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Original Investigation

The Relationship Between Posture and Dynamic Balance In 10-12 Age Group Wrestlers

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Purpose: Posture and balance control is based on a complex set of interrelated mechanisms. Coordination between the musculoskeletal system and the nervous system and receptors that provide this coordination, and the balance organ are needed to ensure postural regularity. This study aimed to determine the relationship between postural problems and dynamic balance.
Methods: The study included 31 wrestling athletes aged 10-12 years. The participants were evaluated for posture analysis and dynamic balance in the study. Posture assessments of the participants were performed with the Posture Screen Mobile application and dynamic balance assessments were performed with the Y-Balance Balance test (YBT). Descriptive statistics, the Shapiro-Wilk test, and Pearson correlation analysis were used to analyze the data. The significance level was fixed as $P \leq .05$.
Results: In the study, a significant negative correlation was found between the forward head angulation of the participants and right and left YBT.
Conclusions: In conclusion, forward head posture negatively affects dynamic balance in wrestling athletes aged 10-12 years. In addition to balance exercises for the development of dynamic balance, head posture should be evaluated, and the existing postural problem should be improved.

Keywords: Children, dynamic balance, motor control; sports, posture.

Introduction

Posture refers to the alignment of the head, neck, body, and upper and lower extremities on anatomical planes.[1] In correct posture, the alignment of the body's center of gravity passes over specific points. Maintaining correct posture offers mechanical advantages, promoting efficient movement without energy loss and enabling internal organs to function optimally.[2,3] The groundwork for postural stabilization is established through intermuscular reflexes, stretching reflexes, and the physiological properties of muscles.[4] To ensure this stability, an intricate relationship develops between muscle groups, giving rise to muscle chains. A change in posture originating in one muscle initially impacts nearby muscles and then propagates throughout the entire segment, resulting in a compensatory chain that affects the overall posture.[5-7] For instance, when abdominal muscles lengthen and weaken, the body's center of gravity shifts forward, causing the shoulders, head, and neck to move forward as well.[7-8]
Posture and balance control is a complex mechanism based on interactive dynamic, sensory and motor processes.[9] It is an autonomous and involuntary process that activates reflex activities and requires continuous co-operation of proprioceptors, visual and vestibular systems.[10] Ensuring posture correctness is achieved because of the coordination of the musculoskeletal system and the nervous system. Any problem in the information flow of the balance organ, proprioceptive receptors and central nervous system, which provide this coordination, may result in deterioration of the body's statics.[11-14]
In the existing literature on postural disorders and balance, several studies have demonstrated that postural disorders can lead to impairments in dynamic balance. For instance, Ostrowska et al.[16] observed that children with idiopathic scoliosis exhibited poor standing balance, which was attributed to delayed central nervous system responses associated with scoliosis. Wiernicka et al.[17] conducted a study revealing that children with scoliosis faced challenges with balance and proprioception due to this postural issue. Furthermore, various studies have highlighted the prevalence of posture disorders among children aged 7-15 years[15,18]. The formation of body posture can lead to imbalances, particularly during the ages of 6-7 years, coinciding with the start of school and lifestyle changes, and from 9-16 years, during intense growth and maturation processes[19]. These postural problems have a detrimental impact on balance.
This study aims to investigate postural issues among boys aged 10-12 who participate in wrestling and to examine the correlation between these postural problems and dynamic balance. Additionally, we seek to determine whether wrestling has a positive impact on posture within this age group and how posture relates to balance. Consequently, we will ascertain whether postural disorders in wrestling negatively affect dynamic balance. This research will provide valuable insights into whether prioritizing posture is necessary to enhance the balance of athletes in the wrestling discipline, benefiting both clinical and field settings.

Methods

Participants

The study's sample comprised athletes in the 10-12 age group who were actively participating in wrestling at sports clubs affiliated with Bursa (İldırım Municipality and Bursa Municipality). The study sample consisted of 31 male wrestlers with an average age of 11.22 ± 0.71 years, a body weight of 44.28 ± 13.32 kg, and a height of 131.02 ± 9.05 cm. Participants were enrolled in the study on a voluntary basis, with parental permission obtained.

