ASSESSMENT OF ASSOCIATION OF PULMONARY FUNCTION TEST WITH DIGIT RATIO

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Abstract

Second to fourth digit ratio (2D:4D) is sexually dimorphic with the ratio being lesser in male. Digit ratio has been considered as a proxy marker for exposure to sex steroids in utero. Digit ratio has been associated with various behavior traits, sporting abilities, diseases which have sex preponderance. Objectives: To determine the association of digit ratio with certain specific pulmonary function test parameters. Methodology: This study was conducted on healthy volunteers of both sex aged between 19-22 years with 40 in each sex. Anthropometric measurements and digit ratio were measured. Pulmonary function parameters assessed include FEV₁, FVC, FEV₁/FVC and PEFR. Result: This study showed that PEFR was the only parameter which associated with Left digit ratio among female. A mean digit ratio of less than 1, when sex was not taken into consideration, negatively correlated with the PEFR. Conclusion: Digit ratio has significant association with Peak Expiratory Flow Rate.

Keywords: Digit ratio; medical student; PFT

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INTRODUCTION: Digit ratio, mainly the ratio of length of index to ring finger (2D:4D) is sexually dimorphic¹. Digit ratio is lower in males than in females. Difference in digit ratio occurs early in foetal life. It tends to be relatively stable during the lifespan of an individual². 2D:4D has been adopted as a non-invasive retrospective biomarker for prenatal androgen exposure¹. This is because it is impractical to measure testosterone exposure during intrauterine life. Digit ratio can be correlated with a broad range of psychological and physiological traits ³, ⁴.
disease susceptibility, physical and competitive ability. Many studies have proven that digit ratio is strongly associated with competitive physical ability. It is a predictor of sporting ability in women, correlates with endurance in rugby players, in endurance athletes, in skiing, rowing, gymnastics and fencing, running speed in Jamaican population and sprinting speed in boys. In the Indian population, digit ratio has been used to predict sporting ability in elite male participants in Kabbadi players. Paul et al in their study used digit ratio as predictor of sporting ability in women conducted only on female twins. Bennett et al correlated digit ratio with performance in elite rugby players with age matched controls. The hypothesis that 2D:4D ratio correlates with endurance running performance was well documented in this study. Though most of the sporting skills that have been associated with digit ratio are aerobic, there is a dearth in the available scientific literature on the association of digit ratio with pulmonary function tests. Hence this study was proposed with the following objectives to assess the association of Digit ratio and certain specific pulmonary functions among healthy adolescent individuals.

MATERIALS AND METHODS: This is the Observational Study done in the Chettinad hospital and research institute and the census method was followed for selection of sample. In order to facilitate statistical analysis a minimum of 40 male and 40 female subjects were included in the study with age group of 19-22 years were included. Students who had any past history of respiratory illness are excluded from this study. The study was initiated after obtaining the clearance from the Institutional human ethics committee. Students willing to participate in the study signed the participant informed consent form. The study protocol consisted of filling up of baseline data, Digit Ratio and PFT has been measured. In an adequately lit room against a white background the study participant was asked to stretch their palms displaying the palmar crease to the tip of the finger and digital photographs of both the hands were taken separately. For identification purposes a label containing the ID number of the study participant and hand side was stuck on their palmar surface before taking the photographs. Lengths of the digits were measured by drawing a line from the bottom crease on the superior aspect of the palm to the tip of the index finger (2D) and ring finger (4D) separately on the digital photographs. The lengths of the digits of both hands were measured using digital ruler (MS Office). From the lengths of the second and fourth digits the ratio was calculated and determined as digit ratio. Mean of digit ratio of both the hands was calculated and given as mean digit ratio. The forced expiratory volume in 1 second (FEV1), the forced vital capacity (FVC), and the peak expiratory flow rate (PEFR) were assessed and the FEV1/FVC ratio was assessed.
calculated. Best of the three trials given was taken as the subjects reading. A sterilized mouth piece was attached for each subject and were requested to breathe in to their maximum, and with their lips kept tight on the mouth piece of the hand held instrument to blow out in full speed till the lungs are completely empty (nose clip was used to close the nostrils while blowing out). Each subject was given 3 trials with 3 – 4 minutes of rest between each trial. Best of the 3 trials was taken as their score.

Photograph 1: Photograph of outstretched palm and measurement of digit length

All data were collected and appropriate statistical analysis were done with level of significance set at p<0.05. Association of digit ratio and anthropometric measurements with the pulmonary function test was done using Pearson correlation.

