European Journal of Applied Sciences 8 (4): 203-208, 2016
ISSN 2079-2077

DOI: 10.5829/idosi.ejas.2016.8.4.10226

An Examination of the Relationship between 2d:4d Finger Length Proportions and Anaerobic Power in Athletes

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Abstract: The objective of this study is to examine the relationship between 2d:4d finger length proportion and anaerobic power in athletes. The study covered 36 voluntary basketball, football and volleyball players of various sports clubs with an average age of 22.66±3.48 years and training age of five years or more. Participating athletes were briefed about the study and measurements to be made and signed an Informed Voluntary Consent Form. ID Information was taken as basis to determine the ages of the participating athletes. Body height and weight as well as the length of index finger (2d) and ring finger (4d) of the dominant hand of the participating athletes were measured by means of a digital compass with 0.01 mm sensitivity. Anaerobic power was calculated in the Lewis formula by taking the vertical jumping test measurements.Data obtained were evaluated in the SPSS statistical software package. Measurement results were presented in arithmetic mean and standard deviation.The power and direction of the relationship between anaerobic power values and finger length of the players was determined by means of the Pearson correlation analysis. The value of $p<0.05$ was accepted as significant. The studyrevealed a strong relationship between the anaerobic power averages of athletes and the 4d finger length (r=0.573). As a conclusion, the fact that there is a correlation between the length of finger 4d and dominance of testosterone hormones in human beings based on the knowledge in the literature can be interpreted as that athletes with longer 4dfingers have higher anaerobic power values. Such studies should be conducted on multiple subjects and multiple repetitions to establish a general norm.

Key words: Athletes · 2d:4d finger length · Anaerobic power

INTRODUCTION

Personal attributes such as the size, shape and composition of each organ of human beings contain significant information concerning the person. In recent years, very important studies have been made in order to reveal the attributes specific to individuals. Within this context, many academic studies were conducted and published concerning the proportion of the index finger to the ring finger in the hand (2d:4d).The concept of finger proportion is used to describe the length proportion between the middle point of the lower curves of hand fingers and the tip point of the finger [1].

The length difference between the index finger (2d) and ring finger (4d) in human hand, which is the subject of our study, varies in males and females. In males, the 2nd finger is often shorter than the 4th finger whereas the 2nd finger is often equal to or longer than the 4th finger in females. In medical literature, this concept is termed as the 2d:4d proportion. D stands for digit (finger). In enumeration of fingers, the thumb is accepted as finger number 1; the index finger is accepted as finger number 2 while the ring finger as number 4 [2].

The Hox gene family in vertebrates is necessary for development of limbs and genital organs [3, 4]. Hoxa and Hoxd genes as members of the Hox gene family are needed for differentiation of genital buds and growth and formation of fingers [5]. There are innumerable publications supporting this situation in the literature.

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The hand-foot-genital syndrome with anatomic defects in fingers and genitals in humans is a result of mutation of the Hoxa gene [6]. Therefore, the proportion of the 2nd finger to the 4th finger (the 2d:4d proportion) is less than 1 in most of males whereas it is equal to or higher than 1 in most of females [7]. There are many completed or ongoing studies that used the 2d:4d proportion as an index of prental hormone exposure and related the finger proportion to physiological conditions and athletic skills [8.9].

There are different opinions and results that came out of studies conducted on finger length and performance, which increases the importance of our study.

Sports have been a great dynamic with millions of practitioners and spectators today. In line with this development, sportive performance has gained more importance. In the world of sports, the goal is to be successful. Many different scientific studies have been conducted in order to maximize performance of athletes for many years.

In sportive games, we observe that motor attributes play a leading role in all movements conducted both in offence and defence [10-12]. In addition to basic motor attributes, anaerobic power is another decisive factor in sportive performance. Anaerobic power including loadings requiring short-term, high-magnitude explosive power, namely the elements decisive in performance such as speed, jumping and vaulting are important success factors in sports [13-15]. Anaerobic system is widely used in team sports. During the game, at offence and defence, athletes are supposed to respond to high-magnitude and short-term physiological loadings. Athletes should therefore develop their anaerobic power that is the reflection of these physiological attributes [16].Although anaerobic performance is crucial for any type of sportive activity, it becomes more important for some sports branches in which anaerobic performance is heavily employed. It is more crucial in offence and defence concepts of team sports such as football, basketball, volleyball and handball since they require formation of immediate and high-magnitude power [17]. It is seen that various field and laboratory tests whose reliability coefficients range between 0.76 and 0.98 are often used in evaluation of anaerobic capacity [18]. In this study, the Lewis formula was employed in order to determine anaerobic powers of the volunteers by measuring vertical-jumping scores and body weights of the athletes [19].

The aim of this study is to examine the relationship between the 2d:4d finger length proportion of athletes and anaerobic power.

