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COMPARATIVE STUDY OF FINGER LENGTHS AND DIGIT RATIO IN MEN OF ANCONA, ITALY AND ORADEA, ROMANIA

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ABSTRACT. Digit ratio (2D:4D) denotes the relative length of the second and fourth digits. Many authors considered this ratio to be a biomarker of the balance between fetal estrogen and testosterone in a narrow window of early ontogeny (Manning et al., 2014). Males and females generally have different finger proportions. Thus, in men, the 2nd digit is shorter than 4th digit, but in women, 2nd has an equal length or longer than the 4th digit. Our study is particularly about the digit ratio 2D:4D, but 2D:3D and 3D:4D, too in men populations. The research was made in two countries (Italy and Romania) in Ancona (Italy) and Oradea (Romania). Our aim was to identify possible significant differences between the two male populations. The results are important because demonstrate the differences between the two men populations coherently the digit ratio.
Keywords: digit ratio, digit length, biomarker, men populations, fetal sex hormones.

INTRODUCTION:

The digit ratio is the ratio of the lengths of different digits or fingers typically measured from the midpoint of bottom crease (where the finger joins the hand) to the tip of the finger (Mayhew *et al*., 2007). Some scientists said that the ratio of two digits in particular, the 2nd and 4th, is affected by exposure to androgens while in the uterus and that this 2D:4D ratio can be considered a crude measure for prenatal androgen exposure, with lower 2D:4D ratios pointing to higher prenatal androgen exposure (Hönekopp *et al.*, 2007, Malas *et al*., 2006, Zheng et Cohn, 2011*)*. Manning is an author who has many investigations about digit ratio and he is a pioneer in this domain. Since 2000, he suggested the following about the 2D:4D digit ratio: a) is fixed in utero; b) is lower in men than in women; c) is negatively related to testosterone and sperm counts; d) is positively related to oestrogen concentrations.

There are more authors who investigated this sex ratio, such are: Brown *et al*., (2002), Peters *et al*. (2002), Burley and Foster (2004) The 2D:4D ratio is calculated by dividing the length of the index finger of the right hand by the length of the ring finger of the right hand. A longer index finger will result in a ratio higher than 1, while a longer ring finger will result in a ratio of less than 1. The 2D:4D digit ratio is sexually dimorphic: while the second digit is typically shorter in both females and males, the difference between the lengths of the two digits is greater in males than in females

Many scientists focused on the possibility of using the digit ratio as a marker to early identifying important diseases, personality and behavior traits, artistic and athletic skills. Thus, Kyriakidis *et al*., (2010), investigated the digit ratios and relations for predisposition to myocardial infarction in Greek men and women and suggested that digit ratios that include ring-finger (4th digit) may be useful biomarkers to myocardial infarction in Greek men but not in Greek women. Lu *et a*l., (2015) proposed that sex steroids exposure during human development may influence diseases susceptibility. Also, they found that second to fourth digit ratio is thought to be a putative biomarker for prenatal hormone level during foetal life and their conclusion was that 2D:4D may correlate particularly with risk of coronary heart disease in Chinese men. Other authors, such as Wu *et al*., (2013), investigated the 2D:4D digit ratio in Chinese women and found no significant differences between the coronary artery disease group and control group.

Hong *et al.*, (2014) found that digit ratio (2D:4D) may correlate with the increased risk of breast cancer. Krishnakumar *et al*., (2014) obtained in their study significant negative associations between myopia and digit ratio favouring a probable causal role of sex steroids on eye growth and development of myopia. Some of scientists focused on digit ratio in individuals with mental disease. Here we mention the studies of Al-Zaid *et al.*, (2015) who found a significantly lower 2D:4D ratio in Saudi boys with autism, which indirectly suggests that these boys were exposed to high levels of prenatal fetal testosterone. The same subject, autism, is discussed by Masuya *et al.*, (2015) and they said that their findings suggest that high prenatal testosterone could be a risk factor both for Japanese men and women with autism spectrum diseases (ASDs), elucidating one potential etiology of ASDs in women.

