Anthropometric characteristics and somatotype of Greek male and female flatwater kayak athletes

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Summary

Study aim: To investigate some anthropometric characteristics of male and female kayakers of four competitive categories. Material and methods: Anthropometric characteristics of 83 kayak athletes were measured during the 2009 Greek Cup. Kayakers were divided into four groups according to their competitive category: Women (n = 13; mean age 22.7 ± 3.1 years), Junior Female (n = 15; mean age 16.2 ± 1.1 years), Men (n = 27; mean age 23.7 ± 4.6 years) and Junior Male (n = 28; mean age 16.3 ± 1.2 years). Results: In both groups, the BMI, lean body mass, and relaxed and flexed arm girth were significantly different with respect to age group; body mass was significantly different, but only in male groups. No differences were found between groups on body fat. Conclusions: The data provided in this study could be used as a guideline for talent identification from the general population and may help coaches establish a specific kayak anthropometric profile in order to distinguish an elite kayak athlete.

Key words: Anthropometry – Body fat – Somatotype – Flatwater kayak

Introduction

Flatwater kayaking is a very demanding outdoor activity, where physical structure, technique, fitness, and other factors (psychology, race strategy) are essential factors for winning a race [4]. Body dimensions are related to performance, and are thus very important [20]. Ackland et al. [1] suggested that the morphology of elite paddlers has altered over the past 25 years. Athletes tended to be heavier but leaner. When compared to untrained men, kayakers had greater sitting height, greater biacromial and chest breadths, less body fat, and smaller bicristal and bitrochanteric breadths [6]. Recent studies reported that kayakers are usually taller than average, they have large body mass, strong muscles, and solid skeletons [19]. Thus, it is recognized that optimal performance depends on the upper body build of the kayaker [1,12]. Although the anthropometric characteristics of kayakers have been extensively described [21], there is limited research comparing different flatwater competitive categories. Thus, the aim of this study was to examine selected anthropometric characteristics of male and female kayakers aged 15-29 (divided in four competitive groups). Furthermore, in order to provide a full description of the physique, Heath-Carter somatotype was calculated and compared between groups. These data of Greek kayakers can be used for the process of talent identification and may help coaches establish a specific kayak anthropometric profile in order to distinguish an elite kayak athlete. It should be emphasised that no other scientific data is been published regarding anthropometric characteristics of Greek kayakers.

Material and Methods

Participants: At the 2009 Greek Cup (Schinias Venue, Athens), anthropometric measurements were performed on 83 Greek male and female flatwater kayak athletes. This event provides the opportunity for national coaches to select the best athletes for the national development camps. The athletes were divided in four groups according to their competitive category: Women (n = 13; mean age 22.7 ± 3.1 years, 5-7 years of experience), Junior Female (n = 15; mean age 16.2 ± 1.1 years, 3-4 years of experience), Men (n = 27; mean age 23.7 ± 4.6 years, 5-7 years of experience) and Junior Male (n = 28; mean age 16.3 ± 1.2 years, 3-4 years of experience). All the subjects were highly trained and experienced kayakers who compete on the national and international levels. At the time of the investigation, the athletes were in their competitive training phase. A full description of the testing procedure was presented to the participants and each athlete read...
and signed a written and informed consent prior to participation. The Athens University Ethics Committee approved this study.

**Anthropometric measurement:** Each subject was tested in the morning. A full anthropometric profile of the participant was taken. Participants were registered by one of the authors, and then directed to the start of the procedure. The following anthropometric variables were measured: body mass, body height, torso length, arm and leg length, humerus and femur width, bi-iliac breadth, relaxed and flexed arm girth and shoulder breadth. Also, measurements of six skinfolds (triceps, biceps, subscapular, supraspinal, front thigh, and medial calf) were performed. All variables were measured on the right side of the body, and according to the methods of Claessens et al. [9]. The variables were measured by an experienced anthropometrist, who took the same measurements for all the surveyed athletes, and was assisted by a recorder. Ratings for the three somatotypes were calculated according to Heath-Carter somatotype method [5]. Using the skinfold data the percent body fat, fat mass, and lean body mass were calculated according to Durnin and Rahaman [10].

**Equipment:** Harpenden skin-fold calliper (to the nearest 0.01 mm) was used to obtain skinfolds, a bone calliper (Holtain, U.K.) to measure width dimensions. The athlete’s height (cm) was measured by a wall stadiometer (Holtain, UK) to the nearest 0.1 cm, athlete’s weight measured to the nearest 0.1 kg on an electronic scale (Tanita TBF 401 A, Japan). Limb lengths (cm) were obtained using a girth tape.