Experimental Design

Y-Balance Test and Determination of Postural Stability

We conducted the Y-Balance Test (YBT) using a specially designed YBT Kit, following the measurement procedures outlined by Plisky et al.[20]. To facilitate learning, athletes were given the opportunity to watch a training video before starting the test[19]. Before the formal tests, each athlete completed six trials in three reach directions: Anterior (AN), Posteromedial (PM), and Posterolateral (PL), for both lower extremities (right and left). If an athlete initiated the test with the left lower extremity, they stood on the left extremity and extended the right lower extremity forward (anteriorly) in the first three trials. In the subsequent three trials, the right lower limb served as the support limb, while the left lower limb extended forward. This trial sequence was repeated for measurements in the posteromedial and posterolateral directions. We measured the distance the indicator moved away from the central platform with an accuracy of .5 cm. If an athlete couldn't maintain one-leg stance, lifted or shifted the supporting leg, made contact with the ground using the reaching leg, or couldn't return the reaching leg to the starting position, the test was invalidated and repeated. We recorded the largest of the three attempts in each reaching direction. During the result analysis, we calculated the maximum reach in each direction during the unilateral balance stance for the length of the supporting limb using the following formula[20]:

Composite Score (CS) YBT was also calculated for each subject, using the following formula: YBT-CS (%) = [(AN + PM + PL)/(LL × 3)] ×100

Posture Measurement and Analysis

We obtained posture measurements of the participants using a photographic method. High-resolution photos were captured using a Canon professional camera mounted on a tripod, positioned two meters away from the measurement point. These photos were subsequently processed using the Posture Screen Mobile application, which offers posture analysis capabilities. The validity and reliability of the Posture Screen Mobile application have been established through previous studies, demonstrating high intra-rater and inter-rater reliability[22].A skilled physiotherapist with at least 6 years[21,22] of active experience performed postural markings and evaluations of the participants using the application. Angulation values in the anterior, left, and right lateral directions for each participant's posture were determined using this application. To collect these data via the mobile application, specific anatomical landmarks, including the earlobe, acromion head, anterior inferior iliac spine, posterior superior iliac spine, femoral head, the area just behind the patella, and lateral malleolus, were marked with artificial markers within the application. Therefore, participants were instructed to wear appropriate clothing that allowed for the visibility of these markers during the posture measurement process. The measurements were conducted in a well-ventilated, isolated area designated for posture measurements, ensuring compliance with COVID-19 safety measures. As a result of the analysis, we obtained values for right lateral angulation (RLA), left lateral angulation (LLA), and anterior angulation (AA) for each of the head, shoulder, pelvis, and knee regions. The lateral angulation (LA) value indicates anterior or posterior angulation of the region when viewed from the lateral perspective, while anterior angulation reflects the angulation value of the region when viewed from the front, either to the right or left. Conversely, posterior angulation indicates the angulation value of the region when viewed from the back, either to the right or left. Table 1 shown the mean and standard deviation values for the participants' angulation measurements. In the case of AA, positive values indicate angulation towards the right, while negative values indicate angulation towards the left. For LA measurements (RLA and LLA), positive values signify anterior angulation, and negative values represent posterior angulation.

Table 1. Mean (SD) Value and Normality Test Results of Postural Angulation

Postur Indices	*n*	Mean±SD	Kolmogorov-Smirnov			Shapiro-Wilk		
			Statistic	df	*P*	Statistic	df	*P*
Head-AA (°)	31	1.15±3.18	.286	31	.000	.854	31	.001
Head-RLA (°)	31	2.91±4.87	.146	31	.089	.961	31	.302
Head-LLA (°)	31	2.86±7.40	.134	31	.165	.963	31	.351
Shoulder-AA (°)	31	.60±1.43	.439	31	.000	.667	31	.000
Shoulder-RLA (°)	31	.62±2.47	.340	31	.000	.842	31	.000
Shoulder-LLA (°)	31	1.46±2.40	.180	31	.012	.936	31	.062
Pelvis-AA (°)	31	- .20±1.74	.319	31	.000	.839	31	.000
Pelvis-RLA (°)	31	2.95±3.52	.186	31	.008	.943	31	.097
Pelvis-LLA (°)	31	5.66±2.83	.086	31	.200	.972	31	.570
Knee-RLA (°)	31	3.56±3.47	.203	31	.002	.931	31	.046
Knee-LLA (°)	31	4.74±2.85	.108	31	.200	.963	31	.355

Note= anterior angulation (AA), right lateral angulation (RLA), left lateral angulation (LLA) for Head-Shoulder-Pelvis-Knee.

