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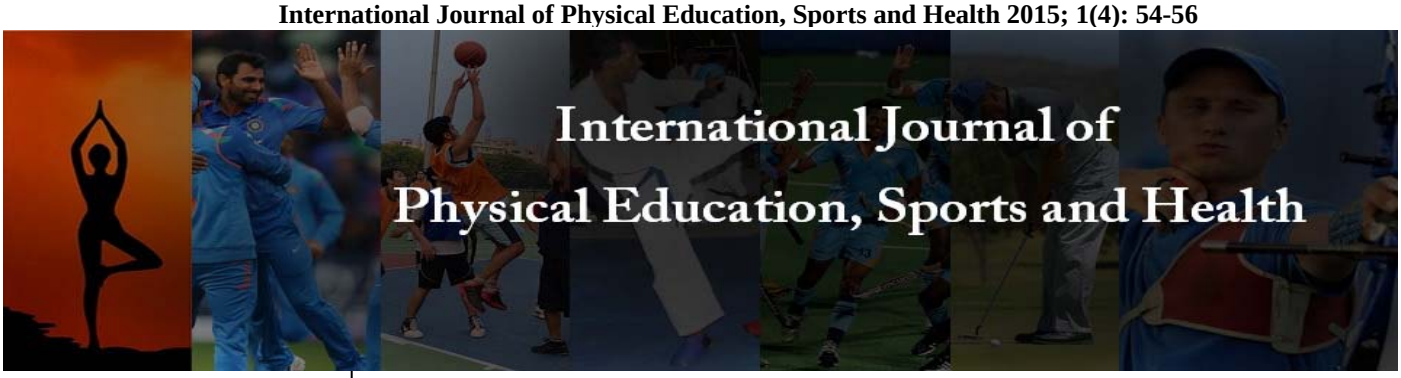

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Acute aerobic exercise effects on brain wave pattern of player and non- player: A pilot study

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Abstract
Background: Brain wave pattern reveals mental state of an individual. Exercise may alter mental state, which could be observed by brain study
Aim: The aim of this study was to examine brain wave pattern of the player and the non-player after acute aerobic exercise
Methods: Two (one player and other non-player) young healthy males aged between 21-23 years were exposed to an Electroencephalogram (EEG) followed by acute aerobic exercise session using cycle ergometer. Again post exercise EEG was recorded on both the subjects.
Results: Result indicated an increase in beta absolute power in various subareas after exercise in both the participants. Whereas, pre exercise EEG recording of both the participants reported no such differences. Acute aerobic exercise may lead to higher cortical activation which influences changes in beta absolute power in brain regions.
Conclusions: Exercises of acute aerobic in nature may increase cortical arousal level which could be useful in health and diseases condition of players and non-players population.

Keywords: Brain wave, aerobic exercise, cortical activation

1. Introduction
The roots of all our thoughts, emotions and behaviors are the communications between neurons within our brain. Brain is made up of billions of cells called neurons which use electricity to communicate with each other. The combinations of electrical activity of the brain commonly known as brain wave pattern, because of their cyclic, 'wave-like' nature. These waves are produced in the brain emitting tiny electrochemical impulses of varied frequencies. These frequencies can be registered by an electroencephalogram (EEG) machine. EEG is frequently used to investigate normal and pathological conditions in brain cortex (Moreas 2007) [10].
Exercise is now a day well recognized as an unconventional modality for preventing or even improving brain function decline. The relationship between physical activity and brain functions has been widely investigated. Studies revealed that physical activity has been related to changes in brain functioning and the affective state of an individual., Many experiments and literature reviews concerning the effects of exercise on brain electrocortical activity was based on normal population. For example, Kakizaki (1988) [6] conducted experiments on effects of bicycle exercise on EEG amplitude on male students. He found no changes at lower workloads. Kubitz and Mott (1996) [8] reported no changes in either alpha or beta activity from pre-to post- exercise. Nybo and Nielson (2001) [12] described changes in EEG during 1 hour of exercise at 60% intensity in normal and hot environments. Crabbe and Dishman (2004) [3] conducted a meta-analysis examining EEG responses during and after exercise and concluded that when compared to pre-exercise alpha activity (absolute) was greater both during and following exercise, but there was no differences in relative alpha activity. From all these studies, we were observed that there was a contradiction between the authors about the effects of exercise on brain wave activity. Influenced by the above studies, present researcher was very much keen to find out the effects of acute aerobic exercise on brain wave pattern of young males.
Thus the purpose of our study was to observe acute exercise effect on EEG of players and non-players.

2. Materials and Methods
2.1 Study Location
The study was conducted in the Megacity Nursing Home Pvt. Ltd; 12 Jessore Road, Barasat, Kolkata-700124, West Bengal, India.

