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Investigation of the relationship between core muscle endurance and postural habits and awareness in young adults

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Abstract

The study investigated the relationship between core muscle endurance, postural habit, and awareness in young adults. Healthy individuals between the ages of 18 and 25 with no back or neck disorders were included in the study. Postural habits and understanding of the participants were assessed using the Postural Habits and Awareness Scale (PHAS), and core muscle endurance was measured using the Mcgill Core Endurance Tests. As a result of the study, a significant positive correlation was found between postural habit score and trunk flexor test time ($r = 0.324$; $p = 0.047$), trunk extensor test time ($r = 0.529$; $p = 0.001$), side bridge test time ($r = 0.337$; $p = 0.039$) and plank test time ($r = 0.508$; $p = 0.001$). However, no significant relationship was found between postural awareness score and core muscle endurance ($p > 0.05$). The study findings reveal that core muscle endurance is related to postural habits but is not directly related to postural awareness. As a result, it was emphasized that core muscle endurance is an essential factor in developing and maintaining postural habits. These findings indicate that improving postural habits may be essential to support musculoskeletal health.

Introduction

Posture refers to the position of the human body in space and the alignment of body segments relative to each other (Elliott et al., 2005). While the alignment that places minimum stress on the joints is defined as good posture, misalignment of body segments and the resulting increase in stress on the joints is considered bad posture (Yamak et al., 2018; Yasmeen et al., 2014). The ability of an individual to consciously perceive the difference between good and bad posture is called postural awareness.

Postural awareness enables the conscious awareness of body posture through proprioceptive feedback transmitted to the central nervous system (Cramer et al., 2018). To maintain healthy posture habits in daily life, it is of great importance for the individual to be aware of posture changes. Poor posture habits can change muscle tone and alignment, leading to poor posture patterns and overall body asymmetry (Bayar et al., 2023). Postural habits are the body positions that individuals acquire and constantly apply in their daily lives, and these habits play an important role in maintaining posture over time. Long-term poor posture habits can increase the load on the spine, leading to pain and other musculoskeletal problems. Therefore, postural habits are fundamental to maintaining a healthy body posture (Bayar et al., 2023; de Assis et al., 2021).

The most important muscle group in maintaining posture is the core muscles. The core muscles consist of superficial and deep muscles that stabilize the spine and support trunk movements (Hodges & Richardson, 1997). Among these muscles, the transversus abdominis, multifidus, diaphragm, and pelvic floor muscles play a critical role (Bergmark, 1989). Sufficient endurance in the core muscles is important in providing spinal stability, increasing sports performance, preventing injuries, and being effective in rehabilitation processes (Khaiyat & Norris, 2018; Maffulli et al., 2016; Tong et al., 2014).

Weakening of the core muscles can lead to low back pain and negatively affect postural control (Akuthota & Nadler, 2004). In addition, fatigue of the

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core muscles during prolonged sitting or standing affects postural adaptations and causes posture disorders (Granacher et al., 2013). These posture disorders can also negatively affect postural habits because poor posture habits disrupt the balance in the spine and overload the muscles, further increasing muscle fatigue.

Although many conditions associated with weakness of the core muscles have been described in the current literature, studies examining the relationship between core muscles and postural awareness and habits in young adults are limited. Low core muscle endurance can make it challenging to maintain postural stability during prolonged sitting, standing, or repetitive movements. This can lead to disruption of postural habits and the emergence of posture-related musculoskeletal problems in the long term (Marshall & Murphy, 2005). In particular, weak core muscles can negatively affect postural awareness, causing an individual to be unable to perceive changes in body posture adequately and to develop compensatory mechanisms. Such mechanisms can lead to poor postural habits and disruption of spinal alignment over time. Therefore, this study examined the relationship between core muscle endurance, strength, postural awareness, and habits.

Methods

Participants

University students aged 18-25 who agreed to participate were included in the study. Approval was obtained from the ethics committee of Erzurum Technical University Scientific Research and Publication Ethics Committee for the conduct of the study, and ethical rules were followed in all procedures (Meeting Number: 01, Decision Number: 11, Date: 02.01.2025). Written consent was obtained from all participants before starting the study.

The minimum number of individuals required for the study was calculated using the G*Power program. It was planned that the study should be completed with 34 participants at a 95% confidence interval, 0.05 level of significance, 0.5 effect size (obtained from reference study data(Paramanidis et al., 2023)), and 0.90 power. The study was completed with 40 participants.

Sedentary healthy individuals between the ages of 18 and 25 who did not have any back or neck problems were included in the study. Individuals with any neurological, orthopedic, or cardiovascular issues or a history of surgical intervention or traumatic injury to the spine or upper extremity within the last year were excluded from the study. Individuals who regularly exercised were also excluded from the study.

