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Comparison of the Dynamic Balance in Youth Male Wrestlers According to Age, Body Mass Index, and Participation Level

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Abstract

The aim of this study was to evaluate the dynamic balance in youth wrestlers according to age, body mass index (BMI), and participation level. A total of 68 youth male wrestlers participated in this study. They were subdivided according to participation levels (elite and sub-elite), age (13-14,15-16,17-18) and BMI (<20, 20-25, >25). The modified star excursion balance test (mSEBT) was performed by the same sports medicine specialist. All directional scores (anterior (A), posterior-lateral (PL), posterior-medial (PM)) and composite score (CS) on the dominant ($p<0.01$; $p<0.01$; $p<0.01$; $p<0.01$; respectively) and non-dominant sides ($p<0.01$; $p<0.03$; $p<0.01$; $p<0.01$; respectively) were higher in elite-level wrestlers compared to sub-elite ones. According to age, the dominant side's A, PM scores and CS in 17-18 year-old wrestlers were higher compared to younger ones ($p<0.01$; $p=0.01$; $p<0.01$; respectively) and the non-dominant side's all scores (A, PL, PM, CS) in 17-18 year-old wrestlers were higher compared to younger ones ($p<0.01$; $p<0.01$; $p<0.01$; $p<0.01$; respectively). According to BMI, the dominant side's A, PL scores, and CS in wrestlers with a BMI<20 were significantly lower compared to BMI>20 ($p=0.01$; $p=0.02$; $p=0.01$; respectively). Dynamic balance in youth wrestlers may differ by age, BMI and level of participation. Balance measurements in youth athletes should be performed periodically and necessary precautions should be taken to fix the balance impairments.

Keywords: Balance, Youth athlete, Sports medicine, Age, Wrestler

Genç Erkek Güreşçilerde Dinamik Dengenin Yaş, Beden Kitle İndeksi ve Katılım Düzeyine Göre Karşılaştırılması

Özet

Bu çalışmanın amacı, genç güreşçilerin dinamik denge profilini yaş, vücut kitle indeksin (VKİ) ve katılım düzeyine göre değerlendirmektir. Çalışmaya toplam 68 genç erkek güreşçi katıldı. Güreşçiler katılım düzeyleri (elit ve sub elit), yaş (13-14, 15-16, 17-18) ve VKI (<20, 20-25,> 25) olarak alt gruplara ayrıldı. Tüm katılımcılara modifiye edilmiş yıldız denge testi (mSEBT) aynı spor hekimliği uzmanı tarafından uygulandı. Tüm yön skorları (ön (Ö), arka-dış (AD), arka-iç (AÇ)) ve toplam skor (TS) dominant ($p<0.01$; $p<0.01$; $p<0.01$; $p<0.01$; sırasıyla) ve dominant olmayan tarafta ($p<0.01$; $p<0.01$; $p<0.01$; $p<0.01$; sırasıyla) elit seviye güreşçilerde sub elitlere göre anlamlı olarak yüksekti. Güreşçiler yaşa göre değerlendirildiğinde, 17-18 yaş güreşçilerde dominant tarafın Ö, Aİ ve TS skorları, 13-14 ve 15-16 yaş güreşçilere göre anlamlı olarak yüksekti ($p<0.01$; $p=0.01$; $p<0.01$; sırasıyla) ve dominant olmayan tarafın tüm skorları (Ö, AD, Aİ, TS) 17-18 yaş güreşçilerde 13-14 ve 15-16 yaş güreşçilere göre anlamlı olarak yüksekti ($p<0.01$; $p<0.01$; $p<0.01$; $p<0.01$; sırasıyla). VKİ'ne göre değerlendirildiğinde, VKİ<20 olan güreşçilerde dominant tarafın Ö, AD skorları ve TS, VKİ>20'den büyük olan güreşçilere göre anlamlı olarak daha düşüktü ($p=0.01$; $p=0.02$; $p=0.01$; sırasıyla). Dinamik denge genç güreşçilerde yaş, VKİ ve katılım düzeyine göre değişiklik gösterebilir. Genç güreşçilerde denge ölçümleri düzenli aralıklarla yapılmalı, denge bozukluklarının giderilmesi için gerekli önlemler alınmalıdır.

Anahtar kelimeler: Denge, Genç sporcu, Spor hekimliği, Yaş, Güreş

INTRODUCTION

Wrestling is a popular sport in Turkey (35). Beside its historical importance, the fact that wrestling is characterized by high-intense, fast-paced movements, it even increases popularity (32). In addition, due to the nature of the sport, some specific drills such as takedown, sparring etc. are also required (34).

