The Anthropometric Ratio of Index Finger to Ring Finger (2D:4D) Correlation with Some Seminal Fluid Analysis Parameters.

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ABSTRACT :

BACKGROUND:

The 2D:4D ratio can be considered as a measure of prenatal androgen exposure, with the lower 2D:4D ratios pointing to higher androgen exposure. Moreover, common molecular signals (HOX genes) control the embryological development of the appendicular skeleton and the gonads.

OBJECTIVE:

To investigate the correlation between semen quality and an anthropometric measurement of digit ratio. To evaluate the relationship of spermatogenesis and body parts ratio which have a common embryological determinants.

METHODS:

The study was performed on individuals attending the Institute of Embryo Research and Infertility Treatment /Al-Nahrain University/ Baghdad / Iraq. They were allocated from random pool of individuals required to perform seminal fluid analysis. The total number was (161) males. The index finger to ring finger (2D:4D) ratio was calculated after measuring the fingers with vernier. The ratio was correlated with sperm concentration, percentage of actively motile sperms and the percentage of normal sperms in single ejaculate.

RESULTS:

sperm concentration was negatively correlated with 2D:4D ratio (P=0.004), while no statistical correlation was found between the digit ratio and percentage of actively motile sperm (P=0.82) and the percentage of normal sperms(P=0.84).

CONCLUSION:

The ration of (2D:4D) is an indicator of sperm concentration. The lower the ratio (indicating longer ring finger), the higher is the sperm concentration. While no significant statistical correlation was found between the digit ratio and the percentages of actively motile sperms and morphologically normal sperms seminal fluid analysis.

KEYWORDS: fingers anthropometry, seminal fluid analysis, 2D:4D ratios.

INTRODUCTION:

The digit ratio is the ratio of the lengths of different digits or fingers typically measured from the bottom crease where the fingers joins the hand to the tips of the fingers. It has been suggested that the ratio of two digits in particular , the second (index finger) and fourth (ring finger), is affected by exposure to androgens, particularly testosterone while in the uterus and that this 2D:4D ratio can be considered as a measure for prenatal androgen exposure, with the lower 2D:4D ratios pointing to higher androgen exposure [(1)].

The 2D:4D ratio is calculated by measuring the index finger of the right hand, then the ring finger , and then dividing the former by latter. A longer ring finger will result in a ratio less than one, a longer index finger will result in a ratio higher than one. The 2D:4D ratio is a sexually dimorphic trait, in males the second digit tend to be shorter than the fourth, while in the females, the second digit tend to be the same size or slightly longer than the fourth digit [(2)].

The sex difference in 2D:4D ratio is present before birth in humans, which rules out any social influences that might affect digit growth differentially in the two sexes [(3)].

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A lot of studies provide evidence that the androgens effect is the factor behind the sexual dimorphism in digit ratio. XY individuals with androgens insensitivity syndrome due to a dysfunctional gene for the androgen receptors present phenotypically as women and have a feminine digit ratios. This demonstrate that this sex difference is unrelated to the Y chromosome per se [(1)].

Several studies had investigated the relationship between 2D:4D ratio with other androgen-controlled processes. It has been suggested that finger length may correlate with function disorders of the male reproductive system, and in particular, spermatogenesis. No established clear cut conclusion is yet agreed upon in this respect. It is still speculative whether the index finger and ring finger ratio (2D:4D) is a reliable predictor of semen quality [(4)].

Earlier studies indicated a link between fertility and longer ring fingers for men and between fertility and longer index finger in women [(5)].

In this study we will investigate the correlation between semen quality and an anthropometric measurement of digit ratio. These two conditions, although they seem away apart, are both under the central regulation of androgens, and testosterone in particular.

The analysis of sperm concentration percentage of morphologically normal sperms and sperm motility in single ejaculated semen will be evaluated as regards its relationship to the index finger and ring finger ratio (2D:4D) as an indicator and predictor of semen quality and testicular function.

MATERIAL AND METHOD:

This work was performed on individuals attending the Institute of Embryo Research and Infertility treatment, Al-Nahrain University, Baghdad, Iraq. Those enrolled in this study were randomly allocated from the pool of males required to performed seminal fluid analysis as the preliminary step in the evaluation of the married couple for infertility problem. No attempt was performed to segregate the individuals according to the provisional diagnosis of infertility, thus the population of the study included a spectrum of conditions, encompassing normal, healthy individuals to those who are azospermic. The total number of individuals participating in this study was (161), the details of all their data were documented at the seminal fluid laboratory of the above mentioned institute.

Freshly ejaculated semen samples were obtained by masturbation after at least 3 days of sexual abstinence. The specimens were placed in an incubator at 37C° for 15-30 minutes to allow for liquefaction. After liquefaction, semen samples were evaluated for seminal fluid parameters. This was done according to WHO criteria [(6)].

Measurements of digit lengths were done manually using measuring calipers. Helios milimetric vernier (Inox) with 0.2mm accuracy was used. The anatomical landmark were first defined and located, then relevant measurements were done. Digit length was measured from proximal crease of the digit (metacarpophalangeal crease) to the tip of the digit [(7)]. Anthropometric index(2D:4D) was obtained according to Trevor's recommendations [(8)]. The ratio was calculated by dividing the length of the index finger by the length of the ring finger all measurements were taken from the right hand.

Data were analyzed using SPSS13 (statistical Package of Social Science, version 13 computer software).

The linear correlation between quantitative variables was measured by Spearman's rank correlation coefficient. P values less than the 0.05 level of significance was considered statistically significant [(9)].

RESULTS:

The measurement of the digit ratio (2D:4D) gave a mean value of the ratio in the right hand of 0.98 . all the outcome variables did not deviate to significant amount (as shown by Kolmogorov-Smeerov test) from the assumption of normal distribution.

