Original Article

Analysis of the relationship between 2d:4d finger length ratios and leg strength among athletes

Hürmüz KOÇ¹ Cemil AKSOY² Günay ESKİCİ³ and Yaşar KÖROĞLU⁴

^{1,4}Erciyes University, School of Physical Education and Sport, TÜRKİYE

²Kahramanmaraş Sütçü İmam University, School of Physical Education and Sport, TÜRKİYE

³Erzincan University, School of Health, Department of Nutrition and Dietetics, TÜRKİYE

Published online: August 25, 2017

(Accepted for publication July 15, 2017)

DOI:10.7752/jpes.2017.s3150

Abstract:

Fourty volunteer athletes participated in this study in which the relationship between 2d:4d finger length ratios and leg strength was analyzed. These volunteers, who play basketball, football and volleyball in different clubs, have 22.66±3.48 average of age and their training age is 5 years and over. The explanations about the study to be conducted and measurements to be taken were made to the athletes participating in the study. The identity information was used for the determination of the age of the athletes. The statures, body weights, leg strengths, index fingers (2d) and ring fingers (4d) of the dominant hands of athletes were measured. The measurement results were presented as arithmetic mean and standard deviation. Pearson Correlation Analysis was applied to determine the strength and direction of the relationship between the leg strength and finger length of the athletes. $p<0.05$ value was accepted as meaningful. As a result of the study, it was determined that there was a powerful relationship between the leg strength and 4d finger length of the athletes ($r=0.631$). Finally, based on the extant literature, the idea that there is a relationship between the dominance of testosterone hormone in human beings and 4d finger length can be commented as the fact that leg strength values of the athletes having 4d finger length is high.

Key words: Athletes, leg strength, 2d:4d finger length.

Introduction

The length difference between the index finger (2d) and ring finger (4d) that are available in human hand and are discussed in the study differ from man and women. In men, with the dominance of testosterone hormone, 4d finger is longer than 2d finger; 2d finger equals to 4d finger or generally longer than 2d finger in women. In medical literature, this concept is called as 2d:4d ratio. Here, “d” letter represents the capital letter of the word, “digit” (finger) (Mayhew et al., 2007; Köroğlu et al., 2016).

In vertebrates, Hox gene family is necessary for the development of the organs and genitals (Herault et al., 1997; Catherina et al., 1997). Hoxa and hoxd genes, which are the members of Hox gene family, are significant for the differentiation of genital bud and shaping and growth of the fingers (Kondo et al., 1997). There are many publications in the literature supporting this situation. Hand-foot-genital syndrome stemming from anatomical defects in fingers and genitalia is the result of Hoxa gene mutation (mortlock et al., 1997). The ratio of the length of 2d finger to 4d finger is lower than 1 in men and equals to 1 or is higher than 1 in women (Baker., 2009). There are many study conducted in which 2d and 4d finger length ratio is used as an index of prenatal hormone exposition and physiological situations and sportive talent are associated with the finger ratio (Manning et al., 2000; Manning et al., 2001). There are different views in the studies conducted for the determination of the relationship between finger lengths and the performance. These different views increase the significance of our study.

We see that basic motor features are in the forefront in all the moves in attack and defense in sportive games (Okur, 2013; Çimemli et al., 2016). The most important of these features is the force. Force is the main element of sports activities. Also, it plays an effective role for the individual to carry out his daily duties effectively and productively. Force is the ability of straining of the muscles facing with a power or becoming persistent to some extent against this power (Sevim, 2010). Especially the concept of attack and defense in sportive games, leg strength is a significant factor in the elements that are the determinants of the performance like speed, leaping, jumping in which there are loads that require short-term severe explosive force (Cases, 2008; Can, 2009). Leg strength is important for all sportive activities. Especially, the force of kicking the ball that is effective for the result is significant in football with the majors in which leaping force is important like basketball, handball and volleyball. As it is known, the force is in the forefront as formation of sudden and severe power is required in attack and defense game concept of team sports like football, handball and volleyball (Yapıcı & Cengiz, 2015).

The aim of this study is to analyze the relationship between 2d:4d finger length ratio and leg strength in the athletes.

Material & Methods

Basketball (n=10), football (n=18) and volleyball (n=12) players, who are aged between 20 and 28 years interval and whose training age is 5 years or more, joined the study as volunteers. Firstly, written and oral explanations about the study to be carried out and the measurements to be taken were made to the athletes joining the study. Identity information was used for the determination of the age of the athletes joining the study. A wall scale, whose sensitivity is 0.1 cm, was used for the measurement of the stature of the athletes joining the study. The body weight of the students was measured with a bascule. The athlete was recorded as kg type by weighing with the bascule without short and t-shirt. It was calculated with body mass index = body weight (kg) / Stature (m²) formula.

