Relationship Between Second to Fourth Digit Ratios and Obesity, Muscle Mass

2.ve 4. Parmak Oranının Obezite ve Kas Kitlesi ile İlişkisi

2D:4D Obezite ve Kas Kitlesi ile İlişkisi / 2D:4D Relationship Obesity, Muscle Mass

Umut Hatay Gölge[1], Zeynep Sivaslı[2], Özhan Pazarcı[3], Ferdi Göksel[1], Burak Kaymaz[1], Hüseyin Emre Kuloğlu[4]
[1]Department of Orthopaedics and Traumatology, Çanakkale Onsekiz Mart University School of Medicine, Çanakkale,
[2]Department of Diet Clinic, Çanakkale Onsekiz Mart University School of Medicine, Çanakkale,
[3]Department of Orthopaedic and Traumatology, Cumhuriyet University School of Medicine, Sivas,
[4]Medical Student, Çanakkale Onsekiz Mart University School of Medicine, Çanakkale, Turkey

Özet

Amaç: Genetik geçişle aktarılan ve sonra değişmeyen 2.ve 4.parmak oranı (2D:4D), oranı testesterone hormonu ile alakadardır. Bizde bu oranın kas kitlesi ve obesite olan ilişkisini incelemeyi amaçladık. Gereç ve Yöntem: Diyet polikliniğine gelen yetişkin hastalar hastaların vücut tipi analizi, yaşı ve cinsiyeti kategorize edildi. Boy, kilo, BMI(Body mass Index) hesaplanarak Tanita (TANITA BC-418 MA III) cihazıyla vücut analizleri yapıldı. Ayrıca bu hastaların dijital kumpas aracılığıyla her iki elinin işaret ve yüzük parmakları ayrı ayrı ölçülerek kayıt edildi. Ölçülen değerlerin birbirine oranları belirlenerek Tanita cihazıyla elde edilen değerlerle karşılaştırma yapıldı. Bulgular: Diyet polikliniğine gelen 216 hastanın 168'i kadın 48 ise erkek idi. Her iki el 2d/4d oranı 1 ve üzeri olan kişilerle 1 'in altında olan kişilerin yapılan ölçümleri karşılaştırıldı. TF(Total Fat), FFM(Fat Free Mass), FM(Fat Mass)ler açısında olarak fark gözlendi. Her iki elin 2d/4d oranlarının ölçümü ile BMI, FM, ve TF ile pozitif yönde korelasyon olduğu görülürken, FFM ile negatif yönde korelasyon gözlenmiştir. Tartışma: 2D:4D parmak oranın obezite ile doğru orantılı vucut kas kitlesi ters orantılı olabileceğini düşünmekteyiz

Anahtar Kelimeler

2.Parmak; 4.Parmak; Oran; Obezite; Kas

Abstract

Aim: Transmitted through genetic inheritance and later unchanging, the ratio of 2nd and 4th fingers (2D:4D) is related to the hormone testosterone. We aimed to investigate the correlation of this ratio to muscle mass and obesity. Material and Method: Adult patients attending the diet clinic were categorized by body type analysis, age and gender. Body mass index (BMI) was calculated from height and weight, and body analysis was completed with a Tanita (TANITA BC-418 MA III) device. Additionally patients had the index and ring fingers of both hands separately measured with the aid of digital calipers and recorded. The ratio of the values was determined and compared with the values obtained by the Tanita device. Result: Of 216 patients at the diet clinic, 168 were female and 48 were male. The measurements of individuals with 2D:4D of both hands above 1 were compared with those of individuals with 2D:4D of both hands below 1. Differences were observed in terms of total fat (TF), fat free mass (FFM) and fat mass (FM). While there was a positive correlation of the 2D:4D of both hands with BMI, FM and TF; there was a negative correlation observed with FFM. Discussion: We believe the 2D:4D may be directly related to obesity and inversely related to body muscle mass.

