Original Article

The Effects of Anxiety on Balance Parameters in Young Female University Students

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Objective: In human beings, the balance control is a result of an integration of physical and psychological factors and people show different reactions when feel anxious or face stability threatened conditions such as standing on an unstable surface. University students, particularly the female ones, are a group of the society who are prone to face anxieties. The current study focused on the effects of anxiety on balance index in young female university students .
Methods: A group of 15 female students with a high anxiety score (higher than 42 in Shpielberger Questionnaire) and a group of 15 female students with a low anxiety score (lower than 42 in Shpielberger Questionnaire) were recruited for this study. Using a Biodex stabilometer (Biodex System, USA), the antero-posterior (AP), medio-latral (ML) and the overall dynamic stability index (SI) of the subjects were recorded and compared .
Results: The results revealed a significant difference between the two groups. Subjects with a high anxiety score showed a stability index higher than those in the low anxiety group ($p<0.005$), which simply indicate significantly less stability in this group.
Conclusion: This study showed that subjects with higher anxiety scores were less stable compared to those subjects with lower anxiety scores.

Key words: *Anxiety, Postural balance, Women*

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To have a proper multi-disciplinary image in this modern complex world requires a universal physiologic, psychological, cultural and social perception. Simultaneous awareness of both physical and psychological parameters and the interaction between them is very important. Therefore, studying all psychological, social and physical parameters of human beings may significantly help reaching comprehensive rehabilitation goals.

People show different actions and reactions when face unusual circumstances. This increases when they face a threatening and stressful condition. Having a good stability is a very essential part of safety in such disturbing situations. Good balance is necessary during daily activities such as walking, running, picking up things from the ground, gardening, passing the street, etc. Without having a good balance, all of our movements would definitely fail. People should be able to keep their balance to adapt new perturbations by reacting on time. They must employ automatic postural reactions using optical, vestibular and somato-sensory inputs to adapt and compensate with any postural perturbations.

Although body position is mainly controlled by physiologic agents, some psychological factors such as anxiety and fear of fall may also affect it (11, 1, 3).

Anxiety is a very common psychological disorder associated with fear and worrying as well as physical modifications (14). Recently, some research was carried out on the effects of state anxiety on human stability. Researchers tried to simulate anxiety by changing the place and height of the test levels. Many recent studies focused on fear and anxiety because neurological and psychological theories have emphasized the combination of these two human characteristics with their evolutionary development.

Falling may result in many complications such as bone fracture, ligament tears, sprain and strains, etc. Brain trauma and hip fractures are two frequent side effects of human falling worldwide (18). Only in 2001, more than 327000 patients with hip fracture following falling were admitted to the USA hospitals; the patients were mostly old. Recurrent fear of fall is a very stressful factor always worrying elderly people and results in living alone, having cognitional problems, depression, weak balance, financial drop and falling again (20,5,17). Falling restricts the old people's activities and takes way their independence. (11) reported the negative effects of state anxiety on postural control, which may affect some postural functions (11,4) were the first to reproduce postural threatening situations by increasing the height of the test level.

In terms of treatment, although physiotherapists have some treatment protocols for patients following falling and disequilibrium problems, no comprehensive and successful methods are offered to these patients due to the lack of knowledge about the effects of psychological factors on their balance return. Therefore, the current study focused on the effects of state anxiety on balance. The results of this study may help to improve the management of patients with disequilibrium. We aimed to objectively prove whether state anxiety affect the balance index of young university students as a sample group with more anxiety due to their age in many developing societies.

Materials and Method

Setting of the study

This study was carried out in the "Center for Physiotherapy Research, Faculty of Rehabilitation, Shahid Beheshti University of Medical Sciences", Tehran, Iran in 2010-2011.

Subjects

Using a selected random sampling technique, 15 healthy girls with the average age of 21.7±2.1 years and a low state anxiety score (less than 42 in Shpielberger's questionnaire score), and 15 healthy girls with the average age of 21.6±2.4 years and a high anxiety score (higher than 42) were selected. A self-constructed questionnaire was also used to exclude the subjects if they had psychiatric problems, internal ear, musculoskeletal, severe anemia or dizziness diseases and/or a history of falling during the last six months. The subjects signed a written consent form.

