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Effect of Smartphone Addiction on Dynamic Balance Control among Physical Therapy Students

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Abstract

Background: Smartphone addiction has increased excessively among university students. Musculoskeletal disorders, faulty posture and disturbance of postural control were linked to smartphone use.

Aim of Study: The aim of this study was to identify the effect of smartphone addiction on dynamic balance control among physical therapy (PT) students.

Material and Methods: Forty healthy PT students were assigned into two equal groups (group A: Non-smartphone addicted, group B: Smartphone-addicted) based on their score from the Arabic version of smartphone addiction scale-short version (SAS-SV). All students were assessed for dynamic balance by using the Biodex balance system (BBS). The overall stability index (OSI), medial-lateral stability index (MLSI) and anterior-posterior stability index (APSI) were measured by the device.

Results: There were a significant increase in all dynamic balance indices (p=0.001) of the smartphone addicted group compared to that of the non-smartphone addicted group.

Conclusion: Smartphone addiction can cause disturbance of dynamic balance control among PT students.

Key Words: *Smartphone addiction – Dynamic balance.*

Introduction

SMARTPHONE use has increased extensively all over the world as it plays an essential role in everyone's life. It does not only have the functions of texting and calling, but it also has a diversity of applications for social net working, productivity and gaming. It also enables people to access the internet at anytime and anywhere **[1,2]**. Moreover, these different functions made people overuse their smartphones that they neglected other aspects of their life, which in turn gave rise to smartphone addiction **[3]**. That is why most university students are more attached to their smartphones. It was stated that the common day by day smartphone use amongst them was about 4 hours a day **[4]**.

The increased dependence on smartphones among university students has driven researchers to investigate the prevalence of smartphone addiction among them **[3,5]**. In Egypt, it was revealed that among 420 PT students, 62.4% were considered smartphone addicted **[6]**. One study reported that 36.5% of Saudi Arabia's Medical Students were smartphone addicted **[7]**.

Smartphone addiction has been linked to several disorders including; psychological, social, loneliness, quality of life **[8]**, respiratory, nervous **[9]**, dizziness, headaches, visual disorders **[10]**, changes in gait parameters, disturbance of postural control **[11,12]**. Moreover, smartphone addiction was found to be associated with increased musculoskeletal pain in the cervical spine, lower back and shoulders **[13]**.

Several musculoskeletal disorders were associated with smartphone addiction **[14]**. It was reported that smartphone addiction could lead to increased cervical disability **[15]**, decreased cervical range of motion **[16]**, impaired cervical proprioception **[17]** and reduced hand grip strength **[18]**.

Further more, proprioceptive inputs from the cervical spine, muscles, ligaments and joint capsules along with the afferent information from the visual and vestibular systems are essential for the sensorimotor control system to help maintain good postural stability and proper balance control **[19]**. Therefore, disturbance of proprioceptive inputs, visual disturbance and dizziness could lead to changes in the postural stability and balance control **[20,21]**.

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Up to the authors' knowledge; static balance was widely investigated in previous researches and there was a lack in literature concerning the impact of smartphone addiction on dynamic balance. It was reported that smartphone use caused a significant reduction in static balance control [22]. Another study revealed that using smartphones for texting or calling caused significant impairment of static balance [23]. The immediate effect of smartphone use on different musculoskeletal disorders including; cervical pain and balance, was repeatedly investigated in previous literature [24,25,26]. In the present study the SAS-SV was used to determine the smartphone addiction level. Therefore, the current study was designed to investigate the impact of smartphone addiction on dynamic balance control among PT students.

Material and Methods

The study was conducted at the outpatient clinic of Faculty of Physical Therapy, Cairo University, Egypt, from December 2021 to June 2022. The approval of the Ethical Research Committee, Faculty of Physical Therapy, Cairo University, was obtained in November 2021 (NO: P.T.REC/012/003471).

Study design:

This was a cross-sectional study, with analytical observational design.

Sample size:

The G*POWER statistical software (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany) was used for sample size calculation [27]. A total sample size of 40 subjects was required to show statistical significance. Calculation was made with a=0.05, power=85% and effect size=0.88.

Subjects:

Forty PT students of both genders were recruited from Faculty of Physical Therapy, Cairo University. Subjects were classified into two equal groupsbased on their score in the (SAS-SV); group A: (Non-smartphone addicted), group B: (Smartphone-addicted). At first, all subjects filled out a questionnaire with their personal information, demographic data, a history of any injury and any existing musculoskeletal deformity.

Aim of study:

The aim of the study and the testing procedures were explained to them. An informed consent form was signed by the subjects prior to the assessment.

Inclusion criteria: Subjects were included if they had a smartphone and their age were ranged from 18-23 years old.

Exclusion criteria: Subjects were excluded if they had any previous musculoskeletal injury or surgery that may affect their balance, any congenital abnormality or a deformity that could affect their balance [22] and any vestibular pathology or reported dizziness [28].

