Assessment and Evaluation of Football Performance

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ABSTRACT

The most important variables for measuring performance in team sports such as football are physical condition and technical and tactical performance. However, because of the complexity of the game of football it is difficult to ascertain the relative importance of each of these variables. The aim of the present study was to develop a standardized test battery to evaluate physical performance in football players. The F-MARC test battery was designed to closely relate to the football player’s normal activity and comprised a functional, structured training session of approximately 2.5 hours. It included a “quality rating” of the warm-up procedure, tests of flexibility, football skills, power, speed, and endurance. The players finished with a cool-down. A total of 588 football players underwent the F-MARC test battery. Mean values for performance on each test are presented for groups of differing age and skill levels. The test battery proved to be a feasible instrument to assess both physical performance and football skills. This study supports the proposal by Balsom (1994) that analysis of an individual player’s physical profile, with respect to his strengths and weaknesses. According to Balsom, such physical profiles could be of use in objectively evaluating the effects of specific training programs. Similarly, an appropriate test battery could be of use in monitoring the progress of injured players during rehabilitation.

The test battery should yield information about the warm-up procedure, the flexibility and motion patterns of the main joints, about football skills, and about power, speed, and endurance. As comprehensive normative data are not currently available in the literature, the F-MARC database should serve as a baseline for comparison among different age groups, skill levels, and, in the future, between male and female athletes.

METHODS

The performance tests were designed to closely relate to the football player’s normal activity and comprised a functional, structured training session of approximately 2.5 hours. After motivating the players and describing the aims of the tests, the evaluation began with a warm-up. This was followed by the evaluation of flexibility, football skills, power, speed, and endurance. The players finished with a cool-down. All performance tests were conducted by eight specially trained physical education students and physical therapists within the last 9 weeks of the playing season (middle of April to beginning of June).

The methodology employed during the tests is summarized in the following paragraphs. Details are described in a specially developed manual that is available from the authors (F-MARC Test Battery Manual, 1997). To make the test battery similarly useful in less-developed countries, advanced laboratory testing procedures were not employed.
Motivation

The positive engagement of participants in the performance tests was of great importance for the quality of data collected. If the participants had not been clear about the aims of the investigation, or if the exercises included did not seem relevant, the motivation of the player and hence the validity of the results would have been diminished. Thus, before starting the battery of tests, the players were informed in detail about the aims and methods of the tests.

From the motivational point of view, it was essential to arouse the curiosity and competitive instinct of the players—with respect to both their own individual condition, agility, and mental fitness, and their standing among their peers and the “super stars”—as well as to encourage them to perform the tests with full concentration and maximum effort.

Warm-up Rating

Before the performance tests began, the players were instructed to perform their “usual” warm-up for 15 minutes. During the warm-up the players were observed and the investigators rated how well each of them prepared for the forthcoming exercises. In rating them, certain qualitative aspects were evaluated, for example, the choice of exercises, the order in which they were performed, and the quality of their execution.

The investigator rated the quality of the warm-up separately for cardiopulmonary, muscular, and coordination aspects, on a five-point scale (1, good; 2, fairly good; 3, average; 4, fairly poor; 5, poor).

Flexibility Tests

Seven flexibility exercises were designed to assess the functional condition of the main muscle groups and to identify possible imbalances.

Leg Raise in a Supine Position (Fig. 1). This exercise allows assessment of the flexibility of the dorsal muscles of the lower extremity. The player lies with his back on top of a board next to a (vertical) wall on which a semicircle is marked out in degrees. The player’s right hip should be

![Figure 1. Leg raise in a supine position.](image)

Sideways Leg Splits (Fig. 2). This exercise allows assessment of the flexibility of (mainly) the adductor muscles. The test should be preceded by easy stretching. The player stands on a smooth board and supports himself with both hands (for example, on a chair). His feet are turned outward. Then he slides both feet slowly apart. Care should be taken to see that the trunk remains upright (vertical line on the wall). The examiner measures the distance between the symphysis and the ground and the distance between the heels; measurement is in units of 0.5 cm.

