The Journal of International Anatolia Sport Science
Vol. 6, No. 2, 2021

E-ISSN:2548-0294

THE EXAMINATION OF RELATIONSHIPS BETWEEN ISOKINETIC MUSCLE STRENGTH AND BALANCE AND ANAEROBIC POWER PARAMETERS IN WRESTLERS 14-15 YEARS OF AGE

[1] Denizhan ÇALIŞKAN, [2]Alparslan İNCE

[1]Marmara University, Faculty of Sport Science, Istanbul, Turkey.

[2]Department of Physical Education and Sports, Ordu University, Ordu, Turkey.

RefNum	JIASS-55265
Manuscript Category	Movement and Training Science
Manuscript Type	Original Research
Rec.Date	20.03.2021
Corresponding Author	Denizhan ÇALIŞKAN [denizhancaliskann@gmail.com] https://orcid.org/ 0000-0002-0433-8039

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doi: 10.5505/jiasscience.2021.55265

Abstract

This study aims to examine the relation between isokinetic muscular strength, and balance and anaerobic power parameters in wrestlers aged 14-15. 23 wrestlers from Ordu province volunteered to be involved in this study (age=14.78±0.42 age, body weight=62.12±15.31 kg, height=167.39±8.31 cm). The athletes' body weights were measured with a body composition analyzer, and their heights were measured with the use of a stadiometer. Isokinetic strength measurements were done with an isokinetic dynamometer, anaerobic power and capacity were measured with a cycle ergometer, and balance was measured with an isokinetic balance device. The analysis of the data gathered in this study was conducted with a statistical package program. The normality distribution of the data was ensured with the Shapiro Wilk test, the relation between dependent and independent variables determined to have a normal distribution were analyzed with the Pearson correlation (r) analysis, and the significance value was determined to be $p<0.05$. While no significant correlation could be identified between the athletes' isokinetic strength levels and their static balance levels with the eyes open and shut ($p>0.05$), a highly significant correlation could be observed between dynamic balance values and isokinetic strength values ($p<0.001$). Additionally, while a positive significant relation could be detected between isokinetic right-hand side 60°/s strength values and anaerobic power and capacity values ($p<0.05$) and right-hand side 120°/s and 180°/s strength values and anaerobic power, no significant correlation could be detected with anaerobic capacity and 120°/s and 180°/s strength values ($p>0.05$). No significant correlation could be found between left-hand side 60°/s, 120°/s and 180°/s strength values and anaerobic power and capacity values ($p>0.05$). Some significant correlations could be identified between isokinetic strength levels and some balance and anaerobic power parameters in wrestlers aged 14-15. In conclusion, it can be inferred that isokinetic strength exercises applied to wrestlers at ages 14-15 at 60°/s, 120°/s and 180°/s angular velocities will improve their anaerobic power and dynamic balance levels.

Keywords: Wrestling, isokinetic strength, balance, anaerobic power

INTRODUCTION

Wrestling is defined as the contest between two opponents where they attempt to overpower one another on a mat of specific dimensions without use of equipment, and by means of a coordination of body parts requiring technique, skill, strength, endurance, balance, and wit, in accordance with the rules determined by FILA (Akgün, 1992). Wrestling is also known as a branch where the anaerobic system is predominantly at play as well as other factors such as strength, flexibility, and balance (Johnson, 1987).

Wrestling requires great force from upper and lower extremity muscular systems which are crucial for the determination of athletic performance. Therefore, the neutral findings regarding these components inferred with the use of isokinetic dynamometers are of great importance for the athletes (Zeren et al., 2006). In addition, wrestling is a sports branch where it is crucial to move quickly in a limited amount of time. In evaluations made with the body weights taken into consideration, wrestlers are found to be among the strongest athletes. Strength as a biomotor characteristic is important in performing a technical attacking move, or in defending against opposing attacks (Baykuş,1989).

Wrestling is a sports branch which involves different functional characteristics. Physical fitness elements such as anaerobic power, static and dynamic balance, strength, recreation time, coordination, agility, and flexibility are known as significant factors which determine success (Akgün, 1989).

METHODS

Study Group

This research was conducted with the voluntary participation of 23 currently active wrestlers aged 14-15 in Ordu province. It was ensured that the athletes involved in this study did not have any illnesses or injuries, and participants were informed about the study. This study was conducted in accordance with the Declaration of Helsinki.