Assessment instrumentations and procedure:

1- Assessment of smartphone addiction by the Arabic smartphone addiction scale- short version (SAS-SV):

The Arabic version of the SAS-SV has been proven to have a high validity and good to excellent reliability [29]. The scale includes 10 items and evaluates 6 elements regarding the addictive behavior including “daily life disturbance - positive anticipation - with drawal - cyberspace-oriented relationships - Overuse and tolerance”. It has a cut-off score of 31 for males and 33 for females [30]. Subjects were asked to respond to each item on a scale ranging from 1 (strongly disagree) to 6 (strongly agree).

Subjects were classified into two groups based on their score in the questionnaire. Group A (non-smartphone addicted) included male subjects with score less than 31 and females with score less than 33. Group B (smartphone-addicted) included male subjects with score more than or equal to 31 and females with score more than or equal to 33.

2- Assessment of dynamic balance by the Biodex Balance System:

Dynamic balance was assessed by the BBS (Model 945-300-E617, Version 3.08, Shirley, NY, USA). The BBS is and an objective and reliable method for balance assessment [31]. It consists of a circular platform that allows tilting up to 20 degrees in all direction (Fig. 1).

The device has different stability levels starting from the 8th stage (the highest stability) and progresses to the 1st stage (the least stability). All subjects were requested to stand on the platform barefoot, arms by their side and looking straight to the display screen [32]. They were evaluated with eyes opened and maintained a bilateral stance [33]. Stage 4 was selected for the assessment procedure. The Subject tried to maintain their center of pressure in the smallest central circle (zone A). The measurement time was 30 seconds per trial, and 3 trials were performed with 1 minute rest between trials. The mean values of the 3 scores

were calculated. All subjects were trained 1 minute before the assessment for adaptation of the machine. The OSI, MLSI and APSI were assessed by the device.

Fig. (1): The Biodex balance system.

Statistical analysis:

The comparison of subject characteristics between groups was evaluated by conducting the Unpaired *t*-test. Comparison of gender distribution between groups was done by using the Chi-squared test. The Shapiro-Wilk test was conducted to check the normal distribution of the data. All the dependent variables were normally distributed ($p>0.05$). The homogeneity of variances by Levene's test was conducted to ensure the homogeneity between groups. One way Multivariate Analysis of Variance (MANOVA) was conducted for comparison of OSI, APSI and MLSI between groups. The level of significance for all statistical tests was set at $p<0.05$. All statistical measures were performed through the statistical package for social sciences (SPSS) version 25 for windows.

Results

The general Characteristicsof the subjects and their demographic data are presented in (Table 1).

Table (1): General characteristics of subjects in the study groups.

	Non-smartphone addicted	Smartphone addicted	MD	*t*-value	*p*-value	Sig.
	X ± SD	X ± SD				
Age (years)	21.65±1.53	21.85±1.49	–0.2	–0.41	0.67	NS
Weight (kg)	61.5±11.14	65.95±11.26	–4.45	–1.25	0.21	NS
Height (cm)	165.55±8.01	165.75±7.32	–0.2	–0.08	0.93	NS
BMI (kg/m^2)	22.31±2.79	23.96±3.65	–1.65	–1.61	0.11	NS

X : Mean. MD: Mean difference. *t*-value: Unpaired *t*-value.
SD: Standard deviation. NS : Non significant. *p*-value: Probability value.

Comparison of stability indices between non-smartphone addicted and smartphone addicted groups:

The one way MANOVA showed that there was a significant difference between the study groups (F-value=6.45, $p=0.001$) and a large effect size (partial eta squared=0.35). The OSI, APSI and MLSI of smartphone addicted group were significantly higher compared to that of non-smartphone addicted group ($p=0.001$). These results indicated that there was a significant effect of smartphone addiction on dynamic balance. (Table 2, Fig. 2) shows the descriptive statistics and the significance level of the dependent variables.

Table (2): Comparison of OSI, APSI and MLSI between non-smartphone addicted and smartphone addicted groups.

	Non-smartphone addicted	Smartphone addicted	MD	*p*-value	Sig.
	X ± SD	X ± SD			
OSI	2.15±0.66	3.31±1.11	–1.16	0.001*	S
APSI	1.72±0.51	2.68±0.97	–0.96	0.001*	S
MLSI	1.54±0.53	2.41±0.94	–0.87	0.001*	S

X : Mean. S(*): Significant.
MD: Mean difference. *p*-value: Probability value.