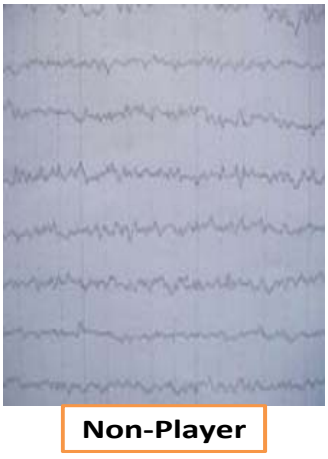
2.2 Subjects
After screening followed by informed consent, two healthy male students aged between 21-23 years from Acharya Prafulla Chandra College, New Barrackpore, Kolkata-700131, West Bengal, India were selected and voluntarily participated in this study. Among the subjects, one was a district level cricket player and another healthy subject did not have any sorts of regular exercise or sports habit, was selected for this study.

2.3 Assessments
2.3.1 EEG Recording
Electrophysiological recording through EEG was collected from twenty monopolar derivations. Twenty electrodes were positioned according to international 10/20 system (Jasper 1958). Data were collected with eyes closed, to observe electrical activity without external stimuli, thus minimizing possible visual artifacts.

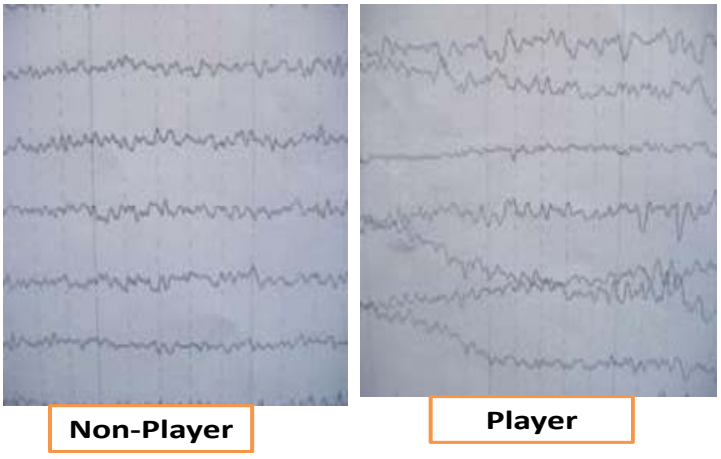
2.3.2 Experimental Procedure
EEG recordings were taken at two different times: pre and post-acute aerobic exercise. The subjects arrived at the laboratory at around 4 p.m. and were given 10 minutes to relax before the beginning of the first recording session. In a sound isolated room, individuals sat comfortably in a chair in order to reduce muscular tension. Baseline (pre exercise) EEG was recorded for eight minutes. During the data recording all other external stimuli like lights, movements of other people, sound were restricted to minimized influences of other stimuli interferences. After the eight minutes of resting EEG recording, subjects were immediately placed on the cycle ergo meter and started exercising up to exhaustion. Then, subjects were again (immediately after the exercise) placed on the chair for the post exercise similar EEG recording session.

2.4 Exercise Protocol
The exercise intervention used for this experiment was continuous ten minutes or upto exhaustion bicycle ergo meter exercise on a static bicycle. The duration of exercise was determined by how long it took for each subject to reach exhaustion. The exercise equipment which was used for this experiment was calibrated before each test.

3. Results
EEG recording of the player and the non-player before acute aerobic exercise showed no marked differences in wave pattern. But in case of post exercise EEG pattern of the subjects, an increase in beta absolute power was observed in various sub areas of the brain.



Picture.1:Resting Condition (original EEG recording)



Picture.2:After acute exercise intervention (original EEG recording)

4. Discussion
The increase in the beta activity observed in this study was similar with the results of previous studies and suggested that the augmentation in beta wave after exercise is related to greater cortical activation (Youngstedt 1993, Nybo 2001, Nielson 2003, Bailey 2004, Doyle 2005, Ogoh 2005) [17, 12, 11, 1, 4, 13]. The other explanation was that exercise causes an increase in brain regional blood flow (Orlandi 1996, Nybo 2001) [14, 12]. The observed EEG changes might be possibly seen as a consequence of exercise (Lardon 1996) [9]. In addition, beta activity after exercise could be related to an attentional demand and a higher arousal level (Nielson 2003) [11]. In fact generalized attentional or arousal effects of exercise might influence electrocortical activity in several frequencies. Leading authors suggested that brain cortical systems are altered generally in response to the increased metabolic arousal that uniquely accompanies physical activity (Tomporowski 1986) [16]. Hypothalamic modulation of increased metabolism and temperature during exercise are also thought to influence electrocortical activity; especially in the beta range (Nielson 2003) [11]. Increased cortical activation due to exercise probably influence information processing and psychological variables like attention and arousal (Tomporowski 1986, Kamijo 2004) [16, 7]. Hence observed increasement in beta power at brain regions could be directly related to an excited or urgent/emergency state of mind and increased cortical activation (Kubitz 1996) [8].

5. Conclusion
The present pilot study was conducted to find out acute aerobic exercise effect on brain wave of player and non-player. The findings of the study documented increase in beta power after acute exercise. This electrophysiological change could represent the rearrangement of different systems as a consequence of exercise. Cognitive, metabolic, physiological and emotional mechanisms might explain the changes in

electrocortical activity observed after exercise.

6. Acknowledgements
We convey sincere thanks to Megacity Nursing Home Pvt. Ltd where the test was conducted. We also offer heartiest thank to those who actively participated in this study.

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