Lengthwise Leg Splits (Fig. 3). This exercise allows assessment of flexibility of the hamstring and quadriceps muscle groups in the hip region. The test should be preceded by easy stretching. The player kneels on one leg, with the other leg stretched out in front. He supports

![Figure 3. Lengthwise leg splits.](image)
himself with one hand (for example, on a chair). Then he slides the extended leg forward, with the other knee remaining on the floor. Care should be taken to see that the buttock area remains upright (vertical line on the wall) and that there is no rotation of the hips. The examiner measures the distance between the symphysis and the ground and the distance between the back knee and front heel. Both right and left side are measured; measurement is in units of 0.5 cm.

Single-Legged Knee Bend (Fig. 4). This exercise allows assessment of the flexibility of the quadriceps muscles. The player kneels on one leg, with the opposite leg out in front, the lower part kept vertical. He supports himself with both hands (for example, on stools). Then he slides the knee as far back as possible. Care should be taken to see that his trunk remains upright (vertical line on the wall), that there is no rotation of the hips, and that the lower part of the front leg remains vertical. The examiner measures the distance between the symphysis and the ground, and the distance between the back knee and the front heel. Both right and left sides are measured; measurement is in units of 0.5 cm.

Bending Backward (Fig. 5). This exercise allows assessment of the flexibility of the quadriceps muscles and the strength of the abdominal muscles. The player kneels sideways in front of a wall with degree markings. His
Knees should be level with the bottom of the vertical line, so that when he bends backward he will be parallel to the scale markings. To avoid bending the hips, his trunk is fixed to a board. The player should bend backward slowly. The examiner guides the player with a hand under his back but does not support him. The player should hold the maximum backward position for 1 second. The examiner measures the degrees of backward bending in units of 5°.

Sideways Bending (Fig. 6). This exercise allows assessment of the lateral flexibility of the trunk muscles and of the spine. The player stands on a firm surface with his back against a wall with horizontal markings. He is strapped with three belts (around the ankles, below the knees, and around the thighs). He is then instructed to move slowly as far as possible, first to the right, then to the left. Both shoulder blades should remain in contact with the wall during the movement. The examiner measures the degrees of backward bending in units of 5°.

Forward Trunk Bending (Fig. 7). This exercise allows assessment of the flexibility of the spine and the hamstring muscles. The player stands on a box, which has a scale marked out on the extended front side. The distance between the player’s feet is set with a wooden block. The toes are level with the front of the box. The player bends slowly forward (without swinging) and touches the front of the box with both hands. The examiner measures the point where the tip of the middle fingers touches the scale. Measurement is in units of 0.5 cm.

Football Skills

Eight tests of football skill allowed assessment of the player’s profile in relation to the most important football techniques.

Juggling (Foot) (Fig. 8). This test allows assessment of football coordination. The player juggles the ball with his foot, trying to touch the ball as many times as possible without letting it hit the ground. If he manages 25 touches at the first attempt, no further attempts are needed. To start, the ball is dropped to the foot by hand. The examiner measures the best of three attempts on the right and left sides. The measurement unit is 1 point per ball contact.

Juggling (Body) (Fig. 9). This test allows assessment of football coordination of various parts of the body. The examiner throws the ball from a 5-meter distance to the player, who tries to play the ball in the following order: 1) chest-foot-head, 2) head-left foot-right foot, 3) foot-chest-head. The examiner measures a total of three attempts per exercise. The measurement unit is 1 point per successful attempt.