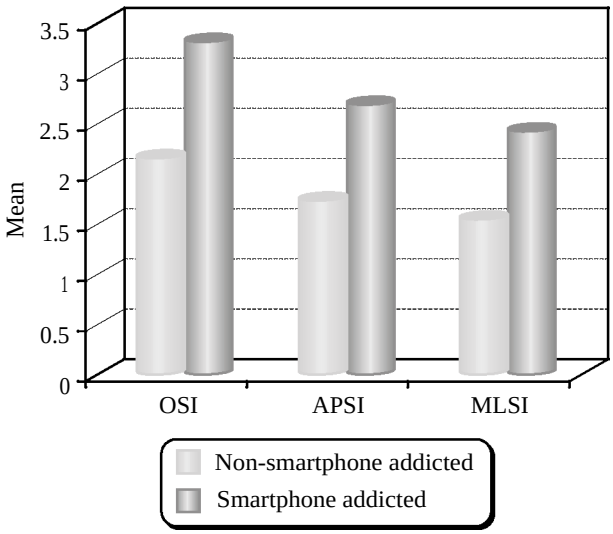

Fig. (2): The mean value of OSI, APSI and MLSI for non-smartphone addicted and smartphone addicted groups.

Discussion

The results of the current study demonstrated that smartphone addiction caused a significant increase in OSI, APSI and MLSI which indicated that smartphone addiction had a negative effect on dynamic balance among PT students. Different studies have reported similar results; although these studies used the daily hours of smartphone use as an indicator of smartphone addiction rather than using the SAS-SV. It was reported that using a smartphone for more than 4 hours a day was associated with a significant reduction in dynamic balance control **[26]**. A similar study by Alshahrani et al., **[32]** reported that subjects who used their smartphones for more than 4 hours per day, showed a significant decrease in dynamic balance control in healthy adults. It wasconcluded that dynamic balance decreased immediately after 30 consecutive minutes of smartphone use in healthy adolescents. However, it was stated that these changes in the dynamic balance after immediate smartphone use were not permanent and could disappeared after 1 hour of not using the smartphone **[34]**.

The visual system is considered one of the crucial parts of the body's somatosensory system that is responsible for postural control. Therefore visual fatigue or any changes or disruption of the visual feedback can cause significant changes in balance control **[35]**. Although the effect of smartphone addiction on visual system has not been investigated, different studies have found a connection between smartphone use and visual disturbance. It was found that using a smartphone for 20 minutes could cause blurred vision and eye strain **[36]**. It was also reported that visual fatigue induced by smartphone use led toincreaseddynamic postural sway and disruption of both static and dynamic limit of stability which indicated impaired balance control **[37]**.

Moreover, smartphone use was found to have an impact on the vestibular system. Dizziness was suggested to be one of the side effects of smartphone use which in turn would cause disturbance of balance control. It has been reported that playing a game on a smartphone for 10 and 20 minutes had caused significant impairment of static balance control and increased the reported dizziness **[22]**. Similarly, Lee et al. (2019) **[38]** revealed that using a smartphone for 20 minutes caused disruption of sensory information from both vestibular and visual systems which led to increased dizziness and oculomotor symptoms. As a result of these changes, static balance control was disrupted.

The current study had a few limitations, as it was only focused on undergraduate physical therapy students. The Subjects ages ranged from 18 to 23; therefore, the findings may not be generalized to older subjects. Gender differences were not investigated in the present study.

Further studies will be recommended to investigate the effect of smartphone addiction on dynamic balance using older age groups. The difference between males and females should be examined.

Conclusions:

According to the results of the present study, smartphone addiction can lead to disturbance of the dynamic balance control among physical therapy students.

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تأثير إدمان الهواتف الذكية على إستقبال الحس العنقى العميق والتحكم فى الإتزان بين طلاب العلاج الطبيعى

\الخلفية : أصبح إستخدام الهواتف الذكية جزءاً أساسياً من حياتنا. لكن، مع الإستخدام المفرط ظهرت العديد من الإضطرابات الجسدية.

\الهدف : الغرض من هذه الدراسة هو التحقيق فى تأثير إدمان الهواتف الذكية على التحكم فى الإتزان بين طلاب العلاج الطبيعى.

\الطرق : تم إختيار إربعين طالباً من كلية العلاج الطبيعى بجامعة القاهرة مصر من كلا الجنسين وتصنيفهم إلى مجموعتين، (المجموعة أ: غير مدمن على الهاتف الذكية، المجوعة ب: مدمن على الهاتف الذكى) بناءً على درجاتهم فى النسخة العربية من مقياس إدمان الهاتف الذكى (النسخة القصيرة). تم تقييم جميع المشاركين بقياس قدرتهم على الإتزان الحركى.

\النتائج : تشير نتائج هذه الدراسة إلى أن هناك زيادة فى إختلال مقاييس التوازن فى المجموعة ب (مدمنى الهاتف الذكى) عند مقارنة النتائج مع المجموعة أ (غير مدمنى الهاتف الذكى).

\الإستنتاج : هذا البحث أظهر أن إدمان إستخدام الهاتف الذكى يمكن أن يؤدى إلى زيادة إختلال الإتزان الحركى لدى طلاب العلاج الطبيعى.