Takei brand leg dynamometer was used in the study to measure leg strength. It is known for long that the use of dynamometer is reliable in the measurement of the force (Fox et al., 1988; Tamer, 2000). The dynamometer operates according to the pressure principle. When an external power is applied to the dynamometer, steel wire stretches and it moves the indicator. Therefore, the indicator on the dynamometer determines how much force the individual applies as kg. The participants pull up dynamometer bar that they hold with their hands by using their legs at maximum level vertically by placing their legs on dynamometer table by bending their knees and their arms are stretched and their knees are bended between 130-140 degrees when their back is straight and their trunk is partially inclined to the front (Tamer, 2000; Özer, 2001; Bookwalter, 1950).

Index finger (2d) and ring finger (4d) length measurements; index finger and ring finger (4d) of the dominant hand (2d) and the athletes that have congenital and any obtained finger deformity weren't included in the study. 2d and 4d finger lengths of the athletes joining the study were measured with 0.01 mm sensitive digital compass (Mar Cal 16 ER Digital Compasses) by taking the distances that Pheasant stated (Pheasant, 1990). The distance between the mid-point of proximal line separating the root of index and ring finger from the palm and terminal point of ring finger was measured. The data obtained was evaluated in statistical package program. Whether the data show normal distribution or not was tested with Shapiro-Wilk test. The measurement results were presented as arithmetic mean and standard deviation. The relationship between finger length and leg strength of the athletes was determined with Pearson correlation analysis. $p < 0.05$ was accepted as meaningful.

Results

Table 1: Statistical Distribution of The Athletes Joining The Study (n=40).

Variables	Mean	S _D
Age (year)	22,97	2,34
Height (cm)	184,55	7,36
Body Weight (kg)	79,61	8,80
Body Mass Index (kg/m ²)	23,52	1,91
Long Jump (cm)	226,82	20,97
Vertical Jump (cm)	56,29	7,50
Leg Strength (kg)	108,88	19,89
2d (mm)	74,48	4,09
4d (mm)	76,72	3,70

The values of all the athletes joining the study were given as the table. When the table was analyzed, it was seen that the volunteers joining the study had average of 22.97 ± 2.34 years age, 184.55 ± 7.36 cm height, 79.61 ± 8.80 kg body weight and 23.52 ± 1.91 kg/m² body mass index. when the values belonging to long jump were analyzed, the values were 226.82 ± 20.97 cm, when the values belonging to vertical jump were analyzed, the values were 56.29 ± 7.50 cm, when the values belonging to the leg strength were analyzed, the values were 108.88 ± 19.89 kg. When the values belonging to 2d length were analyzed, the values were determined as 74.48 ± 4.09 mm and when the values belonging to 4d length, the values were 76.72 ± 3.70 mm.

Table 2: The Relationship Between Finger Length and Leg Strength of The Athletes.

Variables		2d	4d
Age (year)	r	-0,129	-0,022
	p	0,466	0,902
	n	40	40
Height (cm)	r	0,656**	0,717**
	p	0,000	0,000
	n	40	40
Body Weight (kg)	r	0,448**	0,579**
	p	0,008	0,000
	n	40	40
Body Mass Index (kg/m ²)	r	0,136	0,321
	p	0,443	0,064
	n	40	40
Long Jump (cm)	r	0,114	0,065
	p	0,520	0,714
	n	40	40

Vertical Jump (cm)	r	0,087	0,146
	p	0,623	0,411
	n	40	40
Leg strength (kg)	r	0,481**	0,631**
	p	0,004	0,000
	n	40	40
2d (mm)	r	1	0,871**
	p		0,000
	n	40	40
4d (mm)	r	0,871**	1
	p	0,000	
	n	40	40

As a result of Pearson correlation analysis with an aim of determining the power and direction of the relationship between 2d and 4d finger length means and leg strength values of the athletes, it was seen that there was a relationship between 4d finger length ratio and leg strength of the athletes joining the study ($r=0,631$).

Discussion & Conclusions

The strength discussed in our study is the key element of sport activities. Besides it plays an active role in effective and productive actualization of daily exercises of the individual (Sevim, 2010). Strength serves as a resource of strength for lever systems composed of muscles and bones in human body. Strength is defined as a mass's being moved by an athlete in other words the resistance defeating skill. It is the most important element that determines the performance in both individual and team sports (Fox et al., 1988; Sevim, 2010; Muratlı, 1997; Newton et al., 1994; Wilson et al., 1993). In practice, from this point of view, checking 2d:4d finger-length ratio will provide reliable information about the competition performance of athletes to technical directors / coaches. In this study which was conducted in accordance with these ideas, when the findings suggesting that there is a relation between 2d and 4d finger length ratio and leg strength were compared to the findings of the studies conducted in this field, it was seen that there are similarities and differences.