Speed Dribbling (Fig. 10). This test allows assessment of coordinated dribbling under time pressure and assessment of speed. On the signal “Ready—Go,” the player starts with the ball from behind the line (1 on the figure). After 5 meters he dribbles to the right, around the...
first post of a triangle (2). Following the set order, he dribbles around the other posts. After 10 meters he dribbles around a block (3). Then after 8 meters he plays the ball around one side of a square (4) and runs around the other side (5) to collect it (6). Then he sprints through a gate and puts his foot on the ball (7). The examiner measures the time taken from the “Go” signal until the player has the ball under his foot. Measurement is made with a stopwatch in units of 0.1 seconds.

**Long Passing (Fig. 11).** This test allows assessment of passing accuracy and shooting power over a long distance. The player passes the ball from its dead position on the line into a circle (radius, 2 meters; distance, 36 meters) marked in the middle of a square target area (10 × 10 meters). The player has a trial attempt first. The examiner measures a total of five attempts. The measurement unit is points; 3 if the ball lands in the circle or touches its circumference and 1 point if the ball lands elsewhere in the square.

**Short Passing (Fig. 12).** This test allows assessment of accuracy and coordination in passing a moving ball. The player dribbles the ball within a marked rectangle up to a line and from there passes accurately into a hockey goal 11 meters away. The examiner measures a total of five attempts, scoring 3 points if the ball goes into the goal and 1 point if the ball hits the crossbar or goalpost.

**Shooting (Dead Ball) (Fig. 13).** The test allows assessment of accuracy and coordination in shooting from a dead ball. A ball is placed 16 meters from the middle of the goal. The player shoots into the goal, which is divided into six segments. He aims first for the top right, then for the top left segment. The examiner measures a total of three attempts each at the top right and top left segments. Three points are scored if the player shoots into the correct segment, 1 point if the player hits the crossbar or goalpost.
of this segment, 1 point if the player shoots into the top middle segment, and 0 points for shooting into the lower segments.

**Shooting From a Pass (Foot) (Fig. 14).** This test allows assessment of accuracy and coordination in shooting from a ground pass. A 20-meter ground pass is played by the examiner from the edge of the penalty area, level with the goalkeeper’s box, to the penalty spot. After a short run-up, the player shoots into the goal, which is divided into six segments. If the pass is not accurate enough then the attempt is repeated. The examiner measures a total of five attempts, scoring 6 points if the player shoots into the top right or left segments, 1 point if the player hits the crossbar or goalpost of these segments, 2 points if he shoots into the top middle segment, and 1 point if he shoots into the lower segments.

**Heading (Fig. 15).** This test allows assessment of accuracy and coordination in heading a ball. The test is conducted from two vantage points. First, the examiner stands 3 meters in front of the middle of the goal and lobs the ball to the penalty spot. The player stands 3 meters behind the penalty spot while waiting for the ball and then advances to head it into the goal, which is divided into six segments. The player has a trial attempt. For the first part of the test, the examiner measures a total of three attempts: 6 points are scored if the ball goes into the top right or top left segment, 1 point if the ball hits the crossbar or goalpost of these segments, 3 points if the ball goes in the lower left or right segments, and 0 points if it goes in the lower middle segment. For the second part of the test, the examiner measures a total of three attempts: 6 points are scored if the ball goes into the top left segment, 1 point if the ball hits the crossbar or goalpost of this segment, 3 points if the ball goes in the lower left segment, 2 points if the ball goes in the top middle segment, 1 point if the ball goes in the lower middle segment, and 0 points if the ball goes in the right segment.

**Power, Speed, and Endurance Tests**

Seven exercises were designed to assess the most important qualities of the players’ physical condition/fitness level.

**Two-Footed Vertical Jump (Fig. 16).** This test allows assessment of two-footed vertical jumping ability. The player stands on the soles of his feet facing a wall with a marker board on it and stretches his arms upward, making a mark with chalk that has been rubbed onto his middle finger. Then he makes an explosive two-footed jump upward and marks the wall again with the chalk on his finger at the highest point he reaches. The examiner measures the highest of three attempts, recording the
difference between the standing chalk mark and the jumping chalk mark. Measurement is in units of 0.5 cm.

