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Original article

THE IMPACT OF WRIST WIDTH AND PALM WIDTH TO COMPETITION PERFORMANCE IN PROFESSIONAL FEMALE ARM WRESTLERS

ZİLELİ Raif[1], DİKER Gürkan[2], ÖZKAMÇI Hüseyin[3]

Abstract*

Aim. The literature review showed that the number of studies about arm wrestling is insufficient. Within this direction, in order to contribute the development of this sport, this study aims to find out the relation of wrist width and palm width with competition performance among female competitors in Arm Wrestling World Championship Selection in Young Women's Category organised by Turkish Federation of Fitness and Arm Wrestling.

Methods. Fourty-four female arm-wrestlers who were competitors are voluntarily included in the study. Main Outcome Measures; Age, length, weight, wrist and palm width parameters were taken into the scope of the study.

Results. While there is no statistically significant difference for the wrist width parameter between successful and unsuccessful young women athletes who compete in right and left Arm Category ($p>0.05$), there is statistically significant difference ($p<0.05$) for palm width parameter for the same participants.

Conclusions. With reference to the results of the research, palm width values of athletes who became successful in left and right hand are higher than the palm width values of the athletes who could not become successful ($p<0.05$). Similarly, wrist width values of successful athletes in left and right hand are higher than the wrist width values of the unsuccessful athletes, however, there is no statistically significant difference ($p>0.05$). This study is important both in the sense that it is among few studies about this subject in the literature and will hopefully help arm-wrestling become widespread and scouting of the talented arm wrestlers.

*Keywords: A*rm wrestling, palm width, wrist width

Introduction

Arm Wrestling, also called "Indian Wrestling", "Iron Arm", "Wrist Wrestling" (Ahcan, Ales, Zavrsnik, 2000) is considered to be the oldest and the most common sports in the world. It is briefly the two competitors' struggle to gain the upper hand by forcing each other's arm down onto the elbow pad found on the arm wrestling table, under a referee's watch, without commiting foul in an unspecified period of time.

Arm wrestling competitions are hold on the basis of weight and the hand preference of the wrestlers (Silva, Silva,Souza, Silya, Marquez, Soarez, 2009). Arm wrestling is a popular sports done both by professionals and amateurs. Its popularity arises from the simplicity of its rules and it does not require complicated equipments to wrestle (Kruczyński, Nowicki, Topolinski, Srokowski, Manko, Chantsoulis, 2012).

This sports is rapidly increasing worldwide by the participation of paraplegics and hemiplegics who have physical disabilities (Silva, Silva,Souza, Silya, Marquez, Soarez, 2009). Arm wrestling which is originated in common areas like coffee houses has become a professional sports at the present time (Ahcan, Ales, Zavrsnik, 2000). Today, arm wrestling is performed in over a hundred countries worldwide, and the number of member countries in World Armwrestling Federation (WAF) is rapidly increasing (Silva, Silva, Souza, Silya, Marquez, Soarez, 2009).

The literature review showed that the number of studies about arm wrestling is not sufficient. Within this direction, in order to contribute the development of this sport, this study aims to find out the relation of wrist width and palm width with the competition performance among the female competitors in Arm Wrestling World Championship Selection in Young Women's Category.

The main question of this research is to what extent is the mechanical loading significant in bone development. Then, under this main question, this study also explores if the structure of the bone, forearm and hand change among successful young women arm wrestlers as an answer to the scope this

[1] Bilecik Şeyh Edebali Üniversitesi, Sağlık Yüksekokulu, 11210, Bilecik, TURKEY
[2] Cumhuriyet University, Department of Physical Education and Sports, Sivas, TURKEY
[3] Dokuz Eylül University, Department of Coaching Education, , İzmir, TURKEY
E-mail address: raif.zileli@bilecik.edu.tr

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study.

Methods

Subjects:

Fourty-four female arm wrestlers who were competitors in Arm Wrestling World Championship Selection in Young Women's Category organised by Turkish Federation of Fitness and Arm Wrestling are voluntarily included in the study. After informing the voluntary participants about the study, the participants were asked to sign the voluntary form in accordance with the Decleration of Helsinki. Average and standard deviation of age, height and weight of the volunteers are respectively 16.07±1.26 year, 1,65±,0.6 cm. and 58.41±8.58 kg. Right and left arm competition groups consist of seven weights; (45 kg, 50 kg, 55 kg, 60 kg, 65 kg, 70 kg and +70 kg). This study was approved by The Ethics Committee of Bilecik Şeyh Edebali University(With the decision number of 28 in 2015).

