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Research article

VARIATION IN FOOTBALL PLAYERS' SPRINT TEST PERFORMANCE ACROSS DIFFERENT AGES AND LEVELS OF COMPETITION

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ABSTRACT

The purpose of this study was to compare sprint test performance performed by football players of different ages and levels of competition. One hundred and forty six Portuguese players from different teams completed the test (seven maximal sprints interspersed with 25 s active recovery). A 6 (level of competition: 1st national division, 2nd national division, 1st regional division, sub 16, sub 14, sub 12) × 7 (sprint trial: sprint 1, sprint 2, sprint 3, sprint 4, sprint 5, sprint 6, sprint 7) repeated measures ANOVA was carried out on subjects sprint times. The main effect of level of competition was statistically significant, $F_{(5, 140)} = 106.28$, $p < 0.001$. Subjects from 1st national division were significantly faster than subjects from 2nd national division; subjects from 1st regional division obtained similar performances when compared to sub 16 and sub 14 level; subjects from sub 12 level were the slowest. The main effect of sprint trial was also statistically significant, $F_{(6, 840)} = 7.37$, $p < 0.001$. Mean sprint times from the first trial were significantly slower than mean sprint times from the second, third and fourth trial. Results from the fifth, sixth and seventh trials were slower, denoting a decrement in performance. The two main effects were qualified by a significant level of competition × sprint trial interaction, $F_{(30, 840)} = 9.47$ $p < 0.001$, identifying markedly different performance profiles. Coaches should be aware that normative data regarding this test can play a very important role if used frequently and consistently during the whole season.

KEY WORDS: Football, repeated sprint ability, sprint test, young players, high-level players.

INTRODUCTION

The rate of work of a football player ranges between low-level activities like walking, jogging, and those of high intensity like sprinting. The final outcome of a match may be dependent upon a player's ability to perform a sprint faster than an opponent. Despite game sprinting representing less than 10% of total distance covered (Bangsbo et al., 1991), this performance is consensually considered as one of the most critical. Available researches have shown that professional players are faster than non professional players over distances ranging from 5 to 40 m (Davis et al., 1992). Additionally, in top class players the inter-player performance variation with these distances is very small, raising difficulties for the measurement and evaluation of this fitness component. For example, Balsom (1994) recorded sprint times from the Swedish National team performed on grass and measured with photoelectric cells over a course of 15 m with results ranging from 2.32-2.38 s.

The need of performing a sprint during a game varies and players must be ready to perform, recover

Table 1. Characteristics of the football players by competition level. Data are means (±SD).

Competition Level	Age (yrs)	Weight (kg)	Height (m)	Training (hours·week^{-1})
1st national (n = 19)	26 (3)	72.7 (5.5)	1.77 (5.6)	12
2nd national (n = 17)	24 (2)	70.4 (6.1)	1.76 (4.4)	10
1st regional (n = 30)	29 (5)	76.5 (8.2)	1.73 (4.3)	10
Sub 16 years (n =14)	16 (0)	60.7 (4.4)	1.70 (3.9)	10
Sub 14 years (n= 32)	14 (0)	55.1 (5.3)	1.66 (5.9)	8
Sub 12 years (n = 24)	12 (0)	46.8 (5.7)	1.50 (6.0)	4.5

and perform it again at the highest possible level. Thus, research should be focused to the measurement and evaluation of the ability to perform quality sprints consecutively. Bangsbo (1994) devised a sprint test which consists of seven 34.2 m sprints interspersed with 25 s active recovery periods and is often used by coaches as a field tool capable of measuring this ability. At the moment, methodological information regarding this test is limited to the study of Wragg et al. (2000) in which the authors demonstrated the validity and reliability of the test.

A very important topic of research that has not been adequately investigated is the ability of the sprint test to discriminate players performance across different ages and levels of competition and the inter sprint trial effect. In fact, these data can be turned into valuable information on the unique physiological demands of football performance. Additionally, such a test can guide coaches more effectively through conditioning and training programs across a season and also can help coaches to better understand differences between players.

Therefore, the purpose of this study was to compare sprint test performance across the 7 trials by players of different ages and levels of competition.