MATERIALS AND METHODS

The universe of this study was composed of voluntary basketball, football and volleyball players with an average age of 22.66±3.48 years and training age of five years or more. Participating athletes were briefed about the study and measurements to be made and those who accepted to partake in the study signed an Informed Voluntary Consent Form (IVCF). ID Information was taken as basis to determine the ages of the participating athletes. Body height measurements of the participating athletes were made by means of a wall scale with the sensitivity level of 0.1cm. Body weight of the athletes was measured by means of a Tanita-brand weighing machine in kilograms as athletes stood on the weighing machine in anatomic upright position with their shorts and t-shirts and without any shoes. Body mass index was calculated with the formula of BMI = body weight (kg) / body height (m^2).

In finding the anaerobic power, vertical jumping measurement was taken to calculate the anaerobic power in the Lewis formula [19, 20]. For vertical jumping measurements, a Takei-brand (Japan) digital jump-meter with 0.1 cm sensitivity was used. Zorba [21] stated the reliability of this test, based on the reliability studies conducted, as between 0.90 and 0.97. Participants first attached the digital display of the jump-meter to their belly and adjusted its robes and then jumped upwards by stretching on their knees. They also tried to land back on the circular plastic area laid on the ground as attached to the jump-meter. If there were some forward and backward steps right after landing, the jump was considered void and repeated. Three attempts were made and the best score was recorded.

The formula of P = v4.9 (weight) vD^n was used in calculation of anaerobic power. The "P" in the formula stands for power in terms of kilogram-metre/second while "D^m" stands for the vertical jumping distance in terms of metre. Body weights and vertical jumping distances obtained by measurements were put in the formula to find anaerobic power of athletes in terms of kilogram metre/second (kg m/sec) [20].

Athletes with any congenital or acquired finger deformity in index finger (2d) and ring finger (4d) of their dominant hands were not included in the study.

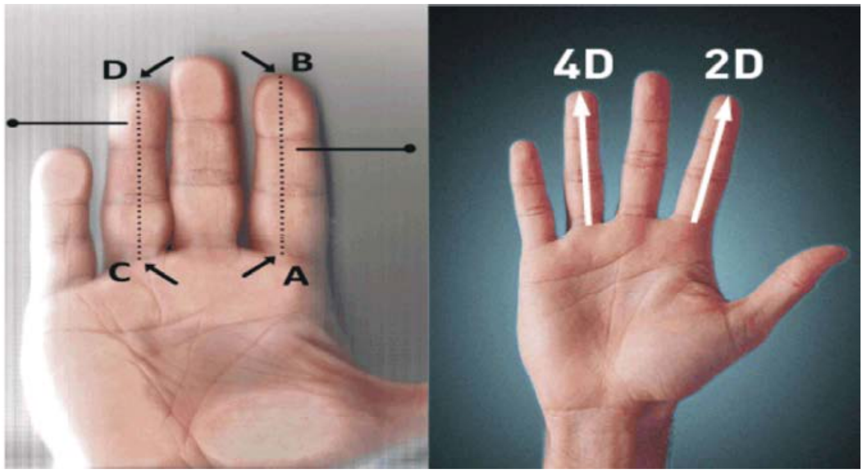

Fig. 1: Measurement of length of index finger (2d) and ring finger (4d)

Table 1: Statistical breakdown of all participating athletes

Variables	n	Mean	SS
Age(year)	36	22.66	3.48383
Height (cm)	36	184.08	8.72116
Body Weight (kg)	36	78.94	12.23248
Body Mass Index (kg/m^2)	36	23.12	2.17340
A.P* (Kg.m/sn)	36	147.67	15.58130
2d (mm)	36	74.19	4.52867
4d (mm)	36	76.56	4.09296
2d:4d (mm)	36	0.9691	0.02588

*Anaerobic Power

Table 2: Relationship between Finger Length of Athletes and their Anaerobic Power Values

Variables		Age (year)	Height (cm)	Body Weight (kg)	Body Mass Index (kg/m^2)	Anaerobic Power (Kg.m/sn)	2d(mm)	4d (mm)
Age (year)	r	1	.084	.248	.335*	.117	-.035	.011
	p		.627	.145	.046	.497	.842	.949
	n	36	36	36	36	36	36	36
Height (cm)	r	.084	1	.851**	.374*	.658**	.654**	.665**
	p	.627		.000	.025	.000	.000	.000
	n	36	36	36	36	36	36	36
Body Weight (kg)	r	.248	.851**	1	.799**	.736**	.514**	.618**
	p	.145	.000		.000	.000	.001	.000
	n	36	36	36	36	36	36	36
Body Mass Index (kg/m^2)	r	.335*	.374*	.799**	1	.553**	.181	.351*
	p	.046	.025	.000		.000	.291	.036
	n	36	36	36	36	36	36	36
Anaerobic Power (Kg.m/sn)	r	.117	.658**	.736**	.553**	1	.476**	.573**
	p	.497	.000	.000	.000		.003	.000
	n	36	36	36	36	36	36	36
2d (mm)	r	-.035	.654**	.514**	.181	.476**	1	.888**
	p	.842	.000	.001	.291	.003		.000
	n	36	36	36	36	36	36	36
4d (mm)	r	.011	.665**	.618**	.351*	0.573**	.888**	1
	p	.949	.000	.000	.036	.000	.000	
	n	36	36	36	36	36	36	36

The length of index finger (2d) and ring finger (4d) of the dominant hand of the participating athletes were measured by means of a digital compass (MarCal 16 ER Digital Compasses) with 0.01 mm sensitivity by taking into consideration the distances indicated by Pheasant [22], (figure 1).For measurement of index finger length (2d); the distance between the middle point of the proximal line running through the index finger stem and palm and the tip point of the index finger (A-B) was measured.For measurement of ring finger length (4d);the distance between the middle point of the proximal line running through the ring finger stem and palm and the tip point of the ring finger (C-D) were measured.