There are interesting the studies about Alzheimer disease. Vladeanu *et al*,. (2014) investigated an association between prenatal sex hormone exposure and dementia diagnosis. Their findings suggest that lower levels of prenatal testosterone and higher levels of estrogen exposure are a risk factor for Alzheimer disease in men and that higher levels of prenatal testosterone and lower levels of prenatal estrogen exposure are a risk factor for women.

Brown *et al.*, (2002) observed masculinized finger length patterns in human males and females with congenital adrenal hyperplasia. Lu *et al.*, (2012) suggested that digit ratio, especially 2D:4D in the left hand may be one of the important markers of infertility in men for early diagnosis. Some studies are related the digit ratio and sexual orientation. Vujovic *et al*,. (2014) found in their researches thar male to female transsexuals showed similar 2D:4D of the right hand

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with control women indicating possible influencing factor in embryogenesis and consequently finger length changes. They also obtained that female to male transsexuals showed the lowest 2D:4D of the left hand when compared to the control males and females. They resumed that their results go in the favour of the biological aetiology of transsexualism. Yang *et al,*. (2009) studied 2D:4D digit ratios, sex differences and behavior in Chinese men and women and resumed that within each sex, however, 2D:4D ratios, measures of masculine characteristics and salivary testosterone showed no significant associations with one another. Some authors suggest that personality and behavior traits are linked much stronger with digit ratio of right hand than of left hand (Williams *et al.,* 2000; Brown *et al.,* 2002; McFadden et Schubel, 2002; Csatho *et al.,* 2003; Williams *et al.,* 2003; Manning et Robinson, 2003; Voracek *et al.,* 2005; Honekopp *et al.,* 2006). Kornhuber *et al.,* (2011) obtained results that provide a novel insights into the role of prenatal exposure in the development of alcohol dependency and for use of 2D:4D as a possible trait marker in identifying patients with alcohol dependency..

There are interesting the studies about artistic and sports performances. Thus, Crocchiola (2014), obtained that both male and female artists had significantly lower 2D:4D ratios (indicating high level of testosterone), than male and female controls. He suggested that his findings support the hypothesis that art may represent a sexually selected, typically masculine behavior that advertise s the carrier's good genes within a courtship context. Manning and Taylor (2001) suggested that fetal and adult testosterone may be important in establishing and maintaining sex-dependent abilities correlated with male physical competitiveness.

Manning et al. (2014 discuss the refinement of the 2D:4D paradigm in relation to the links between 2D:4D and sports performance and aggression. Sudhakar *et al*., (2014a) suggested that 2D:4D ratios can be used as reliable additional criteria when screening for prospective kabaddi players to be inducted into the team. Sudhakar *et al,*. (2014b) investigated digit ratio in Indian swimmers and suggested that 2D:4D ratio could be used to identify young sports personnel who have potential to rich high levels of performance.

MATERIALS AND METHODS:

The studied groups were consisted of 200 individuals of Ancona and 200 individuals of Oradea. We measured the length of index (2^{nd} digit), median (3^{rd} digit) and ring (4^{th} digit). The length of the fingers were measured by a single investigator (for best accuracy) using a digital Vernier caliper. Measurements were taken from the bottom crease to the tip of the finger on the palmar surface of hands. The length of the index finger was divided by the length of the ring finger to obtain the 2D:4D ratio. The length of the index finger was divided by the length of the median finger to obtain 2D:3D ratio. The length of median finger was divided by the length of the ring finger to obtain the 3D:4D ratio. To compare the digit ratios it was used the T test. The statistical significance was set at $p<0.05$.

RESULTS AND DISCUSSIONS:

Table 1 and table 2 are showing the statistical results after the measurements of studied fingers were made. In table 1 are described the statistical data of Italian male group of Ancona. The variability of the trait is medium (all the values are between 11 and 20).

The differences between two hands may be due to prenatal sex hormones exposure and genetic differences. The values of right hand means are lower than left hand.

Table 1.

