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Research Article

Phobia situations increase body sway in young adults

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HIGHLIGHTS
• Phobia increases anterior-posterior displacement and velocity of body sway.
• Effects of phobia on body sway do not persist after the phobia situation.
• Changes in the limbic system due to phobia situation seem to explain the effects on postural control.

ABBREVIATIONS
ANOVA Analyses of variance

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BACKGROUND: Recent studies have analyzed the influence of emotional state. However, most of these studies employed questionnaires exclusively and were conducted outside the context of the phobic episode.
AIM: The study aimed to investigate how phobia interferes with body sway in younger adults.
METHOD: Thirty-seven adults participated in the study and underwent a postural control assessment in which participants should maintain an upright static position while watching a video. They performed three conditions: pre-phobia, which involved viewing neutral images; phobia phase, which involved viewing images based on the previous phobia and fear questionnaire; and post-phobia phase, which involved viewing neutral images. Body sway was measured using a Vicon Motion System® - 200 Hz. Three passive markers were positioned on pre-determined anatomical landmarks of the body. The following parameters were analyzed: anterior-posterior and medial-lateral amplitude, mean velocity and displacement, and the entire oscillation trajectory.
RESULTS: The ANOVA indicated the effect of phobia by analyzing the conditions of anterior-posterior displacement ($F_{2,22} = 10.067$, $p < 0.001$) and mean velocity ($F_{2,22} = 11.142$, $p < 0.001$). The phobia condition showed higher anterior-posterior displacement and mean velocity values than the pre- and post-phobia conditions ($p < 0.001$).
CONCLUSION: The findings indicated an increase in body sway in phobia situations, suggesting that individuals should avoid situations requiring balance when exposed to phobic stimuli.

KEYWORDS: Postural control | Fear | Body sway | Phobia | Balance

INTRODUCTION

Postural control is susceptible to a multitude of external factors, including motivation, environmental conditions, fatigue and psychological state [1,2]. Recently, there has been a notable increase in interest in the influence of emotional states on postural control. A phobia is defined as an emotional state conceptualized as a psycho-emotional response to a previous event that can modulate spinal cord reflex activity during threatening situations [3].

It is noteworthy that significant changes occur in the brain during episodes of phobia. Such alterations may be attributed to modifications in the limbic system, which encompasses the anterior cingulate cortex and orbitofrontal cortex and exerts a pivotal influence on postural control, particularly in regard to posture [1,2]. Moreover, the limbic association cortex receives a projection from superior and limbic areas, which can influence the planning performed by the prefrontal cortex [1]. Following the presentation of the phobic stimulus, a signal indicating danger serves to initiate an appropriate adaptive response. This is related to the thalamus activation, which serves as a relay station for external auditory, visual, olfactory, and somatosensory stimuli, directing them to the amygdala and cortex [4].

Some authors posit that a phobia represents a motivational state elicited by specific stimuli, which in turn engenders defensive behaviors [5,6]. It can be extrapolated from this that during phobic situations, people alter their posture, for example, adopting a "defensive posture" [3,7], which could result in altered body sway and postural control. Previous studies have focused on the relationship between the fear of falling and other factors. A history of falls, depression, and other psychological issues, as well as impaired mobility and postural control, are associated with a phobia of falling [2,10]. It is important to note, however, that the phobia of falling is not the only factor that can affect postural control. It can be reasonably deduced that other forms of phobia, such as that associated with heights, have the potential to alter body control, resulting in a reduction in body amplitude oscillation due to the utilization of a stiffness strategy [3]. However, the majority of these studies employed solely questionnaires [6,10] and were not conducted within the context of a phobia, except the phobia of heights [7]. It can be reasonably deduced that other types of phobias, such as those related to spiders or snakes, may also exert a considerable influence on postural control, which could potentially be linked to an increased risk of falls.

The objective of this study, therefore, is to gain insight into the impact of phobia on body oscillation. In order to analyze the effects of phobia on postural control, phobia situations were created, and the body oscillation was evaluated. We hypothesized that phobia situations would result in increased body oscillation, given that the activation of the sympathetic system and alteration of the limbic system have a meaningful effect on postural control.

METHODS

A total of 37 adults (22 males and 15 females, aged 22 ± 2 years, with a mean body mass of 73.7 ± 12.2 kg and a mean height of 1.72 ± 0.14 m) participated in the study. The G*Power software analysis indicated that a minimum of nine individuals was required to achieve a 95% probability of detecting a 20% difference between the conditions for the primary outcome, with a type I error of 0.05. This was based on the effect size of 1.097 for anterior-posterior body sway displacement, as previously published by Perakakis et al. [15].

