Somatotype and Anthropometric Characteristics of Greek Female Rowers

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Abstract

Background: The aim of the study was to examine selected anthropometric characteristics of young female rowers and compare them with senior female national level rowers and untrained girls of same ages.

Methods: Anthropometric characteristics of 315 female junior’s rowers aged 10-18 years and 19 senior female national level rowers were selected. Young female rowers were categorized in 8 age groups (10-17/18yrs), while the senior national level rowers were divided into heavyweight (n=9, HW) and lightweight (n=10, LW). Body mass, 6 heights or lengths, 4 breadths, 3 girths and 5 skinfolds were measured in total.

Results: The main finding of the study was that female rowers aged 16 yrs and 17-18yrs had similar height, sitting height, arm spam, arm and leg length compared with senior LW rowers. Female rowers aged 16yrs had similar lean body mass and body fat values (%) with LW rowers. Comparison of the young rowers (10-17/18yrs) with a reference group of untrained Greek female children by means of percentiles (P) revealed that rowers in all age groups were heavier (P50-P85) and taller (P74-P85). Conclusion: Skinfold thickness decreased with age, especially from age 15yrs. The results of somatotype ratings reflect the influence of training in endomorphy and mesomorphy rating indicates the muscularity as age increases.

INTRODUCTION

Physical characteristics and body composition have been known to be fundamental to excellence in athletic performance [1]. Specific athletic events require different body types and weights for maximal performance [2,3]. There are several main physiological attributes such as anaerobic and aerobic fitness, level of technical, tactical and physical preparation that are important for success in rowing. In addition, physical body size and composition is also important in the success of a rower as muscularity of the athlete plays a significant role during rowing stroke [4]. Moreover, having proportionally long arms and legs (long levers) provides a biomechanical advantage [5-7]. Most of the literature has focused on anthropometry and somatotype of elite female rowers [4, 8-11] but less data are available for female rowers from childhood through adolescence to adulthood. Therefore, the aim of the present study was to examine selected anthropometric characteristics of female rowers aged 10- 18 (divided in eight age groups) and to compare them with those of national level female athletes (light and heavy weight category) and untrained Greek female children [12]. This anthropometric profile of young female rowers can be used from coaches in the process of talent identification.

METHODS

Subjects

Three hundred and thirty four (n=334) female rowers were measured for their anthropometrical profile from different clubs in Greece. The sample was divided according to age, ranging from 10 to 18 years and 19 senior national level rowers (10 lightweight (LW) and 9 heavyweight (HW)). All female rowers participated in regular training (3-6 session/week, at least 1 year training experience). Senior athletes had 10-12 training sessions/week. The protocols and techniques adopted were approved by Athens University Ethics Committee. The athletes and/or their parents (in case of underage participants) gave their informed consent before a complete anthropometric profile was taken. The study was conducted during the period of the seasons 2015-2017. All data collection was made during the pre-competitive sub-phase.

Anthropometric Measurements

Anthropometric measurements were done on same day for each athlete in same session to avoid technical error of measurement. Each anthropometrist took the same measurements and was assisted by a recorder. In addition to recording age, the following variables were measured: body
mass, height, arm span, trunk length, sitting height, arm length, (acromial height minus dactyline height), leg length (height minus sitting height), biacromial diameter, bicipital diameter, humerus and femur widths, biceps, thigh, calf girths and triceps, biceps, subscapular, supraspinous, thigh and medial calf skinfolds. All measurements were performed on the right side of the body. The three somatotype ratings (ectomorphy, mesomorphy and endomorphy) were calculated according to Heath and Carter method 15. The percent body fat and lean body mass were calculated according to Durnin and Rahaman 14 which is appropriate for these age groups. Chronological age for each participant was calculated using a table of decimals of year [15].

**Statistical Analysis**

The results of female rowers were categorized by age, while the senior national level rowers were divided into two groups according to their weight category (lightweight: LW and heavyweight: HW) to measure width dimensions. The athlete’s height (cm) was measured by a wall stadiometer (Holtain, UK) to the nearest 0.1 cm and athletes were weighed to the nearest 0.1Kg on an electronic scale (Tanita TBF 401 A, Japan). Limb lengths (cm) were obtained using a girth tape.

