Original article

DOES THE OFFSPRING'S SEX RATIO CORRELATES WITH THE DIGIT RATIO AND ANTHROPOMETRIC MEASUREMENTS OF MOTHER?

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ABSTRACT

Objective: Study examined the correlation of the offspring's sex ratio with maternal 2D:4D ratio and also different anthropometric body measurements.

Methods: 269 Participants (mothers who had completed their reproductive stage) were examined for digit lengths, height, weight and circumferences of waist and hip. Anthropometric indices were analysed from the collected data to establish relation of offspring's sex with maternal's digit ratio and anthropometric measurements. The above calculation was done with the help of MS Excel and SPSS (16).

Conclusion: From the analysis of the collected data, the sons are more correlated with WHR and WHtR of the maternal in type 1 of left hand. A correlation between maternal digit ratio and offspring sex ratio have been established on the basis of finger type classification such as the mothers with type I have more daughters than mothers belong from type III, whereas type III mothers have more number of sons than type I mothers.

Keywords: BMI, WHR, WHtR, 2D: 4D

INTRODUCTION

The hormonal level of the prenatal environment is estimated indirectly using a recently suggested indicator of utero hormone levels: the second to fourth digit ratio (2D:4D ratio). The index to ring finger ratio or 2D:4D ratio is thought to be determined by testosterone exposure during early intra-uterine life. It has been examined in relation to various physiological processes, sporting abilities, and diverse health conditions. Manning in 1998 have pointed out that prenatal exposure to testosterone and estrogen may leave morphological markers. A foetus is exposed to prenatal testosterone from two sources: the fetal testes and adrenal glands. The main source of prenatal estrogen comes from the adrenal glands and the placenta through the aromatase conversion of testosterone (by George in 1981). These fetal sources of steroids are highly dependent on the differentiation process of fetal gonads (Lording and De Kretser in 1972). Manning in 1998 suggested that this sharing of causal factors in digit and gonad differentiation raises the possibility that patterns of digit formation can reflect testis function and, therefore, prenatal sex hormone concentration.

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In accordance with the 'Manning hypothesis', the 2D:4D ratio of the human hand is a sexually dimorphic trait. In males the fourth digits tend to be longer than the second (2D<4D) but in females both digits tend to be of equal length (2D=4D). There is evidence that relative digit length is fixed in utero by about the 14th week of pregnancy (by Garn in 1975).

The sexual dimorphism in 2D:4D is established early under the influence of testosterone is indicated by the following:
(a) The waist: hip ratio of mothers (a positive correlate of testosterone) is negatively related to the 2D:4D of their children (by Manning in 1999). Thus women with a propensity to produce high testosterone concentrations also have a tendency to produce children with low 2D:4D.
(b) The children's with congenital adrenal hyperplasia (CAH), a trait which is associated with high concentrations of prenatal androgens, have lower 2D:4D (by Brown in 2001).
(c) The 2D:4D ratio of mothers is positively correlated with the 2D:4D of their children, and mothers with low 2D:4D have high testosterone levels in the amniotic fluid of their fetuses (by Manning, in 2002). Prenatal testosterone and 2D:4D have been implicated in the development of cognitive abilities.

Ecker in 1875 noted that three manifestation of the relative finger length may be seen in the population are:
3. The index finger shorter than ring finger (2d<4d).
4. The index finger equal to ring finger (2d=4d).
5. The index finger greater than ring finger (2d>4d).

The present study is done to check whether there is any correlation between maternal digit ratio and anthropometric measurements of mother with offspring sex ratio.

REVIEW OF LITERATURE:

The study of relevant literature is an essential step to get a clear idea of what has been done, with regard to the problem under study. The literature in any field forms the foundation upon which all future work will be built. The reviews of literature are generally used as a basis for Understanding and reasoning for locating and synthesizing all the relevant literature on a particular topic. The review of literature covers the relevant available literature pertaining to the present study.

Grant in1994 established the maternal dominance hypothesis which arosed from research in human females which showed that women more dominant in personality than other women are more likely to conceive male infants.

Manning et al in 1998 found 2D: 4D in right hands of male and female participants to be positively correlated with luteinizing hormone (LH), after controlling for sex, age, height and weight. As a result females are generally found to have higher LH concentrations then males.

Helle and Lilley (2008) tested 244 contemporary post reproductive Finnish women. They concluded that Maternal 2nd to 4th digit ratio does not predict lifetime offspring sex ratio at birth.

Honekopp et al in 2010 studied on Meta-analysis of digit ratio 2D:4D and concluded that right-hand 2D:4D might be a better indicator of prenatal androgenisation than left-hand 2D:4D. They found a moderate sex difference (with lower 2D:4D for males), which shows substantial heterogeneity (which is unrelated to age). The sex difference is moderated by the type of finger length measurement and by hand. Measurement involving the distortion of soft tissue leads to a significantly larger sex difference than finger length measurement avoiding this. The sex difference in 2D:4D is larger in the right hand than in the left.

