

ORIGINAL RESEARCH

Effect of Acute Bout of Moderate Exercise on P300 Component of Event-Related Potential in Young Women During Different Phases of Menstrual Cycle: An Institutional Based Study

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ABSTRACT

Background: The effect of physical activity on the brain and cognition has attracted the interest of many researchers. The present study was conducted 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 cross-sectional observational study conducted on 45 young, normally menstruating women with normal auditory capability. Each participant attended two laboratory sessions, one of which was in the early follicular phase and the other was in mid-luteal phase. The data collection pro forma was used to record information pertaining to anthropometric measurements following which physiological parameters. Basal brachial artery systolic blood pressure (SBP) and diastolic blood pressure (DBP), mean arterial pressure (MAP), pulse pressure (PP) values were recorded. Central BP and HR, basal P300 was recorded.

Results: A total of 45 subjects participated in the present study. 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

Cognitive function refers to the brain's ability to process information including attention, pattern recognition, learning, memory, problem solving, language processing and abstract reasoning.¹ Event-related potential (ERP) is EEG signals assessing the electrical responses generated within the cortex during processing visual or cognitive events.² Measurement of event-related potentials (ERP) is a noninvasive technique to assess the function of the central nervous system (CNS).³ 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.⁴ The latency of the P300 is used for stimulus classification and for evaluation of speed, with increased latency indicating longer processing time.⁵ Oestrogen and progesterone are implicated in emotional and cognitive processing as well.^{6,7} A fewer studies have investigated the effect of acute exercise on event-related potentials (ERPs), which are time-locked brain responses to specific events.⁸ Both exercise and ovarian hormones seem to effect cognition, the present study was conducted 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 cross-sectional observational study conducted on 45 young, normally menstruating women with normal auditory capability. Before the commencement of the study ethical approval was taken from the ethical committee of the institute and informed consent was taken from the patient. 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 postmenstruation) 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

A total of 45 subjects participated in the present study. 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.

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) | 98.0 | 112.3 | 98.0 | 110.5 |
| Central diastolic blood pressure (mmHg) | 67.0 | 74.0 | 65.0 | 71.0 |
| Peripheral SBP (mmHg) | 106.0 | 120.5 | 106.0 | 121.0 |
| Peripheral DBP (mmHg) | 66.0 | 70.3 | 65.0 | 70.0 |
| Heart rate (bpm) | 82.0 | 102.0 | 84.0 | 96.8 |
| P300 amplitude (μ v) | 18.6 | 16.8 | 18.6 | 17.9 |
| P300 latency at Fz (ms) | 306.0 | 305.0 | 308.0 | 308.0 |
| P300 latency at Cz (ms) | 306.0 | 296.5 | 306.0 | 293.0 |
| P300 latency at Pz (ms) | 306.0 | 296.5 | 306.0 | 293.0 |

DISCUSSION

The latency of the P300 is used for stimulus classification and for evaluation of speed, with increased latency indicating longer processing time.¹¹ Earlier studies have observed increased amplitude and shorter latency, relative to a basal state, following single acute bouts of moderately intense exercise.¹²

A total of 45 subjects participated in the present study. 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.

A short bout of exercise was found to decrease the latency of ERP P300 in the study by Hillman et al. It has been shown that aerobic exercise promotes cerebral blood flow.⁸

Zhou and Qin who demonstrated that acute moderate-intensity aerobic exercise enhanced attentional resources related to perceptual processing through greater P2 amplitude.¹³

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.¹⁴

Another study conducted in India documented that latency of P300 was significantly decreased in sedentary individuals following acute moderate exercise.¹⁵ 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.¹⁶

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.

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