Keywords

2D; 4D; Oran; Obesity; Muscle

DOI: 10.4328/JCAM.3846 Received: 21.08.2015 Accepted: 04.09.2015 Printed: 01.12.2015 J Clin Anal Med 2015;6(suppl 6): 842-5
Corresponding Author: Umut Hatay Gölge, Department of Orthopaedics and Traumatology, Çanakkale Onsekiz Mart University School of Medicine, 17000, Çanakkale, Turkey. GSM: +905059389994 E-Mail: uhg31@hotmail.com

Introduction

Obesity results from the body's intake of energy from nutrients being greater than the energy expended and is a chronic disease characterized by fat mass of the body increasing in proportion to the fat-free body mass [1]. Obesity has become a global public health problem. Worldwide, the proportion of adults with a body mass index (BMI) of 25 kg/m2 or greater increased from 28.8% to 36.9% in men, and from 29.8% to 38.0% in women between 1980 and 2013 [2]. In parallel with the world in general, obesity is a significant public health problem in our country. As a result there is a need for governments to create emergency action plans to reduce this epidemic and for the food industry [3]. Studies on the genetics of obesity have generally been performed on twins, as it was considered that the body mass index (BMI) may be transmitted through genetic inheritance [4]. Another thing transmitted by genetic inheritance is finger length ratio. Research has found that from the moment these are determined in the mother's womb, this does not change either in the adolescent period or in adulthood [5]. There are many studies reporting that the ratio of 2nd and 4th fingers (2D:4D) on the hand is related to the level of gender hormones in the body. Accordingly, there is a relationship between index finger length and the level of the hormone estrogen in the female gender and a relationship between ring finger length and the level of the hormone testosterone in the male gender [6]. Another supporting study found a negative relationship between the ratio of index finger to ring finger on the hand and testosterone in blood [5]. Testosterone increases protein formation and muscle development and is one of the important male-specific hormones that is known to contribute to development of muscle after puberty [7].

In this study based on the association of testosterone levels in patients attending the diet clinic with greater fat mass and lower muscle mass measured by Tanita device, we aimed to investigate the link with 2D:4D length on the hand.

Material and Method

The study included patients attending the Dietary clinic at Çanakkale Onsekiz Mart University Education and Research Hospital from February to June in 2015. The study obtained local ethics committee approval. Patients in the study were categorized according to body type analysis, age and gender.BMI was calculated and recorded along with height and weight. Body types were categorized in three groups. Patients had body analysis completed with a Tanita device (TANITA BC-418 MA III). Basal metabolism rate (BMR), total fat (TF), fat free mass (FFM), total body water (TBW), right leg muscle mass (RLMM), left leg muscle mass (LLMM), right arm muscle mass (RAMM), left arm muscle mass (LAMM), trunk muscle mass (TMM) and fat mass (FM) were calculated. The patients with Tanita measurements had the index and ring fingers of both hands measured individually with digital calipers. Measurements were from the proximal curve on the volar face of the metacarpophalangeal joint to the tip of the finger with digital calipers, (BMI 770150) sensitive to 0.01 mm. The ratios of the measured values were later determined. All measurements were completed by the same person. 2D: 4D1 and is greater than 1, testosterone were considered dominant. Patients were asked about additional diseases. The study excluded patients with osteoarthritis, birth deformities, hand injuries, burns, trauma and fracture history and those who attended the diet clinic for reasons such as anorexia nervosa.

Statistical analysis; All analyses were performed using SPSS 15.0 (SPSS Inc. Chicago, IL, USA). Continuous variables were expressed as mean±SD and categorical variables were expressed as percentages. The comparison of variables between the two groups was performed using the x2 test and Student's t-test. Pearson's correlation analysis was conducted to determine the relationship between relevant parameters. In all analyses, $p<0.05$ was taken to indicate statistical significance.

Results

It was observed that the majority of patients attending the diet clinic were female; of the total of 216 patients, 168 were female and 48 were male.