**RESULTS**

The anthropometric profile of the eight groups of club level female rowers (aged 10-18 yrs) and the national level senior LW and HW female rowers are shown in Table 1. As expected, most anthropometric variables increased with age and the values were higher in the senior HW and LW rowers. Differences between age 10-11(yrs) and 11-12(yrs) were observed on body mass p=0.002, sitting height (p=0.001), trunk length (p=0.014) and calf girth (p=0.001). Considering height, arm span, leg length, biacromial and bicipital diameter, differences were observed among 10-11(yrs), 11-12(yrs), 12-13(yrs).

Differences were observed in biceps and triceps skinfold (Table 2) between 10-11 years (p=0.001). A main effect of age on lean body mass (F=41.619, p=0.001) was observed, where from age 11(yrs) to age 17-18 (yrs) an increase was occurred. LW rowers had lower lean body mass compared to HW (p=0.001) and similar to female rowers of 16 years (Figure 1).

**Table 1:** Anthropometric profile of the ten groups of female rowers (10-18 yrs) and the national level LW and HW female rowers (means±sd).

<table>
<thead>
<tr>
<th>Dimension</th>
<th>10 yrs</th>
<th>11 yrs</th>
<th>12 yrs</th>
<th>13 yrs</th>
<th>14 yrs</th>
<th>15 yrs</th>
<th>16 yrs</th>
<th>17-18 yrs</th>
<th>LW yrs</th>
<th>HW yrs</th>
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<tbody>
<tr>
<td>Age (yrs)</td>
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<td>Body mass (Kg)</td>
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<tr>
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<td>59.5±8.8</td>
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<td>53.1±10.2</td>
<td>58.2±8.9</td>
<td>59.5±8.8</td>
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<td>59.5±8.8</td>
<td>61.2±6.4</td>
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<td>65.1±7.3</td>
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<td>Sitting height (cm)</td>
<td>75.1±3.4</td>
<td>78.9±3.8</td>
<td>82.8±3.7</td>
<td>84.7±3.4</td>
<td>86.2±3.5</td>
<td>86.7±3.1</td>
<td>87.4±3.5</td>
<td>88.8±3.7</td>
<td>168.1±5.1</td>
<td>172.5±4.9</td>
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<td>Trunk length (cm)</td>
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<td>52.9±3.9</td>
<td>55.6±3.1</td>
<td>56.7±2.8</td>
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<td>61.0±2.0</td>
<td>173.0±4.0</td>
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<td>151.5±8.2</td>
<td>158.6±7.8</td>
<td>163.5±7.3</td>
<td>164.2±5.7</td>
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<td>168.2±7.3</td>
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<td>70.3±3.3</td>
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<td>Leg length (cm)</td>
<td>74.9±2.6</td>
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<td>81.6±4.1</td>
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<td>84.2±3.4</td>
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<td>88.5±3.8</td>
<td>87.5±4.4</td>
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<td>Bicipital diameter (cm)</td>
<td>31.3±2.0</td>
<td>33.5±2.9</td>
<td>36.1±4.1</td>
<td>36.4±2.3</td>
<td>36.5±2.4</td>
<td>37.3±2.5</td>
<td>37.3±3.1</td>
<td>36.7±8.8</td>
<td>38.5±0.7</td>
<td>39.7±1.2</td>
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<td>Bicipital diameter (cm)</td>
<td>22.5±2.5</td>
<td>23.5±2.9</td>
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<td>26.8±2.0</td>
<td>27.3±2.5</td>
<td>27.5±3.7</td>
<td>27.7±1.6</td>
<td>28.3±1.6</td>
<td>30.2±4.8</td>
<td>28.3±1.5</td>
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<td>Humerus width (cm)</td>
<td>5.4±0.3</td>
<td>5.7±0.4</td>
<td>5.8±0.6</td>
<td>6.0±0.4</td>
<td>5.9±0.4</td>
<td>5.9±0.5</td>
<td>5.9±0.4</td>
<td>6.0±0.6</td>
<td>6.1±0.5</td>
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<td>Femur width (cm)</td>
<td>8.4±0.5</td>
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<td>9.6±0.4</td>
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<td>9.5±1.3</td>
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<td>9.3±0.4</td>
<td>9.5±0.4</td>
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<tr>
<td>Biceps girth (cm)</td>
<td>21.9±2.7</td>
<td>23.9±2.2</td>
<td>25.6±2.8</td>
<td>26.8±2.3</td>
<td>27.1±2.4</td>
<td>28.0±1.7</td>
<td>27.8±1.9</td>
<td>31.1±7.7</td>
<td>28.3±1.5</td>
<td>29.2±1.5</td>
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<tr>
<td>Thigh girth (cm)</td>
<td>28.9±4.9</td>
<td>44.5±7.0</td>
<td>47.8±5.2</td>
<td>50.4±5.2</td>
<td>51.3±4.6</td>
<td>53.0±3.1</td>
<td>53.1±3.4</td>
<td>52.4±5.9</td>
<td>52.3±1.8</td>
<td>55.0±2.3</td>
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<tr>
<td>Calf girth (cm)</td>
<td>42.1±4.9</td>
<td>31.7±2.7</td>
<td>33.6±2.9</td>
<td>34.9±2.2</td>
<td>35.2±2.3</td>
<td>35.6±1.9</td>
<td>36.0±1.9</td>
<td>36.5±12.2</td>
<td>33.9±11.1</td>
<td>50.7±2.5</td>
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</tbody>
</table>
Table 2: Four skinfolds of all ten groups (mean±sd).

