e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2024; 16(1); 545-548

Original Research Article

Determining the Effect of Acute Bout of Moderate Exercise in Cognitive Processing in Young Women during Different Phases of Menstrual Cycle

Manoj Kumar Singh[1], Sheetal Kumari Gupta[2], H. P. Dubey[3]

[1]Tutor, Department of Physiology, Jawaharlal Nehru Medical College, Bhagalpur, Bihar, India

[2]Assistant professor, Department of Physiology, Jawaharlal Nehru Medical College, Bhagalpur, Bihar, India

[3]Professor and HOD, Department of Physiology, Jawaharlal Nehru Medical College, Bhagalpur, Bihar, India

Received: 15-11-2023 / Revised: 22-12-2023 / Accepted: 19-01-2024
Corresponding Author: Dr. Sheetal Kumari Gupta
Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to determine the effect of acute bout of moderate exercise in cognitive processing in young women during different phases of menstrual cycle.

Methods: It was a retrospective study conducted on 100 young, normally menstruating women with normal auditory capability in the Department of Physiology, Jawaharlal Nehru Medical College, Bhagalpur, Bihar, India . The study was conducted in a clinical physiology laboratory.

Results: There were significant changes in all cardiovascular parameters in post-exercise session in comparison to pre-exercise session in both phases of menstrual cycle. The P300 latency showed significant decrease in postexercise session when recorded at Cz as well as Pz position in both phases of menstrual cycle. However, P300 latency recorded at Fz position displayed no significant change at post- exercise session in comparison to pre-exercise session during both phases of menstrual cycle.

Conclusion: The present study concluded that an acute bout of moderate exercise caused significant decrease in latency of P300 ERP in the participants during both phases of menstrual cycle. That means even acute bout of moderate exercise enhances cognitive functioning of the individual.

Keywords: Phases of Menstrual Cycle, P300 Latency, Exercise

Introduction

The effects of an acute bout of physical activity on cognitive function are thought to depend on the type, duration, and intensity of the physical activity. Long duration aerobic and anaerobic exercise that lead to fatigue have been predicted to impede cognitive function; whereas, bouts of aerobic exercise performed at a moderate intensity over a relatively short period, have been predicted to facilitate cognitive function. [1] Empirical studies have been conducted that directly assess the immediate after effects of an acute bout of physical activity on cognitive function. The results of these studies, however, have been ambiguous. Several researchers have reported that acute bouts of moderate intensity aerobic exercise lead to improved cognitive function, while others have failed to corroborate these findings. [2,3] Several explanations have been proposed to explain discrepancies reported in studies that have examined the effect of an acute bout of physical activity on cognitive function. Arousal theory hypothesizes an inverted "U" relation between arousal and performance. According to Arousal Theory, the level of physiological arousal induced by exercise of different intensities will differentially influence cognitive function. Proponents of Arousal theory predict that cognitive performance will improve to an optimum level as exercise intensity increases to a certain point, after which cognitive performance begins to deteriorate.

Other theorists explain discrepant findings in terms of the relation between physical activity and performance on tasks that measure simple cognitive processing. The Additive Factors Model [4] has been used by researchers to trace and isolate specific cognitive processes. This model assumes that the flow of information travels through a series of independent and serial (non-overlapping) processing stages. These stages include basic information processes such as stimulus identification, response selection, and response initiation; all of which are considered lower-level cognitive processes. [5,6] Results from these types of studies have lead researchers to propose that the effects of physical activity differentially influence specific stages of information processing.

The latency of the P300 is used for stimulus classification and for evaluation of speed, with increased latency indicating longer processing time. [7] Earlier studies have observed increased amplitude and shorter latency, relative to a basal state, following single acute bouts of moderately intense exercise. [8] However, other researchers, examining a different aspect of cognition (other than cognitive P300), failed to demonstrate a beneficial effect of acute aerobic exercise. [9]

The aim of the present study was to determine the effect of acute bout of moderate exercise in cognitive processing in young women during different phases of menstrual cycle.

