Factors influencing the performance of young football players in the yo-yo intermittent endurance test (Level 2)

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Summary

Study aim: To find out whether the ability to accelerate, decelerate and turn may contribute to the performance of young football players during the Yo-Yo Intermittent Endurance Test – Level 2 (YYIEL2).

Material and methods: A group of 239 young male football players from three age categories: under 15 years (U15; n = 102), under 17 years (U17; n = 59) and under 19 years (U19; n = 74) were evaluated in sprint, agility, and intermittent exercise performance. Multiple regression models weighted for maturity status were applied.

Results: Significant (p<0.001) differences were found between the U15 and both other groups in all tests. The YYIEL2 was significantly correlated with 5-m and 30-m sprints and agility (r = 0.361, 0.499 and 0.555, respectively; p<0.001) and the latter 3 variables explained 31% (p<0.001) of the total variance of the YYIEL2 performance, the agility test alone being the strongest predictor (b = 0.56; p<0.001).

Conclusions: Despite the usefulness of the YYIEL2 test used in football to determine aerobic fitness, other factors than VO2max, such as peripheral limitations and the ability to accelerate, decelerate and turn, may influence the performance during the test.

Key words: Soccer – Physical Endurance – Physical fitness – Training

Introduction

The Yo-Yo Intermittent Endurance Test evaluates the ability to perform intense exercise repeatedly after a prolonged intermittent exercise [10], progressively requiring a maximal physiological response from players during a soccer-specific intermittent protocol [3]. The Yo-Yo Intermittent Endurance Test – Level 2 (YYIEL2) is a maximal intensity test [9] which has been considered as an aerobic fitness-related field test to be used in football [4]. The test has been recommended to be used by coaches because it is an easy and helpful instrument for following-up the football player’s endurance capacity during the playing season [8].

Despite its common use in football training at different competitive levels, little information exists regarding the responses to the YYIEL2. It has been suggested that factors other than VO2max may influence the distance covered by football players during the Yo-Yo tests [3,9]. Among young players, maturity status, agility and speed may be related to their capacity to take on in shuttle running [3]. Also, a relation between aerobic capacity and sprint velocity has been previously described [7]. Thus, the aim of this study was to examine whether the ability to accelerate, decelerate and turn may contribute to performance during the YYIEL2 in young football players.

Material and Methods

Subjects: A group of 239 young male soccer players volunteered to participate in the study. They were classified by age into 3 categories: under 15 years (U15; n = 102), under 17 years (U17; n = 59) and under 19 years (U19; n = 74). They trained 2 – 5 times a week, each session lasting about 90 min, throughout the season. The parents and players were informed about the study procedures and written informed consents were provided. The study was approved by the local Ethics Committee.

Methods: Body height was determined by a stadiometer (accuracy 0.1 cm) and body mass by medical scales (accuracy 0.1 kg); Body Mass Index (BMI) was
was computed. Self-reported stage of pubic hair was the indicator of biological maturity status and it was assessed as described by Tanner [11].

All subjects performed sprint (5 and 30 m) and agility (10×5 m shuttle run) tests with a stationary start; the timing started as soon as the trunk passed the first photocell. Flat sprint speed was measured with infrared photocells (Brower Timing System, IRD-T175, Utah, USA) positioned at the starting line (0 m), and 5 and 30 m from the starting line at the height of 1 m. There were two trials for the sprint and agility tests, a 3-min recovery being allowed after each trial. The best running times were selected for analysis.

An intermittent exercise performance test (YYIEL2) was applied as a measure of aerobic performance. The Yo-Yo tests were designed to measure the ability to perform bouts of repeated intense intermittent exercise. After a 10-min warm-up, the subjects performed the YYIEL2 consisting of repeated 2×20 m runs separated by 5-s interruptions. The total distance covered during the YYIEL2 was considered as the line at a progressively increased speed controlled by audio bleeps from a CD-ROM according to Bangsbo [10], the initial speed being equal to 11.5 km/h (12.5 s for 20 m runs separated by 5-s interruptions). The total distance covered during the YYIEL2 was considered as the line at a progressively increased speed controlled by audio bleeps from a CD-ROM according to Bangsbo [10], the initial speed being equal to 11.5 km/h (12.5 s for 20 m). The test was considered terminated when the subject failed twice to reach the starting line (objective evaluation) or felt unable to complete another shuttle at the dictated speed (subjective score). All the field tests were performed on artificial turf, under dry conditions.

Data analysis: Factorial ANOVA with the post hoc Bonferroni’s test was used to assess the between-group differences. Stepwise multiple regressions, weighted for the maturity status, were computed to estimate the association between the performance (distance covered during the YYIEL2 test) and the results of 5- and 30-m sprints and agility tests. The SPSS 17.0 for Windows software was used in data processing, the level of p≤0.05 being considered significant.

Results

The somatic data of subjects (means ±SD) are presented in Table 1 and the results of tests in Table 2. The performance in all functional tests conducted increased with age but significant differences were found only between the U15 and the other two groups (p<0.001).

The YYIEL2 was significantly correlated with 5-m sprint, 30-m sprint and agility test results (respectively: r = 0.361, 0.499 and 0.555, respectively; p<0.001; data computed for all subjects combined), when adjusting the performance for maturity status. With all the independent variables (5-m sprint, 30-m sprint and agility test) considered in the model, R² = 0.319 (p<0.001). The adjusted R² value of 0.310 indicates that almost a third of the variability of the distance covered in YYIEL2 is predicted by 5-m and 30-m sprints and by the agility test results. According to our model, agility test performance seems to be the main predictor, followed by 30-m sprint velocity, the 5-m sprint velocity adding no further improvement in the prediction.