Data were analyzed in the IBM SPSS Statistics 2.1. Shapiro-Wilk test was used to see whether the data displayed a regular distribution. Measurement results were presented in arithmetic mean and standard deviation. The relationship between anaerobic power and finger length of athletes was determined by Pearson correlation analysis. The value of $p<0.05$ was considered to be significant.

Values of all athletes who participated in the study were presented in tables. In the tables, we saw that the participants were 21.64±1.78 years old in average, 189.64±8.90 cm high and 89.07±12.63 kg in weight. When we observed the values regarding Body Mass Index, we found the average value of 24.67±2.12 kg/m^2. We also found out that anaerobic power of athletes was 159.19±11.20 kg-m/sec in average.

The Pearson correlation test that was conducted with finding the magnitude and direction of the relationship between the 2d:4dfinger length averages of athletes and their anaerobic power values revealed that there was a relationship between finger lengths and anaerobic power values of athletes who participated in the study (r=0.573).

DISCUSSION AND CONCLUSION

In the present study, technical and tactical attributes often came first while physical, physiological and motor skills also played an important part. Anaerobic power calculated through vertical jumping as essential elements that increase sportive efficiency is of critical importance. From this perspective; estimating the anaerobic power of athletes practically by looking at their 2d:4d finger length proportions will facilitate coaches to have healthier information about their athletes. The study found out that there was a correlation between the 2d:4d finger length proportion and anaerobic power in athletes. We have observed similarities as well as differences to our findings. Aksu *et al*. found no significant difference when they compared the right hand and left hand finger proportions of athletes and reported no correlation between body mass index and right hand and left hand finger proportions in all athletes [23].

In this study, we found the 2d:4d finger length proportions as 0.9691 ± 0.02588. Çelik *et al*. [24]. found the right hand finger proportion as (0.97 ± 0.04), the left hand finger proportion as (0.96 ± 0.03) and the average finger proportion of both hands as (0.97 ± 0.03), all being less than 1. in all athletes (n=30). Manning and Hill compared the acceleration times of male sprinters and reported that the acceleration time of athletes with lower finger proportion (high testosterone) was shorter than that of athletes with higher finger proportion [25]. Aksu and Çelik suggested that the average finger proportion of male athletes who won the competitions was lower than 1 (0.99 ± 0.06) while it was higher than 1 (1.01 ±0.04) in other male athletes. When the average values of right and left hand finger proportions were evaluated, no significant difference was observed between the athletes who won the competition and other athletes. Also, they did not find any significant difference when they compared right hand and left hand finger proportions of all male athletes and they did not find any significant difference in dominance of testosterone when they compared right hand and left hand finger proportions of the athletes who won the competitions with other athletes [23].

The Pearson correlation test that was conducted with finding the magnitude and direction of the relationship between the 2d:4d finger length averages of athletes and their anaerobic power values revealed that there was a relationship between the 4d finger length averages indicating to testosterone dominance and anaerobic power (r=0.573). Manning *et al*. underlined that skiers with higher testosterone according to their finger proportions had faster and higher performance [26].

Tetik suggested that there was not any correlation between 2d:4d finger length averages and competitive performance in basketball and handball players while he suggested a correlation between 2d:4d finger length averages and competitive performance in volleyball players [27]. Aksu and Çelik stated that individuals with a dominant 4d proportion were more inclined to sports and more enthusiastic for participating in competitions [23].Manning *et al*. found that both male and female long distance running athletes with lower finger proportion suggesting higher testosterone ran faster [28]. Paul *et al* reported in a study they conducted on female athletes that lower finger proportion increased sports skills and running performance [29]. Bescos *et al*. stated in a study on a world-class female epeeist that athletes with finger proportions suggesting testosterone dominance had higher scores which are, nevertheless, not statistically significant [30]. These studies support our findings. The proportion of the index finger to the ring finger is known to be associated with testosterone exposure prenatally [31-33]. Accordingly, the low 2d:4d proportion shows high androgen exposure. As the finger proportion (2d:4d) approaches to 1, we can talk about a high proportion while we can talk about a lower proportion as it reaches to [34].

As a conclusion, it is considered in the light of this study that athletes displaying higher testosterone attributes according to their ring finger proportion have a better performance. Nevertheless, such studies should be conducted on multiple subjects and multiple repetitions to establish a general norm in this field.

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