Table 1. Descriptive statistics of participating athletes

	n	$\bar{X}$	SD	Min.	Max.
Age	23	14.78	0.42	14.00	15.00
Height		167.39	8.31	150.00	181.00
Weight		62.12	15.31	40.00	93.50

Data Collection Tools

Body Weight Measurement

The body weights of the athletes were measured with the use of a 0.1 kg accuracy body composition analyzer (Jawon Body Composition Analyzer Model X-Scan plus II, Seoul, Korea). The athletes were asked to stand barefoot on the stadiometer in anatomical position wearing their sports gear.

Body Height Measurement

The body height measurements of the athletes were taken with the use of a stadiometer (Holtain Ltd. Crymych, UK) with 0.1 cm accuracy. The athletes were asked to stand barefoot on the stadiometer in anatomical position, heels together and the head plate touching the vertex.

Isokinetic Strength Measurement

Lower extremity (knee) isokinetic muscle strength tests were done with an isokinetic dynamometer (CSMI Humac Norm, Stoughton, USA). The dominant legs of the athletes were determined to be their right legs, and the relevant data were recorded on a computer. The measurements were conducted at 60-120-180°/s angular velocities. Before the test, the athletes performed 3 trial repetitions, and afterwards, measurements were taken in 5 repetitions for every angular velocity. 45-second breaks were taken between each angular velocity. Peak torque values were also included in the data.

Balance Measurement

The athletes' balance performances were measured with an isokinetic balance device (CSMI, TecnoBody PK-252, Stoughton, USA). The physical details of the participating athletes were keyed into the device, and the testing process was first explained verbally to the participants, and then demonstrated in practice. The participants were allowed to have practice trials to adapt to the device. First, the athletes' static balance measurements were taken with their eyes open and shut, and later, dynamic balance tests were conducted. In the analysis of the data, a higher score of balance indicates low balance, and a lower score of balance indicates high balance (Güngör, 2010).

Static Balance

Participants looked at the computer screen with their eyes open for 30 seconds for an open-eye test and maintained their position. After 30 seconds, the test is automatically recorded. After the open eye test was finished, the tool automatically switched to closed eye (KG) testing. At this stage, the subject on the platform is prevented from seeing the screen. The subject remained stationary for 30 sec, maintaining his position without seeing the screen. At the end of the test, the tool automatically recorded the results. As a result of static balance measurements, Forward-Backward Standard Deviation / Back-to-back standard deviation value (F-BSD), Medium-Lateral Standard Deviation /Left-right psychic lateral standard deviation value (M-LSD) were collected and static balance score was determined.

Dynamic Balance

Measurements were performed in 60 seconds in double legs. The pressure level of the stabilizer was applied as 10 difficulty levels for testing. The test began when the subject, positioned on the balance platform, touched the red target in the circle. After the test started, the assembly was rotated clockwise for 5 laps and the test was terminated. The test was invalidated when 5 laps were not completed within 60 seconds. The data received after dynamic balance (DD) measurement is known as average tracking error (ATE). This value indicates the level of out-of-line exit in the circle that the subject should follow. If the average tracking error is low, the dynamic balance of the person is assumed to be good, and if the ATE is high, the dynamic balance of the participant is assumed to be bad.

Anaerobic Performance Measurement

Wingate Anaerobic Test (WAnT) was conducted using a cycle ergometer (Monark 874 E, Sweden). The athletes were given detailed information about the test beforehand and were asked to complete a warm-up protocol at the speed of 50-60 rpm. Following the break after the warm-up session, in accordance with the testing protocol, for every kilogram of the participant's body weight, 0.075 kilograms of weights were placed in the scale of the cycle ergometer. The participants were asked to reach the highest pedal speed as fast as they could without resistance weights. The testing process began when the pedal speed reached 90 rpm, which is when the scale automatically drops, putting weight resistance on the pedals. During the anaerobic strength test, the highest value of power performed by the athletes in 30 seconds was recorded as peak power. The mean value of power recorded throughout the test was noted as anaerobic capacity (average power). The relative values (the value equating every 1 kg of the body weight) of these data were used in this study.

Statistical Analysis

All statistical calculations in this study were conducted in SPSS statistical package program (SPSS 25.0. Armonk, NY: IBM Corp). It was determined by the Shapiro-Wilk test that the obtained values were distributed normally. Afterwards, the relationship between isokinetic muscle strength and balance and anaerobic power parameters of wrestlers aged 14-15 years was analyzed with Pearson Correlation test.