Materials and Methods

It was a retrospective study conducted on 100 young, normally menstruating women with normal auditory capability in the Department of Physiology, Jawaharlal Nehru Medical College, Bhagalpur, Bihar, India for one year . The study was conducted in a clinical physiology laboratory.

Each participant attended two laboratory sessions, one of which was in the early follicular phase (initial 3 days post-menstruation) and the other was in mid-luteal phase (days 21–24). Phases were determined by taking menstrual history. Both sessions were attended preferably at the same time of the day. The participants were requested to refrain from tea, coffee at least 2 h before laboratory session. They were asked to fill up Godin Leisure-Time Exercise Questionnaire (GLTEQ) to understand their leisure time exercise habit.9 The data collection pro forma was used to record information pertaining to anthropometric measurements, namely height, weight, body mass index (BMI), waist–hip ratio and detailed menstrual history, following which physiological parameters were recorded. Basal brachial artery systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured using mercury sphygmomanometer following standard protocol and mean arterial pressure (MAP), pulse pressure (PP) values were derived. Central BP and HR were recorded using USCOM BP+®. Following it, basal P300 was recorded. Afterwards, the subjects were asked to perform step test till they achieved 60–80% of their maximum heart rate (maximum heart rate = 220 – age) during exercise.10 The heart rate of the subjects was monitored following exercise by pulse oximeter and P300 ERP was recorded when their heart rate returned to basal value. At the end of exercise, the participants filled up Borg perceived exertion scale questionnaire. Recording and analysis of P300 ERP and stimuli Event-related potentials (ERPs) were recorded using Neuropack X1 MEB-2300K. Silver-silver chloride electrodes were placed on prescribed positions [A1, A2 (reference electrodes), FPz (ground electrode), Fz (medial frontal), Cz (medial central) and Pz (medial parietal) {active electrodes}] as per international 10–20 system on the subject's scalp after proper abrasion of the desired locations on the scalp. All the electrodes were connected to the designated slots in the jack box. The jack box was connected to amplifier of the recording instrument eventually. The impedances of all electrodes were kept below 5 kΩ. ERP signals were digitised at a sampling rate of 1000 Hz and were amplified (band pass, 0.1– 40 Hz). The participant was asked to use headphone as auditory stimuli were presented to her in 'odd ball paradigm' fashion. The subject was asked to respond to target auditory stimulus (40 dB at 2 KHz tone, 20% rare) in the background of nontarget auditory stimuli (40 dB at 1 KHz tone, 80% frequent). These two auditory stimuli were presented to the participant at the rate of 0.5 Hz. The number of trials was 30 for each session. Finally, each trial waveform was averaged. A positive potential with its latency approximately 300 ms (200–400 ms) was scored as P300 ERP after the target stimulus, which the subject was directed to pay attention to. The amplitude of P300 wave was calculated between N200 and P300 peaks.

Results

Table 1: Comparison of various physiological variables of the study participants recorded in pre- and post-exercise session during early follicular and mid-luteal phase

Variables	Phases			
	Follicular		Luteal	
	Pre-exercise	Post-exercise	Pre-exercise	Post-exercise
Central systolic blood pressure (mmHg)	9760	115.5	96.0	113.7
Central diastolic blood pressure (mmHg)	69.0	76.0	68.0	74.0
Peripheral SBP (mmHg)	108.0	122.8	108.0	123.0
Peripheral DBP (mmHg)	68.0	72.6	67.0	72.0
Heart rate (bpm)	84.0	104.0	86.0	96.4
P300 amplitude (μv)	18.4	17.5	18.4	18.6
P300 latency at Fz (ms)	306.0	305.0	308.0	308.0
P300 latency at Cz (ms)	308.0	298.2	308.0	295.0
P300 latency at Pz (ms)	308.0	298.2	308.0	295.0

There were significant changes in all cardiovascular parameters in post-exercise session in comparison to pre-exercise session in both phases of menstrual cycle. The P300 latency showed significant decrease in postexercise session when recorded at Cz as well as Pz position in both phases of menstrual cycle. However, P300 latency recorded at Fz position displayed no significant change at post- exercise session in comparison to pre-exercise session during both phases of menstrual cycle.