**Triple Hop (Fig. 17).** This test allows assessment of single-legged horizontal jumping ability. The player stands in a stepping position behind the take-off line with his right leg forward. The right foot—at least the heel—must be in contact with the ground. The player then takes three hops on the right leg, going as far as possible. The exercise is repeated with the left leg. The examiner measures the best of three attempts for the right and left sides. The tape measure is placed at the rearmost mark and extended straight back to the take-off line. Measurement is in 1 cm units.

**Long Kick (Fig. 18).** This test allows assessment of kicking power. After a one-step run-up, the player kicks the ball from his hands as far as possible. The ball lands in the sector or on the boundary line, where an assistant marks the point of landing with a numbered marker. The examiner measures the best of three attempts. One end of the tape measure is held where the ball lands, the other at the intersection point of the two sector lines. Measurement is in units of 5 cm.

**Long Throw-In (Fig. 19).** This test allows assessment of two-handed throwing strength. The player stands on the arc and takes a two-handed throw-in with his arms overhead. The ball lands in the sector or on the boundary line, where an assistant marks the point of landing with a numbered marker. The examiner measures the best of three attempts. The ball must land in the sector or on the line. One end of the tape measure is held where the ball lands, the other at the intersection point of the two sector lines. Measurement is in units of 5 cm.

**Four-Line Sprint (Fig. 20).** This test allows assessment of sprinting ability and intensive acceleration. The player lies on the ground behind the starting line (A). On the signal “Ready—Go,” he runs 10 meters to line B and touches this with his foot. Then he turns, runs from line B 20 meters back to line C and touches this line. He then turns again, runs 10 meters from line C to line A and touches this line, turns, and then runs 30 meters to the finish line between two flag posts. The touching of the

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**Figure 15.** Heading.
lines should be checked. Using a hand-held stopwatch, the examiner measures in units of 0.1 seconds the time between the “Go” signal and crossing the finish line.

Three-Corner Run (Fig. 21). This test allows assessment of speed endurance and anaerobic endurance. Before the start, the player’s pulse is measured at rest. On the signal “Ready—Go,” he runs in a triangle from the flag post at the start, 80 meters to the flag post (1), around it, 20 meters to the flag post (2), around it, 82.4 meters back to the start, around this flag post and then 20 meters to the finishing line (4). Directly after the run and then 2 minutes later his pulse is measured again. The examiner measures the time between the “Go” signal and crossing the finish line with a hand-held stopwatch. The pulse rate is measured before the start, directly after the finish, and again 2 minutes after the run. Measurement is in units of 0.1 seconds for the time and heart beats per minute for the pulse.

Twelve-Minute Run. This test allows assessment of aerobic endurance. Before the start, the player’s pulse is measured at rest. On the signal “Ready—Go,” he runs as many laps as possible. The laps are counted aloud by the examiner as the runner passes. On the stop signal, the examiner should be near to the player to note the exact distance run and to take his pulse. The pulse is measured again at 1, 3, and 5 minutes after the run. Measurement is in meters for distance covered and in beats per minute for pulse.

Definition of Age and Skill-Level Groups
Players were grouped according to age and skill level of their team. Adult players were categorized into four skill-level groups: top-level adults (first and second league), third league, amateur teams (Division), and local teams. Youth players were divided into two age groups (14- to 16-year-old players and 16- to 18-year-old players) and two skill-level groups (high and low).

Statistical Analysis
All data were processed on a Macintosh computer (Apple Computers, Cupertino, California) using Microsoft Office (Microsoft Corp., Redmond, Washington). The statistical procedures were accomplished using StatView (version 4.5; SAS Institute Inc., Cary, North Carolina) and SPSS (version 6.1; SPSS Inc., Chicago, Illinois). Methods applied were frequencies, cross-tabulations, descriptives, and means. Differences between groups were examined by
-tests. Unless otherwise stated, only results that were significant at the 5% level or less are presented.