Data Collection and Tools:

Age, body height and weight of the athletes and their wrist and palm width parameters were taken into the scope of the study. Aforementioned measurements of the subjects were taken by a single researcher, in a separate room, one day before the competition, right after the weighing. A stadiometer (Holtain Ltd., UK) with 1mm ± sensitivity was used to measure the body height and a scale (Omron BF - 510, Japan) with ± 0.1kg sensitivity was used to measure the body weight of the volunteers. While heights of the volunteers were measured in anatomic position, barefooted, heels touching each other and heads in frontal plane and recorded in cm. Then, body weights were measured with light clothes, barefooted and in anatomic position and recorded in kg (Otman, Demirel, Sade, 1998).

The circumference of the wrist was measured at the joint of the radius and the ulna which corresponds to the perimeter of the thinnest part of the forearm. According to Li, the circumference of the hand was measured as the perimeter of the middle part of hand, located over the two major transverse palmar creases "heart line" and "head line" (Li, Hewson, Duchene, Horgel 2010). Wrist width and palm width measurements were done using antropometric tape measure (Gullick Meter) with 1mm ± sensitivity and recorded in cm.

Data Analysis:

SPSS 17 (SPSS Inc., Chicago, IL, USA) was used in the analysis of the data. Descriptive statistics were used to find standard deviation values and means of anthropometric characteristics (age, height and body weight). Mann Whitney-U Test was used to find out the relation of wrist width and palm width with competition performance and significance was tested at $p<.05$ level.

Competition Performance was regarded as "successful" and "unsuccessful". After the arm wrestling competitions, the ones who rank among the top three in referee's report were counted in group "successful". Rest rankings were counted in group "unsuccessful". Right arm and left arm competitions were evaluated separately.

Results

Right Arm:

Table 1. Characteristics of the subjects (mean ±s.d.)

Young Women Right Arm	**Successful n=19**		**Unsuccessful n=25**	
	x	sd	x	sd
Body Weight (kg)	58.32	9.52	58.48	7.99
Age (year)	16.05	1.07	16.08	1.41
Height (cm)	167	.06	164	.05

x: arithmetic mean
sd: standard deviation

Measures of arm wrestlers who became successful in Young Women Right Arm Category are as follows; weight: 58.32±9.52 kg, age: 16.05±1.07 years, height: 1.67±.06 cm. Measures of arm wrestlers who became unsuccessful in Young Women Right Arm Category are as follows; weight: 58.48±7.99 kg, age: 16.08±1.41 years, height: 1.64±.05 cm.

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Table 2. Body weight, age and height values of the successful and unsuccessful arm wrestlers

Young Women Right Arm Parameter (cm)	Successful n=19		Unsuccessful n=25		z	p
	x	sd	x	sd		
Body Weight (kg)	58.32	9.52	58.48	7.99	-.060	.952
Age (year)	16.05	1.07	16.08	1.41	-.110	.913
Height (cm)	167	.06	164	.05	-1.509	.131

For body weight, age, height parameters of the successful and unsuccessful athletes who compete in Young Women Right Arm Category, there is no statistically significant difference (p>0.05).

Table 3. Wrist width and palm width values of the successful and unsuccessful arm wrestlers

Young Women Right Arm Parameter (cm)	Successful n=19		Unsuccessful n=25		z	p
	x	sd	x	sd		
Wrist Width	16.15	1.34	15.64	1.31	-1.498	.134
Palm Width	19.00	1.00	18.20	1.22	-2.282	.022*

* Significant at p<0.05 level.

While there is no statistically significant difference for the wrist width parameter of the successful and unsuccessful athletes who compete in Young Women Right Arm Category (p>0.05), there is statistically significant difference (p<0.05) for palm width parameter.

Left Arm:

Table 4. Characteristics of the subjects (mean ±s.d.)

Young Women Left Arm	Successful n=19		Unsuccessful n=25	
	x	sd	x	sd
Body Weight (kg)	58.58	9.50	58.28	8.01
Age (year)	16.16	1.16	16.00	1.35
Height (cm)	166	.05	165	.07

x: arithmetic mean
sd: standard deviation

Measures of arm wrestlers who became successful in Young Women Left Arm Category are as follows; weight: 58.58±9.50 kg, age: 16.16±1.16 years, height: 1.66±.05 cm. Measures of arm wrestlers who became unsuccessful in Young Women Left Arm Category are as follows; weight: 58.28±8.01 kg, age: 16.00±1.35 years, height: 1.65±.07 cm.

Table 5. Body weight, age and height values of the successful and unsuccessful arm wrestlers

Young Women Left Arm Parameter (cm)	Successful n=19		Unsuccessful n=25		z	p
	x	sd	x	sd		
Body Weight (kg)	58.58	9.50	58.28	8.01	-.132	.895
Age (year)	16.16	1.16	16.00	1.35	-.317	.751
Height (cm)	166	.05	165	.07	-.618	.537

For body weight, age, height parameters of the successful and unsuccessful athletes who compete in Young Women Left Arm Category, there is no statistically significant difference (p>0.05).