Statistical analysis

The data was analyzed on SPSS (Version 68.0, IBM SPSS Statistics, Chicago, IL, USA).[23] Normal distribution of the data was determined by Shapiro-Wilk test results and the skewness and kurtosis values (Table 1 and 2). It was determined that the Skewness and Kurtosis values of the data were in the range of (+2)-(-2) and that the data showed normal distribution.[24] For this reason, parametric tests were preferred in statistical analysis. Descriptive statistics (mean, standard deviation), Pearson correlation analysis was used to analyze the data. Statistical significance level was set at $P \leq .05$.

Results

Postural Angulation Value

As shown in Table 1, when analyzing the participants' postures from an anterior perspective, the mean head angulation was 1.15±3.18°, the mean right shoulder angulation from the left side was .60±1.43°, and the mean pelvis angulation from the left side to the right side was - .20±1.74°. When assessed from the right lateral side, it was observed that the mean head angulation was 2.91±4.87°, the mean right shoulder angulation was .62±2.47°, the mean pelvis angulation was 2.95±3.52°, and the mean right knee angulation compared to the midline was 3.56±3.47°. From the left lateral perspective, the mean head angulation toward the midline was 2.86±7.40°, the mean left shoulder angulation was 1.46±2.40°, the mean pelvis angulation from the left side was 5.66±2.83°, and the mean left knee angulation compared to the midline was 4.74±2.85°

Analysis of the postural stability

In Table 2, the global YBT results for the participants' right and left extremities.

Analysis of the relationships of Value of Postural Angulation with global YBT results

Relationship with Postural Angulation and Global YBT (%) results is there in Table 3. As seen in Table 3, there was a low, negative, and significant correlation between anterior angulation degree of the head and the right YBT (%), r= -.356, $P< .05$. There was also a negative medium statistically significant relationship between left YBT (%) and anterior angulation degree of the head, r= -.491, $P< .05$.

Table 2. Composite YBT Scores

Composit YBT result [%]	N	Mean±SD	Kolmogorov-Smirnov			Shapiro-Wilk		
			Statistic	df	*P*	Statistic	df	*P*
Right lower extremity	31	98.12±8.41	.098	31	.200	.984	31	.909
Left lower extremity	31	98.43±8.71	.148	31	.083	.966	31	.416

Note: Y-Balance Balance test (YBT); SD = standard deviation

Discussion

Posture disorders occur due to muscle imbalance, overuse, etc.[6,7] Posture disorders may cause problems such as pain, fatigue, decreased muscle tone, increased muscle tension or decreased self-confidence.[25] Unfortunately, posture disorders were widespread health problems.[26] Especially in the student period, situations such as the widespread use of mobile phones and computers have led to an increase in posture disorders.[27] Janiszewska et al.[15] examined the body posture of 264 students aged 6-12 years and found that 93.2% of the participants had problems with body posture. When studies evaluating postural problems in athletes were examined, it was determined that postural problems reduced the athletic performance of athletes and increased the risk of injury.[28,29] In a study comparing posture and FMS scores in wrestlers, it was concluded that postural assessment can help predict the risk of injury in wrestlers.[30]

The postures and functional movements required by the sports branch may affect the postural biomechanics of athletes.[25,31] As a result, postural stances specific to the sports branch can be observed in athletes.[32] For example, scoliosis was detected in 80% of tennis players and javelin throwers with asymmetrical loading on the shoulders and trunk.[33] In another study, thoracic kyphosis degrees of freestyle, Greco-Roman wrestling and non-athletic individuals were compared, and it was determined that freestyle wrestlers had the highest kyphosis value and Greco-Roman wrestlers had the lowest kyphosis value.[32] As a result of this study, it was found that the pelvis (Mean=5.66, SD=2.83) and knee areas (Mean=4.74, SD=2.85) of wrestlers aged 10-12 years were significantly translated forward in the left lateral perspective. These two translations suggest the possibility of scoliosis in athletes, but more detailed spinal posture data were needed for the certainty of this. In addition, the fact that the age group of the participants was between 10-12 years and postural problems were common in this age group[15,18,19] may have led to the angulation values given in Table 1.