Sample

A total of 588 players from Germany, France, and the Czech Republic were examined. The ages of the players ranged from 14 to 41 years (mean, 18.4; SD, 4.0) (see Table 1 in “Medical History and Physical Findings in Football Players of Different Age and Skill Levels”).

RESULTS

The mean values of all tests are presented in Tables 1 through 4. In each age group, the results of high-level players were compared with those of the low-level players.

Adult top-level players achieved significantly better results when compared with adult players of lower skill level in the areas of quality of warm-up, speed dribbling, triple

<table>
<thead>
<tr>
<th>TABLE 1</th>
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<tbody>
<tr>
<td>Quality Rating for Warm-up in Football Players of Different Age and Skill Levels</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rating</th>
<th>Adult players</th>
<th>Youth (16–18 years)</th>
<th>Youth (14–16 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Top-level (N = 40)</td>
<td>Third league (N = 41)</td>
<td>Amateur teams (N = 25)</td>
</tr>
<tr>
<td>Cardiopulmonary</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>(1 = good to 5 = poor)</td>
<td>2.7 (1.2)</td>
<td>2.9 (1.3)</td>
<td>3.8 (0.9)</td>
</tr>
<tr>
<td>Muscular</td>
<td>1.8 (1.0)</td>
<td>2.1 (1.0)</td>
<td>3.3 (1.0)</td>
</tr>
<tr>
<td>(1 = good to 5 = poor)</td>
<td>1.7 (0.7)</td>
<td>1.9 (0.9)</td>
<td>2.7 (0.7)</td>
</tr>
</tbody>
</table>

\(a\) Significance of difference from top or high-level players of the same age group: \(P \leq 0.05\).

\(b\) Significance of difference from top or high-level players of the same age group: \(P \leq 0.01\).

\(c\) Significance of difference from top or high-level players of the same age group: \(P \leq 0.001\).
Tests of Flexibility in Football Players of Different Age and Skill Levels

<table>
<thead>
<tr>
<th>Test</th>
<th>Adult players</th>
<th>Youth (16–18 years)</th>
<th>Youth (14–16 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Top-level (N = 40)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active raising right leg in a supine position (deg)</td>
<td>77.9 (8.7)</td>
<td>77.2 (9.9)</td>
<td>71.4 (8.6)</td>
</tr>
<tr>
<td>Passive raising right leg in a supine position (deg)</td>
<td>90.7 (9.5)</td>
<td>95.5 (9.4)</td>
<td>86.9 (8.9)</td>
</tr>
<tr>
<td>Active raising left leg in a supine position (deg)</td>
<td>75.9 (7.7)</td>
<td>78.6 (7.1)</td>
<td>72.4 (13.2)</td>
</tr>
<tr>
<td>Passive raising left leg in a supine position (deg)</td>
<td>88.3 (7.6)</td>
<td>90.0 (5.7)</td>
<td>82.3 (12.6)</td>
</tr>
<tr>
<td>Bending to the right side (cm)</td>
<td>25.1 (3.3)</td>
<td>25.5 (4.2)</td>
<td>25.6 (3.7)</td>
</tr>
<tr>
<td>Bending to the left side (cm)</td>
<td>25.1 (3.5)</td>
<td>25.4 (3.7)</td>
<td>24.9 (3.9)</td>
</tr>
<tr>
<td>Leg splits forward, right leg to ground (cm)</td>
<td>38.2 (3.0)</td>
<td>38.0 (3.6)</td>
<td>39.6 (2.8)</td>
</tr>
<tr>
<td>Leg splits forward, left leg to ground (cm)</td>
<td>37.7 (3.2)</td>
<td>38.4 (3.0)</td>
<td>39.4 (3.3)</td>
</tr>
<tr>
<td>Bending backward (deg)</td>
<td>56.3 (6.9)</td>
<td>57.1 (6.4)</td>
<td>55.1 (7.9)</td>
</tr>
<tr>
<td>Leg splits sideways, symphysis to ground (cm)</td>
<td>48.4 (10.5)</td>
<td>51.5 (7.9)</td>
<td>54.5 (8.9)</td>
</tr>
<tr>
<td>One-legged knee bend, right symphysis to ground (cm)</td>
<td>31.1 (3.9)</td>
<td>31.4 (3.5)</td>
<td>31.2 (3.7)</td>
</tr>
<tr>
<td>One-legged knee bend, left symphysis to ground (cm)</td>
<td>31.0 (3.6)</td>
<td>31.0 (3.1)</td>
<td>32.4 (3.3)</td>
</tr>
<tr>
<td>Forward trunk bending, fingertips to ground (cm)</td>
<td>-5.6 (7.7)</td>
<td>-7.7 (5.1)</td>
<td>-0.9 (8.5)</td>
</tr>
</tbody>
</table>