Statistical processing of the data representing measured finger lengths in Italian male studied group of Ancona.

Parameters	Right hand			Left hand		
	index	median	ring	index	median	Ring
Average	7.3770	7.9510	7.5610	7.4790	8.0820	7.6650
Standard deviation	0.812137	0.92839	0.86735	0.80795	0.93823	0.86892
Variability coefficient	11.00904	11.67646	11.47141	10.80295	11.60891	11.33623
Variance	0.65956	0.86191	0.75230	0.65278	0.88027	0.75502

In the Romanian male studied group (Table 2), the trait vary less than in Italian group, the values are under 10 (that means low variability of the trait).

Comparing the finger lengths of the right hands in Italian men and Romanian men, we obtained significantly differences in medium fingers (1.7352, $p<0.05$) and ring fingers (1.7594, $p<0.05$). Between index fingers was not significant differences (1.3373, $p>0.05$).

The values of right hand means are lower than left hand in Romanian male population, too.

Table 2.

Statistical processing of the data representing measured finger lengths in Romanian male studied group of Oradea.

Parameters	Right hand			Left hand		
	index	median	ring	index	median	ring
Average	7.5210	8.1590	7.7640	7.6510	8.3320	7.9090
Standard deviation	0.70700	0.75826	0.76085	0.72075	0.76553	0.72224
Variability coefficient	9.40042	9.29362	9.79971	9.42045	9.18783	9.13191
Variance	0.49985	0.57496	0.57889	0.51949	0.58603	0.52163

In Table 3 are showed the values of digit ratios in Italian male studied group. Comparing the averages of digit ratio of the two hands, there were no significant differences (2D:4D=0.0094, p>0.05; 2D:3D=0.3357, p>0.05; 3D:4D=0.4549, p>0.05). The variability of digit ratio values is low (between 0 and 10).

Table 3.
Statistical processing of data representing the digit ratios in Italian male studied group of Ancona.

Parameters	Right hand			Left hand		
	2D:4D index/ ring	2D:3D index/ median	3D:4D median/ ring	2D:4D index/ ring	2D:3D index/ median	3D:4D median/ ring
Average	0.97692	0.92913	1.05233	0.97697	0.92735	1.05494
Standard deviation	0.03860	0.03621	0.04113	0.03639	0.03977	0.04166
Variability coefficient	3.95185	3.89802	3.90919	3.72547	4.28885	3.94936
Variance	0.00149	0.00131	0.00169	0.00132	0.00158	0.00173

Table 4.
Statistical processing of data representing the digit ratios in Romanian male studied group of Oradea.

Parameters	Right hand			Left hand		
	2D:4D index/ ring	2D:3D index/ median	2D:4D index/ ring	2D:3D index/ median	2D:4D index/ ring	2D:3D index/ median
Average	0.96218	0.92201	1.04468	0.96481	0.91997	1.04927
Standard deviation	0.03290	0.03631	0.03013	0.03225	0.03501	0.03249
Variability coefficient	3.42022	3.93870	2.88485	3.34296	3.80643	3.09682
Variance	0.00108	0.00131	0.00090	0.00104	0.00122	0.00105

In Table 4 are the values of digit ratios founded in Romanian male studied group. Comparing the averages of digit ratio of the two hands, we found no significant differences (2D:4D=0.58, p>0.05; 2D:3D=0.4037, p>0.05; 3D:4D=1.0386, p>0.05). The variability of digit ratio values is low (between 0 and 10) and lower than in Italian male studied population.

