

## Original Research Paper

# Determination of Sex from Index and Ring Finger Ratio in Neonates

<sup>1</sup>Manohar Shelake, <sup>2</sup>Nitin Ninal, <sup>3</sup>Rajesh Bardale, <sup>4</sup>Vaibhav Sonar

### Abstract

Determination of identity is one of the important concerns in forensic medicine, especially in neonatal age group. The purpose of present study is to evaluate sexual dimorphism of index and ring finger in neonates. The study was carried out on a cross sectional sample of 60 neonates out of which 30 were males and the remaining 30 were females. Data on age, sex and weight were collected. Statistically data was expressed as mean  $\pm$  Standard deviation ( $\pm$  SD). Descriptive statistics and Students'-test were used to analyze and determine the parameters studied in both male and female neonates. 2D:4D ratio was calculated on both hands of each individual. The relationship between the parameters studied was established using Pearson correlation to establish the strength of the relationship between the lengths of second and fourth digits (2D&4D), and the digit ratios. Statistical significance was accepted at P value less than 0.05 ( $P < 0.05$ ). The 2D:4D ratios were found higher in female neonates than male neonates and appear sexually dimorphic. The present study suggests that 2D:4D ratio of less than 0.93 suggests male neonate while a ratio of 0.93 or more suggests female neonate.

**Key Words:** Forensic, Identification, Neonate, Digit, Sex

### Introduction:

Determination of identity is one of the important concerns in Forensic Medicine, especially in neonatal age group. It assumes greater importance if the child is abandoned one or decomposed or mutilated one. Earlier studies have shown that index and ring finger ratio of hand exhibit sexual dimorphism. [1-8]

However, most of these studies were conducted in adult population or in adolescents or in children. [1-10] Very few studies were conducted in neonatal age group. [11-13] The purpose of present study is to evaluate sexual dimorphism of index and ring finger in neonates.

### Material and Methods:

The present prospective study consists of neonates in PNC ward of Government Medical College and Hospital, Miraj, District Sangli, Maharashtra. Only healthy full term neonates with normal delivery were selected.

The study was carried out on a cross sectional sample of 60 neonates out of which 30 were males and the remaining 30 were females. Data on age, sex and weight were collected.

The length of the second digits (2D) and fourth digits (4D) of the left and right hand of each subject were measured with the aid of rigid transparent plastic ruler with centimeter and millimeter markings.

The measurement was taken from the tip of the digit to the ventral proximal crease, where there was a band of crease at the base of the digit, the most proximal crease was used.

To spread out fingers for ease of measurement dorsum of hand was gently tapped. All aseptic precautions were taken before, during and after taking measurements while handling the babies. All measurements were made in centimeters to the nearest millimeter with digits fully extended. Consent of mother was taken and they were informed that the survey was completely voluntary.

Statistically data was expressed as mean  $\pm$  Standard deviation ( $\pm$  SD). Descriptive statistics and Students'-test were used to analyze and determine the parameters studied in both male and female neonates. 2D:4D ratio was calculated on both hands of each individual.

The relationship between the parameters studied was established using Pearson correlation to establish the strength of the relationship between the lengths of second

### Corresponding Author:

<sup>1</sup>Assistant Professor  
Dept. of Forensic Medicine  
Government Medical College and Hospital,  
Miraj – 416 410 Dist. Sangli (Maharashtra)  
E-mail: dr.manohar\_shelake@yahoo.co.in

<sup>2</sup>Assist. Prof

<sup>3&4</sup>Assoc. Prof

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and fourth digits (2D&4D), and the digit ratios. Statistical significance was accepted at P value less than 0.05 ( $P < 0.05$ ). The sectioning point was calculated for sex differentiation from the index and ring finger ratios as – mean male ratio + mean female ratio  $\div$  2.

### Observations and Results:

The result of present study shows that the mean age of male neonate is 2.8 days while the mean age of female neonate population is 5 days. The mean weight of male neonates is 2.91 Kg while mean weight in female neonates is 2.83 Kg. It is observed that the index and ring finger shows significant difference between the lengths in both sexes ( $P < 0.05$ ).

The mean lengths of index and ring finger in male are 2.61 cm and 2.80 cm respectively in right hand and 2.60 cm and 2.80 cm in left hand respectively.

The mean lengths of index and ring finger in female are 2.61cm and 2.75 cm respectively in right hand and 2.62 cm and 2.78 cm in left hand respectively. (Table 1) In the present study no significant difference exists between the lengths of index and ring finger in right and left hand in both sexes. (Table 2)

In male, the mean difference between index and ring finger in right hand is  $0.19 \pm 0.11$  cm and in left hand it is  $0.19 \pm 0.09$  cm. In female, the mean difference between index and ring finger in right hand is  $0.16 \pm 0.10$  cm and in left hand it is  $0.16 \pm 0.11$  cm. (Table 3)

Statistically significant difference ( $p < 0.05$ ) between 2D:4D ratios in male and female are observed. (Table 4) In male, the mean 2D:4D ratio in right and left hand is 0.932 and 0.932 respectively while in female the mean 2D:4D ratio in right and left hand is 0.950 and 0.944 respectively. (Fig 1 and 2)

A sectioning point was calculated for the index and ring finger ratios (2D:4D) to differentiate between male and female neonates and the value is 0.93. A ratio of 0.93 or more is suggestive of female neonate while ratio less than 0.93 suggest male neonate. With this sectioning point we could predict 63.33% male neonate from right hand and 70% from left hand.