The high-intensity nature of the game combined with the frequent opponent contact places wrestlers at an increased risk of injury (34). Thus, high injury incidence in adult wrestlers (annual average, 4.04 injuries) is noticeable (46). Also, in youth wrestling, the injury incidence is 6.0 and 9.6 injuries per 1,000 athletic-exposures (spent time during matches or trainings) (30, 34). In addition to this, when the injury characteristics are evaluated in youth wrestlers, it can be seen that the most frequently injured areas are the knees and shoulders and the most common injury type are sprain, strain (34). These injuries are not only common but also often serious (34). Since these injuries cause a high injury burden (injury incidenceXinjury severity), it is advised that the physicians should focus to prevent the injury rather than the treat (3).

In order to prevent sports injuries, firstly, the extent of the injury problem should be established. The etiology and mechanism of the injury should be investigated. Then, evidence-based protective measures should be developed (58). It is also necessary to identify the risk factors to prevent the sports injury (6, 12). In this context, it has already been known that poor balance is a risk factor for lower extremity injuries (16, 33). Therefore, balance measurements in athletes should be made to identify balance impairments. These impairments (if any) should be fixed in order to reduce sports injuries (12, 18).

On the other hand, balance does not only have a positive effect to prevent sports injuries, but also affects athletic performance directly (especially in sports branches which sudden perturbations, changes of direction, etc. are frequent; such as wrestling) (19, 33, 52). Moreover, it can improve some athletic parameters (such as: plyometric, coordination, etc.) by increasing proprioceptive acuity (22, 27). In addition to these, balance and physical fitness may be affected by age and level of participation in sports (21, 27). Therefore, evaluating balance can play an important role in youth wrestling in both preventing sports injuries and improving athletic performance (28).

As mentioned above, although balance is very important for youth wrestlers, to our knowledge, there is not enough study evaluating the dynamic balance in elite and sub-elite level youth wrestlers. The aim of the present study is to evaluate the dynamic balance in elite and sub-elite youth wrestlers. It was hypothesized that the elite-level wrestlers and older ages would have better balance.

MATERIAL AND METHOD

Participants

This study was conducted in accordance with the Helsinki declaration, and approved by Sutcu Imam University Clinical Research Ethical Committee (2019-120/1). After the youth athletes and their families were informed of all the experimental procedures to be undertaken, 71 well-trained youth male wrestlers in Turkey Olympic Preparation Center (TOPC) (elite level) and Wrestling Training Center (WTC) (sub-elite level) squad participated in this study voluntarily (written informed consent). All participants in each group have the same team training schedule for 8-9 practices per week. Also, the diet regimens of the participants were the same. Exclusion criteria: 1) history of surgery or severe injury in the lower extremity, 2) chronic neuromuscular and/or musculoskeletal disease, 3) acute injuries in the lower extremity.

Study Design

At the beginning of the study, all participants were evaluated by the same sports medicine specialist. Three participants were excluded from the study (meniscus surgery history, knee joint laxity, and acute ankle sprain). Then height, weight, and leg length of 68 participants were measured. Also, participants were asked which side was dominant by asking the kicking leg. They were subdivided according to participation levels (elite and sub-elite), age (13-14, 15-16, 17-18) and BMI (<20, 20-25, >25). Since it is known that there is a negative effect of fatigue on balance, balance measurements were performed after 2 days of rest (56). The study was completed with 68 participants. Confidentiality of all participant data was ensured.

Measurements

Height, weight and leg length, BMI

On the morning of the modified Star excursion balance test (mSEBT) day, before breakfast, the weights of wrestlers were measured with an electronic scale device (Omron HN-286). Then the heights of wrestlers were measured with a tape measure. Each leg length was measured from the anterior superior iliac spine to the ipsilateral medial malleolus while wrestlers were lying on supine position. All measurements were performed by the same sports medicine specialist.