The inclusion criteria were as follows: the ability to stand for a minimum of two minutes without resting, the absence of visual problems without correction (i.e., glasses or lenses), and the absence of any muscle or bone issues that could influence performance. Prior to the commencement of the study, participants were interviewed and subsequently provided with an evaluation questionnaire comprising two questions: (i) "Please describe your greatest phobia"; and (ii) "Please describe your greatest dread". The term "phobia" was defined as a feeling of being threatened or an aversion to being in the presence of a particular object or situation. The term "dread" was defined as a state of being in which an individual loses control and is placed in an extreme state of alert. The questionnaire data was used to create a video for each participant, featuring images that were deemed to be relevant to the phobia or dread that had been reported in the survey. In instances where participants reported both a phobia and a dread, the latter was selected.

The study protocol was approved by the local ethics committee (CAAE #33587520.0.0000.5398) and was conducted in accordance with the ethical standards set forth in the 1964 Declaration of Helsinki and its subsequent amendments. Prior to the commencement of the experiments, all participants were required to provide written informed consent.

Following the completion of the questionnaire, participants were invited to proceed to the Human Movement Research Laboratory (MOVI-LAB) at UNESP-Campus Bauru for the second phase of the experimental protocol. The objective of this task was to evaluate the participants' postural control. The participants were instructed to maintain a stationary posture in a side-by-side position, with their arms relaxed alongside their trunk while observing a video displayed on a monitor situated at a distance of 1 m. Prior to data collection, participants were instructed to raise their arms and look away from the screen. It was observed that the participants experienced significant distress as a result of the content of the video and expressed a desire to terminate the trial. In such instances, the test was discarded and a new one was conducted with the participant's consent. If the subject exhibited exaggerated movements as a result of distress during the video presentation, the trial was repeated.

The monitor used for video playback was a Samsung® 22-inch model, and the videos were played in three stages (Figure 1): i) Pre-phobia: participants watched a baseline condition of a video comprising images that did not elicit any reactions (e.g., landscapes) without any images of the phobia or dread that they had reported in the questionnaires; ii) Phobia: participants were presented with a video comprising images based on their responses in the questionnaire. They were instructed to refrain from making sudden movements, such as grimaces and abrupt changes in the distance between themselves and the image. Subsequently, the participants viewed the identical video from the initial phase once more. To ascertain whether any residual effect of the phobia remained, the baseline video was repeated. The videos were created with only images, comprising four images of the phobia, without sound. The duration of each image was approximately 30 seconds. The duration of the video and the trials was two minutes. Each participant completed one trial for each condition. A 45-second seated rest period was allocated between the conditions.

A Vicon Motion System® comprising eight Bonita System Cameras was employed for the acquisition of postural control data, with a sampling frequency of 200 Hz. Three passive markers were positioned at pre-determined points on the body of the participants. The aforementioned points were located as follows: i) between the shoulder blades; ii) in the manubrium of the sternum; and iii) in the frontal bone of the skull. These points were selected due to their correlation with upper body oscillation, which allows for a comprehensive understanding of postural control [11]. In order to analyze body oscillation, the oscillation of the aforementioned three markers was calculated. Subsequently, the mean oscillation of the three markers was obtained by summing the values and dividing by three. This is a validated protocol that has been previously employed in other studies [11]. The data were filtered using a Butterworth low-pass cutoff filter with a frequency of 5 Hz, as previously defined in studies conducted by our research group [16]. The following parameters were analyzed: anterior-posterior and medial-lateral amplitude and displacement, as well as the complete trajectory of oscillation, all expressed in centimeters. Additionally, the anterior-posterior and medial-lateral velocity was examined in centimeters per second.

All statistical inferences were performed using the IBM Statistical Package for the Social Sciences (SPSS) version 25 (IBM Corp. ©, Armonk, USA). One-way analyses of variance (ANOVA) with repeated measures were conducted to examine the impact of phobia on body sway, with a factor for condition (pre-phobia, phobia, and post-phobia). The distribution of the data, homogeneity of the variances and sphericity were verified by applying Shapiro-Wilk, Levene and Mauchly tests, respectively. The level of significance was set at 5% ($p < 0.05$).