RESULTS

Table 2. Descriptive values denoting the wrestlers' isokinetic strength, balance, anaerobic power, and anaerobic capacities

		n	X̄	SD	Min.	Max.
İsokinetic Strength Parameters	Right 60°/sn (Nm)	23	158.43	48.08	60.00	250.00
	Right 120°/sn (Nm)		125.43	36.43	50.00	198.00
	Right 180°/sn (Nm)		101.82	30.81	45.00	171.00
	Left 60°/sn (Nm)		160.21	49.10	60.00	241.00
	Left 120°/sn (Nm)		125.04	37.14	53.00	186.00
	Left 180°/sn (Nm)		103.08	31.56	47.00	159.00
Anaerobic Parameters	Anaerobic Power (W/kg)		10.83	1.46	8.44	13.34
	Anaerobic Capacity (W/kg)		7.91	0.85	6.08	9.87
Balance Parameters	EO Static		10.43	3.35	5.00	17.00
	EC Static		14.26	3.89	9.00	23.00
	Dynamic		49.30	26.11	15.00	89.00

*Nm: Newtonmeter, W/kg: Weight/kilogram, EO: Eyes Open, EC: Eyes Close

Table 3. The results of the correlation analysis between the athletes' isokinetic strength parameters and anaerobic power and capacity parameters

	n		Anaerobic power	Anaerobic Capacity
Right 60°/sec	23	r	.461	.498
		p	.027*	.016*
Right 120°/sec		r	.369	.434
		p	.083	.039*
Right 180°/sec		r	.372	.427
		p	.080	.042*
Left 60°/sec		r	.264	.264
		p	.224	.224
Left 120°/sec		r	.265	.265
		p	.221	.221
Left 180°/sec		r	.262	.262
		p	.227	.227

*p<0.05

Table 3 indicates a positive correlation between the amount of strength produced at the 60°/s on the right side and the anaerobic power and capacity values (p<0.05). On the right side, while positive correlation is observed between the amount of strength produced at the 120 and 180°/s and the anaerobic capacity values of the athletes (p<0.05), there is no significant correlation between other strength values and anaerobic power/capacity values (p>0.05).

Table 4: The results of correlation analysis of the relation between the participants' strength parameters and balance parameters

	n		EO Static	EC Static	Dynamic
Right 60°/sec	23	r	.146	.007	-.734**
		p	.505	.976	.000
Right 120°/sec		r	.123	.002	-.676**
		p	.576	.993	.000
Right 180°/sec		r	.057	-.151	-.704**
		p	.795	.493	.000
Left 60°/sec		r	.005	.214	-.717**
		p	.981	.328	.000
Left 120°/sec		r	-.005	-.289	-.719**
		p	.982	.181	.000
Left 180°/sec		r	-.061	-.070	-.806**
		p	.784	.750	.000

*p<0.05 **p<0.001

Table 4 indicates that there is no significant correlation between the amount of strength producted at the 60, 120 and 180°/s on the left and right side and the EO (eyes open) and EC (eyes closed) static balance values (p>0.05). A highly significant correlation was found between isokinetic strength values and dynamic balance values (p<0.001).

Table 5. The results of correlation analysis between the athletes' balance parameters and anaerobic power and capacity parameters

	n		Anaerobic Power	Anaerobic Capacity
EO static	23	r	-.032	.075
		p	.886	.734
EC static		r	.048	.239
		p	.829	.273
Dynamic		r	-.459	-.359
		p	.028*	.092

*p<0.05 EO: Eyes Open, EC: Eyes Close

Table 5 shows that there is no significant correlation between the athletes' EO and EC static balance scores and anaerobic power parameters (p>0.05). However, it was found that there is a significant correlation between dynamic balance scores and anaerobic power parameters (p<0.05).

DISCUSSION AND CONCLUSION

This study examines the relation between isokinetic muscle strength, and balance and anaerobic power parameters in wrestlers aged 14-15.

The average right leg isokinetic strength of the participating wrestlers was found to be 158.43±48.08 at 60°/s, 125.43±36.43 at 120°/s, and 101.82±30.81 at 180°/s. The average left leg isokinetic strength for 60°/s was found to be 160.21±49.10, for 120°/s 125.04±37.14, and for 180°/s 108.10±19.8. The 60°/s average of nondominant leg was found to be 257.15±55,6 and for 180°/s 132.70±32.7. In this study, it was determined that there is a considerable difference between right leg 60°/s-80°/s and left leg 60°/s-180°/s angular velocities. One possible reason for this is the average age of the participating wrestlers.

The anaerobic power levels of participating wrestlers were found to be PP absolute 702.40±204.51, PP relative 10,83±1.46, AP absolute 499.45±176.49 and AP relative 7.91±0.85. In their study of a group of international wrestlers, Ünver (2011) found the PP absolute value to be 1206.2±258.5, PP relative to be 15.35±2.34, and AP relative to be 7.35±0.7. It can be seen that there is a difference in all anaerobic figures between our study and Ünver's. The reason for this is considered to be the young age of participants in our study, as well as the participating athletes being a non-national level group.

