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Selection of agility tests according to sports branches in terms of basic motor characteristics

Izzet Ucan

Department of Coaching Education, School of Physical Education and Sports, Bayburt University, Bayburt, Turkey.

ABSTRACT

The aim of this study is to determine the most usable of the three most commonly used tests for male and female athletes, which are applied to determine the agility levels of athletes according to sports branches in terms of their basic motor characteristics. The research group consists of a total of 72 volunteer students, 26 females and 46 males, who were studying at the Coaching Department at Bayburt University School of Physical Education and Sports. In the study, the Sit and Reach test, Takkei brand back and leg dynamometer, 20-meter speed test, T-test which is one of the agility tests, the 505 test and Illinois tests were used. In the analysis of the data obtained in the study, descriptive statistics and normality analysis were performed by SPSS 25.0 program. In order to determine the relationship between motoric properties and agility test values Bivariate-Pearson Correlation test was applied. 0.05 was determined as the level of significance. In the study, a negative correlation was found between women's leg strength and T-test, and flexibility values and the 505 test, while a positive correlation was found between the speed values and the Illinois test. And statistically significant and positive correlations were found between men's leg strength and Illinois test, and speed values and T-test. In addition, a negative relationship was found between Illinois test and flexibility values although it is not significant. The study showed that while agility test is preferred; T-test should be preferred for branches requiring strength, Illinois test should be preferred for branches requiring speed and 505 test for branches requiring flexibility in women. For men, T-test should be preferred in branches that require speed, and Illinois test should be preferred in branches that require flexibility. In addition, it shows that the Illinois test should not be preferred in the branches requiring force.

Keywords: Agility, flexibility, strength, speed.

E-mail: iucan@bayburt.edu.tr. Tel: +90-458 211 11 52.

INTRODUCTION

A successful performance depends on the tests used with the technology and their measurement results. For this reason, it is known that coaches and sports scientists who try to maximize their athletes' performance frequently use these tests. With the technological developments, sports scientists have created many different training equipment in order to push the highest level that athletes can reach and increase athletes' physical performance (Nalbant, 2018). If we look at the importance of developing societies for sports and their success in sports, we can see that technology is one of the most important indicators (Akcan, 2013). In his study in 2005, Şahin mentioned that not only technical and tactical skills but also physical and physiological skills are very important for sportive success.

It is known that basic motoric feature, which is a requirement of a sport branch practiced, is the most important factor that brings success in that sports branch (Filiz 2003). Motoric features refer to the strength that all muscles in the body, which are not specific to a single sports branch, produce in multi-directional flexion, extension, abduction and adduction (Muratlı, 1997). The basic motor abilities include both some of the organism and genetic traits, as well as all of the abilities gained in the development and maturation of the organism (Günsel, 2004). The basic motoric abilities are mentioned under five headings as strength, endurance, speed, mobility (flexibility) and coordination. Although these basic motor skills are genetic, they are both known and can be developed (Sevim, 1995; Çakıroğlu, 1997).

Among these, the first three items are examined as basic abilities and the other two complementary abilities (Günay et al. 2017). In the literature, motoric features are defined as follows:

Strength: Sevim (2002) defines strength as the ability of muscles to meet and contract a resistance or to a certain extent against a certain resistance. Taşkıran (1997) defines the strength as the situation arising from the stimulation of the nerves with the muscle cell and the work of the muscles in opposite directions from each other, but with the opposite effect. According to Çakıroğlu (1997) strength is defined as the ability of the power to be able to resist a certain resistance and defeat a resistance so that person can move. According to Muratlı (1997), the strength is defined as the concept that means that the athlete moves a substance from a point to a different point, that is, it means overpowering a resistance or interacting with the joint work of the muscles.

Speed: Bompa (2001) defines speed as the ability of a person to move himself from one place to another with maximum speed or the ability to apply the movement as quickly as possible. Speed in sports, on the other hand, means that a person applies the basic motor movements in the shortest time and most intensively (Muratlı, 2003).

Endurance: It can be defined as the physical strength capacity required to be able to continue any physical activity for a long time without reducing the activity level or to delay fatigue (Karatosun, 2010). Mülazımoğlu et al. (2000) define endurance as the ability of the organism to resist this fatigue after prolonged loads.

Flexibility: Zorba (1999) stated that flexibility is all the functional properties of the muscles and joints that perform the movements of the human body. Muratlı (1987) defines flexibility as the ability to move joint movements as extensively as possible. Flexibility is also important in terms of people's quality of life as it deals with all kinds of sports. Flexibility and aesthetic harmony are required both in sports and in our daily actions. Flexibility reduces muscle tension and helps body relax (Akandere, 1999).