T Ventura and A Taylor (2012) conducted a study among 106 new born and their mothers ,and found that NB males had lower mean 2D:4D ratios than females but this dimorphism was significant only for the left hand (males: 0.927; females: 0.950; p=0.004). Mothers who had sons had lower 2D:4D ratios than those who had daughters and the mother's 2D:4D were higher than those of NBs regardless of sex. Both hands of NB females were negatively correlated with AF testosterone and positively correlated with the mother's 2D:4D, but males showed no significant associations. Maternal plasma testosterone also showed a negative weak correlation with NB's digit ratio in both sexes.

Kim et al (2015) conducted study among 508 Korean patients (257 males and 251 females) less than 60 years old who had one or more offspring. They concluded that maternal digit ratio was negatively associated with offspring sex ratio. Females with a lower digit ratio were more likely to have more male offspring compared to those with a higher digit ratio. Thus, their results suggest that the sex of offspring might be more influenced by maternal rather than paternal factors.

METHODOLOGY

Study Design:
Cross-sectional observational study was done with a specific age group among mothers. The study was done to fulfil the required criteria for the specific purpose. The datas were collected with the use of specific schedule containing the details of all the measurements. Apart from this census were also taken for the detailing of the population required for the study. The data was collected over the time period of twenty days.

Studied Area:
The studied area consisted of three villages- Berunanpukuria, Malikapur and Kokapur. These villages are placed under Nilguanj panchayat, Barasat-I sub division, North 24 Paraganas, District of Indian State West Bengal. The two villages (Malikapur and Kokapur) are mainly inhabited by Sunni Muslims and the others mostly migrant like Biharis (workers in the brick factories in and around the villages).

Sampling:

The study was done among the Muslim community on the basis of judgemental sampling to full fill the requirements. The participants were chosen on the basis of requirements. Previously a pilot study was done among the small no of participants, only those mothers who had completed their reproductive phase are considered.

Participants:

The study consists of 269 participants of particular criteria. The participants were house hold wife who had completed their reproductive phase. The study mainly focuses on the sex and number of the offspring of the participants throughout their reproductive stage.

Therefore inclusion criteria were:
- The Muslim individuals whose family for generations is following endogamy.
- Woman's who had completed their reproductive phase.

And the exclusion criteria were:
- Mothers with artificial interference in their reproductive health like abortion, taking of contraceptive pills, etc. we're not considered for the study.
- The participants with injuries in second and fourth finger were also not considered.

Data Collection:

The measurement of the 2D:4D was taken along with other Anthropometric measurements like height, weight, hip, waist from each participant. The total number and sex of the offspring's were also recorded. The length of the second and fourth digits was measured directly on the ventral surface of the right and left hand from the basal crease of the digit to the tip. The digits were measured thrice, using a digital Vernier caliper, measuring to the nearest 0.01 mm. collected data were analyzed with reference to WHO (2004 and 2008) and others standardized values.

DIGIT RATIO: The 2D and 4D ratio of palm digit were calculated by dividing the length of second digit with the fourth digit. Further it was classified according to the classification done by ECKER (1875) on different hand type depending on their digit ratio.

Digit Classification: The classification of the digits is done on the basis of their length. The type 1 classification means 2d >4d and the type 3 classification means 2d<4d.The type 2 classification means 2d=4d, which was not found in the present studied population.

Data Analysis:

The data like BMI, Waist-Hip Ratio, Digit Ratio and their averages, classification, charts and graphs were done with the help of MS Excel. For the further analysis of the data like Minimum, Maximum Mean, Standard Deviation, Standard Error, Correlation and etc. were done with the help of descriptive statistics in Statistical Package for the Social Sciences (SPSS 16.0)

RESULTS AND DISCUSSIONS

Table.1. shows the criteria like age, weight, height, Body mass index, waist and hip circumference and waist-hip ratio. The mean of weight, height, BMI, WC, HC and WHR are 57.40, 149.29, 25.69, 84.46, 93.78 and 0.901 respectively. The standard deviation of waist and hip circumference is 11.70 and 10.48. Along with this the, values like minimum, maximum, mean, standard error, standard deviation of different measurements are shown in the table below.

Table.2. gives the minimum, maximum, mean, standard error, standard deviation and variance of the digits ratio. The mean of second digit of right hand and fourth digit of right hand are 66.29 and 69.35. The standard deviation of second digit of left hand and fourth digit of left hand are 4.49 and 4.50, etc. are mentioned in the table below. Here the total no refers to total sample size.

The table.3. shows the no. of mothers belonging from a particular categories with total no daughter and son. There are maximum mothers in type III (245 or 91.08%), with very less in type I (124 or 8.92%) and nil at type II.

The table.4. describes the no. of mothers belonging from a particular categories with total no daughter and son. There are maximum mothers in type III (220 or 81.78%), with very less in type I (49 or 18.22%) and nil at type II.

Table.5. indicates correlation of maternals measurements with daughters. The p value is less than 0.05 therefore the correlation is significant. Hence the maternal measurements are negatively correlated with daughters.