Balance test

The mSEBT is a screening tool used to measure dynamic balance and it has been shown to have good interrater and intrarater reliability (51, 54). The mSEBT consists of three 2 meters lines taped on floor (anterior (A), posterior-lateral (PL), and posterior-medial (PM)) joining at an angle of 120 degrees at the midpoint. First, all athletes were shown how to perform the mSEBT. Before the test, the participants were warmed up for 8-10 minutes. Then, participants had 4 practice reaches in each direction for familiarization. The test was performed on barefoot. The stance legs of participants were placed at the center of the "Y" with the most distal end of the big toe stays on the mark zero. Participants were asked to reach as far as possible to tap the floor with one foot. The reach distance was noted for each participant by the distal part of the big toe in each direction while hands remained on hips for valid trials. If the participant removed their hands from hips, did not return to the starting position, moved stance foot position, and transferred their bodyweight to the reaching foot to increase distance, the trial was accepted as invalid and the participant repeated the trial. Three valid tests were performed for each participant on both legs (dominant and non-dominant sides). Visual cues, such as objects on the floor and people not involved in the study, were removed from the testing area to avoid visual and auditory influences. No encouragement or further instruction was given to the participants throughout testing. All tests were performed by the same sports medicine specialist and the results were recorded by the same assistant. Directional scores for each direction were calculated according to the formula DS= (S1+S2+S3)/3/LLX100, where DS means direction score, S means score, LL means leg length. Also, the composite score for each leg was calculated according to formula CS= (Am+PLm+PMm)/3/LLX100, where CS means composite score, A means anterior, PL means posterior-lateral, PM means posterior-medial, and m means mean.

Statistical Analysis

SPSS 25.0 statistical package program was used to evaluate the data and find the calculated values. Data was summarized by giving means and standard deviations. Whether the data showed normal distribution or not was checked with Kurtosis-Skewness coefficient intervals, and it was determined that the data were normally distributed, as the range did not exceed the values of +2.0 and -2.0 (23). Since the data showed normal distribution, independent group t test was used for pairwise set comparisons, and One-Way Analysis of Variance (ANOVA) was used for comparisons of more than two sets. The level of significance was taken as 0.05.

RESULTS

The characteristics of participants were given in Table 1.

Table 1: Characteristics of participants (n=68)

	TOPC (n=34)	*WTC (n=34)*
Age	16.26±0.82	13.50±1.39
Height	169.88±6.78	158.08±12.23
Weight	69.11±13.82	50.44±15.65
LL	85.94±6.48	82.00±7.16
BMI	23.78±3.37	19.74±3.38
Years in sport	6.47±1.81	2.88±1.12

TOPC= Turkey Olympic Preparation Center; LL= leg length
WTC= Wrestling Training Center; BMI= Body Mass Index

There were significant differences in each directional score between the elite and sub-elite groups. All directional scores (A, PL, PM) on the dominant ($p<0.01$; $p<0.01$; $p<0.01$; respectively) and non-dominant sides ($p<0.01$; $p<0.01$; $p<0.01$; respectively) were higher in elite-level wrestlers compared to sub-elite ones. There were also significant differences in the dominant ($p<0.01$) and non-dominant sides composite scores ($p<0.01$) in favor of elite-level wrestlers (Table 2).

Table 2: Differences in balance between groups according to the level of participation (n=68)

		Mean	*Std*	*t*	*p*	*%95 CI*	
						Lower	*Upper*
D-A	TOPC	96.74	5.35	3.80	**<0.01****	2.51	8.05
	WTC	91.46	6.07				
D-PL	TOPC	110.55	7.03	3.14	**<0.01****	2.00	8.99
	WTC	105.05	7.38				
D-PM	TOPC	104.57	6.37	2.21	**<0.01***	0.40	7.84
	WTC	100.44	8.78				
D-CS	TOPC	104.03	5.03	3.50	**<0.01***	2.17	7.93
	WTC	98.98	6.72				
ND-A	TOPC	98.06	5.80	3.97	**<0.01****	3.02	9.13
	WTC	91.97	6.77				
ND-PL	TOPC	111.09	6.93	3.12	**<0.01***	2.10	9.55
	WTC	105.26	8.38				
ND-PM	TOPC	106.01	7.21	3.01	**<0.01***	1.98	9.78
	WTC	100.12	8.81				
ND-CS	TOPC	105.05	5.47	3.77	**<0.001****	2.79	9.07
	WTC	99.12	7.35				

Std= Standart deviation; D= dominant; ND= Non-dominant; A= Anterior, PL= Posteriolateral, PM= Posteriomedial; CS= Composite score; TOPC= Turkey Olympic Preparation Center; WTC= Wrestling Training Center; CI= Confidence interval; *p<0.01; **p<0.001

According to age, all directional scores (except dominant-PM) and both composite scores of 17-18 year-old wrestlers were significantly higher compared to scores of 13-14 year-old wrestlers (p<0.05). Additionally, dominant-A, non-dominant-A, PL and composite scores of 17-18 year-old wrestlers were significantly higher compared to scores of 15-16 year-old wrestlers (p<0.05) (Table 3).