Table 1. Mean values (±SD) of anthropometric data and frequencies (n and %) of attaining maturation stages by pubic hair

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>U19 n = 74</th>
<th>U17 n = 59</th>
<th>U15 n = 102</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somatic data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td>18.3 ± 0.5</td>
<td>16.6 ± 0.4</td>
<td>14.3 ± 0.6</td>
</tr>
<tr>
<td>Tr. exp. (years)</td>
<td></td>
<td>8.5 ± 2.6</td>
<td>7.4 ± 1.8</td>
<td>3.9 ± 2.2</td>
</tr>
<tr>
<td>Body height (cm)</td>
<td></td>
<td>177 ± 6</td>
<td>174 ± 6</td>
<td>168 ± 7</td>
</tr>
<tr>
<td>Body mass (kg)</td>
<td></td>
<td>72.4 ± 7.8</td>
<td>68.5 ± 7.5</td>
<td>57.7 ± 9.5</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td>23.1 ± 1.9</td>
<td>22.6 ± 1.7</td>
<td>20.4 ± 2.6</td>
</tr>
<tr>
<td>Maturation stage (by pubic hair)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td></td>
<td>--</td>
<td>--</td>
<td>4 (4%)</td>
</tr>
<tr>
<td>III</td>
<td></td>
<td>--</td>
<td>1 (2%)</td>
<td>38 (36%)</td>
</tr>
<tr>
<td>IV</td>
<td></td>
<td>--</td>
<td>35 (59%)</td>
<td>59 (56%)</td>
</tr>
<tr>
<td>V</td>
<td></td>
<td>74 (100%)</td>
<td>23 (39%)</td>
<td>5 (5%)</td>
</tr>
</tbody>
</table>

Legend: U15 – Under 15 years; U17 – Under 17 years; U19 – under 19 years of age; Tr. exp. – Training experience

Table 2. Mean values (±SD) of performance tests

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>U19 n = 74</th>
<th>U17 n = 59</th>
<th>U15 n = 102</th>
</tr>
</thead>
<tbody>
<tr>
<td>YYIEL2 (m)</td>
<td></td>
<td>1280 ± 358</td>
<td>1132 ± 367</td>
<td>786 ± 369*</td>
</tr>
<tr>
<td>5-m sprint (s)</td>
<td></td>
<td>1.06 ± 0.07</td>
<td>1.05 ± 0.08</td>
<td>1.15 ± 0.11*</td>
</tr>
<tr>
<td>30-m sprint (s)</td>
<td></td>
<td>4.25 ± 0.14</td>
<td>4.26 ± 0.17</td>
<td>4.75 ± 0.37*</td>
</tr>
<tr>
<td>Agility (s)</td>
<td></td>
<td>8.92 ± 0.33</td>
<td>9.06 ± 0.30</td>
<td>9.78 ± 0.57*</td>
</tr>
</tbody>
</table>

* Significantly different from other groups (p<0.001)

Discussion

Football requires high levels of aerobic fitness and the Yo-Yo tests are very popular and have been considered as useful tools in football training, since its procedures are quite similar to the intermittent characteristics of game activities. Previous studies pointed out that the performance in the YYIEL2 seemed to be a weak indicator of maximal aerobic power in football players [3,9], suggesting that peripheral limitations [9] and the ability to accelerate, decelerate and turn affected the performance of the Yo-Yo tests [3].
We found moderate correlations between the distance covered during the YYIEL2 test by young football players and their performance in sprint and agility tests. Similar correlations were found between VO\textsubscript{2}max in a laboratory treadmill protocol and the YYIEL2 [9]. Thus, despite the usefulness of the YYIEL2 as an aerobic fitness-related field test to be used in football training, our results seem to confirm that factors other than VO\textsubscript{2}max may also influence the aerobic performance during high-intensity intermittent activities such as football.

The multiple regression calculus excluded the 5-m sprint test from the analysis and only the agility and 30-m sprint tests could be considered when predicting the YYIEL2 performance. These results are in accordance with previous studies conducted on adult elite football players, but using the Yo-Yo Intermittent Recovery Test, since performance in that similar shuttle running protocol was not correlated with the 30- or 50-m sprint performance [5].

The correlation coefficients found between the agility test and the distance covered during the YYIEL2 were similar to those reported in previous studies that considered the relation between VO\textsubscript{2}max and the results of the YYIEL2 [9]. The results are also in agreement with studies using the YYIEL1 (Level 1), meaning that the performance in Yo-Yo tests is not exclusively determined by subject’s maximal aerobic power [3].

High correlations between the distance covered in the Yo-Yo Intermittent Recovery Test – Level 2 (YYIR2) and physical performance during a game were found in adult elite football players [6]. Moreover, the YYIR2 also seems to be correlated with VO\textsubscript{2}max [5]. Thus, the YYIR2, more than the YYIE2, should be considered as a valid tool to evaluate football-specific endurance [3].

However, the YYIEL2 seems to differentiate the training level and the standard of the endurance capacity of players; our results showed that the YYIEL2 performance improved with age even when adjusting for the maturity status of young football players like in case of the Yo-Yo Intermittent Recovery Test [2]. The ability to accelerate, decelerate and turn contributes to the performance of young football players during the YYIEL2. Thus, when an increase in the intermittent endurance capacity of soccer players is intended, attention must be also devoted to the development of power-dependent skills.

### References


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