<table>
<thead>
<tr>
<th>Skinfolds (mm)</th>
<th>10 n=16</th>
<th>11 n=29</th>
<th>12 n=50</th>
<th>13 n=51</th>
<th>14 n=55</th>
<th>15 n=56</th>
<th>16 n=38</th>
<th>17-18 n=20</th>
<th>LW n=10</th>
<th>HW n=9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biceps</td>
<td>7.5±3.2</td>
<td>7.9±2.6</td>
<td>8.5±3.2</td>
<td>8.6±2.3</td>
<td>7.8±2.4</td>
<td>8.3±2.9</td>
<td>6.6±1.8</td>
<td>7.2±3.1</td>
<td>4.6±1.6</td>
<td>6±1.8</td>
</tr>
<tr>
<td>Triceps</td>
<td>28.9±3.1</td>
<td>14.2±3.8</td>
<td>14.4±4.9</td>
<td>14.7±4.2</td>
<td>13.8±4.1</td>
<td>15.4±4.4</td>
<td>13.3±3.3</td>
<td>13.7±4.5</td>
<td>12.2±5.6</td>
<td>11.9±4.3</td>
</tr>
<tr>
<td>Subscapular</td>
<td>8.6±5.1</td>
<td>12.5±6.4</td>
<td>12.9±5.3</td>
<td>13.5±5.3</td>
<td>12.8±5.7</td>
<td>14.3±5.5</td>
<td>12.5±3.4</td>
<td>12.2±4.0</td>
<td>10.3±5.4</td>
<td>12±7.4</td>
</tr>
<tr>
<td>Supraspinale</td>
<td>10.9±6.6</td>
<td>13.6±6.3</td>
<td>13.2±5.8</td>
<td>13.6±4.6</td>
<td>13.0±5.1</td>
<td>14.3±5.5</td>
<td>11.6±3.6</td>
<td>11.7±5.2</td>
<td>8.1±3.4</td>
<td>9.9±4.5</td>
</tr>
</tbody>
</table>

Figure 1 Percentage body fat (%) and lean body fat (kg) for all age group.
* Differences between 10-11 years in lean body mass
# Differences between 11-12 years in lean body mass
$ Differences between 12-13 years in lean body mass
† Difference between 15-17-18 years in lean body mass

Figure 2 shows the mean somatotype of all age groups of the present study. Endomorphy and ectomorphy ratings were not different between any groups of the female rowers examined. Mesomorphy ratings showed a significant difference between age 14-17 (p=0.001) and 15-17 (p=0.002).