METHODS

Subjects

One hundred and forty six Portuguese football players from different teams volunteered to participate in this study (see Table 1). Subjects from the 1st and 2nd national levels were all professional players; whereas subjects from 1st regional division were semi-professional and sub 16, sub 14 and sub 12 subjects were all amateur. Before taking part, participants provided written informed consent and were told that they were free to withdraw at any time.

Procedures

At the time of test execution, all teams were approximately in the middle of the competition period. On the morning of the test, subjects were advised to consume two small snacks approximately 2-3 h before exercise. Each snack was designed to have an energy content of 100-150 kcal and contained 60%-65% carbohydrate. To ensure proper hydration 2 h prior to the test, adults and sub 16 players were instructed to consume approximately 1 l of water, whereas sub 14 and sub 12 players consumed 0.5 l. Additionally, during the 24 h before the test, subjects were advised to avoid drinking alcohol and caffeine containing fluids and any type of exercise. Subjects had all these instructions in writing, however verbal confirmation of compliance was given prior to test execution. Additionally, the young players (sub 12, sub 14 and sub 16) participation was authorized by their parents, who signed an informed consent containing all test procedures. Also, parents' were encouraged to be present at the test. All groups were tested between 10 h 00 and 13 h 00 to avoid any circadian variability. The test was performed outside on a grass surface. All subjects wore shorts and football shoes.

Before the test, subjects completed a 20 min warm up of jogging, sprinting and stretching, followed by a 5 min rest. In the sprinting period, each subject was allowed to perform one sprint along the test course for familiarization purposes. These pre-test procedures were the same for all groups.

The protocol consisted of seven maximal 34.2 m sprints (Bangsbo, 1994). Each sprint was performed with a change in direction as showed on Figure 1. Photoelectric cells (Digitest 1000, Digitest Oy, Finland) were used to measure the subjects' performance and to increase test reliability. Following each sprint there was a period of active recovery (25 s to cover a distance of 40 m), which consisted of jogging. Recovery was timed (stop-watch) in order to ensure that subjects returned to initial point of course between the 23rd and 24th second. Additionally, verbal feedback was given at 5, 10, 15, and 20 s of the recovery. Performance was measured as the mean sprint time in seconds.

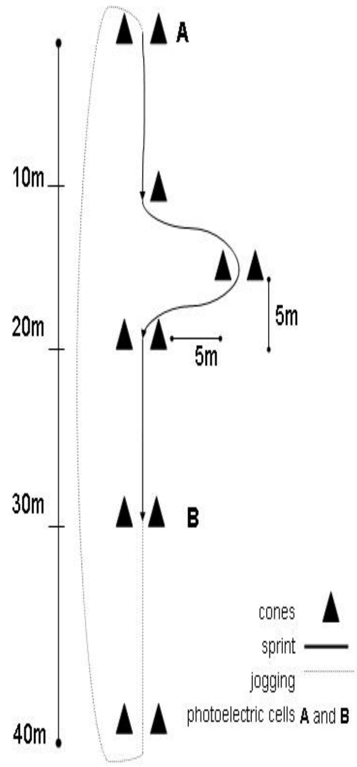

Figure 1. Diagram of sprint test protocol.

Data analysis

For statistical analysis, a 6 (level of competition: 1st national division, 2nd national division, 1st regional division, sub 16, sub 14, sub 12) × 7 (sprint trial: sprint 1, sprint 2, sprint 3, sprint 4, sprint 5, sprint 6, sprint 7) repeated measures ANOVA was carried out using with level of competition and sprint trial as factors (between and within factors, respectively). A Tukey post-hoc test was used to identify differences between levels and trials. All data undergoing ANOVA were tested for assumptions of normality, homogeneity of variance and covariance matrices and sphericity. Neither assumption was violated. Statistical significance was set at 5%.

RESULTS

The main effect of level of competition was statistically significant, $F_{(5,\ 140)} = 106.28$ $p < 0.001$. Tukey tests revealed that all pair wise comparisons were significant (all $p \leq 0.05$) with an exception between pair 1st regional and Sub 16 and pair 1st regional and Sub 14 (Figure 2).

Subjects from 1st national division were significantly faster than subjects from 2nd national division; subjects from 1st regional division obtained similar performances when compared to Sub 16 and Sub14; subjects from Sub 12 were the slowest.

The main effect of sprint trial was also statistically significant, $F_{(6,\ 840)} = 7.37$, $p \leq 0.001$ (Figure 3). Mean sprint times from the first trial were significantly slower than mean sprint times from the second, third and fourth trial. Results from the fifth, sixth and seventh trials were slower.