**Statistical analysis:** All statistical analyses were performed using the SPSS 15. Descriptive statistics (mean, standard deviation) were calculated for all variables for each competitive group of kayakers. Comparison between Women and Junior Female and between Men and Junior Male were performed using the independent t-test (two-tailed). The level of statistical significance was set at p<0.05.

**Results**

Descriptive statistics for absolute parameters of the four groups are presented in Table 1. The junior male kayakers had lower body mass than their men counterparts and the t-test results pointed to a statistically significant difference (p<0.01). Also, the female junior kayakers had lower body mass compared to women athletes, however the difference was not statistically significant. Men had higher values of lean body mass than the junior male (p<0.01).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Women (n=13)</th>
<th>Junior Female (n=15)</th>
<th>Men (n=27)</th>
<th>Junior Male (n=28)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>22.7±3.1</td>
<td>16.2±1.1</td>
<td>23.7±4.6</td>
<td>16.3±1.2</td>
</tr>
<tr>
<td>Body mass (Kg)</td>
<td>65.9±10.1</td>
<td>59.0±9.0</td>
<td>78.8±7.3***</td>
<td>73.1±7.5</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>23.8 ± 2.3***</td>
<td>21.0 ± 2.2</td>
<td>25.1 ± 1.8***</td>
<td>23.6 ± 2.3</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>26.4±4.4</td>
<td>25.9±3.1</td>
<td>23.7±3.9</td>
<td>22.7±4.0</td>
</tr>
<tr>
<td>Lean body mass (Kg)</td>
<td>48.3±5.8**</td>
<td>43.5±5.4</td>
<td>59.6±5.8**</td>
<td>56.0±5.4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>165.8±7.2</td>
<td>167.1±6.1</td>
<td>176.5±4.5</td>
<td>175.6±4.4</td>
</tr>
<tr>
<td>Total Arm length (cm)</td>
<td>71.7±4.3</td>
<td>70.6±3.8</td>
<td>76.0±3.4</td>
<td>75.9±3.6</td>
</tr>
<tr>
<td>Total Leg Length (cm)</td>
<td>89.7±4.8</td>
<td>89.6±4.8</td>
<td>98.1±5.6</td>
<td>97.0±4.6</td>
</tr>
<tr>
<td>Torso Length (cm)</td>
<td>55.5±4.7</td>
<td>54.3±4.9</td>
<td>62.7±8.2</td>
<td>61.5±8.2</td>
</tr>
<tr>
<td>Biceps skinfold (mm)</td>
<td>10.3±4.1</td>
<td>11.3±2.8</td>
<td>8.8±3.8</td>
<td>7.5±2.7</td>
</tr>
<tr>
<td>Triceps skinfold (mm)</td>
<td>16.1±4.3</td>
<td>15.9±3.8</td>
<td>12.8±4.9</td>
<td>11.7±3.6</td>
</tr>
<tr>
<td>Subscapular skinfold (mm)</td>
<td>15.5±5.4</td>
<td>14.5±3.7</td>
<td>14.4±4.9</td>
<td>13.1±4.5</td>
</tr>
<tr>
<td>Suprailiac skinfold (mm)</td>
<td>20.7±9.1</td>
<td>16.5±6.5</td>
<td>15.0±5.4</td>
<td>14.0±4.6</td>
</tr>
<tr>
<td>Thigh skinfold (mm)</td>
<td>22.6±6.7</td>
<td>24.0±5.7</td>
<td>16.5±4.9</td>
<td>14.8±4.2</td>
</tr>
<tr>
<td>Calf skinfold (mm)</td>
<td>14.4±5.1</td>
<td>16.6±4.3</td>
<td>11.8±4.2</td>
<td>13.6±4.6</td>
</tr>
<tr>
<td>Relaxed Arm girth (cm)</td>
<td>27.6±2.8***</td>
<td>25.6±2.6</td>
<td>30.3±2.2***</td>
<td>28.3±2.3</td>
</tr>
<tr>
<td>Flexed Arm girth (cm)</td>
<td>30.2±3.8***</td>
<td>27.0±2.5</td>
<td>34.1±2.8***</td>
<td>31.2±3.5</td>
</tr>
<tr>
<td>Bio-iliac Breadth (cm)</td>
<td>27.4±2.2</td>
<td>28.6±2.3</td>
<td>28.6±1.8</td>
<td>28.0±2.3</td>
</tr>
<tr>
<td>Shoulder Breadth (cm)</td>
<td>38.9±3.1</td>
<td>38.6±2.1</td>
<td>42.0±8.1</td>
<td>41.3±7.5</td>
</tr>
<tr>
<td>Humerus width (cm)</td>
<td>6.2±0.7</td>
<td>6.0±0.4</td>
<td>6.6±0.6</td>
<td>6.5±0.8</td>
</tr>
<tr>
<td>Femur width (cm)</td>
<td>7.3±1.2</td>
<td>7.5±0.9</td>
<td>8.8±1.4</td>
<td>9.3±1.7</td>
</tr>
</tbody>
</table>