When the relationship between posture and balance was analyzed, a moderate negative relationship was observed between forward head posture and right and left lower extremity Y-Balance values ($P< .05$). In other words, the forward head posture levels of the athletes negatively affect their dynamic balance. When the literature was examined, the number of studies examining the relationship between Y-Balance and body posture was limited. For this reason, different measurement methods (Neurocom Balance, Tetrax Multiple System, Biodex Balance System) were used in most of the studies. The relationship between body posture and balance was not demonstrated clearly in the studies conducted on the subject. Some of the studies argue that there was a relationship between body posture and balance, while others argue that there was no relationship.[34] In the study conducted by Jain et al.[35] on young adults, it was observed that individuals with forward head posture had lower balance compared to the normal head posture group. On the contrary, in another study, the effect of forward and backward head posture on dynamic balance compared to neutral head posture was examined and it was reported that forward and backward head posture did not significantly affect dynamic balance when compared to neutral head posture. The authors attributed the fact that head posture does not affect dynamic balance to the fact that the vestibular system, which helps balance control, maybe in good condition in the participants.[36] Hyong et al.[37] reported in their study that forward head posture did not

Table 3. Correlations between postural angulation and dynamic balance

Postur Indices	*n*	Right YBT %		Left YBT %	
		r	*P*	r	*P*
Head-AA (°)	31	- .356	.049*	- .491	.005*
Head-RLA (°)	31	.158	.395	.032	.864
Head-LLA (°)	31	- .129	.491	- .109	.558
Shoulder-AA (°)	31	- .254	.168	- .176	.345
Shoulder-RLA (°)	31	- .117	.529	- .025	.894
Shoulder-LLA (°)	31	.125	.503	.016	.932
Pelvis-AA (°)	31	- .016	.934	.031	.869
Pelvis-RLA (°)	31	.216	.243	.126	.501
Pelvis-LLA (°)	31	.011	.951	- .003	.989
Knee-RLA (°)	31	.173	.351	.137	.461
Knee-LLA (°)	31	- .250	.174	- .207	.265

Note= anterior angulation (AA), right lateral angulation (RLA), left lateral angulation (LLA) for Head-Shoulder-Pelvis-Knee.
"*" $P < .05$; r = Pearson correlation coefficient; SD = standard deviation

affect static balance. In the study conducted by Abdelghany et al.[38], no relationship was found between forward head posture and dynamic balance. While some of the studies in the literature supported the results of this study, some did not. The fact that the participant group of this study was different from that of other studies may have created this difference.

Practical Application

This study confirmed that postural asymmetries in the head area of athletes negatively affect dynamic balance, one of the physical fitness parameters. The study provided information to doctors, physiotherapists, kinesiologists, conditioners, and coaches working in the field of sports that head posture should be corrected for balance development, and that athletes with balance problems should also be given balance exercises and exercises to correct the posture of the head area. This result sheds light on preventing sports injuries that may occur due to lack of balance. To generalize this result to all sports branches, it also pioneers' studies to be carried out on other sports branches.

Study Limitation

The small number of participants in the study and the fact that the participants were selected from a single branch constitute the limitations of the study. We recommend selecting a high number of participants in future studies and conducting similar studies in other branches.

Conclusions

As a result, it was determined that forward head posture had negative effects on dynamic balance. It is thought that this result may be due to the initial postural change in the body center of gravity, but more detailed studies are needed. Based on this result, it can be said that postural assessment was very important in the development of balance, which was one of the components of physical fitness related to performance, and the treatment of postural disorder in the head area carries the development of balance one step forward. In addition, it was found that the left side pelvis and knee postures of the 10-12 age group wrestling athletes were significantly angulated forward. Studies using different posture assessment methods were needed to reveal the postural problems of the participants in detail. The small number of participants in the study constitutes a limitation for the generalization of the study. We suggest that the number of participants should be increased in future studies and posture and balance should be analyzed with different methods.

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Ethical Committee approval

Yalova University Human Research Ethics Committee n. 2022/86.

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Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Topic

Sport Science, Public Health.

Conflicts of interest

The authors have no conflicts of interest to declare.

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Declaration if used ChatGPT

We don't used ChatGPT.

Author-s contribution

Conceptualization, S.A.K. and B.K.; methodology, S.A.K. and B.K.; formal analysis, S.A.K.; investigation, S.A.K.; resources, S.A.K. and S.K.; writing, S.A.K. and S.K.; original draft preparation, S.A.K.; writing—review and editing, S.A.K. and B.K.; supervision, S.A.K. and B.K.; project administration, S.A.K. and B.K. All authors have read and agreed to the published version of the manuscript.

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