Procedure

Postural habits and awareness

To determine the level of postural habits and awareness of the participants, the 19-item Postural Habits and Awareness Scale (PHAS), which was developed by Bayar et al. for Turkish validity and reliability, was applied. PHAS is a scale designed to evaluate awareness of body position and postural habits. This scale helps to determine how well people have correct posture habits in their daily lives and how much awareness they have about their posture. The highest score for postural habits is 35, and the highest for postural awareness is 60. The total score range of the scale is 0-95 points, and a high score indicates good posture and awareness (Bayar et al., 2023).

Core muscle endurance

The participants' core muscle endurance was evaluated using the time spent in the plank position. For the plank, the abdominal, leg, and chest muscles were used, and a position was taken at 45 degrees to the ground. The shoulders were kept back; the chest was up; the whole body was squeezed with the help of the fingertips on the elbows, and the person was asked to look ahead. The evaluator recorded the time using a digital stopwatch (Reiman & Manske, 2009) (Figure 1).

Core muscle endurance was also assessed using three core endurance tests developed by McGill. The McGill Core Endurance Tests are the trunk flexor, trunk extensor, and side bridge tests. The trunk flexor test was performed with the trunk at 60° flexion and knees and hips at 90° flexion. Arms were crossed on the chest, and individuals were asked to maintain this position for as long as possible. The trunk extensor test was performed in a prone position on the treatment table. The pelvis, hips, and knees were fixed to the treatment table up to the level of the anterior superior iliac spine. Individuals were asked to maintain a horizontal body position with arms crossed on the chest for as long as possible. A side bridge test was performed on the mat while lying on the side. While lifting the hips upwards on the mat, the body weight was supported only by the lower elbows and feet. Tests were terminated when the positions were disrupted. Measurement results were recorded in seconds (Waldhelm & Li, 2012) (Figure 2).

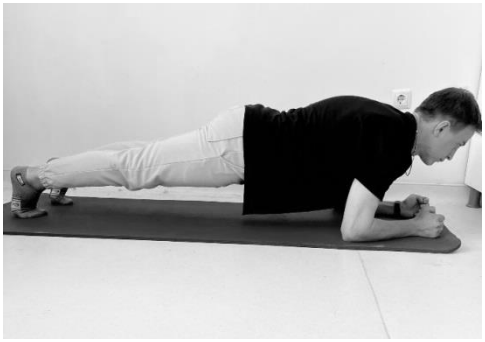

Figure 1. Plank test.

Figure 2. McGill core endurance tests.

Data Analyses

For data analysis, the Windows SPSS package program was used (IBM SPSS Statistics 25.0, IBM, New York, USA). The Shapiro-Wilk test was used to check the normal distribution assumption and to examine whether the data were normally distributed. Mean, standard deviation, median, and interquartile range were used to distribute the participants' demographic data and test results. The Spearman correlation test was used to evaluate the ordinal relationship between variables. For all analyses, $p<0.05$ was considered statistically significant.

Results

A total of 40 participants were included in the study. The mean age of the participants was 21 ± 1.04 years. 55% of the participants were female, and only 4% were smokers. Demographic data of the participants are given in Table 1. The participants' PHAS scores and data obtained from core muscle endurance tests are summarized in Table 2.

According to the results of Spearman correlation analysis, trunk flexor test duration showed a significant positive correlation with postural habit score ($r = 0.324$; $p = 0.047$). Trunk extensor test duration also significantly correlated with postural habit score ($r = 0.529$; $p = 0.001$). Side bridge test ($r = 0.337$; $p = 0.039$) and plank test ($r = 0.508$; $p = 0.001$) also significantly correlated with postural habit score. However, no significant correlation was found between postural awareness score and any core muscle endurance test ($p > 0.05$; Table 3).

Table 1
Demographic characteristics of participants (n=40).

Variables	Median (IQR)
Age (years)	21 (20-22)
Weight (kg)	63 (52.75-76.5)
Height (cm)	164(159.25-165.75)
BMI (kg/m^2)	21.7 (19.8-25.2)
	n (%)
Smokers	4 (10)
Gender	
Female	22 (55)
Male	18 (45)

IQR: Interquartile range.

Table 2
PHAS scores and core muscle endurance test results.

Variables	Mean ± SD
Trunk Flexor test (sec)	44.06 ± 14.01
Trunk Extensor test (sec)	45.79 ± 27.79
	Median (IQR)
Side bridge test (sec)	24.06 (17.75-35.30)
Plank test (sec)	54 (43-77.75)
PHAS- Postural Habit score	21 (17.75–24.50)
PHAS- Postural Awareness score	41 (38.50-43)
PHAS Total	63 (58.75-66.50)

PHAS: Postural Habits and Awareness Scale; IQR: Interquartile range; SD: Standard Deviation.