Coordination: While explaining coordination, Yıldız (2007) stated that the skeletal muscles, joints and joint ligaments involved in the movement are in cooperation with the central nervous system. Athletes' bodies need coordination in different situations as well as when they lose their aesthetics of movement (Bompa, 2011).

Agility, on the other hand, is another conditional feature realized with more than one motoric feature, which also includes changing direction. Some definitions made by researchers are as follows: Agility is the ability to change the direction of the body moving from one point to another as quickly and fluently as possible, simple and controlled, maintaining balance without lack of speed (Özkan et al. 2009; Turner et al.2011). According to Chelladurai (1976), agility is the ability of the entire body to move quickly and accurately in response to a perceived stimulus. In another definition, agility is defined as the activity of controlling the position of the body and maintaining the movement, while the athlete can change direction rapidly in the whole series of movements (Asadi, 2012). Verstegen and Marcello (2001) stated that agility is perceived as a locomotor ability that makes the athlete change direction. Moreover, according to Katis and Kellis (2009) agility is a combination of several basic motor traits and depends on speed, muscle strength and balance ability. It is observed that the agility feature includes the speed, flexibility and coordination of the whole body or only the lower extremities to change direction and position (Hazır et al. 2010). Agility is affected by factors such as speed, general strength and muscular strength that help determine the quality of the muscles in the legs. Agility includes components of biomechanics, motor learning and strength (Sheppard and Young, 2006). The striking aspect of agility is that many motoric features are coordinated and integrated in a short of time (Renklikurt, 1991). Agility should be developed in order to bring the body's position control and balance to a better level in the whole movement (Miller et al., 2006). Based on these definitions, we can state that agility is a rapid change of direction of the whole body in response to an instantly developing effect.

Agility measurement is very important in planning the development stages of the athlete. A number of agility tests have been developed that can be easily applied by both trainers and athletes. A Among the common features of all these tests, the remarkable ones are that they can be easily applied and measurements can be made with a few simple materials. In terms of examples of tests, the most common use in sports in the field are: T-Test, Illinois Test, 505 Agility Test, Pro-Agility Test, Repetitive Agility Test. The application areas of the specified tests may vary depending on the sports branches and equipment and field conditions (Tamer, 2000; Young and Farrow, 2006; Shepard and Young, 2006). The studies on agility in the literature show that the T-Test, Illinois Test and the 505 Agility Test are the most widely used tests.

Sports movements and game techniques emerge by using one or several of the motoric features in a certain harmony in different ratios. For this reason, sports branches can be classified according to their motoric properties such as strength sports, endurance sports or speed sports. Considering that agility is a feature in many branches, it is also important to know the agility levels of athletes. At this point, in the studies done by trainers or sports scientists, the issue of selection of agility test according to the motoric characteristics of sports branches is not clear in the literature. This research was

designed to reveal the relationships between motoric properties and the most preferred agility tests, and to give an idea to the researchers or trainers on test choices.

METHODOLOGY

Universe and sample of the research

The research was group consisted of a total of 72 volunteer students, 26 female and 46 males, who were studying at the Department of Coaching at Bayburt University School of Physical Education and Sports.

Research model

Leg strength measurement

Back and Leg Dynamometer (Takkei Grip-D) brand was used in the measurement of strength. Participants took their places in the upper part of the dynamometer standing in a position with their backs straight, and their knees were placed in a bent position with an angle of 130-140 degrees. Participants were asked to stretch the dynamometer slowly but with all the strength, without allowing to use their back muscles (Biçer, 2003). Each participant had two trials, with 5 minutes intervals, and at the end the best grade was obtained and the measurements were recorded in kg.

Flexibility (sit and reach) test

The Sit and Reach test was used in the flexibility measurements of the participants. The table dimensions are 35 cm long, 45 cm wide and 32 cm high. The upper surface dimensions of the table are: 55 cm long, 45 cm wide, the upper surface is 15 cm further than the area where the legs are leaned, and it has a 50 cm long ruler marked with one-centimeter intervals (Özer, 2001; Ercan, 2012). During the application of this test, the participant is seated on the ground and leaned on the test bench with bare feet and flat soles. The torso is tilted forward at the waist and hips; it is desirable to reach forward as far as possible, with the hands in front of the body without bending the knees. In this way, participant tries to reach the farthest point they can reach. At the farthest point, participant waits for 2 seconds and the point is recorded. The person checking the test stands next to the participant and ensures that the participant does not bend his knees. Each participant repeats the test twice and the highest point is recorded.