RESULT: A total of 84 subjects participated in the study, however 4 of the subject data were not included as their age given were 18 years. Equal number of male and female subjects had complete set of data that were used for analysis (n=40 each sex). Table 1 gives the measurement of the digit ratio. We found that the digit ratio did not show any significant difference between the sexes. Mean digit ratio was 0.9509 ±0.03.
Table 1: Sex wise digit ratio of the participants

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sex</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Student T Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIGHT DIGIT RATIO</td>
<td>MALE</td>
<td>40</td>
<td>.9451</td>
<td>.04034</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>40</td>
<td>.9434</td>
<td>.04612</td>
<td></td>
</tr>
<tr>
<td>LEFT DIGIT RATIO</td>
<td>MALE</td>
<td>40</td>
<td>.9568</td>
<td>.04795</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>40</td>
<td>.9720</td>
<td>.04612</td>
<td></td>
</tr>
<tr>
<td>MEAN DIGIT RATIO</td>
<td>MALE</td>
<td>40</td>
<td>.9509</td>
<td>.03652</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>40</td>
<td>.9577</td>
<td>.03961</td>
<td></td>
</tr>
</tbody>
</table>
It was observed that all the parameters were significantly higher in the male when compared to female except FEV1/FVC.

**Table 3: Sex wise distribution and comparison of Pulmonary function test**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sex</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>T test</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV1 (L)</td>
<td>MALE</td>
<td>40</td>
<td>3.4889</td>
<td>.76621</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>40</td>
<td>2.3997</td>
<td>.47180</td>
<td></td>
</tr>
<tr>
<td>FVC (L)</td>
<td>MALE</td>
<td>40</td>
<td>5.0509</td>
<td>1.77575</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>40</td>
<td>3.0603</td>
<td>.83546</td>
<td></td>
</tr>
<tr>
<td>PEFR (L/min)</td>
<td>MALE</td>
<td>40</td>
<td>7.2106</td>
<td>1.90563</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>40</td>
<td>4.4952</td>
<td>1.29631</td>
<td></td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>MALE</td>
<td>40</td>
<td>0.7346</td>
<td>.169463</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>40</td>
<td>0.8088</td>
<td>.152950</td>
<td></td>
</tr>
</tbody>
</table>

Association of the pulmonary function test parameters with the digit ratio and anthropometric measurements were done using the Pearson correlation (Table 4). Height and weight showed significant positive correlation with FEV1, FVC and PEFR when sex was not taken into consideration. However when the correlation analysis was performed for male and female data separately, significant positive correlation was obtained only of FEV1 with height in the females. No significance were observed in the males for any association with the pulmonary function test and the anthropometric measures and digit ratio. The only digit ratio that correlated with the pulmonary function test assessment was the significant negative association that was observed with...
the left hand digit ratio and the FEV1/FVC.
Table 4: Pearson correlation analysis between PFT parameters and other measurements