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Table 6. Wrist width and palm width values of the successful and unsuccessful arm wrestlers

Young Women Left Arm Parameter (cm)	Successful n=19		Unsuccessful n=25			
	x	sd	x	sd	z	p
Wrist Width	16.21	1.27	15.60	1.35	-1.732	.083
Palm Width	18.94	1.12	18.24	1.05	-1.972	.049*

* Significant at p<0.05 level.

While there is no statistically significant difference for the wrist width parameter of the successful and unsuccessful athletes who compete in Young Women Left Arm Category (p>0.05), there is statistically significant difference (p<0.05) for palm width parameter.

Discussion

This research aims to study the relation of wrist width and palm width with the competition performance among the female competitors in Arm Wrestling World Championship Selection in Young Women's Category. With reference to the results of the research, palm width values of athletes who became successful in left and right hand are higher than the palm width values of the athletes who could not become successful (p<0.05). Similarly, wrist width values of athletes who became successful in left and right hand are higher than the wrist width values of the athletes who could not become successful, however, there is no statistically significant difference (p>0.05).

Another factor that affects the performance is bodily structure, in other words, physical characteristics as bodily structure or physical characteristics affects the revelation of physiological capacities. It is unlikely to come to a condition of desired performance level as long as the characteristic of the possessed physical structure is not suitable sports branch. Physical structure –for an athlete – is just one of the indicators to show high performance and affects the athlete's performance positively combining with the performance indicators such as strength, power, flexibility, speed, endurance and rapidity (Köklü, Özkan, Alemdaroğlu, 2009).

When it comes to this study whose main subject matter is arm wrestling, the movements of shoulder, forearm, wrist and the fingers (Ahcan, Ales, Zavrsnik, 2000) are distinctive for performance. Arm wrestling involves primarily the medial rotation of the upper arm, pronation of the hand and the forearm, flexion of the wrist, and secondarily flexion of the forearm and the arm. These movements are performed through the use of Pectoralis Major (PM), Biceps Brachii (BB), Pronator Teres (PT) and Flexor Carpi Ulnaris (FCU) muscles (Silva, Silva, Souza, Silya, Marquez, Soarez, 2009; Jim and Greg, 2011).

Studies in the literature related to arm wrestling mainly focuses on periodization (Kamaev and Bezkorovainyi, 2013), disabled arm wrestling (Boguszewski and Torzewska, 2011), injuries (Lee, Chou, Chiou, Lai, 2014; Marks, Penkowski, Stasiak, Witkowski, Dąbrowski, Wieruszewski 2014; Bumbasirevic, Lesic, Andjelkovic, Palibrk, Milutinovic, 2014; Kruczynski, Nowicki, Topolinski, Srokowski, Manko, Chantsoulis, 2012), EMG studies (Ahamed, Sundaraj, Ahmad, Rahman, Ali, Islam, 2013, Silva, Silva, Souza, Silya, Marquez, Soarez, 2009, Bumbasirevic, Lesic, Andjelkovic, Palibrk, Milutinovic, 2014; Hong, Lin, Liao , Hong , Wang, 2011) and anthropometry studies (Zileli , Vatansever, Özen, Şenyüzlü, 2012, Akpinar, Zileli, Şenyüzlü, Tunca, 2013, Akpinar, Zileli, Şenyüzlü, Tunca, 2012a, Akpinar, Zileli, Şenyüzlü, Tunca, 2012b). Whereas, more and distinctive studies on performance in arm wrestling are needed.

When examining the anatomy of the wrist, the function of the wrist can be described as positioning the hand in order to hold and grip an object. The bone and the connective tissue are in a special form in order to function in this way. Classically, the anatomy of the wrist consists of carpal bones at distal and proximal. Proximal set is composed of scaphoid, lunate and triquetrum, while distal set is composed of trapezium, trapezoid, capitate and hamate (Arthur, Rettig, 1998).

Geometric properties of bone have significant contributions for bone strength. External stresses forced on the bone complies with inner properties of the bone such as mass, geometry and microstructure. This process is genetic and related to the factors such as type of pressure, hormonal factors, development and age. Bones which carry on their development are affected more by these factors than the bones which already completed their development (Petit, Mac Donal, Mac Kay, 2006). High intensity aerobics and exercises with high speed resistance are required for optimal bone development (Pereira, Costa, Palmeira, Soares, Monteiro, Williams, 2016).

The most efficient method in increasing the bone strength is adding mass onto the periosteal surface. There is 4%~ more bone mass on the dominant arm in comparision with the non-dominant arm. For instance, when the dominant and non-dominant arm compared in players of racket sports, (i.e. tennis, badminton, squash) mineral content of humerus differs averagely 13%~ and this difference stems from the increase in the mineral content of bone on the periosteal surface in tennis players (Petit, Mac Donal, Mac Kay, 2006). Besides, cross sectional studies on tennis players show that exercise builds up the increase in bone strength and bone width, cortical expansion, by raising the periosteal growth. As exercise provides endocortical increase; cortical width, bone mineral content (BMC), and areal and volumetric bone mineral denstiy (BMD) increase, bone width remains stable and there is an increase in bone strength (Brandley, Pearce, Nauhton, Sullivan, Bass, Beck, 1998).