Table 3
Relationship between PHAS scores and core muscle endurance tests.

Variables		PHAS Postural Habit score	PHAS Postural Awareness score	PHAS Total
Trunk Flexor test (sec)	r	0.324	0.263	0.464
	p	**0.047**	0.111	**0.003**
Trunk Extensor test (sec)	r	0.529	0.20	0.501
	p	**0.001**	0.905	**0.001**
Side bridge test (sec)	r	0.337	0.050	0.276
	p	**0.039**	0.765	0.094
Plank test (sec)	r	0.508	0.253	**0.395**
	p	**0.001**	0.126	**0.014**

PHAS: Postural Habits and Awareness Scale.

Discussion

This study's findings indicate a significant relationship between core muscle endurance and postural habit in young adults. Still, it is not directly related to postural awareness.

Core muscles maintain spinal stability, support force production in the upper and lower extremities, and control body movements (Akduman et al., 2019). Core muscle endurance is one of the main factors determining the core muscles' ability to maintain posture and movement. The literature has stated that core muscle endurance is associated with better posture and that the risk of postural disorders is reduced in individuals with adequate core muscle endurance. For example, a study conducted on farmers found a strong correlation between core muscle endurance and low back pain, emphasizing the importance of core endurance in maintaining proper posture during physically demanding tasks (Anggreni et al., 2024). Similarly, methods recommended for correcting posture disorders include strengthening core muscles and endurance exercises (Bansal et al., 2014). Studies on athletes have shown that core training, especially on moving surfaces, improves posture stability by increasing core muscle endurance (Nuhmani, 2021). A study on basketball players also reported a positive correlation between core muscle endurance and postural stability (Cengizhan et al., 2019).

Although the relationship between core muscle endurance and posture has been widely studied in the existing literature, its relationship with postural habits and awareness has not been sufficiently investigated. Core muscle endurance can affect not only posture but also postural habits and awareness. Tsao and Hodges reported that postural awareness training improved muscle activation and postural control (Tsao & Hodges, 2008). Additionally, Hodges and Richardson proposed that motor strategies shape postural control mechanisms learned over time (Hodges & Richardson, 1999). These findings suggest that core muscle endurance may also affect postural habits that an individual develops unconsciously. In the current study, core muscle endurance was related to postural habits. This suggests that core muscle endurance provides instant postural stability and may also affect the postural habits that an individual adopts in the long term. However, this study found no significant relationship between postural awareness and core muscle endurance. This result suggests that postural awareness may be affected more by cognitive processes, education level, habits, or ergonomic factors.

Postural habits and awareness are critical factors affecting physical health, especially in adolescents and young adults. Research shows that poor postural habits, often exacerbated by sedentary lifestyles and excessive internet use, can lead to musculoskeletal problems such as back pain (Çankaya et al., 2024; Schwertner et al., 2022). Awareness of and correcting these habits is crucial to preventing musculoskeletal disorders (Schwertner et al., 2022). Therefore, this study evaluated postural awareness and habits in young adults, and a multi-faceted examination of core endurance was provided. In addition, the high applicability of the tests used in the study and the fact that they were performed under field conditions increase the practical value of the study.

The practical value of our study lies in the use of applicable and easily accessible tests for the assessment of postural habits and awareness in young adults. In particular, the fact that the tests used to assess core muscle endurance can be easily applied under field conditions increases the practicality of the study in terms of clinical and sports sciences.

This study has some limitations. First, factors affecting postural habits, such as the participant's physical activity level and daily living habits, were not evaluated in detail. Examining these factors may provide more comprehensive information about the formation process of postural habits. Second, analyzing only the endurance dimension of core muscle functions may have limited the full extent of muscle functions. Future studies can examine this relationship more comprehensively with objective muscle strength assessment methods such as isokinetic strength measurements.

In addition, the study's cross-sectional design prevents the determination of causal relationships between core muscle endurance and postural habits. In the future, longitudinal studies can examine the effects of changes in core muscle endurance on postural habits over time.

Conclusion

As a result, a significant relationship between core muscle endurance and postural habits in young adults was found in the study. Still, no direct relationship was found between postural awareness and core muscle endurance. The findings suggest that core muscle endurance may affect postural habits, but postural awareness is more affected by cognitive processes, education level, and environmental factors.

Authors' Contribution

Study Design: AY; Data Collection: AY, RY; Statistical Analysis: RY; Manuscript Preparation: AY, RY.

Ethical Approval

The study was approved by the Erzurum Technical University Scientific Research and Publication Ethics Committee (Meeting Number: 01, Decision Number: 11, Date: 02.01.2025) and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a declaration of Helsinki.

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Conflict of interest

The authors hereby declare that there was no conflict of interest in conducting this study.

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