Methods

This study was carried out in two steps. Firstly, to discover the level of state anxiety, the Shpielberger questionnaire (10) was given to 120 female university students. Then, 15 female students with an anxiety score of less than 42(as the sample group with low anxiety) and 15 with anxiety score above 42 (as the sample group with high anxiety score) were selected. Then, all the selected subjects were tested by a Biodex stabiliometer system (Biodex System, USA), and their stability parameters were measured.

The outcome measures were Anterior-Posterior (AP) stability score, Latero-Medial (LM) stability score and the total dynamic stability index (SI) in both groups. An independent *t*-test was used to compare the above scores between the two groups.

Figure 1

The Biodex stabiliometer (Figure 1) has shown reliable and repeatable results in healthy subjects and has been used frequently in balance evaluation research. This system has a multi-level test platform able to tilt around 20 degrees in all sides. The stiffness of the platform is also changeable from number one (the most unstable position) to number eight (the most stable position). A small screen shows the position of the platform to the subjects (where the subject stands on) as a point and reports the online computerized results to the researcher. When the system is running, the platform is released to the stability position that has been programmed by the researcher. In this study, the stability score was set on 5 to provide a higher, but safe instability for the subjects. Before starting the test, the system was calibrated based on the software's installation program. Each subject stood on the platform for 20 seconds while their hands were crossed on their chest and tried to maintain a balance on both feet. Then, the tests were carried out on the subjects and the results were graphed as anterior-posterior (AP), latero-medial (LM) and the total dynamic stability index (SI) scores. The obtained scores revealed the variance of changing the subject's body related to the horizontal platform. The higher the stability index score, the higher the platform inclination. i.e. the less ability of the subjects to maintain their balance.

Repeatability test

To verify whether the test measurements are repeatable, all measurements were carried out by an expert researcher. All stability index tests were carried out twice on six normal subjects who were randomly selected by the researcher. The Intra-Class Coefficient of Correlation (ICC) was 0.90 and the Chronbach alpha was 0.88 which confirmed that the test was repeatable enough to continue the test with more subjects.

Statistical Analysis

The results of the first-height effects also showed no significant differences between the two tests (p=0.45).

A Kolomogrov Smirinov test revealed that the data were normally distributed. An independent t-test was used to compare the results between the two groups. The SPSS version 16 was used for all statistical analyses.

Figure 1: The Biodex stability measurement system (Biodex Company, Canada).

Results

Table 1 demonstrates the demographic characteristics of the subjects including their personal information and mean estate anxiety scores. An independent t-test showed a significant difference in total anxiety score between the two groups (p=0.002).

The average total balance indexes were 2.9±1.6 and 1.4±0.5 in the high and low anxiety groups, respectively. This clearly showed lower stability in the high anxiety group. The anterior-posterior (AP) stability score was 2.1±0.9 and 1.3±0.6 in the high and low anxiety groups, respectively showing a significant less stability in the group with higher anxiety score (p=0.004). The latera-medial (LM) stability index was also 1.9±1.1 and 0.85±0.34 in the high and low anxiety groups, respectively also demonstrating a significant less stability in the group with higher anxiety score (p=0.001) (Table 2).