Table.6. shows correlation of maternal measurements with sons. The p value is less than 0.05 therefore the correlation is significant. Hence the maternal measurements are positively correlated with sons.

Table.7. gives correlation of maternal measurements with sons. The p value is less than 0.05 therefore the correlation is significant. Hence the maternal measurements are positively correlated with sons.

Table.8. indicates correlation of maternal WHR with offspring. The p value is less than 0.05 therefore the correlation is significant. Hence the maternal measurements are positively correlated with both the offspring.

TABLE 1.ANTHROPOMETRIC MEASUREMENTS AND INDICES OF STUDIED MOTHERS.

CRITERIA	TOTAL	MIN	MAX	MEAN	SE	SD
AGE (years)	269	40	100	54.26	0.71	11.62
WEIGHT (kg)	269	30.0	95	57.40	0.73	12.05
HEIGHT(cm)	269	130.1	169.5	149.29	0.37	6.07
BMI (kg/m$^{2)}$	269	13.68	41.34	25.69	0.30	4.94
WC (cm)	269	39.4	120	84.46	0.71	11.70
HC(cm)	269	69.2	154.5	93.74	0.64	10.48
WHR(cm)	269	0.41	1.18	0.901	0.00	0.08

BMI – Body mass index, WC- Waist circumference, HC- hip circumference, WHR – Waist to hip ratio.

TABLE.2. DESCRIPTIVE STATISTICS OF DIGIT RATIO OF THE PARTICIPANTS.

DIGIT RATIO	TOTAL NO.	MIN	MAX	MEAN	SE	SD	VARIANCE
R2D	269	40.92	81.70	66.29	0.27	4.41	19.45
R4D	269	58.26	86.45	69.35	0.27	4.43	19.63
L2D	269	42.58	83.62	66.36	0.27	4.49	20.14
L4D	269	56.45	85.6	68.46	0.27	4.50	20.25
R2D:4D	269	0.69	1.065	0.96	0.0022	0.036	0.001
L2D:4D	269	0.674	1.07	0.97	0.0023	0.039	0.002

R2D- second digit of right hand, R4D- forth digit of right hand, L2D- second digit of left hand, L4D- forth digit of left hand.

TABLE.3. DIGIT TYPE CLASSIFICATION OF MOTHER ON THE BASIS OF RIGHT HAND.

RIGHT HAND			
CATEGORY	MOTHERS	DAUGHTER	SON
TYPE -I (2D>4D)	24 (8.92%)	58 (52.73%)	52 (47.27%)
TYPE -II (2D=4D)	0 (0%)	0 (0%)	0 (0%)
TYPE -III (2D<4D)	245 (91.08%)	554 (51.87%)	514 (48.13%)

From the above table it can be concluded that mothers with type 1 have more daughters than type 3, but mother with type 3 have more sons than type 1.

TABLE.4. DIGIT TYPE CLASSIFICATION OF MOTHER ON THE BASIS OF LEFT HAND.

LEFT HAND			
CATEGORY	MOTHERS	DAUGHTER	SON
TYPE -I (2D>4D)	49(18.22%)	114 (55.61%)	91 (44.39%)
TYPE -II (2D=4D)	0 (0%)	0 (0%)	0 (0%)
TYPE -III (2D<4D)	220 (81.78%)	498 (51.77%)	464 (48.23%)

From the above table it can be concluded that mothers with type 1 have more daughters than type 3, but mother with type 3 have more sons than type 1.

TABLE .5.SHOWING CORRELATION BETWEEN MOTHER AND DAUGHTERS.

Measurements	Pearson correlation
Weight	-0.297
HC	-0.293

TABLE .6.CORRELATION BETWEEN MOTHER AND SONS.

Measurements	Pearson correlation
WHR	0.44
WHtR	0.344

TABLE .7.CORRELATION BETWEEN MOTHER AND SONS.

Measurements	Pearson correlation
Weight	0.011
Height	0.26

TABLE .8.CORRELATION OF OFFSPRING SEX WITH MATERNAL WHR.

Offspring sex	Pearson correlation
Daughters	0.209
Sons	0.144

CONCLUSION

The present study focuses on the correlation between the offspring's sex ratio with digit ratio and anthropometric measurements of mothers. Among the offsprings, the sons are more correlated with WHR and WHtR of the mothers in type 1 of left hand. Further studies with variable population may help in determining the best marker for 2D:4D ratio and its correlation with the anthropometric measurements. A correlation between maternal digit ratio and offspring sex ratio have been established on the basis of finger type classification such as the mothers with type I have more daughters than mothers belong from type III, whereas type III mothers have more number of sons than type I mothers.(from table no. 3 and 4).

Therefore from the above statement it can be concluded that women with lower digit ratio have more sons than women's with higher digit ratio, whereas women with higher digit ratio have more female offsprings. The above statement is on the basis of the present study data, and might be different from various populations and with big sample size.

ACKNOWLEDMENTS

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