Table 3: Differences in balance according to age

	Age	*Mean*	*Std*	*f*	*p*	*Post-hoc*
D-A	1	92.12	6.24	6.53	<0.01*	**1-2<3**
	2	93.37	4.81			
	3	98.78	6.74			
D-PL	1	105.17	7.86	4.91	0.01*	**1<3**
	2	107.57	7.01			
	3	112.59	6.63			
D-PM	1	101.02	9.37	1.23	0.29	-
	2	102.47	6.57			
	3	105.05	7.30			
D-CS	1	99.43	7.13	5.02	<0.01*	**1<3**
	2	101.14	5.03			
	3	105.66	5.88			
ND-A	1	92.58	6.71	7.72	<0.01*	**1-2<3**
	2	94.22	6.11			
	3	100.55	6.21			
ND-PL	1	105.46	7.88	6.49	<0.01*	**1-2<3**
	2	107.37	8.08			
	3	114.20	5.85			
ND-PM	1	100.01	9.21	5.36	<0.01*	**1<3**
	2	102.84	7.33			
	3	108.57	7.02			
ND-CS	1	99.35	7.35	8.25	<0.01*	**1-2<3**
	2	101.48	6.05			
	3	107.77	5.36			

Std= Standart deviation; D= dominant; ND= Non-dominant; A= Anterior; PL= Posteriolateral; PM= Posteriomedial; CS= Composite score; 1= 13-14; 2= 15-16; 3= 17-18 *p<0.01

According to BMI, the dominant side's anterior, posterior-lateral, and composite scores in those with a BMI<20 were significantly lower compared to BMI>20 (p=0.01; p=0.02; p=0.01; respectively). In addition, the non-dominant side's directional scores and composite scores in those with BMI<20 were lower, despite not statistically significant (p>0.05) (Table 4).

Table 4: Differences in balance according to BMI (n=68)

	BMI	*Mean*	*Std*	*f*	*p*	*Post-hoc*
D-A	1	91.35	6.13	4.98	**0.01***	**1<2**
	2	96.34	5.19			
	3	95.17	6.74			
D-PL	1	104.96	651	3.99	**0.02***	**1<3**
	2	108.66	8.23			
	3	111.41	7.15			
D-PM	1	99.98	8.65	2.39	0.09	-
	2	104.03	7.19			
	3	104.40	6.80			
D-CS	1	98.76	6.25	4.62	**0.01***	**1<2-3**
	2	103.01	5.92			
	3	103.84	6.11			
ND-A	1	92.72	7.00	2.78	0.06	-
	2	97.07	6.22			
	3	95.59	7.34			
ND-PL	1	105.71	7.21	2.93	0.06	-
	2	108.61	8.63			
	3	111.85	7.99			
ND-PM	1	100.32	7.45	2.54	0.08	-
	2	104.37	8.71			
	3	105.73	9.16			
ND-CS	1	99.58	6.33	3.05	0.05	-
	2	103.35	7.27			
	3	104.39	7.13			

BMI= Body mass index; Std= Standart deviation; D= dominant; ND= Non-dominant; A= Anterior; PL= Posteriolateral; PM= Posteriomedial; CS= Composite score; 1= BMI<20; 2= 20<BMI<25; 3= 25<BMI; *p<0.01

DISCUSSION

The main results of the present study were that i) elite-level youth wrestlers had better dynamic balance than sub-elite levels; ii) older youth wrestlers (17-18 years) had better dynamic balance than younger ones (13-14); and iii) wrestlers with higher BMI had better dominant side balance than lower BMI ones.