Significance of difference between high- and low-level players within each age group after correction for height: $P < 0.05$.

Significance of difference between high- and low-level players within each age group after correction for height: $P < 0.01$.

Significance of difference between high- and low-level players within each age group after correction for height: $P < 0.001$.

Tests of Football Skills in Football Players of Different Age and Skill Levels

<table>
<thead>
<tr>
<th>Test</th>
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<th>Youth (16–18 years)</th>
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<tr>
<td></td>
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</tr>
<tr>
<td>Top-level (N = 40)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long pass (points)</td>
<td>6.8 (2.3)</td>
<td>7.0 (2.4)</td>
<td>6.6 (2.8)</td>
</tr>
<tr>
<td>Short pass (points)</td>
<td>10.1 (3.6)</td>
<td>9.0 (2.5)</td>
<td>10.4 (3.1)</td>
</tr>
</tbody>
</table>

Significance of difference from top- or high-level players of the same age group: $P < 0.05$.

Significance of difference from top- or high-level players of the same age group: $P < 0.01$.

Significance of difference from top- or high-level players of the same age group: $P < 0.001$.
pass; two-footed vertical jump; triple hop; long throw-in; long kick; four-line sprint; three-corner run; and the 12-minute run. The pulse rate of high-level players immediately after, 1 minute after, and 5 minutes after the 12-minute run was significantly lower than that of low-level players at the same time points (Tables 1 through 4).

CONCLUSION

Compliance with the tests, which required 180 minutes to complete, was excellent in all subgroups. The comprehensive information given to the teams before the tests, the relevance of the tests to the footballers' normal activity, as well as the complete dedication of the examiners, were probably the most important factors motivating the players and allowed for the generation of reliable test results. Mean values in different age and skill-level groups were established for tests of flexibility, football skills, power, speed, and endurance.

In comparing different age and skill levels, we found no systematic differences for flexibility or for accuracy in shooting or heading into the goal. Forward trunk bending was the only flexibility test that revealed (after correction for body height) differences between high- and low-level groups. Among the football skill tests, speed dribbling was the most powerful in discriminating between age and skill levels. In youth players, dexterity tests (juggling, passing) differed significantly between high- and low-level groups.

All power, speed, and endurance tests discriminated between age and skill-level groups, especially in youth players. The significant differences between the quality of the warm-up performed by the different skill-level groups possibly reflected the lower standard of training in less skilled players.

In summary, the F-MARC test battery proved to be a feasible instrument for assessing physical performance as well as football-specific skills. The results have not been systematically checked for their reproducibility because of the complexity of the examination. However, they are presented as a database for comparative purposes in future studies, such as in the evaluation of different socio-cultural environments on performance and the incidence of injuries.

The present study strongly supports the proposal by Balsom\(^1\) that analysis of an individual player's physical profile, in relation to mean values for a similar age group and skill level, might be of assistance to the coach in objectively evaluating the effects of a specific training program. It may also be of use to the responsible physician and physical therapist in monitoring progress during rehabilitation after football injuries.

REFERENCES