According to the data obtained in our study the 2D:4D of females was 0.9962±0.325 for the right hand and 0.994±0.403 for the left hand. For males the 2D:4D was 0.999±0.297 for the right hand and 0.996±0.279 for the left hand. While there was no statistically significant difference observed between the finger ratios of both hands, significant differences were observed for the separate measurements. Both fingers and hands were longer in the male gender. This is a clinically expected situation. There was a statistically significant difference between height, weight and BMR ratios between the genders; however this is an expected situation. Additionally of patients included in our study, 72.2% (109 people) of patients with BMI 30 and above were female and 27.8% (42 people) were male. Of patients with BMI below 30 90.8% (59 people) were female and 9.2% (6 people) were male. There were statistically significant differences observed between the genders in terms of TF, FFM, TBW, trunk and extremity muscle mass (MM) ($p<0.001$) (Table 1).

According to statistics obtained as a result of correlating values with 2D:4D, the measurements of people with 2D:4D of 1 and above on both hands were compared with those whose 2D:4D was below 1. 2D: 4D1 and is greater than 1, testosterone were considered dominant. While there was a statistical difference observed in terms of total fat, FFM, and fat mass, there was no difference in terms of the other measurements. As can be seen, the individuals with 2D:4D of 1 and above had high total fat and fat mass, while FFM values were low (Table 2). As a result it may be considered that this ratio is related to body muscle mass.

While there was a positive correlation between 2D:4D measurements of both hands with BMI, fat mass and total fat, a negative correlation was observed with FFM (Table 3). In other words; as 2D:4D increases fat mass increases, and as the ratio decreases muscle mass is observed to decrease. This leads to the consideration that 2D:4D may be related to obesity.

Discussion

Obesity is a widespread health problem observed in nearly all societies and is becoming a global epidemic. The TURDEP-II study found that the incidence of obesity was 44% for women, 27% for males and 35% in the general population. We observed that 77.7% of patients attending our diet clinic were female [8].

Table 1. Comparison by gender

	Female (n=168)	Male (n=48)	P value
Ages (year)	39.1±13.9	41.1±13.3	0.377
Height(cm)	160.2±5.5	173.5±7.9	<0.001
Weight(kg)	86.9±18.3	106.5±20.0	<0.001
BMI(Body mass index)			
30≥	109(72.2%)	42(27.8%)	
30<	59(90.8%)	6(9.2%)	0.002
Body type			
Ectomorph	23(56.1%)	1(0.9%)	<0.001
Mezomorph	32(52.5%)	18(43.9%)	<0.001
Endomorph	113(99.1%)	29(47.5%)	0.116
Right hand 2D	67.0±4.0	72.5±4.6	<0.001
Right hand 4D	67.3±4.3	72.6±4.8	<0.001
Left hand 2D	67.2±4.0	72.0±4.7	<0.001
Left hand 4D	67.7±4.8	72.3±4.9	<0.001
Right hand 2D:4D	0.9962±.0325	0.999±.0297	0.503
Left hand 2D:4D	0.994±.0403	0.996±.0279	0.685
BMR	1587.6±202.5	2242.2±357.1	<0.001
TTF	39.9±6.4	30.1±6.0	<0.001
FFM	51.0±5.9	73.9±10.6	<0.001
TBW	37.2±4.3	54.1±7.7	<0.001
RLMM	8.6±1.3	13.0±2.2	<0.001
LLMM	8.5±1.2	12.9±2.2	<0.001
RAMM	2.5±0.3	4.4±0.8	<0.001
LAMM	2.6±0.4	4.4±0.8	<0.001
TMM	28.2±2.9	38.8±4.8	<0.001
FM	36.2±15.0	32.6±11.5	0.133

Table 2. The right 2D:4D, a comparison with are smaller than 1 to 1 and above ones.