Discussion

Cognitive function refers to the brain's ability to process information including attention, pattern recognition, learning, memory, problem solving, language processing and abstract reasoning. [10] Event-related potential (ERP) is EEG signals assessing the electrical responses generated within the cortex during processing visual or cognitive events. [11] Measurement of event-related potentials (ERP) is a noninvasive technique to assess the function of the central nervous system (CNS). [12] ERPs are patterns of neuroelectric activation that occur in response to a stimulus. The amplitude of the P300 is directly related to the allocation of attentional resources during stimulus engagement. [13]

There were significant changes in all cardiovascular parameters in post-exercise session in comparison to pre-exercise session in both phases of menstrual cycle. The P300 latency showed significant decrease in postexercise session when recorded at Cz as well as Pz position in both phases of menstrual cycle. However, P300 latency recorded at Fz position displayed no significant change at post- exercise session in comparison to pre-exercise session during both phases of menstrual cycle. There is no consistent finding in the literature regarding changes in latency and amplitude of P300 ERP during menstrual cycle. It was reported earlier that ERPs inclusive of P300 elicited with auditory discrimination paradigm in women on the 1st day of menstrual cycle and approx. 14 days later revealed no change in amplitude or latency. Moreover, there was no difference noted in the response between the women who were on OCP and not on OCP. Therefore, the study concluded that menstrual cycle and use of oral contraceptives do not affect P300 and other ERP components. [14] Later on, a cross-sectional study was conducted to examine the changes in P300 component of visual ERPs and in BAEPs across the menstrual cycle in healthy women. It was documented that latency of P300 was longer during ovulatory phase. [15] Another study reported that amplitude of P300 ERP was significantly greater during menses than ovulatory phase. The study concluded that context updating mechanisms as indexed by P300 ERP are sensitive to cyclic hormonal fluctuations. [16] Zhou and Qin who demonstrated that acute moderate-intensity aerobic exercise enhanced attentional resources related to perceptual processing through greater P2 amplitude. [17] Another study reported that amplitude of P300 ERP was significantly greater during menses than ovulatory phase. The study concluded that context updating mechanisms as indexed by P300 ERP are sensitive to cyclic hormonal fluctuations. It is understandable that there is no agreement regarding changes in amplitude and latency of P300 ERP in different phases of menstrual cycle. [18]

Many research studies documented the beneficiary effect of acute bout of exercise on improving cognitive function of brain which involves response inhibition, cognitive flexibility, selective attention and working memory. It was reported earlier that there were differential influences of mild, moderate and high-intensity pedaling exercise on P300 ERP. The authors observed that amount of attentional resources to a given task was decreased with high-intensity pedaling exercise, but it was increased with moderate intensity pedaling exercise. However, there was no change after low-intensity pedaling exercise. Hence, it was inferred that differences in exercise intensity influenced information processing in the CNS. [19] Another study conducted in India documented that latency of P300 was significantly decreased in sedentary individuals following acute moderate exercise. [20] It was further reported that acute bout of physical exercise causes reduction in P300 ERP latency and reaction times in both athlete and non-athlete groups. [21]

Conclusion

The present study concluded that an acute bout of moderate exercise caused significant decrease in latency of P300 ERP in the participants during both phases of menstrual cycle. That means even acute bout of moderate exercise enhances cognitive functioning of the individual.