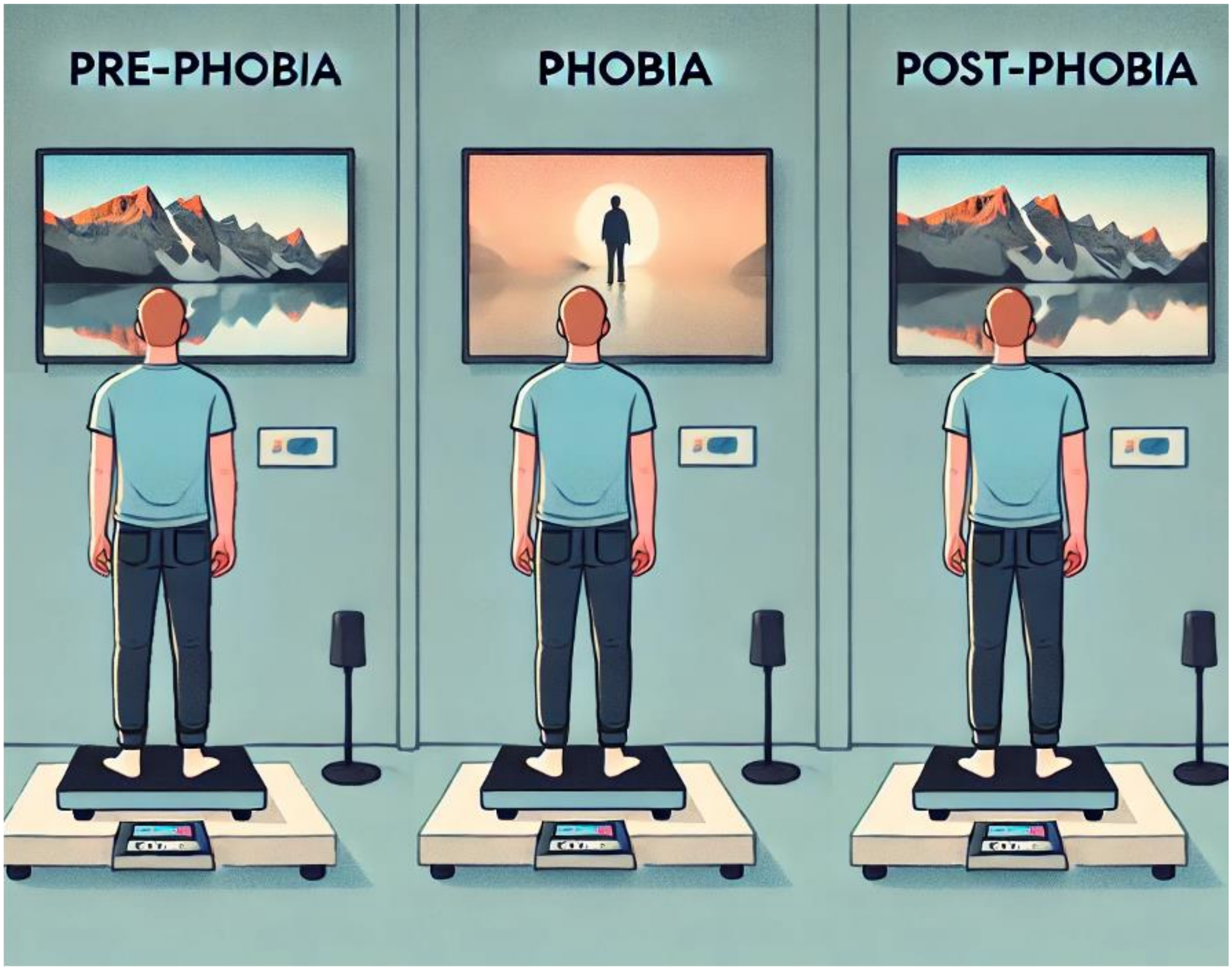

Figure 1. Schematic of postural control conditions.

RESULTS

No participants were excluded from the study. However, five trials had to be repeated due to excessive movements resulting from the video's reaction (fear manifested as exaggerated arm movements). The majority of these movements were the result of involuntary responses during the exhibition of the phobia video. The phobias reported by the participants included fear of snakes, frogs, heights, spiders, insects, decapitation, and horror movies.

