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## **State Anxiety Affects on Balance Scores in Young Female University Students**

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The current study focused on the effects of anxiety on balance index in young female university students. A group of 15 female students with a high anxiety score (higher than 42 in Spielberger's score) and a group of 15 female students with a low anxiety score (lower than 42 in Spielberger's score) were recruited in this study. The Anteroposterior (AP), Mediolateral (ML) and the overall dynamic Stability Index (SI) of the subjects were recorded by use of a Biodex stabilometer (Biodex Stabilometer System, USA) and were compared with each other. The results revealed a significant difference between the two groups. The subjects with a high anxiety score showed a stability index higher than those in low anxiety group ( $p < 0.005$ ) which simply means significantly less stability in this group. In conclusion, this study showed a less stability index existed in subjects with higher anxiety scores. It could be inferred from the results that carrying out a state anxiety assessment concurrently with a clinical balance test certainly help clinicians to predict the hidden associated instability disorders of the patients.

**Key words:** State anxiety effects, postural stability index, biodex stabilometer, Spielberger's state anxiety inventory

## INTRODUCTION

To have a correct multi-disciplinary image in this current complex world needs a universal physiological, psychological, cultural and social perception. The simultaneous notice of both physical and psychological parameters and the interaction between them are very important. Therefore, studying all physical, psychological and social parameters of the human being may significantly help to reach comprehensive rehabilitation goals. People show different actions and reactions when face unusual accidents. This increases even when they face a threatening and stressful condition. Having a good stability is a very essential part of safety in such disturbing situation. For humans, good balance is necessary during daily activities such as walking, running, picking up something from the ground, gardening, passing through the streets, etc. Any movement without having good balance would definitely fail at the end. People should be able to keep their balance to adapt with new perturbations via reacting on time. They must employ automatic postural reactions using optical, vestibular and somato-sensory inputs to adapt and compensate with any postural perturbations. Body position is mainly controlled via physiological agents; however, psychological factors such as anxiety and fear of fall are likely to affect on it (Maki *et al.*, 1991; Adkin *et al.*, 2000; Bolmont *et al.*, 2002). State anxiety is an emotional condition characterized by apprehension, tension and fear about a particular situation or activity. Recently, some research was carried out on the effects of state anxiety on human stability. Researchers tried to simulate anxiety via changing the place and the height of the test levels. The reason that fear and anxiety have been focused in many recent studies is the fact that neurological and psychological theories have emphasized on the combination of these two human characteristics with its evolutionary development. To measure state anxiety, Spielberger's State Anxiety Inventory is considered to be gold standard (Barnes *et al.*, 2002). This questionnaire, consists of 20 items that ask how a person feels now and reflects situational factors that may influence anxiety levels. 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 (Wada *et al.*, 2001). Just in 2001, more than 327,000 patients with hip fracture following falling were admitted in the USA hospitals, mostly due to falls in the elderly. Recurrent fear of fall, albeit easily ignored by people, is always a very stressful factor in elderly people resulting in living with loneliness, having cognitional problems, depression, weak

balance, financial drop and falling again (Yardley and Smith, 2002; Brown *et al.*, 2005; Stevens, 2005). Falling restricts his/her activities and ruins his/her independence. Firstly, Maki *et al.* (1991) reported the negative effects of state anxiety on postural control which may affect on some postural functions (Maki *et al.*, 1991). Brown and Frank (1997) were the first who reproduced postural threatening situations with increasing the height of the test level. Measuring the subject's Spielberger's state anxiety score plus dynamic posturography shown to be a more valid measure of stability routinely using equilibrium score seems to provide a good overview for researchers to assess patients with state anxiety (Chaudhry *et al.*, 2005). In terms of treatment, although physiotherapists have many treatment protocols for patients following falling and disequilibrium problems, there is no comprehensive successful method for these patients probably due to the ignorance of the effects of psychological factors on their balance return. Therefore, the current study focusing on the effects of state anxiety as a common psychological disorder of human balance may help in better management of patients with disequilibrium. Our investigation aimed to objectively prove if state anxiety affects on the balance index of young university students considered to be the sample group with more anxiety due to their age in many developing societies.

