigorous intensity exercise is an effective method for improving perceived stress, stress symptoms and quality of life. [4] Academic performance involving memory and cognitive functions is strongly related with aerobic exercises and that the cardiovascular fitness has the strongest association. [5]

Each individual reacts differently to same type of stress that is shaped by our own experience and genetic makeup. Does three months practice of exercise effects general and emotional intelligence? Does stress response changes with practice of MIPE? Does three months exercise effects higher cognitive functions? To answer these intriguing questions, present study was designed to explore the effect of three months exercise on intelligence, stress and cognition.

Material and Method

The present study was carried out at GMC Jammu after taking ethical clearance from the Institutional Ethics Committee of GMC Jammu, J&K, India vide no. IEC/ Pharma/ Thesis/ Research/ T7B/ C/ 2017/ 436 dated 26/ 10/2017. The subjects were briefed about the study and informed written consent for participation was taken. Each subject served as his own control. Only educated volunteers were chosen for the reasons that adequate educational background is required for filling of questionnaires and visual time reaction measurements. All the experiments were done in forenoon to minimize the diurnal variations in cortisol level. Only male subjects were chosen because females have different levels of stress and stress reactivity during different phases of menstrual cycle.

The study was conducted on 50 healthy male volunteers for three months duration in age group of 20 - 30 years. Subjects already involved in physical activity and with past or present significant history, psychiatric illness, CNS disorder, drug or alcohol abuse and any other known medical conditions were excluded.

Basal parameters of IQ, EQ, chronic stress, acute stress, cognitive tests and stress parameters (PR, BP, handgrip, serum cortisol) were assessed. Effect of three months practice of MIPE was assessed on all parameters.

Serum cortisol was assessed via ADVIA centaur cortisol assay. [6] Handgrip dynamometer [7] was used for IHG measurement. Scales used were Wechsler Adult Performance Intelligence Scale, Indian adaptation version [8] for IQ; N.S. Schutte Emotional Intelligence Scale [9] for EQ; Acute stress questionnaire [10] for acute stress and Sheldon Cohen Perceived Stress Scale [11] for chronic stress. For moderate intensity physical exercise (MIPE), subjects were instructed to walk briskly at the rate of 4 mph [12] for 30 minutes a day for five days a week (150 minutes a week). [13]

Statistical analysis

Comparison of pre-exercise and post-exercise mean data was done by student t-test. Wilcoxon sign- rank test was used for EQ, AS, PS scores. The results were computed as significant at $p < 0.05$ level (*), more significant at $p < 0.01$ level (**) and highly significant at $p < 0.001$ level (***).

Results

The effect of three months practice of MIPE was analysed on intelligence and stress parameters as depicted in *Table 1.*

The effect of three months practice of MIPE was

Table 1. Effect of Three Months Practice of MIPE on Intelligence and Stress Parameters

S. No	Parameters	Baseline	Three month	p Value
1	IQ	110.16 ± 9.85	118.9 ± 7.79	0.000***
2	EQ	129.8 ± 13.1	132.1 ± 14.41	0.32
3	ASS	44.44 ± 16.92	29.5 ± 13.54	0.000***
4	PSS	18.42 ± 7.15	12.78 ± 6.02	0.000***
5	S. Cortisol	12.52 ± 3.78	11.94 ± 3.74	0.44
6	Pulse Rate	77.04 ± 4.43	73.12 ± 4.52	0.000***
7	BP			
(i)	SBP	118.96 ± 2.63	116.88 ± 2.30	0.000***
(ii)	DBP	76.12 ± 3.84	73.4 ± 3.53	0.000***
8	IHG	24.72 ± 3.91	20.32 ± 2.60	0.000***

IQ: intelligence quotient; EQ: emotional quotient; ASS: acute stress score; PSS: perceived stress score; PR: pulse rate (bpm); SBP: systolic blood pressure (mmHg); DBP: diastolic BP (mmHg); IHG: handgrip (mm Hg); Serum cortisol (µg/dl)