Figure 2 presents the body sway parameters in pre-phobia, phobia and post-phobia conditions. ANOVA revealed a significant effect of the condition on both anterior-posterior displacement ($F_{2,22} = 10.067$, $p < 0.001$, ηp^2: 0.219) and mean velocity ($F_{2,22} = 11.142$, $p < 0.001$, ηp^2: 0.237). The phobia condition demonstrated significantly higher values for both anterior-posterior displacement and mean velocity in comparison to the Pre- and Post-phobia conditions ($p < 0.001$). No significant differences were observed for the remaining parameters ($p > 0.05$).

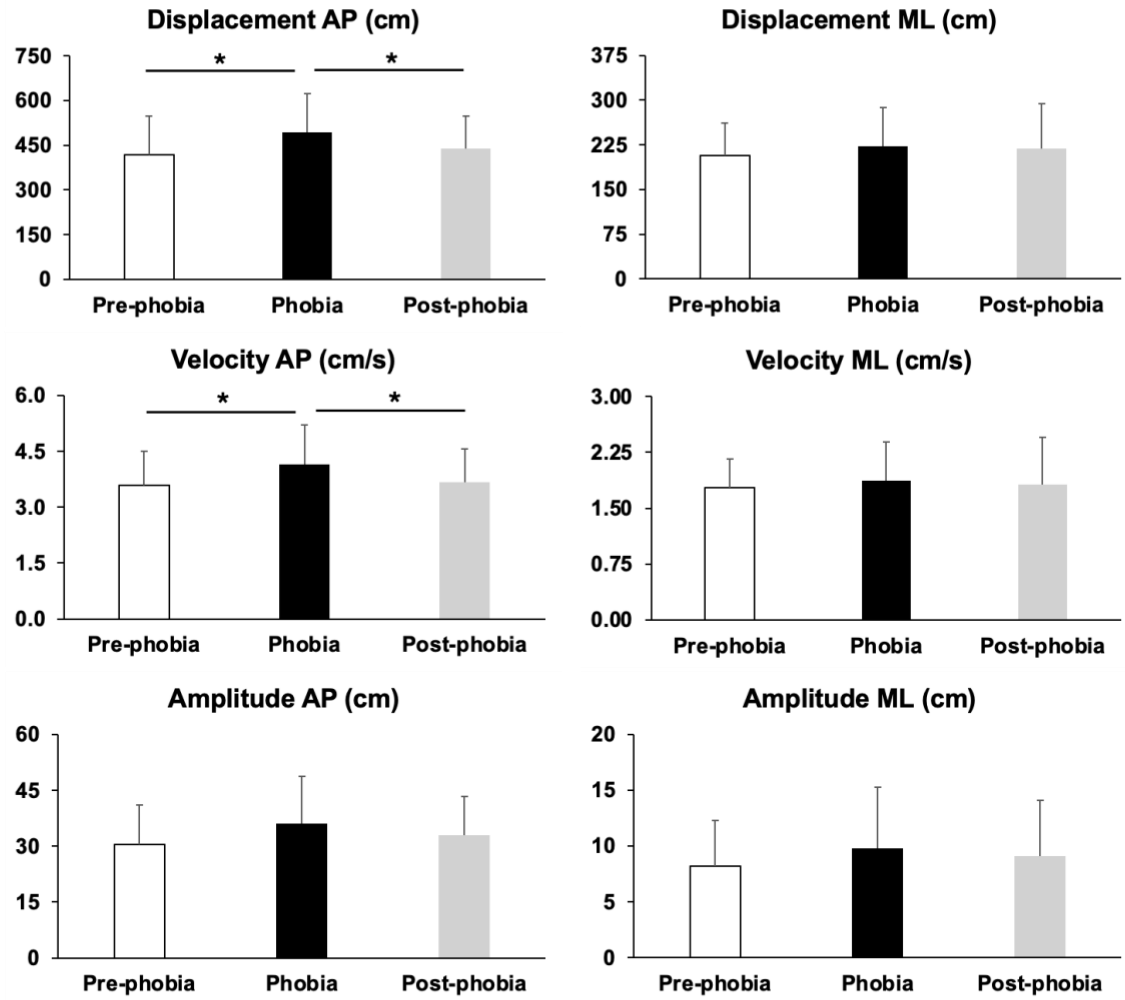

Figure 2. Means and standard deviations of body sway parameters in the three conditions. AP – anterior-posterior; ML – medial-lateral. * - indicates difference for Phobia condition.

