The Determination of the Relationship between Somatotypes and Speed of Sub-Elite Athletes

İrfan MARANGOZ

Ahi Evran University, School of Physical Education and Sports, Kırşehir, Turkey
Email: imarangoz@ahievran.edu.tr Tel. 506 632 21 00

Abstract
This study aims to analyze the relationship between somatotypes and speed of 180 male sub-elite athletes aged between 18 and 25. Athletes were divided into two categories as balanced group (balanced somatotype groups) and randomly selected groups (groups outside balanced somatotypes groups) based on their somatotype structures. The arithmetic means and standard deviations of groups are (n=30) 21.95±2.80 years of age, height 168.40±2.62 cm, weight 69.20±5.26 kg in balanced endomorph group, (n=30) 21.60±3.15 years of age, height 170.25±6.39 cm, weight 67.25±6.09 kg in balanced mesomorph group, and (n=30) 20.40±1.46 years of age, height 175.10±5.02 cm, and weight 60.05±6.09 kg in balanced ectomorph group. On the other hand, the same values are (n=30) 21.35±2.30 years of age, height 160.10±2.20 cm, and weight 69.30±5.70 kg in random endomorph group, (n=30) 21.36±2.40 years of age, height 169.24±2.21 cm and weight 65.40±3.25 kg in random mesomorph groups, and (n=30) 20.50±1.85 years of age, height 176.15±3.30 cm and weight 70.10±4.45 kg in random ectomorph group. The measurement data were analyzed using SPSS 2.0 package program for Windows. Somatotype calculations were done in SOMATOTURK Calculation Program. The statistical analysis demonstrated that a highly positive significant correlation (p<0.001) was found between balanced somatotype groups (balanced endomorph, mesomorph and ectomorph) and randomly selected somatotype groups (random endomorph, mesomorph and ectomorph).

Keywords: Sub-elite athletes, Somatotypes, Speed.


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Transparency: The author confirms that the manuscript is an honest, accurate, and transparent account of the study was reported; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Ethical: This study follows all ethical practices during writing.

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1. Introduction

It is not possible to reach a certain level of performance without physical properties suitable to the sports that an individual performs (Marangoz and Polat, 2017). Body structure is one of the factors influencing performance. Physical properties or body structures affect an individual’s physiological capacity (Hazır and Açıkada, 2002). Strength and condition training are key elements in terms of reaching a high speed. Athletes need to effectively reach a maximum speed running speed for a successful performance (Murphy et al., 2003). Success requires a fast start, reaching the highest running speed as possible and keeping it for a certain duration (Delecluse et al., 1995; Johnson and Buckley, 2001) which is influenced by anthropometric, metabolic, neural and biomechanical factors (Abe et al., 2001; Ross et al., 2001).

2. Materials and Method

180 male sub-elite athletes aged between 18 and 25 and living in Kırşehir and Kahramanmaraş provinces of Turkey voluntarily participated in this study. They were divided into two categories as balanced group (balanced somatotype groups) and randomly selected groups (groups outside balanced somatotypes groups) based on their somatotype structures. The somatotypes and speed of sub-elite athletes were measured. Average means and standard deviations are given below:

Balanced endomorph group (n=30): 21.95±2.80 years of age, 168.40±2.62 cm height, 69.20±5.26 kg weight.
Balanced mesomorph group (n=30): 21.60±3.15 years of age, 170.25±6.39 cm height, 67.25±6.09 kg weight.
Balanced ectomorph group (n=30): 20.40±1.46 years of age, 175.10±5.02 cm height, 60.05±5.09 kg weight.
Random endomorph group (n=30): 21.35±2.30 years of age, 160.10±2.20 cm height, 69.30±5.70 kg weight.
Random mesomorph group (n=30): 21.36±2.40 years of age, 169.24±2.21 cm height, 65.40±3.25 kg weight.
Random ectomorph group (n=30): 20.50±1.85 years of age, 176.15±3.30 cm height, 70.10±4.45 kg weight.

2.1. Determination of Somatotypes

The somatotype values of the participants were determined using Heath Carter method of somatotyping. Based on this method, body weight, height, biceps and calf circumference during flexion, humerus and femur breadth, triceps, subscapular, suprailliac and calf skinfold as well as following formulas (Ross and Marfell-Jones, 1991; Carter, 2002) are used to calculate somatotype values. In addition, “SOMATOTURK” program was used for calculations (Marangoz and Özbalci, 2017).

2.1.1. Determination of Endomorph

\[ A = \text{triceps} + \text{subscapular} + \text{suprailiac} \]
\[ B = \left(\frac{170.18}{\text{height}}\right) \text{(Adjustment coefficient for height)} \]
Adjusted sum \( X = A \times B \)
Endomorph = \(-0.7182 + 0.1451 \times X - 0.000068 \times X^2 + 0.0000014 \times X^3\)

2.1.2. Determination of Mesomorph

Mesoromorph = \((0.558 \times HB + 0.601 \times FB + 0.188 \times CAG + 0.161 \times CCG) - (0.131 \times H) + 4.5\)

<table>
<thead>
<tr>
<th>HB</th>
<th>Humerus breadth (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB</td>
<td>Femur breadth (cm)</td>
</tr>
<tr>
<td>CAG</td>
<td>Arm circumference during flexion – Triceps skinfold /10</td>
</tr>
<tr>
<td>CCG</td>
<td>Maximal calf circumference – Calf skinfold /10</td>
</tr>
<tr>
<td>H</td>
<td>Height (cm)</td>
</tr>
</tbody>
</table>

2.1.3. Determination of Ectomorph

Height and weight are calculated in cm and kg, respectively. Height is divided by the cube root of weight to calculate HWR (HWR=height/cube root of weight). Ectomorph is calculated based on HWR value using one of the formulas below:

\[ \text{IF } HWR \geq 40.75, \text{ Ectomorph } = 0.732 \times HWR - 28.58 \]
\[ \text{IF } 38.25 < HWR < 40.75, \text{ Ectomorph } = 0.463 \times HWR - 17.63 \]
\[ \text{IF } HWR \leq 38.25, \text{ Ectomorph } = 0.1 \]

2.2. 10 and 20 m Speed Performance

10 m and 20 m speed performances were measured using a New Test 2000 photocell device. The athletes warmed up for 10 minutes prior to the test. The track closing time was recorded in milliseconds. The test was repeated twice following a full rest, and the best results were used in the study.