The two main effects were qualified by a significant level of competition × sprint trial interaction, $F_{(30,\ 840)} = 9.47$ $p \leq 0.001$, identifying markedly different performance profiles (Figure 4).

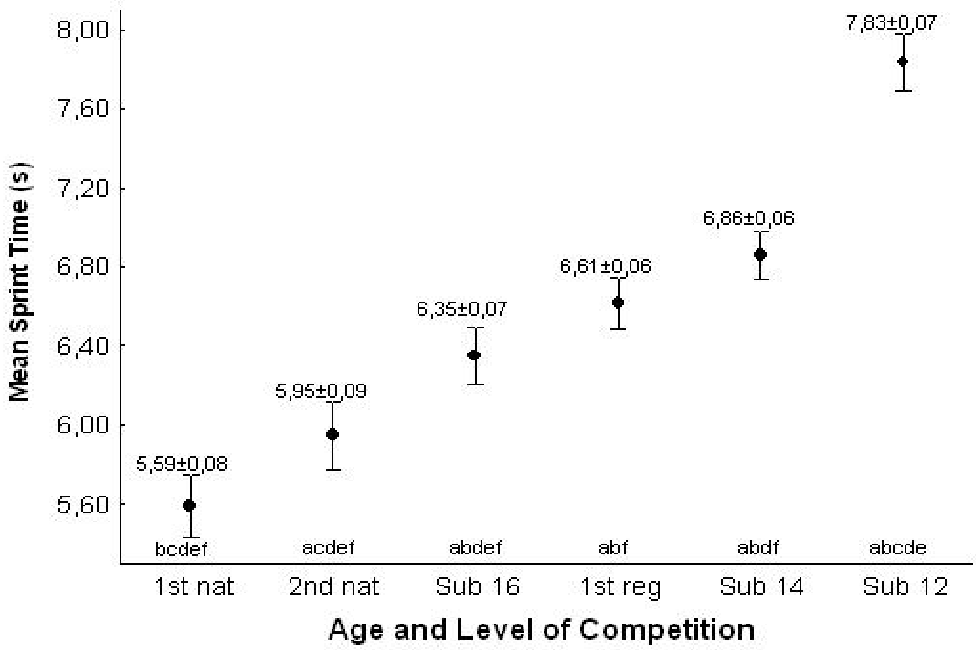

Figure 2. Mean sprint time (s) across levels of competition. Legend: a → significantly different from G1; b → from G2; c → from G3; d → from G4; e → from G5; f → from G6.

