Cephalic Index in Sexual Dimorphism and Racial Diversity: A Mini Review

Abstract
Cranimetry and cephalometry are useful in classification of race and sex of individuals of unknown identity. This is a synoptic capture of cephalic index and cephalic dimensions in different populations. Cephalic index of females was higher than that of males in most populations with mesocephalic head shape in both sexes. Cephalic length and breadth of Indians were higher than those of Nigerians. Cephalic length and breadth were higher in male than female. Cephalic index and dimensions are important parameters in identification of both sexes and races.

Keywords: Cephalic index; Anthropometry; Skull

Mini Review
Cranimetry is the scientific measurement of skulls, especially in relation to craniology while cephalometry is a branch of anthropometry in which the anatomical dimensions of head and face are measured. Cephalometry continues to be the most versatile technique in the investigation of the craniofacial skeleton because of its validity and practicality [1]. Human body dimensions are affected by ecological, geographical, racial, gender, and age factors [2,3]. Indices show the percentage relationship between different dimensions [4]. It is an important parameter for classification of race and sex of individuals of unknown identity. Anthropometric study of head is useful in designing various head and face gadgets like helmets, head phones, goggles etc. by formulating standard sizes [5].

Cranial index and cranial dimensions are invaluable tools in racial and sexual dimorphism. Cranial index is ratio of the maximum breadth of the bare skull to its maximum length multiplied by hundred [6]. It is classified into four main types namely dolichocephalic which is less than 74.9, mesocephalic with cranial index between 75 to 79.9, brachycephalic with cranial index between 80 to 84.9 and hyperbrachycephalic with cranial index from 85 to 89.9 [6]. Maximum head length measures straight distance between glabella and opisthocranion while maximum head breadth measures maximum biparietal diameter and is the distance between the most lateral points on the parietal bones [6].

In a bid to understand racial differences and sexual dimorphism among various populations metrical studies (cephalic index and cephalic dimensions) have long been studied by several researchers in different populations namely Caucasians, Indians, Turkman and native Fars groups, Kosov and Albanians, Iranians Japanese, Serbs, Greek, Bulgarians, Mapuche individuals in Chile, Nigerians [7,8] and all have shown clear differences in cephalic index and cephalic dimensions. This mini review is an update aimed at understanding sexual dimorphism and racial diversity employing cephalic index as a tool.

Table 1 shows different values of cephalic index in various countries and tribes. The variations or differences can be attributed to a complex interaction between genetics and environmental factors [9]. Reports by several workers from different parts of the world, indicate that cephalic index of females was higher than that of males [4,10-17] though the work of [18,19] reported higher cephalic index in males. Majority of head shape was observed to be Mesoscephalic. In different studies based in Nigerian population by [4,10,18] (Nigerian Igbo) head shape of both sexes was mesoscephalic which is in line with studies done in Indian population by [14,17,19-21] who also reported the head shape to be mesoscephalic in both sexes.

Study in Indian population by [13], had head shape as dolichocephalic in both sexes. Similarly [16,22] working in Nigerian population reported head shape as dolichocephalic, Brachycephalic head shape was reported in Gujarat population [23], Chile population [24], and Iran population [3] with respect to mean cephalic index of both sexes. Brachycephalic head shape was reported in male while mesoscephalic in female by [19], among Ijaws of Nigeria. Similarly [12,15] documented mesoscephalic head shape in males and brachycephalic in females among Indians.

Head shape in Punjab is hyper brachycephalic according to [25], with respect to mean cephalic index while in Nigeria (Ogoni) [18] reported that males have hyper brachycephalic while females have mesoscephalic head shapes.

The cephalic length and breadth of different populations is shown in Table 2. In all, male parameters were higher than female parameters but with varying ranges of dimensions. The cephalic length and breadth of Indian population reported by various workers [11,15,17,25] showed higher value than that of Nigerian study by [4]. However, Nigeria cephalic dimensions do not differ much from the Southern Indian data according to the work of [13].