In the study conducted by Aksu & Çelik (2010) it was stated that there is not any meaningful differences found when right hand and left hand ratios of athletes were compared, and that there is not a relation between body mass index in all athletes and ratios of right and left hand. Results of this study support our findings.

As a result of Pearson correlation analysis, which was carried out to determine the strength and direction of the relationship between 2d:4d finger length ratio and leg strength, it was found that there is a relationship between 4d finger length ratio, which shows Testosterone dominance, and leg strength ($r=0,631$). Manning & Hill (2009) compared acceleration time of male short distance racers, and stated that acceleration time is shorter in athletes with low finger ratios [high testosterone] than in athletes with high finger ratios.

Manning et. al., (2002) emphasized in another study that skiers with high Testosterone hormone according to their finger ratios, have a faster and a higher performance. In a study conducted by Aksu and Çelik (2010), it was indicated that individuals, who have the dominant fourth finger ratio, have more tendency to doing sport and are more eager to attend competitions. Manning et al (2007) determined that female and male long distance racers with low finger ratio, and displaying high testosterone level, are faster runners than others. This information in literature supports our findings. Tetik (2015) in his study, indicated that there is not a relationship between 2d and 4d finger length ratios and competition performance in basketball and handball players, however; he stated that there is a relationship between 4d finger length ratio and performance in volleyball players. Pulur et al., (2015) stated in their study on basketball players that there is a relationship between 4d finger length ratios of athletes and static leg strength values ratios. Findings of Pulur et. al. support our findings.

Paul et al., (2006) stated in their study conducted with a female athlete that low finger ratio increases the race performance and sport skill. Bescos et al., (2009) stated in their study conducted with a world-ranking female fencer that athletes with finger ratios displaying testosterone dominance get higher points, However; that these results are not statistically meaningful. When the results of the study are examined, it is seen that a consensus is not reached. It is known that index finger and ring finger length ratios is linked to testosterone exposure rate in mother's womb (Aksu et al., 2009; Honekoop et al., 2006; Manning, 2002). From this point of view, the idea, that athletes displaying high testosterone quality according to ring finger ratio show a higher performance, is obvious according to the results of conducted study.

As a result, it is thought that athletes with high testosterone quality according to ring finger ratio have a higher level of performance in the light of present study. Nevertheless there is a need for similar studies with more subjects and with more repetition.

References

- Mayhew, T.M., Gillam, L., McDonald, R., & Ebling, F.J.P. (2007). Human 2D (index) and 4D (ring) digit lengths: Their variation and relationships during the menstrual cycle. *Journal of Anatomy* 211 (5): 630–638.