20 meter speed test

In determining the speed, 20 meters speed test was applied to the participants. Participants practice 10 minutes of slow pace warm-up before the test and then run at maximum speed with a sprint start in the designated area of 20 m. The finish time is determined by the photocell in seconds. The best result is recorded after repeating the test twice with 5 min intervals (Balcıoğlu, 2018).

Illinois agility test

The entire Illinois agility test covers a distance of 60 m (Figure 1). 20 m of this distance consists of runs with multiple changes of direction. And 40 m is a straight run with 2 turns within itself. Participants start the agility test while lying prone position and hands are at shoulder level, and try to complete the test as soon as possible. Participants were allowed to do a few exercises at a slow pace so that they could learn the racecourse. In order to determine the best running time, the participants were performed 2 times with 5 min break and the best running time was recorded in seconds (Hazır et al., 2010).

Agility t-test

Pauole et al. (2000) investigated the validity and reliability of the T-test and found that the T-test was reliable in measuring leg strength, leg speed and agility (Figure 2). The general purpose of the T-test is to ensure balance, maintain continuity in speed, and test the ability to make rapid, sudden and stable changes in a certain running direction (Kızılet et al., 2010). The athlete moves from the starting point with the voice command and runs straight towards the 1st funnel. After touching the 1st funnel with his right hand, he goes to the 2nd funnel with a slide step and touches it again with his right hand. Then, with a sliding step to the left he touches the first funnel again, and he goes to the third funnel with a sliding step and touching it with his left hand. Finally, he comes back to the first funnel with a sliding step and run back to the area where he began and finishes the test.

The 505 agility test

This test is completed by passing the 5-meter distance round-trip after a 10-meter acceleration run (Hazır et al., 2010) (Figure 3). After determining the distances to be run, both start and stop gates of the time determining system are placed on the 5 m line. After participants are informed about the test, they were allowed to exercise a few slow pace exercises. In order not to cause any injury at the beginning of the test, participants are given 10 min of warm-up and flexibility exercises before the test. The test was repeated twice with an interval of 5 min rest, and the best degree is recorded in seconds.

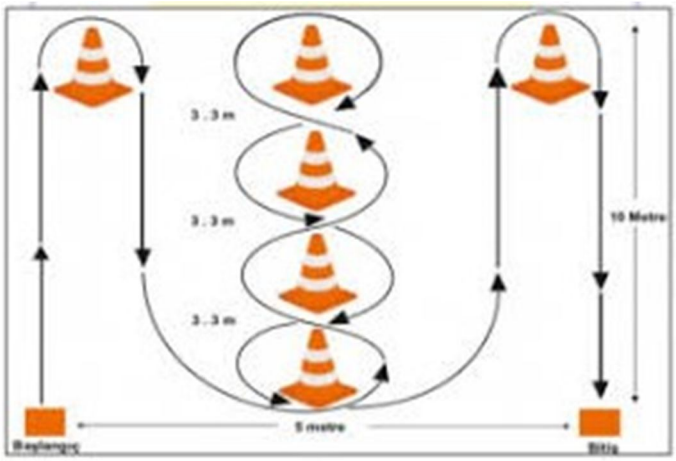

Figure 1. Illinois agility test.

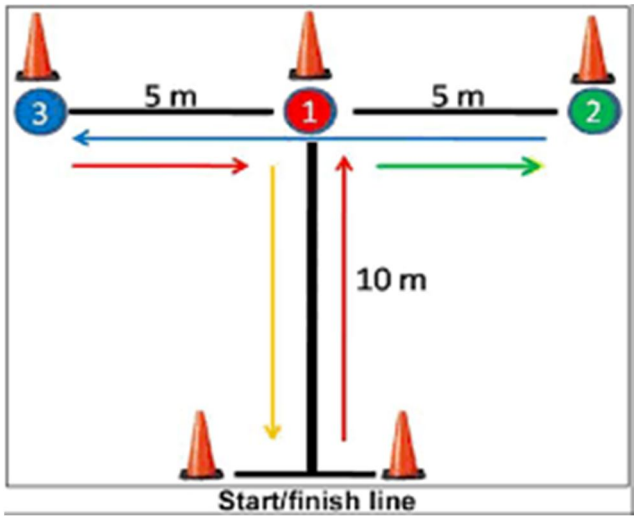

Figure 2. Agility t-test.