Table 2. Effect of Three Month MIPE on Cognitive Functions

S. No	Parameters	Baseline	Three month	p Value
1	Memory Test			
(i)	RMT	23.95 ± 3.9	18.22 ± 4.13	0.000***
(ii)	AC			
a	Score	38.1 ± 7.54	50.46 ± 6.22	0.000***
b	Time	203.82 ± 4.24	199.31 ± 3.70	0.000***
2	Stroop Test			
(i)	Neutral			
a	Score	64.74 ± 5.96	72.14 ± 5.61	0.000***
b	Time	859.48 ± 125.48	803.24 ± 103.09	0.01*
(ii)	Interference			
a	Score	73.94 ± 3.93	77.06 ± 4.21	0.000***
b	Time	893.84 ± 85.48	850.62 ± 87.75	0.01*
(iii)	Facilitation			
a	Score	77.08 ± 3.67	78.86 ± 5.4	0.05
b	Time	746.22 ± 125.45	705.80 ± 127.07	0.1912

RMT: recent memory time (sec); ACS: attention concentration score; ACT: attention concentration time (sec); STNS: stroop test neutral score; STNT: stroop test neutral time (ms); STIS: stroop test interference score; STIT: stroop test interference time (ms); STFS: stroop test facilitation score; STFT: stroop test facilitation time (ms).

analysed on cognitive functions as depicted in *Table 2*.

Discussion

Different levels of general and emotional intelligence and their differential combination is predictive of baseline stress reactivity. Aerobic exercises produces lasting effect on intelligence enhancement, mood upliftment, improvement in stress coping behaviour and also improves a large number of cognitive functions like attention, working memory, problem solving, decision making and verbal memory. In the present study, effect of three months practice of MIPE was assessed on intelligence, stress parameters and cognitive functions.

Present study reported significant decrease in resting pulse rate in post exercise period compared to basal value with results being similar to previous studies. [14] Both SBP and DBP showed significant decrease at resting level over basal values that were similar to the previous studies. [15]

Handgrip value exhibited significant reduction over basal value in present study. A study comparing long term aerobic exercise and isometric handgrip exercise stated that aerobic exercises led to significant reduction in DBP while no statistical significant changes were recorded with isometric handgrip exercise, proving that reduction in DBP and hence handgrip values in present study was due to effect of aerobic exercise. [16] Serum cortisol exhibited no significant change in present study. Statistically insignificant results were obtained in a study involving the effect of five weeks of moderate intensity aerobic exercise on serum cortisol level. [17]

Memory test exhibited significant decrease in RMT and ACT while ACS observed significant increase in the present study. Similar results of enhanced performance in attention concentration and cognitive abilities were obtained [18] with exercise promoting neurogenesis and plasticity in brain. [19] Significant and non significant results were obtained for various sub-tests of stroop test in the present study. Similar study reported significant improvement in reaction time on executive cognitive tasks i.e. Stroop incongruent (facilitation) and interference after moderate aerobic exercise that maybe possibly due to physiological adaptations through increase in fitness. [20]

Limitations of the study

A study for longer duration is needed for assessing the long term effects of MIPE on intelligence, stress and cognitive functions. The results of the study maybe specific to the type of subject chosen, individual variation in physical fitness and activities performed in daily routine.

Conclusion

It can be inferred that significant improvement in IQ and performance in cognitive function tests was due to physiological adaptations to exercise through increase in fitness, the results being long lasting.There was significant decrease in acute stress reactivity, chronic stress

reactivity and stress parameters indicating improvement in stress response.Overall there was no change in serum cortisol level and EQ. However, EQ exhibited dual response with tendency to increase signifying improvement in regulation of emotions. Three months practice of MIPE improves intelligence, has positive impact on cognitive functions and helps develop better stress coping strategies.

Financial Support and Sponsorship
Nil.

Conflicts of Interest
There are no conflicts of interest.