Taken together cephalic index and dimensions tend to show sexual dimorphism and can be employed as veritable anthropometric tools in classification of races.
Table 1: Cephalic index/head shapes in different populations.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year of Study</th>
<th>Country/People</th>
<th>Cephalic Index (M)</th>
<th>Cephalic Index (F)</th>
<th>Mean Cephalic Index</th>
<th>Head Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhargava &amp; Kher [21]</td>
<td>1960</td>
<td>Bhils of Central India</td>
<td>76.98</td>
<td></td>
<td>76.98</td>
<td>Mesocephalic</td>
</tr>
<tr>
<td>Bhargava &amp; Kher [22]</td>
<td>1961</td>
<td>Berelas of Central India</td>
<td>79.8</td>
<td></td>
<td>79.8</td>
<td>Mesocephalic</td>
</tr>
<tr>
<td>Shah &amp; Jadhav [24]</td>
<td>2004</td>
<td>Gujarat population</td>
<td>80.81</td>
<td></td>
<td>80.81</td>
<td>Brachycephalic</td>
</tr>
<tr>
<td>Del Sol [25]</td>
<td>2005</td>
<td>9th Region of Chile</td>
<td></td>
<td>80.42</td>
<td></td>
<td>Brachycephalic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F: Mesocephalic</td>
</tr>
<tr>
<td>Oladipo &amp; Olotu [19]</td>
<td>2006</td>
<td>Nigeria/Igbo</td>
<td>79.04</td>
<td>76.83</td>
<td></td>
<td>Both: Mesocephalic</td>
</tr>
<tr>
<td>Golalipour et al. [3]</td>
<td>2006</td>
<td>Gorgan-North of Iran</td>
<td></td>
<td>84</td>
<td></td>
<td>Brachycephalic</td>
</tr>
<tr>
<td>Oladipo &amp; Olotu [20]</td>
<td>2009</td>
<td>Nigeria/Ogoni</td>
<td>111.18</td>
<td>75.09</td>
<td></td>
<td>M: Hyper brachycephalic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F: Mesocephalic</td>
</tr>
<tr>
<td>Mahajan et al. [25]</td>
<td>2009</td>
<td>Medical students of Punjab</td>
<td></td>
<td></td>
<td>85.53</td>
<td>Hyper brachycephalic</td>
</tr>
<tr>
<td>Eroje et al. [23]</td>
<td>2010</td>
<td>Nigeria/ Ogbia</td>
<td></td>
<td>72.96</td>
<td></td>
<td>Dolichocephalic</td>
</tr>
<tr>
<td>Ilayperuma [12]</td>
<td>2011</td>
<td>Srilankan</td>
<td>78.04</td>
<td>79.32</td>
<td></td>
<td>Both Mesocephalic</td>
</tr>
<tr>
<td>Anitha et al. [13]</td>
<td>2011</td>
<td>Northern India</td>
<td>79.14</td>
<td>80.74</td>
<td></td>
<td>M: Mesocephalic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F: Brachycephalic</td>
</tr>
<tr>
<td>Gujaria &amp; Sahia [15]</td>
<td>2012</td>
<td>India/Maranthi</td>
<td>77.08</td>
<td>79.02</td>
<td></td>
<td>Both: Mesocephalic</td>
</tr>
<tr>
<td>Gujaria &amp; Sahia [15]</td>
<td>2012</td>
<td>India/Andhra</td>
<td>76.28</td>
<td>78.16</td>
<td></td>
<td>Both: Mesocephalic</td>
</tr>
<tr>
<td>Yagain et al. [16]</td>
<td>2012</td>
<td>India</td>
<td>77.92</td>
<td>80.85</td>
<td></td>
<td>M: Mesocephalic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F: Brachycephalic</td>
</tr>
<tr>
<td>Kumar &amp; Gopichand [14]</td>
<td>2013</td>
<td>India/Haryanvi</td>
<td>66.67</td>
<td>72.25</td>
<td></td>
<td>Both: Dolichocephalic</td>
</tr>
<tr>
<td>Patro et al. [18]</td>
<td>2014</td>
<td>India/Southern Odisha</td>
<td>77.28</td>
<td>78.38</td>
<td></td>
<td>Both: Mesocephalic</td>
</tr>
<tr>
<td>Orish &amp; Ibeachu [4]</td>
<td>2016</td>
<td>Nigeria</td>
<td>76.03</td>
<td>76.12</td>
<td></td>
<td>Both: Mesocephalic</td>
</tr>
<tr>
<td>Jervas et al. [17]</td>
<td>2016</td>
<td>Nigeria/ Igbo</td>
<td>68.8</td>
<td>73.6</td>
<td></td>
<td>Both: Dolichocephalic</td>
</tr>
</tbody>
</table>

Table 2: Cephalic dimensions in different populations.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year of Study</th>
<th>Country/People</th>
<th>Cephalic Length</th>
<th>Cephalic Breadth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahajan et al. [25]</td>
<td>2009</td>
<td>Medical students of Punjab (India)</td>
<td>18.58 cm</td>
<td>17.92 cm</td>
</tr>
<tr>
<td>Ilayperuma [12]</td>
<td>2011</td>
<td>Srilankan</td>
<td>180.5 ±13.22*</td>
<td>175 ± 6.61</td>
</tr>
<tr>
<td>Yagain et al. [16]</td>
<td>2012</td>
<td>India</td>
<td>18.76 cm</td>
<td>17.67 cm</td>
</tr>
<tr>
<td>Kumar &amp; Gopichand [14]</td>
<td>2013</td>
<td>Haryan (Northern India)</td>
<td>18.80 ±1.06</td>
<td>17.85±0.78</td>
</tr>
<tr>
<td>Patro et al. [18]</td>
<td>2014</td>
<td>India/Southern Odisha</td>
<td>19.5±1.14</td>
<td>19.1±1.53</td>
</tr>
</tbody>
</table>

Acknowledgement

None.

Conflict of Interest

None.

References

Cephalic Index in Sexual Dimorphism and Racial Diversity: A Mini Review


