Relationship between agility and change of direction speed in soccer players

Abstract of the PhD Thesis

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INTRODUCTION

Field sports are constantly evolving, and players must be in possession of high fitness level to cope with the physical demands of the increasing pace of matches. It can also be stated that the physical background of performance is very complex in these sports. One of the most important factors of success is the ability to perform effectively in tight areas and in very short time intervals. To solve these kind of game situations, players must perform rapid and accurate changes of direction very often. Changes of direction occur in open-skilled sports most of the time in decision-making situations. Players make decisions according to the procession of stimuli from their environment. They perform their movements, also changes of directions, as the conclusions of these decisions. The complex ability to perform the above-mentioned movements is called agility in the scientific literature. There is a consensus that agility is not the same as the ability required to run at maximum speed in a straight line.

According to the definition of Sheppard and Young (2006) agility is "a rapid whole-body movement with change of velocity or direction in response to a stimulus". There are two main components of agility: physical component and perception and decision-making factors (also called cognitive component).

In contrast, traditional agility tests are pre-planned and do not contain reacting to a stimulus. Authors in this field aimed to develop agility tests, which contain the perception and decision-making component, too. In these tests participants must react to a visual stimulus and make changes of direction according to these reactions. This kind of tests are called reactive agility tests and the traditional, pre-planned running tests with directional changes are called change of direction speed (CODS) tests.

Authors assess the relationship between reactive agility and CODS test completion times. Most of the above-mentioned studies have found a significant correlation between CODS and reactive agility test times. This finding could question the separate use of reactive agility and CODS. It can be stated that most of these studies used reactive agility tests with only one change of direction in response to a stimulus, so participants had to change direction once while running. Furthermore, in most of these tests, participants had

two alternatives in the decision-making situations, namely running to the left, or right. Only a few studies investigated reactive agility using running tests with more directional changes, and with more than two directional alternatives during change of direction. The question arises, is there any relationship between reactive agility and CODS, if the running tests contain more changes of direction and more complex decision-making situations.

We assessed the agility of soccer players in our study, using a reactive agility test, in which participants had to response to a visual stimulus and change running direction repeatedly, and with more directional alternatives. We also examined the relationship among reactive agility, CODS, leg power, and movement frequency.

OBJECTIVES

After reviewing the literature, the following aims were set:

Our first aim was to assess the relationship between reactive agility and CODS using running tests with four directional changes, and with eight directional alternatives during the changes of direction in the reactive agility test.

The second aim was to assess the relationship among the above-mentioned reactive agility and CODS test times and results of vertical jump test.

Our third aim was to assess the relationship among the above-mentioned reactive agility and CODS tests and results of foot tapping test.

According to our aims the following hypotheses were formulated:

Hypotheses about differences between reactive agility and CODS test times:

1. The total time in the reactive agility test is longer than the total time in the CODS test, using a reactive agility test with four directional changes and with eight directional alternatives during change of direction, and a CODS test with four directional changes.

2. Contact time is longer in the reactive agility test than in the CODS test

3. There is no difference between time intervals between the changes of direction (split times) in the reactive agility and CODS tests

Hypotheses about the relationship between reactive agility and CODS test times:

4. There is no significant relationship between total times in the reactive agility and CODS tests

5. There is no significant relationship between contact times in the reactive agility and CODS tests

6. There is a significant relationship between split times in the reactive agility and CODS tests

Hypotheses about the relationship between the results of CODS test and vertical jump tests:

7. There is a significant relationship between total time in the CODS test and jumping height in the vertical jump test

8. There is a significant relationship between contact time in the CODS test and jumping height in the vertical jump test

Hypothesis about the relationship between the results of reactive agility and vertical jump test:

9. There is no significant relationship among results of the reactive agility test and vertical jump test

Hypothesis about the relationship between the results of CODS and foot tapping tests:

10. There is a significant relationship among results of CODS and foot tapping tests.

Hypothesis about the relationship between the results of reactive agility and foot tapping tests:

11. There is no significant relationship among results of reactive test agility and foot tapping test

METHODS

Participants:

Our sample consisted of 16 amateur male soccer players from Hungarian third and fourth division teams (24.1 ± 3.3 years; 72.4 ± 7.3 kg; 78.7 ± 6 cm). Participants were outfield players with at least ten years of playing experience in soccer.

Device:

All tests were conducted on the SpeedCourt system (Globalspeed GmbH, Hemsbach, Germany). The device consists of a square court (4 x 4 m), a TV screen and a personal computer. There are nine pressure sensors on the court arranged in 30 x 30-cm squares. CODS, reactive agility, vertical jump and tapping tests can also be carried out on this system. The square court and the nine pressure sensors are represented on the TV screen. During reactive agility testing one of the squares turns yellow on the screen. Participants have to follow the yellow squares while running on the court and touching the appropriate sensor with one of their feet. As soon as the player touched the appropriate

sensor another square turned yellow on the screen. This process was repeated until touching the last sensor.

Procedures:

After standardized warm-up, participants completed the following tests in the same order: CODS, vertical jumping, tapping and reactive agility.

CODS test: The CODS test used in this study was a 14.5 m long running test on the SpeedCourt and it contained four changes of direction. We described to the participants which sensors to touch and in what order. Participants completed the test three times with a 1-minute rest between trials. Total time (ToC), contact time (ATuC) and split time (ASC) were measured during the test. Total time refers to the time interval from the start signal to the moment the participant's foot touched the fifth pressure sensor. Turn time refers to the time interval from the moment the participant's foot touched the pressure sensor to the moment it left the sensor while changing direction. The average of the four turn times was calculated. Split time refers to the time interval between the moment the participant's foot left a pressure sensor and the moment the participant's foot touched the next sensor. The average of the five split times was calculated. The best attempt with the shortest total time was used for statistical analyses.