Significantly different from respective value in junior category* p<0.05; ** p<0.01; ***p<0.001
Moreover, women had bigger values of lean body mass compared to junior female (p<0.05). No differences were found between groups on body fat percentage. The women and men kayakers did not differ statistically with junior female and junior male in height, arm, and leg length, respectively. Women had higher BMI than junior female (p<0.01); men also had higher BMI than junior male athletes (p<0.01).

Men kayakers had bigger relaxed and flexed arm girth than the junior male (p<0.001) and (p<0.01), respectively. Women differed significantly in flexed arm girth compared to junior female (p<0.006). Moreover, all groups had significant differences between relaxed and flexed arm girth (p<0.001).

Mean endomorphy, mesomorphy, and ectomorphy ratings for each group are shown in Fig. 1. Endomorphy ratings were the same between women and female junior. Mesomorphy ratings were higher in women (p<0.01) compared to junior female. The women and junior female had statistically significant differences in endomorphy ratings (p<0.001). Men and junior did not differ significantly in endomorphy and mesomorphy ratings. Ectomorphy ratings were higher in junior athletes (p<0.005). The mean somatotype of women kayakers demonstrates that these athletes are described as mesomorph-endomorph, while the female junior kayakers are best described as balanced endomorph. Male paddlers were endomorphic mesomorph and junior males were showed to be balanced mesomorph.

**Discussion**

The individual data were compared with the reference group [8]. Male and female paddlers were taller and heavier than the reference group. Regular training, according to Malina [14], does not affect statural growth, but rowers are already taller than reference group during childhood, and this position remains during adolescence.

One finding of this study was that women and men kayakers had similar body height, arm and leg length, but higher lean body mass compared with the junior female and junior male kayakers. The height of the men is similar to those reported by Ridge et al. [18], but the body mass of our athletes is higher. Also, the height and body mass is similar with the values reported by Anca and Muniroglou [3]. However, our men kayakers are less tall and somewhat lighter than those in the study of Ackland et al. [1].

Regarding the breadth of shoulder, humerus, and femur of women and men, our results have small differences with those of Ridge et al. [18] and Ackland et al. [1]. In addition, flexed arm girth is almost similar with those of Ridge et al. [18] for both categories. Ackland et al. [1] reported higher values of flexed arm girth for both sexes (32.1 women, 37.6 men) compared to ours (30.2 women, 34.1 men). Moreover, body fat percentage of our kayakers is higher in all categories compared to the body fat percentage reported in other studies [3,11,20,21].

The somatotype of men is very similar to this reported by Anca and Muniroglou [3]. Men kayakers are best de-

![Fig.1. Mean endomorphy (left), mesomorphy (middle), ectomorphy (right) ratings in four groups of kayakers](image-url)
On the other hand, mesomorphy was similar between men and junior male (cf. Fig. 1) [15].

There is no available data, as far as we know, for the ages of female and male junior kayakers. Most of the published studies present the anthropometric characteristics of high level kayak athletes. Thus, the present study tries to highlight the physical structure of male kayakers and male kayakers aged 15-17. Comparing junior male kayakers with rowers of the same age revealed that rowers are taller, with lower body fat and slightly higher lean body mass. Their body mass was very similar [13].

A recent study by Alacid et al. [2] describes the anthropometric characteristics of male and female elite sprint paddlers aged 13-14 and is useful for talent identification. Furthermore, the results of this study have shown that there are not large differences between male and female flatwater kayakers, and a reference population of non-athletes. For coaches and others who seek talent, there may be a large pool of potential kayakers to choose from the general population.

In conclusion, the present investigation has shown that male and female kayakers aged 16-17 had similar height, arm, and leg length, but lower lean body mass compared with men and women kayakers. Anthropometric characteristics and somatotype of our athletes were found to be almost similar when compared to kayakers at the international level. Anthropometric data is useful because some anthropometric variables are correlated with performance [12,21]. Additionally, coaches could use anthropometric variables to control the training process and to select the appropriate paddle and boat set up [17]. A comprehensive anthropometric description may help coaches to understand and to better select their athletes, as in Greece especially there is a paucity of this data in the investigation of kayak profiles.

References


Received 05.03.2011
Accepted 28.10.2011

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