	Right 2D:4D 1≥	Right 2D:4D 1<	P value	Left 2D:4D 1≥	Left 2D:4D 1<	P value
BMR	1778.9±371.6	1700.5±360.9	0.122	1772.9±375.5	1706.1±359.2	0.189
TF	37,9±13,7	33,5±10,8	*0.010	37,9±13,6	33,6±11,0	*0.015
FFM	56,2±12,8	60,0±11,7	*0.026	56,3±13	59,9±11,6	*0.038
TBW	41.9±8.9	40.3±8.6	0.201	41.9±9.0	40.4±8.5	0.227
RLMM	9.9±2.3	9.4±2.4	0.107	9.9±2.3	9.4±2.4	0.141
LLMM	9.8±2.3	9.3±2.4	0.123	9.3±2.3	9.8±2.3	0.162
RAMM	3.0±0.9	2.9±0.9	0.363	3.0±0.9	2.9±0.9	0.362
LAMM	3.1±0.9	3.0±0.8	0.222	3.1±0.9	3.0±0.8	0.190
TMM	31.1±5.8	30.2±5.4	0.295	31.1±5.9	30.3±5.4	0.310
FM	37,9±14,1	33,4±10,8	*0.013	37,8±14,0	33,6±11,0	*0.020

The left 2D:4D a comparison with are smaller than 1 to 1 and above ones.

Tables 3. Right hand and left 2D:4D ratio of BMI, Fat Mass, Total Fat while there is a correlation with a positive value, a negative correlation is observed by the FFM.

		BMI	Fat Mass	Total Fat	FFM
Right 2D:4D	Pearson Correlation	r: 0,166*	r: 0,175	r:0,177**	r:-0,152
	Sig. (2-tailed)	p: 0,015	p:0,010	p:0,009	p:0,026
Left 2D:4D	Pearson Correlation	r:0,172*	r:0,171	r:0,164*	r:-0,142
	Sig. (2-tailed)	p:0,011	p:0,012	p:0,016	p:0,038

The 2D:4D is a popular measurement transmitted by genetic inheritance, with many studies on this ratio published in the literature in recent years. Studies have shown that the 2D:4D is related to the hormone testosterone [9-12]. Other studies have shown that a low 2D:4D on both hands is inversely correlated with sports ability, performance and success level [13-16]. The sport of athletics is related to prenatal testosterone and finger length and there is said to be strong evidence of this ratio being a marker of predisposition [17]. We considered that 2D:4D may be linked to the muscle mass of the body and may affect sports ability and performance. However, there are studies stating that this ratio has no place in the determination of athletic skills and physical fitness of adolescent girls [18]. Testosterone increases muscle mass, reduces adiposity and has a relationship with the 2D: 4D ratio, thus we thought it might be a risk factor for obesity.

In our study body type analysis of both genders indicated that the majority were endomorph body type. A somatotype study of university students observed that in both genders endomorph body type was dominant and in spite of similar waist circumference values to the national mean, increased cardiometabolic risk was found [19].

The relationship between 2D:4D and severe knee and hip osteoarthritis risk requiring total joint replacement has been investigated. The study found that low 2D:4D was related to severe knee osteoarthritis, though this relationship was not found for hip osteoarthritis. This cohort study with high numbers of patients concluded that knee and hip osteoarthritis diseases may have different mechanisms [20]. We believe that as 2D:4D increases, there is a tendency toward obesity and osteoarthritis.

The most important limitation of our study is that hormonal laboratory results, such as testosterone, were not studied. As finger ratio is determined in the womb and it is considered that it does not change in adolescence and adulthood, the lack of this measurement may not have affected the study. Another limitation is that there was no control group of normal individuals and the low numbers of patients.

In conclusion, in this study we observed that 2D:4D may be directly correlated to obesity and inversely correlated to body muscle mass. Maybe this rate in the future be considered as a risk factor.However, there is a need for more comprehensive studies about it.

Declaration of conflicting interests: The authors declare no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

Competing interests

The authors declare that they have no competing interests.