Based on the above assumption the confidence interval of the measurement of digit ratio 2D:4D was 0.96-1.00 in males according to current study sample. The descriptive statistics of the digit ratio 2D:4D of the right hand are illustrated in table (1).

The metacarpophalangeal crease was used as the base of finger length measurements. In some cases it was found that the fingers develop an extra crease that is parallel, but distal , to the metacarpophalangeal crease. When this pattern was found, digit measurements were taken from the proximal crease.

A common oblique creased angled off from proximal crease, giving the appearance of horizontal Y, or several oblique creases was also found. In these cases measurements were taken from the middle of the Y pattern.

Using Spearman's rank correlation coefficient to measure the strength of association between the variables of the seminal fluid analysis (sperm concentration, percentage of actively motile sperms , percentage of morphologically normal sperms). It

was found that the Spearman's rank correlation coefficient (roho) was (-0.91) in the case of correlation between the sperm concentration and the digit ratio 2D:4D. This indicates a strong negative correlation between the two variables. This means a decreasing monotonic trend between the two variables. Testing the significance of this correlation, it was found to be statistically significant (P=0.004).

Regarding the percentage of actively motile sperms, the Spearman rank correlation coefficients was (-0.17) which means a very low correlation and a statistically non significant correlation (P=0.82).

The correlation between the digit ratio 2D:4D and the percentage of morphologically normal sperms, yielded a Spearman's rank correlation coefficient of (-0.13) which indicates a statistically non-significant correlation (P=0.84).

Table 1: Descriptive statistics of the digit ratio 2D:4D of the right hand

Mean	0.9822
Standard Error	0.0021
Median	0.9855
Standard Deviation	0.0269
Sample variance	0.0007
Kortosis	0.8192
Skewness	0.4080
Range	0.1551
Total number	161

DISCUSSION:

The measurements of the index finger to ring finger ratio (2D:4D) was rather simple and standardized. In this study, this ratio was determined from the right hand measurements only, because right hand digit ratio have been shown previously to display more robust sex differences and are thus thought to be more sensitive to prenatal androgens [10,11].

Regular skin crease should be differentiated from irregular or secondary creases. The irregular or secondary creases form later than the regular creases, after the 11th week of gestation when the fingers start to bend disturbing the dermal surface [12].

In this study, the mean value of the 2D:4D ratio in males was found to be 0.98. This finding is in agreement with previous studies which yielded a similar mean value [13]. It also fall within the range of normative values of male 2D:4D ratio across population which was found to be 0.94-1.00 [14].

It is now established that the digit ratio 2D:4D is close to 1.0 in females, and smaller than 1.0 in males. The digit ratio 2D:4D did exhibit the largest sex difference for both hands followed by 2D:5D and 3D:4D. the sex differences were larger for the right hand than for the left hand [15].

This study attempts to correlate the digit ratio 2D:4D with some parameters of the seminal fluid analysis. In particular, sperm concentration, percentage of actively motile sperms and percentage of morphologically normal sperms.

It was found that the sperm concentration was negatively related to the digit ratio 2D:4D of the right hand (P=0.004). This means that lower 2D:4D ratios are related to higher sperm concentrations. On the other hand, high 2D:4D ratios are indicator of lower sperm concentration in the seminal fluid analysis. This finding is in agreement with that of Manning et al. whom did and extensive studies in this field [13]. However, a Korean study [4], did not correlate the digit ratio 2D:4D with the semen quality in young healthy Korean male population.

This work also found no statistically significant correlation of the digit ratio 2D:4D with the percentage of morphologically normal sperms (P=0.84). A Danish study [14], also failed to correlate finger length with testicular function in Danish adult males.

It seems that the measurements of the anthropometric ratio of the index finger to ring finger 2D:4D is useful preliminary indicator of the number of the sperms that will be found in seminal fluid analysis. The digit ratio 2D:4D has the power to predict the sperm concentration and subsequently the sperm count in seminal fluid analysis.

Nevertheless, functional aspects as the percentage of actively motile sperms and morphological integrity of the sperms as revealed by the

percentage of the morphologically normal sperms, are not related to this anthropometric measurement. The digit ratio can predict the number but not the shape or activity of the produced sperms by the process of spermatogenesis.

The explanation for the observed correlation is that sexual differentiation leads to the development of distinctive anatomical structures as the gonads and genitalia. It also produces less obvious anatomical shifts in brain, bone and muscles [16].

The differentiation of the urogenital system and the appendicular skeleton in vertebrates is under the control of HOX genes. The common control of the digit and gonad embryological differentiation supports the view that the pattern of the digit formation may be related to spermatogenesis and hormonal concentration [13].

HOX genes are group of related genes that specify the anterior-posterior axis and segment identify in the body during early embryonic development.

Mammals have 39 HOX genes in four conserved clusters HOXA, HOXB, HOXC and HOXD, each located on chromosome. In human, HOXA cluster is located on chromosome 7, HOXB on chromosome 17, HOXC on chromosome 12 and HOXD on chromosome 2.

The HOX genes are under the regulatory control of several endocrine hormons. This inter-relationship allows the generation of structural and functional diversity both in developing and adult tissues [17].

Experimental studies have shown that HOX-5 gene is expressed specifically in male and female developing gonads [18]. HOXC-10 have been shown to regulate many aspects of embryonic body plan development and patterning. In particular, the regional patterning of axial and appendicular skeletons [19].

This work suggests that the finger length as expressed by the anthropometric ratio of index finger to ring finger may correlated with functions or disorders of the male reproductive system and the process of spermatogenesis and its outcomes. This is based on the HOXA and HOCD genes common embryological control of finger development and differentiation of the genital bud.

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