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Original Research Article

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

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**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:** The cross-sectional observational study was conducted on 100 young women who were menstruating properly and had normal auditory function.

**Results:** The post-exercise session showed significant changes in all cardiovascular parameters as compared to the pre-exercise session. These alterations were seen throughout both phases of the menstrual cycle. Following the workout session, there was a significant decrease in P300 latency when evaluated at both the Cz and Pz positions. This phenomenon was seen throughout both phases of the menstrual cycle. However, the P300 delay measured at the Fz site did not exhibit any notable disparity between the pre-exercise session and the post-exercise session in any phase of the menstrual cycle.

**Conclusion:** An acute bout of moderate exercise significantly reduced the latency of P300 ERP in both stages of the menstrual cycle, according to the current study's participants. In other words, the brain benefits from even brief bursts of moderate activity.

**Keywords:** Phases of Menstrual Cycle, P300 Latency, Exercise



## Introduction

The effects of an acute bout of physical exercise on cognitive performance are assumed to vary on the kind, duration, and intensity of the physical activity. Long duration aerobic and anaerobic exercise that lead to tiredness have been expected to inhibit cognitive performance; conversely, bursts of aerobic exercise done at a moderate intensity over a relatively short time, have been projected to promote cognitive function. [1] Empirical research have been undertaken that directly measure the immediate after effects of an acute bout of physical exercise on cognitive function. The outcomes of these research, however, have been equivocal. Several researches have claimed that acute bouts of moderate intensity aerobic exercise lead to enhanced cognitive performance, but others have failed to replicate similar results. [2,3] Several hypotheses have been presented to explain inconsistencies revealed in studies that have evaluated the impact of an acute bout of physical exercise on cognitive performance. Arousal theory hypothesizes an inverted "U" link between arousal and performance. According to Arousal Theory, the amount of physiological arousal caused by exercise of various intensities would variably effect cognitive performance. Proponents of Arousal theory anticipate that cognitive performance will improve to an optimal level when exercise intensity rises to a certain degree, beyond which cognitive performance starts to degrade.

Other hypotheses explain discrepant data in terms of the link between physical activity and performance on tests that evaluate basic cognitive functioning. The Additive Factors Model [4] has been utilized by researchers to track and isolate distinct cognitive processes. This model posits that the flow of information goes via a succession of separate and serial (non-overlapping) processing phases. These phases involve fundamental information processing such as stimulus recognition, response selection, and reaction initiation; all of which are considered lower-level cognitive activities. [5,6] Results from these sorts of studies have prompted researchers to postulate that the impacts of physical exercise differently alter certain stages of information processing.

For both stimulus classification and speed evaluation, the P300's latency is utilized; a longer

latency indicates a longer processing time. [7] In comparison to a resting state, previous research has shown that one acute bout of moderately intense exercise increases amplitude and decreases latency. [8] Acute aerobic exercise may have positive effects on some people, but other studies that looked at other parts of cognition (not cognitive P300) found no such thing. [9]

The purpose of this study was to examine the impact of a brief period of moderate exercise on the cognitive processing of young women at various stages of their menstrual cycles.

**Materials and Methods**

One hundred young women with normal hearing abilities who were participants in cross-sectional observational research at J.N.K.T. Medical College in Madhepura, Bihar, India for one year.were surveyed.

**Materials and Methods**

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

A person's cognitive function include their capacity to pay attention, recognise patterns, learn, remember, solve problems, understand language, and reason abstractly. [10] Electroencephalogram (EEG) signals measuring the cortical electrical responses to visual or cognitive stimuli are called event-related potentials (ERPs). [11] A noninvasive method for evaluating CNS function is the measurement of event-related potentials (ERP). [12] Response-related patterns of electrical activity in the brain are known as electroreceptive potentials (ERPs). Allocation of attentional resources during stimulus engagement is closely correlated with the magnitude of the P300. [13]

Throughout the menstrual cycle, all cardiovascular measures changed significantly between the pre- and post-exercise sessions. During the pre- and post-workout periods of the menstrual cycle, the P300 latency decreased significantly when measured at the Cz and Pz positions, respectively. Nevertheless, there was no discernible change in the P300 delay measured at the Fz location between the pre- and post-exercise sessions for either the first or second half of the menstrual cycle. There is a lack of consensus in the research about the effects of the menstrual cycle on the latency and amplitude of P300 ERP. Prior research indicated that there was no change in amplitude or latency of ERPs, which include P300, when evoked using an auditory discrimination paradigm in women on the first day of their menstrual cycle and around fourteen days later. In addition, the reaction of the women on OCP was identical to that of the women who were not on OCP. Thus, the research found that P300 and other ERP components are unaffected by menstruation cycle and oral contraceptive usage. [14] After that, researchers used a cross-sectional design to look at how healthy women's BAEPs and the P300 component of visual ERPs changed over the menstrual cycle. Evidence suggests that the ovulatory phase is associated with a prolonged P300 delay. [15] The amplitude of the P300 ERP was shown to be much larger during menstruation compared to the ovulatory period, according to another research. According to the results, cyclic hormonal variations may influence the processes that update context, as measured by P300 ERP. [16] Acute moderate-intensity aerobic exercise improved perceptual processing attentional resources via increased P2 amplitude, as shown by Zhou and Qin. [17] The amplitude of the P300 ERP was shown to be much larger during menstruation compared to the ovulatory period, according to another research. According to the results, cyclic hormonal variations may influence the processes that update context, as measured by P300 ERP. It is reasonable that opinions vary on how the amplitude and latency of the P300 ERP alter during the menstrual cycle. [18]

Response inhibition, cognitive flexibility, working memory, and selective attention are all areas of brain function that may be benefited by an acute bout of exercise, according to several studies. There was a prior study showing pedalling at low, moderate, and high intensities had varied effects on P300 ERP. The authors found that moderate-intensity pedalling exercise increased the amount of attentional resources available to a task, whereas high-intensity pedalling exercise decreased it. Yet, after a session of light pedalling, no improvement was seen. Therefore, it was concluded that variations in the intensity of the exercise affected the processing of information in the central nervous system. [19] Another Indian study found that after sedentary people did acute moderate exercise, the latency of P300 was much reduced. [20] Acute physical exercise reduces P300 ERP latency and reaction times in both athletes and non-athletes, according to other reports. [21]

## Conclusion

The current investigation showed that a single session of moderate exercise led to a significant reduction in the latency of P300 event-related potential (ERP) in the participants, regardless of the period of their menstrual cycle. This implies that even a short period of intense exercise improves the cognitive abilities of the person.

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