2.3. Statistical Analyses

In this study, which analyzes the relationship between speed and balanced/randomly selected endomorph, mesomorph and ectomorph groups of sub-elite athletes, Windows SPSS 22.0 package program was used for spearman correlation analysis with a significance level of 0.05.
3. Findings

<table>
<thead>
<tr>
<th>Table-1. Descriptive analyses of balanced and random somatotype groups</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BALANCED GROUPS</strong></td>
</tr>
<tr>
<td>Endomorph Group</td>
</tr>
<tr>
<td>(n=30)</td>
</tr>
<tr>
<td>x±sd</td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>Height (cm)</td>
</tr>
<tr>
<td>Weight (kg)</td>
</tr>
<tr>
<td>10 m (sec)</td>
</tr>
<tr>
<td>20 m (sec)</td>
</tr>
</tbody>
</table>

Table-2. The comparisons of 10m Pearson correlation analysis between balanced and randomly selected somatotype groups

<table>
<thead>
<tr>
<th>Random Endomorph</th>
<th>Balanced Endomorph</th>
<th>Random Mesomorph</th>
<th>Balanced Mesomorph</th>
<th>Random Ectomorph</th>
<th>Balanced Ectomorph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balanced Endomorph</td>
<td>r 1.000***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Random Mesomorph</td>
<td>r 1.000***</td>
<td>1.000***</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Random Ectomorph</td>
<td>r 1.000***</td>
<td>1.000***</td>
<td>1.000***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Balanced Ectomorph</td>
<td>r 1.000***</td>
<td>1.000***</td>
<td>1.000***</td>
<td>1.000***</td>
<td>1.000***</td>
</tr>
</tbody>
</table>

Table-3. The comparisons of 20m Pearson correlation analysis between balanced and randomly selected somatotype groups

<table>
<thead>
<tr>
<th>Random Endomorph</th>
<th>Balanced Endomorph</th>
<th>Random Endomorph</th>
<th>Balanced Mesomorph</th>
<th>Random Mesomorph</th>
<th>Random Ectomorph</th>
<th>Balanced Ectomorph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balanced Endomorph</td>
<td>r 1.000***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Random Mesomorph</td>
<td>r 1.000***</td>
<td>1.000***</td>
<td>1.000***</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Random Ectomorph</td>
<td>r 1.000***</td>
<td>1.000***</td>
<td>1.000***</td>
<td>1.000***</td>
<td>1.000***</td>
<td>1.000***</td>
</tr>
</tbody>
</table>

Pearson correlation between balanced and randomly selected somatotype groups for 10m and 20m distance ranges were compared as shown in Table 2 and 3. The results indicate a very highly positive correlation with a significance level of p<0.001 between balanced somatotype groups (balanced endomorph, mesomorph and ectomorph) and randomly selected somatotype groups (random endomorph, mesomorph and ectomorph) for 10m and 20m distance ranges.

4. Discussion

Speed is the rate of change that enables a player to reach the highest speed within the shortest amount of time (Gambetta, 1996). In a study on 24 male sub-elite athletes (8 rugby players, 8 sprinters and 8 active athletes), 5-10m test values of rugby players, sprinters and active athletes were measured as 0.71±0.09, 0.68±0.04 and 0.74±0.04, respectively. On the other hand, the same study found out 10-15 m test value of rugby players, sprinters and active athletes as 0.63±0.03, 0.63±0.03 and 0.66±0.05, respectively. A significant was also found between rugby players and sprinters in terms of group correlation (Dowson et al., 1998). Speed times of physical education students whose average years of age was 20.1±0.9, height was 1.79±0.04 cm and weight was 74.5±9.8 kg (n=24) were measured for 0-5m, 5-10m and 10-15m distance ranges, and average time was measured as 1.86±0.08 seconds for 5-10m and as 2.60±0.10 for 10-15m (Kukolj et al., 1999). A study found 10 m speed of 14 sub-elite male athletes as 1.7 seconds (Chaouachi et al., 2009). In a similar study, 10 m speed values of 16 male athletes were measured as 1.92±0.15 (Cochrane et al., 2004). Another study found speed values as 0.80±0.05 for 5-10m and as

Graph-1. Speed graph of balanced and randomly selected somatypes
0.72±0.05 for 10-15m (Gabbett et al., 2008). While speed is defined as the time that elapses in the first 10 m, maximum speed time is defined as the time that elapses in 20 m (Little and Williams, 2005).

In conclusion, when the correlation between balanced and randomly selected somatotype groups of sub-elite athletes and their speed in 10m and 20m distance ranges is analyzed, it was observed that the speed of athletes who have balanced endomorph, mesomorph and ecomorph groups are fairly better than sub-elite athletes who have random endomorph, mesomorph and ecomorph groups, and that a highly positive correlation with a significance level of p<0.001 was found between them. It can be argued that this results from differences of physical properties and sports branches.

References