Reactive agility test: Participants completed the reactive agility test subsequent to touching five pressure sensors in a row, thus they completed a running test with four directional changes. Participants completed five different running patterns with a 1-minute rest between trials. The running patterns were different from each other and every participant completed the same five patterns in the same order. The average of total times (AToA), the average of turn times (ATuA) and the average of split times (ASA) were used for statistical analyses.

Tapping test: Participants made as many alternating foot contacts in standing position as possible within 3 seconds. The test was repeated three times with a 1-minute rest between trials. The number of foot contacts within three seconds were measured during the test (Tap).

Counter-Movement Jump (CMJ) test: Participants jumped from standing position, without any arm movement, holding their arms on the hips. The test was repeated three times with a 1-minute rest between trials. Jumping height was registered during the test.

Statistical analyses: Pearson correlation analysis was used to examine relationships between variables. Significance level was set to $p \leq 0.05$. Student's paired t-tests was used to assess differences between means. Bonferroni adjustment was used to eliminate the problem of enhanced risk of type I error. Significance level $p \leq 0.017$ was used for pairwise comparisons. Statistical analyses were conducted using the Statistica software, version 12.0 (StatSoft Inc., Tulsa, OK, USA)

RESULTS

Differences between reactive agility and CODS times:

AToA was found to be longer than ToC ($p < 0.0001$). No difference was observed between ATuA and ATuC. ASA was longer than ASC ($p < 0.001$).

Relationships between reactive agility and CODS times:

Nonsignificant correlations were found between AToA and ToC ($r = 0.245$; $p > 0.05$), ATuA and ATuC ($r = 0.333$; $p > 0.05$), ASA and ASC ($r = 0.307$; $p > 0.05$).

Relationships among CODS test times and vertical jump height:

Nonsignificant correlations were found between ToC and CMJ ($r = 0.242$; $p > 0.05$), ATuC and CMJ ($r = 0.242$; $p > 0.05$), ASC and CMJ ($r = 0.102$; $p > 0.05$).

Relationships among reactive agility test times and vertical jump height:

Nonsignificant correlations were found between AToA and CMJ ($r = - 0.308$; $p > 0.05$), ATuA and CMJ ($r = - 0.322$; $p > 0.05$), ASA and CMJ ($r = - 0.108$; $p > 0.05$).

Relationships among CODS test times and foot tapping count:

Nonsignificant correlations were observed between ToC and Tap ($r = -0.038$; $p > 0.05$), ATuC and Tap ($r = 0.186$; $p > 0.05$), ASC and Tap ($r = -0.134$; $p > 0.05$).

Relationships among reactive agility times and foot tapping count

Nonsignificant correlation was found between AToA and Tap ($r = -0.255$; $p > 0.05$). Significant positive correlation was observed between ATuA and Tap ($r = 0.529$; $p < 0.05$). Significant negative correlation was found between ASA and Tap ($r = -0.513$; $p < 0.05$).

Relationship between foot tapping count and vertical jump height

Nonsignificant correlations were observed between Tap and CMJ ($r = 0.232$; $p > 0.05$).

CONCLUSIONS

1. Our first hypothesis has been verified, because total time in the reactive agility was found to be significantly longer than total time in the CODS test.
2. The second hypothesis has not been verified, because no difference was found between turn times in the reactive agility and CODS tests.
3. Our third hypothesis has not been verified, because split time in the reactive agility test was found to be significantly longer than split time in the CODS test.
4. The fourth hypothesis has been verified, because a nonsignificant correlation was found between total time in the reactive agility test and total time in the CODS test.
5. The fifth hypothesis has been verified, because a nonsignificant correlation was found between turn time in the reactive agility test and turn time in the CODS test.
6. Our sixth hypothesis has been verified, because a nonsignificant correlation was found between split time in the reactive agility test and split time in the CODS test.
7. The seventh hypothesis has not been verified, because no significant correlation was found between total time in the CODS test and vertical jump height.

8. Our eighth hypothesis has not been verified, because no significant correlation was found between turn time in the CODS test and vertical jump height.
9. The ninth hypothesis has been verified, because no significant correlation was found between total time, turn time, split time in the reactive agility test and vertical jump height.
10. Our tenth hypothesis has not been verified, because no significant correlation was found between variables measured in the CODS test and foot tapping count.
11. The eleventh hypothesis has been partly verified. No significant correlation was found between total time in the reactive agility test and foot tapping count. Significant negative correlation was found between split time in the reactive agility test and foot tapping count. Significant positive correlation was found between turn time in the reactive agility test and foot tapping count.

LIST OF OWN PUBLICATIONS

Original research papers in connection with the thesis:

Matlák J, Rácz L, Tihanyi J. (2017) Assessment of repeated reactive agility performance in amateur soccer players. Sci Sports, 32: 235-238.

Matlák J, Tihanyi J, Rácz L. (2016) Relationship between reactive agility and change of direction speed in amateur soccer players. J Strength Cond Res, 30: 1547-1552.

Matlák J, Rácz L, Tihanyi J. (2014) Az agilitással kapcsolatos kutatások áttekintése. Magyar Sporttudományi Szemle, 15: 23-31.