<table>
<thead>
<tr>
<th></th>
<th>Right digit ratio</th>
<th>Left digit ratio</th>
<th>Mean digit ratio</th>
<th>Height</th>
<th>Weight</th>
<th>BMI</th>
<th>Waist</th>
<th>Hip circumference</th>
<th>Waist hip ratio</th>
<th>Chest circumference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both the sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEV1</td>
<td>Pearson Correlation</td>
<td>-.077</td>
<td>-1.170</td>
<td>.642*</td>
<td>.413*</td>
<td>.106</td>
<td>.147</td>
<td>.213</td>
<td>-.082</td>
<td>.152</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.530</td>
<td>.166</td>
<td>.223</td>
<td>.000</td>
<td>.000</td>
<td>.389</td>
<td>.230</td>
<td>.082</td>
<td>.508</td>
<td>.217</td>
</tr>
<tr>
<td>FVC</td>
<td>Pearson Correlation</td>
<td>-.001</td>
<td>-1.096</td>
<td>.543*</td>
<td>.276*</td>
<td>-1.025</td>
<td>.016</td>
<td>.115</td>
<td>-1.139</td>
<td>.021</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.992</td>
<td>.212</td>
<td>.434</td>
<td>.000</td>
<td>.023</td>
<td>.841</td>
<td>.897</td>
<td>.351</td>
<td>.258</td>
<td>.867</td>
</tr>
<tr>
<td>PEFR</td>
<td>Pearson Correlation</td>
<td>-.129</td>
<td>-1.203</td>
<td>.567*</td>
<td>.350*</td>
<td>.053</td>
<td>.125</td>
<td>.132</td>
<td>-1.005</td>
<td>.097</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.295</td>
<td>.088</td>
<td>.096</td>
<td>.000</td>
<td>.003</td>
<td>.670</td>
<td>.310</td>
<td>.284</td>
<td>.966</td>
<td>.431</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>Pearson Correlation</td>
<td>-.068</td>
<td>-.036</td>
<td>-.061</td>
<td>-.170</td>
<td>-.030</td>
<td>.094</td>
<td>.110</td>
<td>.016</td>
<td>.146</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.583</td>
<td>.772</td>
<td>.623</td>
<td>.166</td>
<td>.806</td>
<td>.444</td>
<td>.371</td>
<td>.900</td>
<td>.235</td>
<td>.411</td>
</tr>
<tr>
<td>MALE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEV1</td>
<td>Pearson Correlation</td>
<td>-.154</td>
<td>-.053</td>
<td>-.120</td>
<td>.182</td>
<td>.170</td>
<td>.102</td>
<td>.170</td>
<td>.202</td>
<td>.003</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.377</td>
<td>.762</td>
<td>.492</td>
<td>.296</td>
<td>.330</td>
<td>.560</td>
<td>.329</td>
<td>.244</td>
<td>.986</td>
<td>.414</td>
</tr>
<tr>
<td>FVC</td>
<td>Pearson Correlation</td>
<td>.025</td>
<td>-.202</td>
<td>-.118</td>
<td>-.015</td>
<td>-.015</td>
<td>-.102</td>
<td>-.060</td>
<td>-.011</td>
<td>-.081</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.885</td>
<td>.245</td>
<td>.498</td>
<td>.552</td>
<td>.933</td>
<td>.562</td>
<td>.730</td>
<td>.951</td>
<td>.644</td>
<td>.686</td>
</tr>
<tr>
<td>PEFR</td>
<td>Pearson Correlation</td>
<td>-.211</td>
<td>-.042</td>
<td>-.144</td>
<td>.106</td>
<td>.210</td>
<td>.154</td>
<td>.253</td>
<td>.264</td>
<td>.038</td>
</tr>
</tbody>
</table>
As digit ratio of less than 1 is considered to be a male trait and commonly seen even among the women who are good at sports, the data obtained were recategorized based on their digit ratio as greater than or equal to 1 and less than 1. When doing so we had 60 subjects whose mean digit ratio score was less than 1 and 20 of them had a score $\geq 1$. PEFR was the only pulmonary function test parameter that showed significant negative association with Mean digit ratio ($-0.282$, $p<0.02$).
DISCUSSION

This study was initiated with the primary objective to verify the association of digit ratio with certain specific pulmonary function test parameters. Left hand digit ratio of the female showed a significant positive correlation with FEV1/FVC. At the outset it has to be highlighted that though male and female subjects of 40 each were included in this study, no significance were observed in the digit ratio of both the hands or mean of the digit ratio right and left hand. Though the mean values were higher among the female for all the 3 ratios, they were statistically not significant. However published reports have shown that the method that we have adopted is not inferior to the digital vernier method or the photo copy of hand method\(^1\). Hence the only probable reason could be the sample size. McQuade in his commentary\(^2\) has stated that “Although digit ratio is regarded as a sexually dimorphic trait, differences between the sexes are small and ranges are overlapping”. This is in correlation with our study too. The significant association that was observed between the left hand digit ratio and PEFR correlates with other studies as well\(^3\).

Digit ratio is reflective of prenatal steroid hormone activity in an individual. As none of the subjects in this study were smokers or suffered from any pulmonary disease, the observed result assumes significance. Published data show that in utero milieu may influence adult lung function. In addition sex hormones appear to regulate human lung development before and during the neonatal period\(^4\). This can be accepted as androgen receptors are expressed in mesenchymal and epithelial cells of the human lungs throughout the life time. Androgens also play a part in the branching morphogenesis of the lungs. At this juncture we wish to bring to the attention of the readers that studies have shown that sex of the older sibling if it were male, i.e. a testosterone primed uterus, could have an impact on the digit ratio of the female fetus. The order of birth and the older sibling data also need to be collected during preliminary data collection. This study does show a significant negative correlation between the digit ratio and PEFR, that is less the digit ratio, i.e. male pattern of digit ratio, indicating androgen exposure in utero, higher the PEFR.

**CONCLUSION:** Left hand digit ratio of female shows a significant negative correlation with PEFR. In addition if the mean digit ratio is less than one, or a male pattern of digit ratio enhances the PEFR.

**Ethical clearance**- Taken from Institutional Human ethical committee, Chettinad Academy of Research and Education (CARE), Kelambakkam, Chennai.

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Conflict of Interest - Nil.

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