DISCUSSION

To the best of our knowledge, this is the inaugural study to analyze postural oscillation in the context of phobic conditions. We hypothesized that situations characterized by a phobia would increase body oscillation. The findings revealed that watching videos with phobias altered postural control in young adults, characterized by an increase in both displacement and velocity of body oscillation in the anterior-posterior direction. However, these alterations did not persist beyond the period of the phobia. The following paragraphs will elucidate the alterations in body oscillation that are attributable to this condition.

The limbic system exerts a significant influence on postural control. In situations perceived as dangerous or eliciting a phobia, individuals tend to exhibit a disruption in their postural control [7]. The limbic system, primarily the amygdala, exerts influence over the basis nuclei, which regulate voluntary movements, as well as the brainstem, which oversees posture [12]. Previous studies have demonstrated that the limbic pathway serves as the primary recipient of information during the processing stage, as this region is activated in response to threatening stimuli [13]. Additionally, the amygdala is capable of modifying the information it receives (via the attentional network) and prioritizing threatening information, which can result in the disruption of other cognitive processes [13]. A phobia threat during a video exhibition has been observed to alter the attentional focus [14], which in turn affects postural control. Our findings were analogous to those of Perakakis et al. [15], who observed an increase in anterior-posterior displacement during the presentation of unpleasant images. Given the relationship between limbic projections and the reticular formation, as well as their role in regulating muscle tone, it is plausible that the muscles responsible for postural control during the viewing of phobic videos exhibited increased rigidity (hypertonia). This could have led to an increase in movement of other joints (such as the shoulders and arms) that are not directly related to the control of body oscillation (such as the heel and hip) [12]. This may have resulted in an increase in body oscillation, which would then require control in order to avoid falls and unbalances. It is also important to consider the emotional state of the participants following the phobia condition. It seems reasonable to posit that this postural compensation can be attributed to an impairment of anticipatory postural adjustments during such a situation [3,12]. This is in addition to the heightened level of anxiety, given that the videos were not previously described to the participants, thus not creating a genuine phobic situation.

Even young adults may experience a sense of disorientation and helplessness when confronted with a threatening situation. The condition of the limbic system is a significant determinant of postural control [12,17]. In studies conducted with older individuals, a significant correlation was observed between the fear of falling and the occurrence of falls [2,6,18]. Nevertheless, even young adults appear to experience difficulties in maintaining postural control when faced with a threatening situation. Furthermore, postural control is an automatic process. In the context of phobic situations, the process becomes less mechanical as a result of the influence exerted by the limbic system on the brainstem and basis nuclei [12,19]. Notwithstanding these substantial modifications, they persisted for a limited duration (~2 minutes), as evidenced by the outcomes of the Post-phobia phase, wherein the subject resumed their erstwhile behavior or a comparable one.

While the findings of this study are relevant, this study has few limitations. A phobia has the potential to disrupt the body's ability to maintain postural control and sensory function. Situations characterized by a phobia result in alterations related to the 'fight or flight' response [12]. In such circumstances, the sensory system is subject to a greater adrenergic discharge, which has the potential to alter the manner in which the subject processes the surrounding environment [7,16]. Furthermore, involuntary muscle contractions resulting from the physiological response to video stimuli, such as frightening or startling scenes, could potentially contribute to an increase in body oscillations. However, in the event of an exacerbation of the fright or response to the video scenes, such as arm movements, the trial was repeated. Some participants indicated that they experienced feelings of concern about the content of the video. However, in a real-life scenario, the reaction would likely be more pronounced if the phobia were present. Further research could be conducted to examine these scenarios in greater depth. Additionally, the impact of anxiety on the phobic condition was not assessed. Although anxiety may have a significant influence, a substantial body of research has addressed this behavior, indicating that this gap is adequately addressed [2,3]. Furthermore, an analysis of gaze behavior during the task may prove invaluable in enhancing our understanding of phobia and its impact on postural control. This could potentially elucidate the observed increase in body oscillation in phobic situations. Finally, a basic model was employed to calculate body sway. Despite previous studies have employed a similar protocol for postural control [11], it is customary to use the centre of mass as a global reference for postural control analyses.

CONCLUSION

In conclusion, it can be stated that there is an increase in body oscillation in individuals with phobic conditions, particularly in the anterior-posterior direction. It is recommended that individuals should avoid situations that require balance in the presence of phobic stimuli. It is similarly important to note that the provision of comfortable conditions in phobic situations can help to reduce the risk of falls.

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