Similarly with a value of 0.93 or more we could predict 76.66% female neonates from right hand and 73.33% from left hand.

### Discussion:

Many times bodies are mutilated so badly that only pieces of body parts are recovered. Establishment of identity in such cases is big challenge. Nowadays various statistically approved methods and anthropological principles are implemented in

establishing the identity and for solving the medico-legal issues. Sophisticated techniques like DNA profiling are not always available at periphery or rural setup. Also their practical usefulness and implementation is largely uncertain in many cases for example in decomposed bodies or contaminated samples.

So, the methods which can be easily implemented without much technical difficulties would better serve the purpose. The present study was conducted with an aim to determine sexual dimorphism in neonates.

Manning et al had noted that females had longer second digits than fourth digits while males have longer fourth digits than second digits. [2] This difference was accounted for higher digit ratios in females than in males.

This sexual dimorphism in 2D: 4D ratio is apparent by 2 years of age and appears to be established early in life, by the 14th week of gestation. [11, 12, 14] The differences may be linked to the prenatal production of testosterone and oestradiol and in the case of testosterone, to interactions with the homeobox genes *Hoxa* and *Hoxd*, which control differentiation of the urogenital system and development of the digits. [4] Galis et al had noted a slight but significant sexual dimorphism in deceased human fetuses in the age group of 14 to 42 weeks.

On an average a ratio of 0.924 in females and 0.916 for males were noted. [11] Ventura et al studied the digit ratio in 106 newborns and noted that males had lower mean 2D:4D ratios than females but this dimorphism was significant only for the left hand. [13]

The findings of the present study are in agreement with these studies. We had noted slight but significant sexual dimorphism in male and female neonates. In male neonates, the mean 2D:4D ratio in right and left hand is 0.932 and 0.932 respectively while in female neonate the mean 2D:4D ratio in right and left hand is 0.950 and 0.944 respectively.

The data of present study confirms sexual dimorphism at birth and confirms the findings of previous studies. [11, 13] However, considering the studies conducted in adults, the ratio for sexual dimorphism is less and this was also noted in previous studies conducted by Galis et and Ventura et al. [11,13] The probable reason could be that, in addition to prenatal exposure, postnatal androgen exposure would be influential for the accentuation of dimorphism and subsequent stabilization of 2D:4D ratio.

In a longitudinal study of Jamaican children conducted by Trivers et al it was noted that a slight but significant increase in the 2D:4D ratios for boys and girls from 7-13 to 11-17 years

of age four years later, with a high correlation between the measurements on the same individuals suggesting that 2D:4D ratios slowly increases in a stable manner during childhood. [15] Previous studies conducted on children, adolescents and adults also exhibit the increasing difference of ratio as per advancing age. [7-10, 13, 15]

**Conclusion:**

In conclusion, it was observed that lengths of second and fourth digits in female neonates were approximately same or was like that of male neonates. The 2D:4D ratios were found higher in female neonates than male neonates and appear sexually dimorphic.

The present study suggests that 2D:4D ratio of less than 0.93 suggests male neonate while a ratio of 0.93 or more suggests female neonate. The findings of present study can be utilized to establish sex especially in circumstances where body is mutilated or only remains are brought for medical examination.

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**Table 3: Difference between Male and Female Index and Ring Fingers (cm)**

Parameters	Male	Female
	Mean ±SD	Mean ±SD
R2D – R4D	0.19±0.11	0.16 ±0.10
L2D – L4D	0.19 ±0.09	0.16 ±0.11

**Table 1: Descriptive Statistics of Male and Female Index and Ring Finger Measurements (cm)**

Sex	Parameters	Min	Max	Mean	SEM	SD	Significance
Male (n = 30)	R2D	2.2	2.9	2.61	0.0354	0.194	P < 0.05
	R4D	2.4	3.2	2.80	0.0368	0.202	
	L2D	2.2	2.9	2.60	0.0328	0.180	P < 0.05
	L4D	2.4	3.1	2.80	0.0380	0.208	
Female (n = 30)	R2D	2.3	2.9	2.61	0.0278	0.153	P < 0.05
	R4D	2.4	3	2.75	0.0290	0.159	
	L2D	2.4	2.9	2.62	0.0238	0.130	P < 0.05

**Table 2: Measurements of Index and Ring Fingers in Male and Female Neonates (cm)**

Measures	Right Index Finger		Right Ring Finger		Left Index Finger		Left Ring Finger	
	Male	Female	Male	Female	Male	Female	Male	Female
Minimum	2.20	2.3	2.4	2.4	2.2	2.4	2.4	2.4
Maximum	2.9	2.9	3.2	3	2.9	3.1	2.9	2.9
Mean	2.61	2.61	2.80	2.75	2.60	2.80	2.78	2.78
SD	0.19	0.15	0.20	0.16	0.18	0.20	0.13	0.13

**Table 4: Ratios of Index and Ring Fingers in Male and Female Neonates**

Sex	Parameters	Min	Max	Mean	Median	SD	CV**%	CD**	Correlation
Male (n =30)	D2:D4 ratio right	0.857	1	0.932	0.927	0.038	4.1%	0.031	0.843
	D2:D4 ratio left	0.871	1	0.932	0.930	0.030	3.2%	0.023	0.901
Female (n=30)	D2:D4 ratio right	0.889	1.080	0.950	0.931	0.046	4.9%	0.037	0.680
	D2:D4 ratio left	0.893	1.038	0.944	0.930	0.041	4.4%	0.035	0.607

\* CV- Coefficient of Variation \*\*CD- Coefficient of Dispersion