## MATERIALS AND METHODS

This study was carried out at the Center for Physiotherapy Research, Faculty of Rehabilitation, Shahid Beheshti University of Medical Sciences (SBUMS), Tehran, Iran in 2011. The materials used in this study included the Spielberger's questionnaire to measure the state anxiety and a stabilometer to measure the Anterior-Posterior (AP) stability score and the Latero-Medial (LM), as well as the total dynamic stability scores. The method used in this study had partly been carried out by Ohno *et al.* (2004).

**Subjects:** Using a simple random sampling technique, 15 healthy female students with a low state anxiety score (less than 42 in Spielberger's score), with their average age being  $21.7 \pm 2.1$  years old and 15 healthy female students with a high anxiety score (higher than 42), with their average age being  $21.6 \pm 2.4$  years old were selected (Table 1). A self-constructed questionnaire was 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. All subjects signed a written consent form when entering in the study.

**Methods:** This study was carried out in two steps. Firstly, a standard Spielberger's questionnaire was completed by 120 university female students to find out the level of their state anxiety. Then, 15 female students with an anxiety score less than 42 and 15 female students with anxiety score above 42 were selected and went through for the second round test. In this step, all subjects were tested by a Biodex stability system (Biodex Stabilometer, USA) and their stability parameters were measured. The outcome measures were the AP stability score, the 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 low and high anxiety scores subjects.

The Biodex balance measurement system (Fig. 1) has shown reliable and repeatable results in healthy subjects and has frequently been used in balance evaluation research. This system has a multi-level test platform able to tilt around 20° in all sides. The stiffness of the platform is also changeable from 1 (the most unstable position) to 8 (the most stable position). In front of the subject's view, a small screen shows the position of the platform (where the subject stands on it) as a point and reports the online computerized results to the researcher. When the system

gets on, 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 on the basis on the software installed on the system. The subject stood on the platform for 20 sec while her hands were crossed on her chest and tried to maintain her balance on her both feet. Then, the tests were carried out on the subjects and the results were graphed as AP, LM and the total dynamic stability index scores. The obtained scores revealed the variance of changing the subject's body related to the horizontal platform. The bigger the stability index score, the higher platform inclination i.e., the less ability of the subjects to keep their balances.

**Repeatability test:** To verify if the test measurements are repeatable, all measurements were carried out by an expert researcher. All stability index tests were carried out twice on six 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.



Fig. 1: The Biodex stability measurement system (Biodex Stabilometer, USA)

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

**Statistical analysis:** A Kolomogrov-Smirinov (K-S) 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.

## RESULTS

Table 1 shows the demographic characteristics of the subjects including their personal information and mean state 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 index were  $2.9 \pm 1.6$  and  $1.4 \pm 0.5$  in the high and low anxiety groups, respectively. This clearly showed the lower stability ability in the high anxiety group. The AP stability score was  $2.1 \pm 0.9$  and  $1.3 \pm 0.6$  in the high and low anxiety groups, respectively, thus showing a significantly less stability in the group with higher anxiety score ( $p = 0.004$ ). The LM stability index was also  $1.9 \pm 1.1$  and  $0.85 \pm 0.34$  in the high and low anxiety groups, respectively, thus also showing a significantly less stability in the group with higher anxiety score ( $p = 0.001$ ) (Table 2).

## DISCUSSION

Since increased stressful conditions are occurring in most people, including young and elderly people, in each and every job, understanding the factors related to anxiety is considered crucial. Thus, the current study aiming to investigate if state anxiety affects on the balance score in people with anxiety was carried out. The literature in this area is divided into two groups: Some have investigated the issue from the biological and physical points of view. Others have discussed the matter from the psychosocial points of view. The current study focused on anxiety as one of the most important factors affecting balance and equilibrium in people. The results of the current study revealed a higher total balance score in subjects with higher anxiety, thus implying that there is less stability in this group. The same results were also achieved in the AP and LM stability scores showing a lower stability in subjects with higher anxiety. The results of the current study confirmed the findings of previous researches (Maki and Macclory, 1996; Ohno *et al.*, 2004; Maki and Macclory, 1996), reported significant effects of

Table 1: Subjects' characteristics participated in this study

Groups	No.	Age (years)	Height (cm)	Weight (kg)	Average score	SD
1: low score	15	21.6	164.7	57.9	32.6	4.9
2: score high	15	21.6	164.7	56.9	54.1	7.9