DISCUSSION

The aim of this study was to analyze the anthropometric characteristics of female young rowers (10 yrs old) in order to determine whether they possess unique physical characteristics that provide them an advantage for their sport. Moreover, anthropometric profile is one of the links in the chain of performance related factors in rowing [9]. Several studies have examined the importance of anthropometric characteristics for competitive performance [16]. It is well established that most successful rowers are taller and heavier, with long arms and legs, higher sitting height and with a lower fat mass compared to less successful counterparts [17,18]. Most of the previous studies focused on male rowers anthropometric characteristics and fewer works have been done on female rower’s physique and especially from so young age.

The primary finding of the present investigation was that, female rowers aged 16 yrs and 17-18 yrs had similar height, sitting height, trunk length, arm span, arm and leg length compared with the senior LW female rowers. Height and weight of LW female were similar with values reported in previous studies [19]. Upper and lower length extremities are factors related to stroke rate and drive phase of stroke, providing a biomechanical advantage [20]. Additionally, it is interesting to note that club female aged 16 had similar lean body mass but higher body fat compared with LW rowers. That finding is in accordance with previous results reported in other studies [21]. Based on lean body mass and body fat values, seems that the main change in anthropometric characteristics with training from age of 13 onwards is an increase in muscle mass with parallel decrease in body fat. Muscle mass increase is important factor to successful rowing performance [22].

Moreover, support for the importance of height and body mass for rowing success even from an early age [23], is given by the fact that female rowers in all age groups are heavier (P50 to P85) and much taller (P74 to P85) compared to the reference group of Greek female children. This is similar with results reported by Bourgeois et al., [9] for female junior rowers aged 17.5±0.8 yrs that were compared to a reference group of Belgian girls of the same chronological age. According to the results of past studies [24,25] and the findings of this study, seems that coaches select children with specific anthropometric characteristics for each sport from early age. Also, greater body mass of female rowers compared to reference group of girls may be due to an increased lean body mass as a result of training. Furthermore, the lower body fat and increased body mass is due to lower skinfold thickness. Especially, skinfold thickness decreased with age from 15 yrs group. The lowest body fat and skinfold thickness were found in both LW and HW female rowers compared to the other groups, indicating the influence of training on body composition [26]. Body fat values were similar to those reported in the literature for LW and HW female rowers [4].
The somatotype of the LW group was very similar to those of another study [4]. HW rower’s somatotype ratings are closer to Hungarian female rowers [27]. Examining previous studies [28,8,9] there is a variability regarding female somatotype. Comparison of the somatotype ratings across all age groups, endomorphy decreased from 15 to senior rowers (LW and HW). On the other hand, mesomorphy, had greater fluctuations and ectomorphy did not different between age group. The results of somatotype ratings reflect the influence of training in endomorphy and mesomorphy rating indicates the muscularity as age increases.

**LIMITATIONS OF THE STUDY**

We have to notice that more data are needed for LW and HW categories. Our study consists of a great sample size, especially for ages between 12-15yrs. In this way, the results of these ages could be used as a reference, but should be interpreted with caution according to individual characteristics and necessities. A longitudinal follow-up study of these characteristics is recommended. Even though the DEXA method would be more accurate than anthropometrical measurements, DEXA is an expensive method.
Summing up the findings of the study, the following conclusions were drawn:

- To our knowledge, this is the first paper, presenting anthropometric data from aged 10 years for female rowers.
- Female rowers aged 15 years, had similar height, body mass, lower & upper extremities with LW female rowers.
- Rowers aged 15 years had similar lean body mass with the female of LW group.
- Across all ages, rowers had higher values in height and body mass than reference group of same age.
- LW and HW female rowers follow the anthropometric and somatotype described in previous studies.

Anthropometric characteristics contribute to high performance and coaches should work to identify the physical characteristics of young children for rowing.

REFERENCES