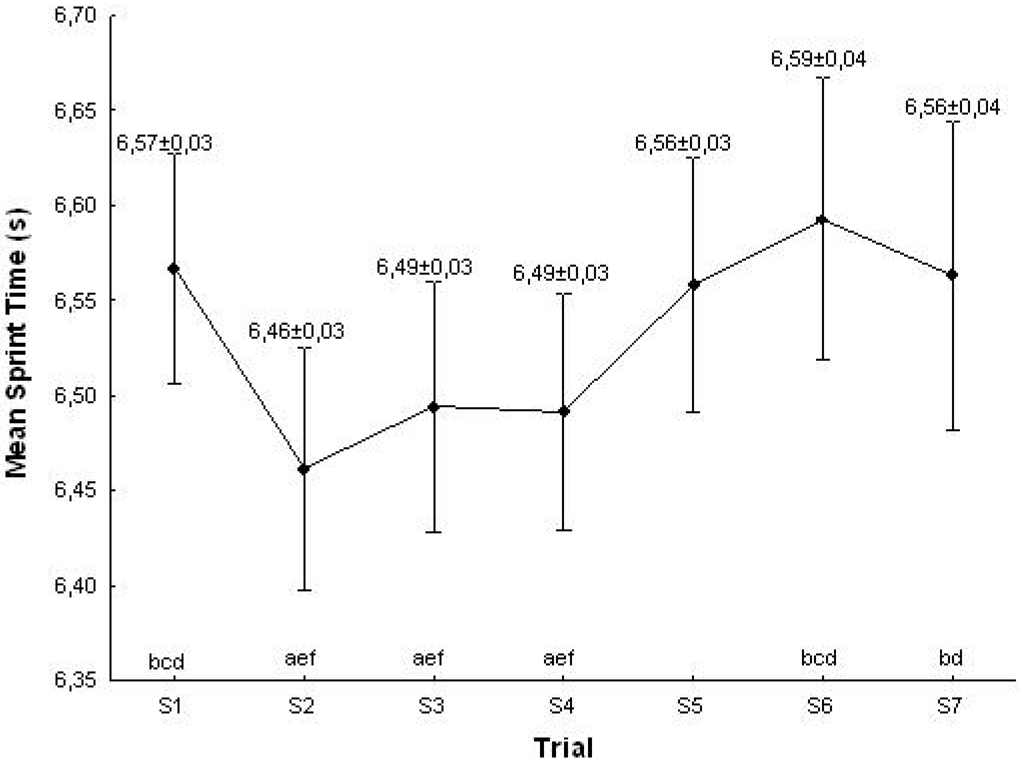

Figure 3. Mean sprint time (s) across the seven trials. Legend: a → significantly different from S1; b → from S2; c → from S3; d → from S4; e → from S6; f → from S7.

DISCUSSION

The main purpose of this study was to compare sprint test performance across the 7 trials on six different groups of football players. We hypothesized that these data can be turned into very valuable information for talent detection, fitness evaluation and planning. Similar studies showed that professional players tend to perform more high speed and moderate speed sprints than semi-professional (Reilly and Thomas, 1976; Bangsbo et al., 1991). Results concerning the repeated sprint ability in field conditions are only available in the field hockey game (Spencer et al., 2004). The authors' criterion for repeated-sprint activity (minimum of 3 sprints, with mean recovery duration between sprints of less than 21 s) was met on 17 occasions with a mean 4±1 sprints per bout. However, the authors have not investigated differences between players or teams. Our results pointed out important differences between groups, demonstrating professional players being superior to semi-professional players in repeated sprint ability. Thus, it appears that this capacity is developed in match situations.

The fact that higher mean times were observed from the 5th to the 7th sprint is very interesting and met the previous result of 4±1 sprints per bout registered in field hockey (Spencer et al., 2004). These fatigue effect can be explained by lactate accumulation and difficulties in creatine phosphate resynthesis (Ratel et al., 2004). As this resynthesis occurs primarily by oxidative processes it has been suggested that aerobic fitness is an important determinant of this performance (Bishop and Spencer, 2004).

Despite its utility for coaches, published research focusing on Bangsbo repeated sprint test is limited to the study of Wragg et al. (2000). Their subjects (seven national level student players from the United Kingdom) averaged 7.66±0.29 seconds to complete a sprint, which result is substantially different from those obtained in the senior groups of our study (1st and 2nd national divisions and 1st regional division). These differences can be explained by a modification done by the authors in the original protocol that involved adding a random right or left turn (using two light-emitting diodes, LED) in order to improve game specificity and also to place muscular demand upon both legs. Therefore, players were not aware if they had to make a right or left turn until the corresponding LED illuminates. This choice reaction task probably caused the subjects to produce much slower times.

Results from the main effects of level of competition revealed different performance profiles between the varying groups. On the other hand, based on previous research (Wragg et al., 2000), we believe that results from the main effects and pairwise differences of sprint trial seem to have