There is a positive correlation between bone density and muscular force (Tamcı, Aksu, Gülbahar, Bircan, El, Kızıl, 2009). In addition, different bone widths (femur, radius, and ulna) are positively related with hand grip strength (Sil, 2013). Another research shows that muscle length and grip strength correlate with bone length and bone strength (Edwards, Gregson, Patel, Jameson, Harvey, Sayer, 2013).

Grip strength is positively related with bone width and palm width (Memberal, Doreswamy, Rajkumar, Hemberal, 2014; Li, Hewson, Duchene, Hogrel, 2010). There are some studies in literature which found significant relation between grip strength of both right and left arm and hand width (Link, Lukens, Bush, 1995) and which found significant relation between grip strength at dominant right arm and hand width (Koley and Singh, 2009).

As can be clearly seen in literature, grip strength, which is associated with bone mineral density, hand width, muscle density and body strength, is commonly used to evaluate fitness level and is measured via dynamometer, which is a valid, reliable, inexpensive, portable and user friendly evaluation method (Cohen, Voss, Taylor,2010, Charles, Burchfiel, Fekedulegn, Kashon, Ross, Sanderson, 2006; Clerke, Clerke, Adams, 2005).

In the studies on anthropometric characteristics, there are debates on which body profiles are suitable for which branches and to what extent this has important role in selecting the talented. In accordance with the classification sorted from the scores of Turkish Tennis Federation, (TTF), hand and wrist diameter measurements of young men tennis players in category A are significantly different than young men tennis players in category B and this shows that hand and wrist diameter measurements are important factors that affect the former category to be classified upper than the latter category (Söğüt et al., 2004). Supportingly, another study on biathletes shows that top athletes have wider wrist diameter (Shepieliev, 2012).

Besides, in a study on arm wrestling, Zileli et al., have found out that biceps muscle width, forearm width, humerus length, span length and hand length were significantly affected ($p< 0.001$) in positive direction by hand grip strength in the research in which they studied the anthropometric characteristics of 53 male arm wrestlers who participated Turkey Interuniversity Championship (Zileli, Vatansever, Özen, Şenyüzlü, 2012).

Correspondingly, Akpınar et al., analysed the difference between successful (who rank among the top three) and unsuccessful (who could not rank among the top three) professional male arm wrestlers (69 right arm, 65 left arm) who tried out in selection for National Team for European Championship. As a result, they found out that successful athletes have higher grip strength in both hands and have higher fore arm width for left arm ($p<0.05$) and also have less auditory reaction ($p<0.05$) for left arm (Akpinar, Zileli, Şenyüzlü, Tunca, 2013).

In another study, Akpınar et al., analysed the difference between successful (who rank among the top three) and unsuccessful (who could not rank among the top three) professional female arm wrestlers (31 wrestlers) who tried out in selection for National Team for European Championship. For the wrestlers who compete with right hand, they found out that successful athletes have higher grip strength and fore arm length ($p<0.05$). Besides, they found that the top three athletes have higher fore arm width and less aural reaction time in comparision with the rest. However, these differences are not statistically significant ($p<0.05$) (Akpınar, Zileli, Şenyüzlü, Tunca, 2012a).

Akpınar et al., in another study, have analysed the impact of hand preference on hand grip strength among 68 professional male arm wrestlers who tried out in selection for National Team for European Championship. As a result of the study on athletes who compete with right arm, they found out that hand grip strength is higher in right arm than in left arm ($p<0.05$) (Akpınar, Zileli, Şenyüzlü, Ince, Tunca,2012b).

Conclusion

Consequently, as it is understood from the studies mentioned above, successful athletes are different than unsuccessful athletes in terms of some factors such as hand length, span length, finger length, fore arm length, humerus length,

hand width, wrist width, fore arm width, biceps muscle width, grip strength, reaction time, EMG values and etc. Accordantly, this study has also found similar results as answer to the main question of this study. Additionally, this study supports the literature (Memberal, Doreswamy, Rajkumar, Hemberal, 2014; Li, Hewson, Duchene, Hogrel, 2010; Koley and Singh, 2009; Shepieliev, 2012) which shows that in scouting for talented, canalizing the ones with wide palm and thick wrist to arm wrestling will be effective in leading them succeed. Besides, literature review reveals that more studies on arm wrestling are needed. Such studies will contribute arm wrestling to become widespread and exercise prescriptions prepared to make athletes successful.

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