Editorial

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Clinical Psychiatry
ISSN 2471-9854

2016
Vol.2 No.2:10

DOI: 10.4172/2471-9854.100023

Is EEG Asymmetry a Predictor of Mood in Practitioners of Aerobic Exercise?

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Recived date: 28 May, 2016; **Accepted date:** 29 May, 2016; **Published date:** 31 May, 2016

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Citation: Machado S, Lattari E, Paes F, et al. Is EEG asymmetry a predictor of mood in practitioners of aerobic exercise?. 2016. 2:2.

The positive effects and the best configuration of aerobic exercises on mood are well documented in the literature [1]. In addition, single bouts of physical activity, apart from type, significantly reduce mood, tension, depression, anger and confusion [2]. Studies demonstrated acute improvements in psychological state of mood after exercise using self-report instruments [1,3,4]. However, most studies lack of neurophysiological explanation about the mechanisms associated with changes in mood after exercise practice. Consequently, cortical activity has been utilized to examine the effects of exercise on mood after a unique session of exercise, for example, asymmetry.

Asymmetry reflects an unbalanced distribution of energy (i.e., power) between pairs of homologous electrodes. It is associated with emotional responses and disorders, and a concomitant emotional response-dependent state [5]. According to Coan and Allen [5], asymmetry can assume trait properties, being considered a predictor of emotional responses or modulated by emotional responses. The modulation of emotional responses occur due to several provoked stimuli [5]. However, methodological differences imposed on exercise, such as intensity and volume, determine different results on the responses of mood and EEG asymmetry [6-8].

Studies that have investigated asymmetry as a predictor found in four studies significant results on causality in mood improvement [6,9-11]. However, this improvement was dependent on the configuration of the exercise (i.e., intensity) and the fitness level of the participants. On the other hand, one study did not provide improvement in mood and another showed both enhance and worsening of mood state [12].

Considering asymmetry as a modulator significant changes (e.g., vitality) were observed after 30 minutes of exercise with different intensities (45%, 60% and 75% VO2max) [8,13]. However, another study demonstrated that the intervention of aerobic exercise performed on a cycle ergometer with different intensities (50-55% VO2 peak, 80-85% VO2peak and self-selected intensity) was not able to generate any change in asymmetry, despite several changes have occurred in mood [7].

Although studies have found evidence for cortical activity in form of asymmetry as a predictor and modulator of mood responses induced by exercise, divergent results were observed, which can be explained by different methods of exercise. It seems that frontal asymmetry may be a predictor of improvement in positive affect immediately after exercise with intensities near to ventilatory threshold (VT), which appears to be a physiological marker ideal to promote better affective responses. This was confirmed in a comparative study where authors compared different intensities, i.e., 55% VO2max, 70% VO2max and control group. Results revealed significant findings in favor of 70% VO2max condition [10].

On the other hand, Schneider et al. [7] found no significant results for lower (50-55% of peak VO2) and high (80-85% of peak VO2) intensities of exercise. The moment for measurement of mood after exercise seems to be important so that asymmetry can be predictive. For instance, in the condition above the VT, frontomedial and frontolateral asymmetry, respectively predicted increase in the variation of both measures immediately (15.7%) and 5 minutes (13.7%) after exercise. On the contrary, i.e., below the VT, frontal asymmetry predicted an increase in the variation by 12.6% immediately after exercise, and 15.8% after 20 minutes of the end of exercise session [6]. In strenuous exercise, the left frontal asymmetry (F3-F4) predicted relaxation, but also fatigue. Still, the moment of relaxation and fatigue could be observed only 10 and 20 minutes after exercise respectively, suggesting again a minimum time required to achieve these psychological states [12]. On exercises with intensities self-selected, again frontal asymmetry was not sufficient to predict changes in affective state [7,11].

The frontal asymmetry, as a modulator, provided an increase in vigor after 30 minutes of aerobic exercise at 60% VO2max. However, under scondition of 15 and 45 minutes, there is modulation of mood by frontal asymmetry [8]. The results provide support for the dose-response relationship between duration of exercise and affection characterized by an inverted U. The cardiovascular fitness may be related to resting asymmetry as a predictor of mood. Participants with high aerobic fitness level exhibited resting frontal asymmetry as a predictor for energetic excitation and energy after 10 minutes at the end of the exercise [9]. In participants with low-moderate aerobic fitness level resting frontal asymmetry did not predict mood state. Perhaps, the relative intensity of effort has been very high for individuals with low-moderate fitness level; however for individuals with high aerobic fitness level it may have been sufficient to elicit the expected affective responses.

Studies show that mood state can be partially modulated by prefrontal asymmetry after a single bout of aerobic exercise. However, we cannot establish a relation of cause and effect between exercise-induced mood and EEG variations. Future studies examining the chronic effects of aerobic exercise on prefrontal asymmetry in depressed patients are recommended.

Conflict of Interest

Authors declare have not conflict of interest.

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