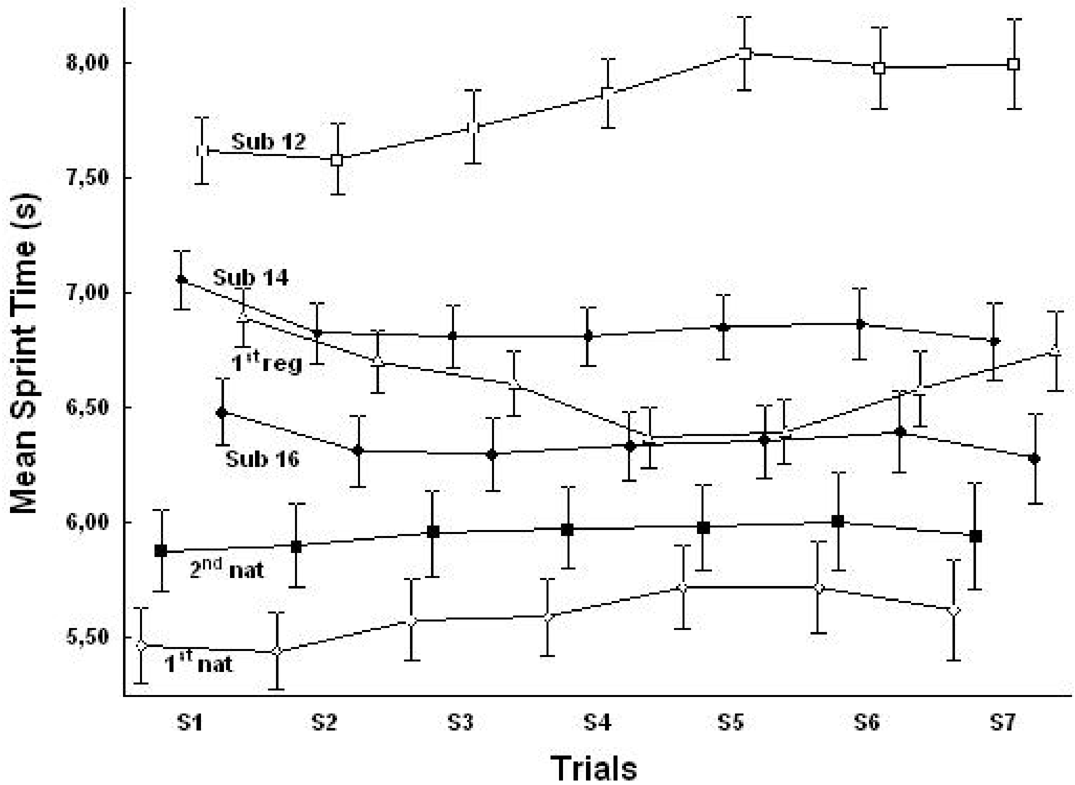

Figure 4. Mean sprint time (s) across levels of competition and trials.

identified the first sprint as a familiarization bout. Thus, it might be advisable to increase familiarization bouts in pre-test procedures.

Interestingly, the two main effects were qualified by a significant interaction, identifying markedly different performance profiles. These findings might help support the general hypothesis that an athletes' ability to maintain power over time is associated with their age and fitness level. However, there is no doubt that considerable human variation exists in the ability to perform maximally over a short period of time. According to Van Praagh and Doré (2002), differences between children and young adults' performances can be attributable to size dependent factors (e.g., muscle size) and size independent factors (e.g., genetics, hormonal factors). Anaerobic performance is mainly determined by fibre type proportion and glycolytic enzyme capacity of skeletal muscle which are clearly influenced by genetic factors. Despite these facts, there is always a training potential to be considered (Simoneau and Bouchard, 1998).

Anaerobic trainability increases with age (from childhood to adulthood with greater increases during puberty) and also with the increase in glycolytic enzyme activity (particularly phosphofructokinase) triggered by training (Fournier et al., 1982). The findings of our study seem to provide some additional field test support to these differences because groups of different ages (Sub 16, Sub 14 and Sub 12) and groups of different training quality (1st and 2nd national divisions and 1st regional division) were clearly discriminated by sprint test performances. Another interesting finding in our study was the fact that Sub 16 players' outruned 1st regional division players probably explained by age and weight differences which are determinant factors in short term muscle power (Van Praagh and Doré 2002).

Therefore, considering that during childhood and adolescence direct measurements of the rate or capacity of anaerobic pathways for energy turnover present several ethical and methodological difficulties (Van Praagh and Doré 2002), sprint test appears to be a good alternative field tool.

CONCLUSIONS

To conclude, professional players exhibited higher performances in sprint test that seems to be the result of a combined effect of age and level of competition. In all groups, the fatigue effects were the strongest between 5th to the 7th sprint, which may help the coaches to plan the training more effectively. Furthermore, coaches should be aware that normative data regarding this test may play a very important role if used frequently and consistently during the whole season. In fact, the knowledge of these results may allow the coaches to establish and monitor physical fitness and increase the validity of the player recruitment process.

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KEY POINTS

- Groups of different ages (Sub 16, Sub 14 and Sub 12) and groups of different training quality (1st and 2nd national divisions and 1st regional division) were clearly discriminated by sprint test performances.
- Professional players exhibited higher performances in sprint test.
- Fatigue effects were the strongest between 5th to the 7th sprint.

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