References

1. Hruby A, Hu FB. The Epidemiology of Obesity: A Big Picture. Pharmacoeconomics 2015;33(7):673-89.
2. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 201430;384(9945):766–81.
3. Gortmaker SL, Swinburn BA, Levy D, Carter R, Mabry PL, Finegood DT, et al. Changing the future of obesity: science, policy, and action. Lancet 2011;378(9793):838–47.
4. Sengier A. Multifactorial etiology of obesity: nutritional and central aspects. Rev Med Brux 2005;26:211-4.
5. Çelik A, Aksu F, Tunar M, Daşdan Ada E N, Topaçoğlu H. Master atletlerin fi-

ziksel performans düzeylerinin eldeki parmak oranlarıyla ilişkisi. DEÜ Tıp Fakültesi Dergisi 2010;24:5-10.
6. Manning JT, Taylor RP. Second to fourth digit ratio and male ability in sport: implications for sexual selection in humans. Evol Hum Behav 2001;22:61–9.
7. Griggs RC, Kingston W, Jozefowicz RF, Herr BE, Forbes G, Halliday D. Effect of testosterone on muscle mass and muscle protein synthesis. J Appl Physiol (1985) 1989;66(1):498-503.
8. Satman I, Omer B, Tutuncu Y, Kalaca S, Gedik S, Dinccag N, Et al. Twelve-year trends in the prevalence and risk factors of diabetes and prediabetes in Turkish adults. Eur J Epidemiol 2013;28(2):169-80.
9. McIntyre MH, The use of digit ratios as markers for perinatal androgen action. Reprod Biol Endocrinol 2006;26;4:10.
10. Crewther B, Cook C, Kilduff L, Manning J. Digit ratio (2D:4D) and salivary testosterone, oestradiol and cortisol levels under challenge: Evidence for prenatal effects on adult endocrine responses. Early Hum Dev 2015;91(8):451-6.
11. Montag C, Bleek B, Breuer S, Prüss H, Richardt K, Cook S, et al. Prenatal testosterone and stuttering. Early Hum Dev 2015;91(1):43-6.
12. Kilduff LP, Hopp RN, Cook CJ, Crewther BT, Manning JT. Digit ratio (2D:4D), aggression, and testosterone in men exposed to an aggressive video stimulus. Evol Psychol 2013;11(5):953-64.
13. Tester N, Campbell A. Sporting achievement: what is the contribution of digit ratio? J Pers 2007;75(4):663-77.
14. Paul SN, Kato BS, Hunkin JL, Vivekanandan S, Spector TD. The big finger: the second to fourth digit ratio is a predictor of sporting ability in women. Br J Sports Med 2006;40(12):981-3.
15. Sudhakar HH, Majumdar P, Umesh V, Panda K. Second to fourth digit ratio is a predictor of sporting ability in elite Indian male kabaddi players. Asian J Sports Med 2014;5(3):e23073
16. Bennett M, Manning JT, Cook CJ, Kilduff LP. Digit ratio (2D:4D) and performance in elite rugby players. J Sports Sci 2010;28(13):1415-21.
17. Moffit DM, Swanik CB. The association between athleticism, prenatal testosterone, and finger length. J Strength Cond Res 2011;25(4):1085-8.
18. Peeters MW, Van Aken K, Claessens AL. The left hand second to fourth digit ratio (2D:4D) is not related to any physical fitness component in adolescentgirls. PLoS One 2013;8(4):e59766.
19. Carrasco Alarcón V, Martínez Salazar C, Álvarez Lepín C, Jorquera Aguilera C, Aguilar Farías N. variation on somatotype and waist circumference in a sample of university students between years 2012 and 2014 ın the temuco, chıle. Nutr Hosp 2015;32(1):373-8.
20. Hussain SM, Wang Y, Muller DC, Wluka AE, Giles GG, Manning JT, et al. Association between index-to-ring finger length ratio and risk of severe knee and hip osteoarthritis requiring total joint replacement. Rheumatology (Oxford) 2014;53(7):1200-7.

How to cite this article:
Gölge U.H, Sivaslı Z, Pazarcı Ö, Göksel F, Kaymaz B, Kuloğlu H.E. Relationship Between Second to Fourth Digit Ratios and Obesity, Muscle Mass. J Clin Anal Med 2015;6(suppl 6): 842-5.