- Köroğlu, Y., Aksoy, C., Atar, Ö., & Koç, H. (2016). An examination of the relationship between 2d:4d Finger Length Proportions and Anaerobic Power in Athletes. *European Journal of Applied Sciences*, 8 (4): 203-208, 2016
- Herault, Y., Fraudeau, N., Zakany, J., & Duboule, D. (1997). Ulnaless (UI) A regulatory mutation inducing both loss-of-function of posterior Hoxd genes. *Development*, 18 (124) :3493-3500.
- Catherine, L., Peichel, B., Prabhakaran, B., & Vogt, T.F. (1997). The mouse Ulnaless mutation deregulates posterior HoxD gene expression and alters appendicular patterning. *Development*, 124:3481-3492.
- Kondo, T., Zakany, J., Innis, J.W., & Duboule, D. (1997). Of fingers, toes and penises. *Nature*, 390:185-198.
- Mortlock, D.P & Innis J.W. (1997). Mutation of HOXA13 in hand-foot-genital syndrome. *Nat Genet*, 15:179-80.
- Baker, F. (2009). Anthropological notes on the human hand. *Am Anthropol*, 1:51-76.
- Manning, J.T, Barley, J., Walton, J., et al., (2000). The 2nd:4th digit ratio, sexual dimorphism, population differences, and reproductive success. Evidence for sexually antagonistic genes? *Evol Hum Behav*, 21:163-83.
- Manning, J.T., & Taylor, R.P. (2001). Second to fourth digit ratio and male ability in sport: Implications for sexual selection in humans. *Evol Hum Behav*, 22:61-69.
- Okur, F. (2013). An Examination of the Relationship Between Vertical Jumping Performance with Competition Performance in Sub –Elit Basketball Players. *Master's Thesis*, Erciyes University, Institute of Health Sciences, Department of Physical education and Sports, Kayseri.
- Çimenli, Ö., Koç, H., Çimenli, F., Kaçoğlu. (2016). Effect of an eight-week plyometric training on different surfaces on the jumping performance of male volleyball players, *Journal of Physical Education and Sport (JPES)*, 16 (1) : 162 – 169.
- Sevim, Y. (2010). *Training Studies*, Pelin Offset Tipo Publishing House Industry and Trade Co. Ankara.
- Casas, A. (2008). Physiology and methodology of intermittent resistance training for acyclic sports. *Journal of Human Sport and Exercise*, 3 (1): 23-52.
- Can, İ. (2009). A Comparison of Aerobic Power Performances of Basketball, Football and Handball Players at the Age Group of 16–18 Years: An Experimental Study. *Master's Thesis*, Black Sea Technical University, Institute of Social Sciences, Department of Physical Education and Sports, Trabzon.
- Yapıcı, A & Cengiz, C. (2015). The Relationship Between Lower Extremity Wingate Anaerobic Test (WAnT) and 50m Freestyle Swimming Performance. *International Journal of Science Culture and Sport (IntJSCS)*, 3 (3) : 44-54.
- Fox, E.L., Bowers R.W., & Foss, M.L. (1988). *The Physiological Basis of Physical Education and Athletics*. 4th Edition, Philadelphia: Saunders Collage Publishing.
- Tamer, K. (2000). *Measurement and Evaluation of Physical - Physiological Performance in Sports*, Bağırhan Publishing House, Ankara, 138-140.
- Özer, K. (2001). *Physical Fitness*. Nobel Publications, Ankara:
- Bookwalter, K.W. (1950) Grip Strength Norms For Male. *The Research Quarterly*, 21(3) 249-273.
- Pheasant, S. (1990). *Anthropometrics: Introduction*. BSI Education. Milton Keynes, 18-19.
- Muratlı, S. (1997). *Training Science Under the Lights Children and Sports*, Bağırhan Publisher, Ankara.
- Newton, R.U & Kraemer, W.J. (1994). Developing explosive muscular power: implications for a mixed methods training strategy, *Strength and Conditioning Journal*, 16:20-31.
- Wilson, G., Newton, R. Murphy, A. & Humphries, B. (1993). The Optimal Training Load For The Development Of Dynamic Athletic Performance, *Med. Sci. Sports Exerc.* 25:1279-1286.
- Aksu, F.A & Çelik, A (2010). Effects of digit ratio of master athletes on sporting achievement levels, *Dokuz Eylül University Journal of Medical Faculty*, 24 (3) : 89 – 93.
- Manning, J.T & Hill M.R. (2009). Digit Ratio (2D:4D) and Sprinting Speed in Boys, *Am J Hum Biol*, 21:210-213.
- Manning, J.T. (2002). The ratio of 2nd to 4th digit length and performance in skiing. *J Sports Med Phys Fitness*, 42 : 446-450.
- Manning, J.T, Morris, L., & Caswell, N. (2007). Endurance running and digit ratio (2D:4D): implications for fetal testosterone effects on running speed and vascular health. *Am J Hum Biol*, 19 : 416–421.
- Tetik, S. (2015). Examination of relationship between 2d: 4d digit (finger length) ratios and competition performance of athletes, *Master's Thesis*, Erciyes University, Institute of Medical Sciences, Department of Physical Education and Sports, Kayseri.
- Pulur, A., Koç, K., Köroğlu, Y., & Çimen, K. (2015). Examination of the Relationship

- Between 2d:4d Finger Length Proportion and Leg Strength and Anaerobic Power in Basketball Players. *Advances in Biological Research*. 9 (5): 299-304.
- Paul, S.N, Kato, B.S., Hunkin, J.L., Vivekanandan S., & Spector, T.D. (2006). The big finger-The second to fourth digit ratio (2D:4D) is a predictor of sporting ability in females. *Br J Sports Med*, 40 : 981–983.
- Bescos, R, Esteve, M., Porta, J., Mateu, Irurtia, A., & Voracek, M. (2009). Prenatal Programming of sporting success: associations of digit ratio (2D:4D), a putative marker for prenatal androgen action, with world rankings in female fencers. *J Sports Sci*, 27:625-632.
- Aksu, F, Topaçoğlu, H., Arman, C., Ataç, A., & Tetik, S. (2009). Neck Circumference and 2:4 Digit Ratio in Patients with Acute Myocardial Infarction. *Turkiye Klinikleri J Cardiovasc Sci*, 21:147-152.
- Honekopp, J. Manning, J.T., & Muller, C. (2006). Digit ratio and physical fitness in males and females: evidence for effects of prenatal androgens on sexually selected traits. *Horm Behav*, 49:545–549.
- Manning, J.T. (2002). *Digit ratio. A pointer to fertility, behavior, and health*. New Brunswick, NJ Rutgers University Press, 126-139.