References

1. Tirri K and Nokelainen P. Multiple intelligence profiling questionnaire. In: Oser F, Vengelers W (eds):Measuring multiple intelligence and moral sensitivities in education. Sense Publishers, Boston 2011; 5: 1-13.

2. Mayer JD, Caruso DR, Salovey P. Selecting a measure of emotional intelligence: The case for ability scale. In Bar-On R, Parker JDA (eds): The Handbook of Emotional Intelligence. Jossey Bass, NY 2000: pp. 320-42.

3. Segerstrom SC, Miller GE. Psychological Stress and the Human Immune System: A Meta- Analytic Study of 30 years of Inquiry. Psychol Bull 2017; 130(4): 601-30.

4. Wilcox S, Dowda M, Leviton LC, Bartlett-Prescott J, Bazzarre T, Campbell-Voytal K, et al.Active for life-final results from the translation of two physical activity programs. Am J Prev Med 2008; 35(4): 340-45.

5. Van Dusen DP, Kelder SH, Kohl HW, Ranjit N and Perry CL. Association of physical fitness and academic performance among school children. J Sch Hlth 2011; 81(12): 733-40.

6. US Food and Drug Administration. Siemens centaur cortisol assay. Siemens HC, USA 2012; pp 1-12.

7. Van den Berg MP and Smit AJ. Bedside autonomic function testing in patients with vasovagal syncope. Pace Clin Electrophysiol 1997; 20: 2039-42.

8. Swami PR. Indian adaptation of Wechsler Adult Intelligence Scale Performance Scale. A Man India 1974; 115-18.

9. Schutte SN, Malouff MJ, Hall EL, Haggerty JD, Cooper TJ, Golden JC, et al. Development and validation of a measure of emotional intelligence. Pers Indiv Diff 1998; 25(2): 167-77.

10. Cardena E, Koopman C, Classen C, Waelde LC and Spiegel D. Psychometric properties of the Stanford Acute Stress Reaction Questionnaire (SASRQ): a valid and reliable measure of acute stress. J Traum Sts 2000; 13(4): 719-34.

11. Cohen S, Kamarck T and Mermelstein R. Global measure of Perceived stress. J Hlth Soc Behav 1983; 24(4): 385-96.

12. Haskell LW, Lee MI, Pate RR, Powell EK, Blair NS, Franklin AB, et al. Physical Activity and Public Health Updated Recommendation for Adults from the American College of Sports Medicine and the American Heart Association. Circu 2007; 116: 1081-93.

13. World Health Organization. The Global Recommendations on Physical Activity for Health. WHO Press, Geneva 2010; pp 16, 26.

14. Rennie KL. Effects of moderate and vigorous physical activity on heart rate variability in a British study of civil servants. Am J Epidemiol 2003; 158(2): 135-43.

15. King AC, Bauman K, O'Sullivan P, Wilcox S and Castro C. Effects of moderate intensity exercise on physiological, behavioural and emotional responses to family care giving: A randomized controlled trial. J Gerontol 2002; 57(1): 26-36.

16. Pagonas N, Vlatsas S, Bauer F, Seibert FS, Zidek W, Babel N, et al. Aerobic versus isometric handgrip exercise in hypertension: A randomized controlled trial. J Hypertens 2017; 35(11): 2199-206.

17. Grandys M. The effect of endurance training on muscle strength in young, healthy men in relation to hormonal status. J Physiol Pharmacol 2008; 59 (7): 89-103.

18. Stroth S, Hille K, Spitzer M and Reinhardt R. Aerobic endurance exercise benefits memory and affect in young adults. Neuropsychol Rehabil 2009; 19 (2): 223-43.

19. Vaynman S, Ying Z and Gomez PF. Hippocampal BDNF mediate the efficacy of exercise on synaptic plasticity and cognition. Eur J Neurosci 2004; 20(10): 2580-90.

20. Coetsee C andTerblanche E. The effect of three different exercise training modalities on cognition and physical function in healthy older population. Eur Rev Aging Phys Act 2017; 14:13.