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

Groups	No.	Lateral-medial SI	Anterior-posterior SI	Total SI
Low score	15	$0.85 \pm 0.3$	$1.3 \pm 0.6$	$1.4 \pm 0.53$
High score	15	$1.9 \pm 1.1$	$2.1 \pm 0.9$	$2.9 \pm 1.6$
p-value		0.001*	0.004*	0.002*

\*Significant differences at  $\alpha = 0.05$

anxiety on postural functions. The results demonstrated that carrying out a state anxiety assessment concurrently with a clinical balance test can certainly help clinicians predict the hidden associated instability disorders of the patients. Based on the Spielberger questionnaire's results, Ohno *et al.* (2004) divided their subjects into two high and low anxiety score groups and with use of a force platform, they found that subjects with higher anxiety score showed more instability in AP direction. In the current study, the use of stability measurement has provided a method that differs from previous approaches. In most of the previous studies, force plate was used to measure the subjects' stabilities. In the current study, however, a standard Biodex system was used. Adkin *et al.* (2000) reported reduced amplitude and altered center of pressure in the subjects' body. Brown *et al.* (2005) also reported a changing in the position of the Center of Mass (COM) of the subjects with high anxiety during the threatening situation. This contradicts the findings of Wada *et al.* (2001) who reported no significant difference between the duration, the average speed and the level of fluctuations between the higher and the lower anxiety groups. The literature reveals the fact 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. Studying literature showed that a threatening position affects on 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 (Hauck *et al.*, 2008). However, some theories have been declared. In contrast to Solopova *et al.* (2003) who believed in a change of motor cortex role during balance following the positional instability, Bolmont *et al.* (2002) reported that anxiety and fear of falling will change the positional control strategies which may indirectly result in reduced positional

functions. Balaban and Thayer (2001) studied the neurological basis between the balance control and anxiety via studying the interneurons in the automated control pathways and the opposite role played by the vestibular system and anxiety. The central core of this system included the para-brachial nuclei network and its connections with the central amygdaloid nuclei, the infralimbic cortex and the hypothalamus. The para-brachial nuclei are the junction point of the vestibular information and the somato-sensory and motor information of falling, anxiety and avoidance pathways. Anxiety and alertness may affect the balance control on these pathways. In addition, the anxiety may affect vestibular function through the central nervous system's connections between the balance control and the autonomic nervous system, thus being effective on equilibrium. All the participants of this study were unable to keep their balance with closed eyes. Sibley *et al.* (2007) emphasized on the significant role that visual system play in state anxiety during standing on the edge of a high height stool. When anxiety increases, the neural mechanisms use different ways such as reducing spinal irritability to control the instable condition while the visual system is activated (Sibley *et al.*, 2007). It has been shown that in high risk of falling conditions, the COM spreads out of the base of support and increases the supra-spinal control mechanism (Carpenter *et al.*, 2001; Brown *et al.*, 2005). In the current study, the foot position and the kinematics of standing balance were not studied. However, a previous research showed a backward inclination of the COM and the Center of Pressure (COP) on the edge of the platform which reduced the activities of the gastrocnemius muscle (Carpenter *et al.*, 2006). Winter *et al.* (2001) reported that joint stiffness is an adaptation strategy via the central nervous system to passively control the COM. Ankle joint stiffness could also occur when non-trustable information is received during instable conditions (Koceja *et al.* 1995). In conclusion, it seems that anxiety affects balance through the para-brachial nuclei. In anxious people, when the instability increases, the supra-segmental control increases too. Due to the complexity of many neuro-musculo-skeletal disorders, it seems that assessment of psychological characteristics of patients with balance disorders might help the clinicians to better treat these patients. With regards to the results of the current study and deliberately looking at the two neurophysiological and evolutionary psychology theories, it can be understood that anxiety should be carefully monitored during rehabilitation in subjects with psychological and neurophysiological disorders. These

factors should be in mind when treating these patients in balance clinics. The current study provided some basic information in better understanding about anxiety and balance and can be used in rehabilitation of patients with state anxiety with focusing on their balance improvements. It is recommended that further research should focus on the effects of state anxiety in different age groups. Furthermore, based on the recommendations of the WHO focusing more on prevention, rather than treatment, a combined psychological and physiological approach will be helpful in prevention as well as in diagnosis and treatment of some neuro-musculo-skeletal disorders. An effective rehabilitation should consist of all these parameters.

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