Discussion

This study aimed to investigate whether state anxiety affects the balance score in people with anxiety. With regards to the increased stressful conditions of most people in their everyday life, understanding the factors related to anxiety is crucial. The literature in this area is divided into two groups: Some have investigated it from the biological and physical points of view and others from the psychosocial points of view. The current study focused on anxiety as one of the most important factors affecting balance and equilibrium. The results of the current study revealed a higher total balance score in subjects with higher anxiety that refers to a less stability in this group. The same results were also achieved in the latero-medial and anterior-posterior stability scores showing a lower stability in subjects with higher anxiety. The results of the current study confirmed the findings of some previous researchers (12, 13). (12) reported significant effects of anxiety on postural functions. Based on the Shpielberger questionnaire's results, (13) divided their subjects into two high and low anxiety score groups, using a force platform. They found that subjects with higher anxiety score showed more instability in AP direction. The methodology of the current study differs from the previous studies with respect to the stability measurement system used in this study. While most of the previous studies used forceplate for measuring the subjects' stabilities, a standard Biodex system was used in the current study. (1) reported reduced amplitude and altered centre of pressure of the subjects' body. (5) also reported a change in the position of the COM (Center Of Mass) of the subjects with high anxiety during a threatening situation. This contradicts to (18) study which reported no significant difference between the duration, average speed and the level of fluctuations between the lower and higher anxiety groups. The literature reveals that a threatening condition not only changes the physical measurements of the positional control, but also changes the psychological measures following anxiety during a static standing or activities of daily living. In the literature, it was shown that a threatening position affects most common balance tests such as quiet standing, functional reach and single leg standing tests. Therefore, psychological assessments should be emphasized when rehabilitation programs are organized for patients (8).

Regarding the mechanisms that these findings take place, to date, there is no logical reason has been mentioned by scientists to explain the mechanisms of the above-mentioned findings. However, some theories have been declared. Opposed to (16) who believed a change of motor cortex role during balance following the positional instability, (3) reported that anxiety and fear of falling will change the positional control strategies which may indirectly result in reduced positional functions. (2) Studied the neurological basis between the balance control and anxiety by studying inter-neurones between the automated control pathways and the opposite role between the vestibular system and anxiety.

The central core of this system included the para-brachial nuclei network and its connections with the central amigdaloid nuclei, the infra-lymbic cortex and the hypothalamus.

The central core of this system included the para-brachial nuclei network and its connections with the central amigdaloid nuclei, the infra-lymbic cortex and the hypothalamus. The para-brachial nuclei are the junction point of the vestibular information and the somato-senssory and motor information of falling, anxiety and avoidance pathways. Anxiety and alertness may affect the balance control on these pathways.

Table 1. Participants' characteristics

	Groups	Numbers	Age (years)	Height (cm)	Weight (Kg.)	Average Score
1	Low score	15	21.6±2.1	164.7±5.7	57.9±9.3	32.6±4.89
2	Score High	15	21.6±2.9	164.7±3.9	56.9±5.1	54.1±7.8

Table 2. The lateral-medial, anterior-posterior and total stability scores in anxiety groups

Groups		Numbers	Total SI	Anterior-posterior SI	Lateral-Medial SI
1	Low score	15	1.4±0.53	1.3±0.6	0.85±0.3
2	High Score	15	2.9±1.6	2.1±0.9	1.9±1.1
	***P* value**		**0.002***	**0.004***	**0.001***

*significant differences

addition, anxiety may affect vestibular function through the central nervous system's connections between the balance control and the autonomic nervous system, thus affecting equilibrium. All the participants of this study were unable to maintain their balance with closed eyes. (15) emphasized the significant role of the visual system in state anxiety during standing on the edge of a high height stool. When anxiety increases, the neural mechanisms uses different ways such as reducing spinal irritability to control the instable condition while the visual system is activated (15). It has been shown that in high risk falling conditions, the COM spreads to out of the base of support and increases the supra-spinal control mechanism (5, 6). In the current study, the foot position and the kinematics of standing balance were not studied. However, the previous research showed a backward inclination of the COM and COP (center Of Pressure) of the edge of the platform, which reduced the activities of the gastrocnemius muscle (6,19) reported that joint stiffness is an adaptation strategy of the central nervous system to passively control the COM. Ankle joint stiffness could also occur when non-trustable signals receives during unstable conditions (9). In conclusion, it seems that anxiety affects balance through parabrachial nuclei. In anxious people, when instability increases, the supra-segmental control increases as well. With regards to the results of the current study and deliberately looking at the two neurophysiologic and evolutional psychology theories, it can be understood that anxiety should be carefully monitored during rehabilitation in subjects with psychological and neurophysiologic disorders. These factors should be kept in mind when treating patients in balance clinics. The current study provided some basic information in better understanding anxiety and balance.

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