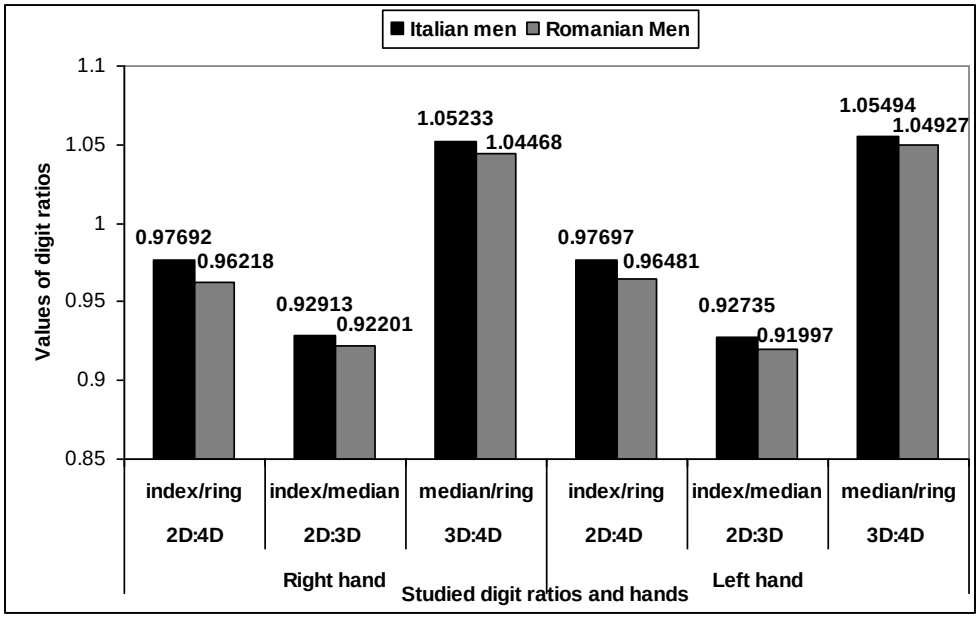

Fig. 1. Comparative graphic representation of digit ratios in the two studied populations.

In Figure 1 is represented a comparison of digit ratio values obtained in the two male populations. We found significant differences after comparison of 2D:4D digit ratio in the right hands (2.9073, p<0.05). 2D:3D and 3D:4D digit ratios were not significantly different (2D:3D=1.3891, p>0.05, 3D:4D=1.5024, p>0.05).

Our study is according with other studies on this theme. Thus, Trivers et al. (2006) made a longitudinal study of digit ratio 2D:4D and other finger ratios in Jamaican children. They found that 2D:4D increases slightly with age in children the effect less marked for the right hand. In our study, the age of subjects was over 18 and under 60. in our study we didn't selected the subjects to belong to a certain family.

Manning *et al.*, (2003) investigated 2D:4D digit ratio in three ethnic groups. They obtained strong ethnic differences because were associated with large family size in men. In our research there are no strong differences between the two studied populations because they are heterogenous. Fink *et al.*, (2004)

tested whether digit ratio is related to the degree of hand skill. Their findings in Caucasian population with high mean 2D:4D suggest that a tendency o improved left-hand performance due to prenatal testosterone may be found across ethnic groups.

Also, in China, Xu and Zheng (2015) made a meta-analysis of 2D:4D digit ratio, and concluded that the sex differences in Chinese 2D:4D are consistent with the results from western studies, and that latitude-related environmental variables don't affect significant the digit ratio. They conclude that genetic pool differences are responsible for the 2D:4D values.

Oberg and Villamor (2012) suggested that digit ratio is positively associated with age at menarche in a longitudinal study.

We hope that this study can be useful for future investigations and so, we start to create a database to be able to compare different subjects from different geographic area.

CONCLUSIONS:

After measurements of 200 subjects of each populations we can conclude that we found significant differences about finger lengths and digit ratio, too. Variability of finger lengths is medium in Italians and low in Romanians. Comparing the finger lengths of the two populations, we obtained significant differences between medium finger of right hand and, respectively, ring finger. Also, we observed a very significant difference between 2D:4D digit ratio of right hand in the two studied populations. These results are because of genetic pool. The differences are not significant in each comparison (digit ratio or finger length) because the studied localities have more than 100.000 inhabitants, so are heterogenous. The differences are more visible comparing the two populations than comparing the values of the two hand in each population. For more accuracy of the data and results, we recommend to not mix the methods of measurement in one study. We recommend to use only one method.

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