Dynamic balance is an important component in executing complex sport skills (15). In combat sports, especially in wrestling, it is important to use unstable dynamic situations to turn them to their advantage using the stimulation of muscular, articular, and cutaneous mechanoreceptors to adapt to the constant modifications of posture, ground and opponent contact (49, 50). Thus in recent studies, it has been reported that there are some physiological and neuromuscular differences between elite and amateur wrestlers (21, 40). Considering that elite-level wrestlers had better balance in all directions both legs compared to sub-elite ones in our study, it can be said that superior balance in elite-level wrestlers is a result of repetitive training experiences that influence motor responses and vestibular system (5). The superior balance may have also provided through higher training experiences that influence the athlete's ability to attend to relevant proprioceptive and visual cues (1, 44). Also, the results of our study suggested that higher-level wrestlers may possess a greater sensitivity of sensory receptors or better integration of information than lower-level ones (53). On the other hand, it is known that there is a relationship between dynamic balance and lower extremity injuries. Researchers reported that athletes with poor dynamic balance were 2-4 times more likely to the lower extremity injury compared to athletes with

better dynamic balance (11, 25, 41, 52, 55, 60). When considering that poor balance is a modifiable risk factor for sports injury, balance measurements of youth athletes should be performed and necessary precautions (if any) should be taken to reduce sports injuries (4, 13, 16). Lastly, for athletic performance, during a match, a wrestler with relatively low balance performance may consume more energy to maintain high athletic performance (21). Therefore, the fatigue may occur quickly due to the great amount of anaerobic energy expenditure generated, and this can cause impairment in performance (42).

It is known that postural control and balance may differ by age in healthy children (26, 59). The age dependency of dynamic balance is also valid for youth athletes. Thus, researchers reported that dynamic balance performance in youth athletes was lower than older and more mature ones (7, 8, 43, 45). Moreover, Steindl et al. stated that dynamic balance increases with age in childhood; until the visual and vestibular afferent systems reach to adult levels at 15 to 16 years of age (57). According to the results in our study supporting the literature, it can be said that the main reason why almost all dynamic balance directional scores of 17-18-year-old wrestlers were better than 13-14-year-old wrestlers was the difference in maturation. While the visual component of proprioception becomes more important in the anterior direction, vestibular and mechanoreceptive components are more important in posterior-medial, posterior-lateral directions, and composite score (38). When considering that these basic components that affect dynamic balance performance continue their development throughout adolescence, 17-18-year-old wrestlers had better balance than younger ones is an expected result (14, 45). Another important reason for balance differences according to wrestlers' age is years of experience in the sport. Because, training experiences that improve neuromuscular coordination, strength, etc. also improve the balance indirectly (9, 36, 48). Additionally, proprioceptive acuity may have directly improved with training experience by learning to pay attention to biomechanical cues (eg, joint position sense) in longer adaptation time (20, 31). In our study, the fact that 17-18-year-old wrestlers had more years of experience in the sport than younger counterparts may have positively affected their dynamic balance performance. In order to create good adult athletes, the most important thing is to ensure the complete and harmonic development of motor abilities from early ages and in accordance with youth athlete's body development (53). In the light of this information, the balance measurement in youth athletes should be performed periodically and necessary precautions should be taken to improve balance.

Although there is a relationship between muscle strength and balance in adults, the relationship between BMI and balance is little-known in childhood and adolescence (29, 37, 61). Moreover, the relationship between balance and injury in youth athletes is not clear in the literature. On the other hand, while some researchers reported that athletes who were lighter or had lower BMI were more likely to be injured compared to their heavier counterparts, others reported an increased rate of injury among heavier athletes with high BMI (2, 10, 24). Especially in older boys who tend to have higher BMI, the risk for injury may be higher due to they are faster, heavier, and stronger and they can easily generate greater forces that can cause injury to joints and tendons (17). In our study, since most athletes with a higher BMI are also elite level and older, it may not be very appropriate to evaluate the balance according to BMI alone. Nonetheless, the better dynamic balance was only on the dominant side in wrestlers with high BMI, because it was known that they often prefer the dominant side in specific drills such as takedown (47). It would not be wrong to say that athletes with higher BMI have better physical development and more muscle mass, and therefore their dynamic balance is better than those with lower BMI.

The present study has some limitations. We did not evaluate some athletic parameters affecting balance such as strength, plyometric, and coordination. Since dynamic balance may differ by gender and requirements of nature of sports, our results can not be generalized in both genders and all sports branches. The balance profiles of female wrestlers, and athletes participating in different sports should be assessed. Lastly, we did not measure the maturity level of youth athletes, despite the same chronological age may vary considerably in the biological maturity status and this can have substantial effects in executing complex sport skills in adolescent athletes (8, 39).

CONCLUSION

Dynamic balance in youth male wrestlers may differ by age, BMI and level of participation. Balance

measurements in youth athletes should be performed periodically and necessary precautions should be taken to fix the balance impairments.

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