References

1. Tomporowski PD, Ellis NR. Effects of exercise on cognitive processes: A review. Psychological bulletin. 1986 May;99(3):338.
2. Tomporowski PD. Effects of acute bouts of exercise on cognition. Acta psychologica. 2003 Mar 1;112(3):297-324.
3. Brisswalter J, Collardeau M, René A. Effects of acute physical exercise characteristics on cognitive performance. Sports medicine. 2002 Aug;32:555-66.
4. Sternberg S. The discovery of processing stages: Extensions of Donders' method. Acta psychologica. 1969 Jan 1;30:276-315.
5. Arcelin R, Brisswalter J, Delignieres D. Effect of physical exercise duration on decisional

performance. Journal of Human Movement Studies. 1997 Jan 1;32(3):123.
6. Davranche K, Audiffren M. Facilitating effects of exercise on information processing. Journal of Sports Sciences. 2004 May 1;22(5):419-28.
7. Duncan-Johnson CC. P3 latency: A new metric of information processing. Psychophysiology 1981;18:207-15.
8. Kamijo K, Nishihira Y, Hatta A, Kaneda T, Wasaka T, Kida T, Kuroiwa K. Differential influences of exercise intensity on information processing in the central nervous system. European journal of applied physiology. 2004 Jul;92:305-11.
9. Tomporowski PD, Davis CL, Miller PH, Naglieri JA. Exercise and children's intelligence, cognition, and academic achievement . Educational psychology review. 2008 Jun;20:1 11-31.
10. Sherwin BB. Estrogen and cognitive functioning in women. Endocrine reviews. 200 3 Apr 1; 24(2):133-51.
11. Bekdash M, Asirvadam VS, Kamel N, Hutapea DK. Identifying the human attention to different colors and intensities using P300. In2015 IEEE International Conference on Signal and Image Processing Applications (ICSIPA) 2015 Oct 19 (pp. 538-541). IEEE.
12. Beck EC, Dustman RE. Changes in evoked responses during maturation and aging in man and macaque. InBehavior and brain electrical activity 1975 (pp. 431-472). Boston, MA: Springer US.
13. Polich J. Task difficulty, probability, and inter-stimulus interval as determinants of P300 from auditory stimuli. Electroencephalography and Clinical Neurophysiology/Evoked Potentials Section. 1987 Jul 1;68(4):311-20.
14. Fleck KM, Polich J. P300 and the menstrual cycle. Electroencephalography and Clinical Neurophysiology/Evoked Potentials Section. 1988 Mar 1;71(2):157-60.
15. Tasman A, Hahn T, Maiste A. Menstrual cycle synchronized changes in brain stem auditory evoked potentials and visual evoked potentials. Biological psychiatry. 1999 Jun 1;45(11):151 6-9.
16. O'Reilly MA, Cunningham CJ, Lawlor BA, Walsh CD, Rowan MJ. The effect of the menstrual cycle on electrophysiological and behavioral measures of memory and mood. Psychophysiology. 2004 Jul;41(4):592-603.
17. Zhou F, Qin C. Acute moderate-intensity exercise generally enhances attentional resources related to perceptual processing. Frontiers in Psychology. 2019 Nov 8;10:2547.
18. O'Reilly MA, Cunningham CJ, Lawlor BA, Walsh CD, Rowan MJ. The effect of the menstrual cycle on electrophysiological and behavioral measures of memory and mood. Psychophysiology. 2004 Jul;41(4):592-603.
19. Kamijo K, Nishihira Y, Hatta A, Kaneda T, Wasaka T, Kida T, Kuroiwa K. Differential influences of exercise intensity on information processing in the central nervous system. European journal of applied physiology. 2004 Jul;92:305-11.
20. Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. Can J Appl Sport Sci. 1985 Sep 1;10(3):141-6.
21. Gowsi K, Sharma VK, Pal GK, Aaramban P. Effects of Moderate and high-intensity exercise on P300 latency and reaction time in athletes and non-athletes-an interim analysis. Biomedicine. 2016;36(4):96-101.