The dynamic balance value of the wrestlers in this research was determined to be 49.30±26.11. In their study of freestyle and greco-roman wrestlers, Çaloğlu (2017) determined pre-crossfit the dynamic balance score of the participants to be 19.82±4.92, and 14.12±4.15 after the crossfit training. A difference can be observed in comparison to our study. It is possible that the cause of this variation is the average age of our study group which consists of adolescent children. In this research, the EO value of static balance score was determined to be 10.43±3.35, and EC value to be 14.26±3.89. In their study of male children who are play football, Yıldızer (2014) determines the EO static balance score as 11.68±8.12 and EC static balance score as 9.86±8.81. While the EO static balance score appears to be similar in two studies, a difference can be observed between EC static balance scores. This is possibly due to the fact that in wrestling, athletes are locked one-on-one with their opponents where they regularly make eye-contact.

In their study of a group of amateur athletes who exercise on a regular basis, Yılmaz (2019) concluded that in right and left leg 60°/s isokinetic strength measurements correlate with static balance with eyes open and shut ($p<0.05$). In this study, on the other hand, no significant correlation could be found between the static balance scores with eyes open/eyes shut, and isokinetic strength measurements ($p>0.05$). A possible reason for this variation could be that in wrestling, static balance is more important than dynamic balance, as dynamic foot work, rapid dives, squats, and pickups are common. In their study of elite wrestlers, Bulgay and Polat (2017) determined that according to upper leg strength values, left leg strength has an effect on left leg balance; however, right leg strength does not have an effect on right lag balance. In our study, it was observed that isokinetic leg strength has an effect on dynamic balance, which means that there is no parallelism with Bugay and Polat's findings. The reason for this is considered to be the use of different platforms in balance tests.

In their examination of volleyball players, Akarçeşme and Aktuğ (2018) found that there is a significant negative correlation between the right and left leg isokinetic strength at 60°/s and 180°/s, and the dynamic balance scores. This is in line with the findings in our study. The reason for this parallelism could be that both sports branches have a dynamic and agile structure. Mohammedi et al. (2012) found in his study of young athletes that a six-week leg training plan has a positive effect on both static and dynamic balance. While this is in line with the results of our study in terms of the correlation between leg strength and dynamic balance, a difference can also be observed in terms of leg strength and static balance. In their study of national team level female wrestlers, İbis (2017) concluded that leg strength has an effect on both dynamic and static balance ($p<0.05$). While there is a parallelism between these findings and our research in terms of leg strength and dynamic balance, there is variation in results in terms of static balance. This is possibly due to the fact that the wrestlers in our study group are younger and not on the national team level.

In their study of handball and volleyball players, Yücel (2015) determined a significant correlation between dynamic balance and anaerobic power ($p<0.05$). The findings in this study are in line with the results obtained in our research. This means that since all three of these branches require intense effort, anaerobic exercises are of great importance. It can be said that enhanced anaerobic performance increases the capacity of foot work, jumps, and sudden movements in athletes, thereby improving dynamic balance. In their study of sedentary males, Mahmood et al. (2017) found that intense anaerobic exercises had a negative impact in the group's dynamic balance. The results of this study are in parallel with our findings in terms of anaerobic power's effect on dynamic balance.

In their study of football players aged 15-16, Özay (2009) observed a significant correlation between 60°/s and 180°/s isokinetic strength parameters and values of active squat jumps and active jumping performed to determine anaerobic power ($p<0.05$). These results are in line with the findings of our study. This is possibly due to the fact that in both branches foot strength plays an actively crucial role. In their study of elite futsal players, Köse et al. (2019) identified a positive correlation between the values of 120°/s, 180°/s for right and left legs, and the PP relative ($p<0.05$). This correlation observed by Köse et al. is in line with our study. In both branches, players need leg strength in order to apply force to their movements. Here, the importance of anaerobic exercise becomes obvious. It can also be added that this correlation is due to the relation between the two parameters. In their study conducted with a group of mountain climbers, Özkan and Sarol (2008) identified significant correlations between the PP absolute and PP relative among leg strength and anaerobic power parameters ($p<0.05$). These findings are in line with the results of our study in terms of the correlation between leg strength and anaerobic power parameters. In their study of young male and female participants of varying fitness levels, Arslan (2005) identified a significant correlation between AP absolute and AP relative among the leg strength and anaerobic performance parameters ($p<0.05$). The results of Arslan's study and ours show parallelism in this sense.

In conclusion, it can be inferred that isokinetic strength exercises applied to wrestlers at ages 14-15 at 60°/s, 120°/s and 180°/s angular velocities will improve their anaerobic power and dynamic balance levels.

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