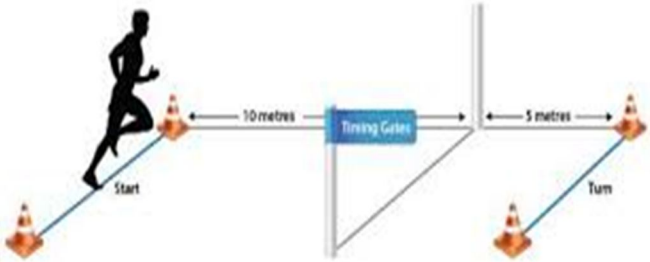

Figure 3. The 505 agility test.

Statistical analysis

Descriptive statistics and normality analysis were performed on the data obtained in the study by SPSS 25.0 for WINDOWS package program. As a result of the "Kolmogorov-Smirrow" and "Shapiro Wilk" tests, it was determined that the data has normal distribution. "Bivariate-Pearson Correlation" test was used as a parametric correlation test to determine the relationship between motoric characteristics and agility test values. The significance level was determined as 0.05 in the interpretation of statistical procedures.

RESULTS

Table 1 shows that average age (year) of women is 23.30 ± 2.05, height (cm) is 166.46 ± 5.73, body mass (kg) is 58.30 ± 5.57 and body mass index (kg / m2) is 21.05 ± 1.87. The table also shows that average age (year) of men is 23.82 ± 2.51, height is 177.47 ± 7.87 cm, body mass is 74.78 ± 11.68 kg and body mass index is 23.71 ± 3.21 kg/m^2.

Table 2 shows that of women's average leg strength is 73.46 ± 12.93 kg, speed (20 m) is 3.69 ± .235, flexibility is 26.60 ± 6.86 cm, agility T Test is 14.88 ± .979 sec, agility Illinois Test is 23.15 ± 1.14 sec, and agility 505 test is 3.64 ± .179 sec. The table also shows that male's average leg strength is 137.13 ± 22.35 kg, speed (20 m.) is 3.14 ± 213, flexibility is 22.66 ± 7.80 cm, agility t test is 12.50 ± .989 sec, agility Illinois Test is 20.57 ± 1.58 sec, agility 505 test is 3.07 ± .241 sec.

Table 3 shows that there is statistically significant negative relationship between the leg strengths of women and the T test (r = -.650; p = 0.016) and between the flexibility values and the 505 Test (r = -.718; p = 0.019), and there is a statistically significant positive relationship between the speed values and the Illinois test (r = .555; p = 0.049).

Table 4 shows that there is a statistically significant relationship between the leg strength of men and the Illinois Test (r = .464; p = 0.026) and between the speed values and the T-test (r = .426; P = 0.043). In addition, although there is no significant relationship between

Table 1. Demographic characteristics of the participants.

Gender	N	Measurement	Average	Standard deviation
Female	26	Age (year)	23.30	2.05
		Height (cm)	166.46	5.73
		Body Mass (kg)	58.30	5.57
		Body Mass Index (kg/m^2)	21.05	1.87
Male	46	Age (year)	23.82	2.51
		Height (cm)	177.47	7.87
		Body Mass (kg)	74.78	11.68
		Body Mass Index (kg/m^2)	23.71	3.21

Table 2. Average values of strength, speed, flexibility and agility tests.

Gender	N	Measurement	Average	Standard Deviation
Female	26	Leg Force (kg)	73.46	12.93
		Speed (20 m.)	3.69	.235
		Flexibility (cm)	26.60	6.86
		Agility T Test (sec)	14.88	.979
		Agility Illionis Test (sec)	23.15	1.14
		Agility 505 Test (sec)	3.64	.179
Male	46	Leg Force (kg)	137.13	22.35
		Speed (20 m.)	3.14	.213
		Flexibility (cm)	22.66	7.80
		Agility T Test (sec)	12.50	.989
		Agility Illionis Test (sec)	20.57	1.58
		Agility 505 Test (sec)	3.07	.241

Table 3. The relationship between agility values and motoric characteristics of the female participants.

Agility test		Leg force	Speed	Flexibility
T-test (sec)	r	-.650*	.407	-.587
	P	.016	.168	.075
Illinois test (sec)	r	-.460	.555*	-.401
	P	.114	.049	.250
505 test (sec)	r	-.501	-.074	-.718*
	P	.081	.809	.019

*P < .05.

Table 4. The relationship between agility values and motoric characteristics of the male participants.

Agility test		Leg force	Speed	Flexibility
T-test (sec)	r	.296	.426*	-.078
	P	.170	.043	.783
Illinois test (sec)	r	.464*	.362	-.398
	P	.026	.089	.141
505 test (sec)	r	-.145	.135	-.019
	P	.511	.539	.945

*P < .05.

flexibility values and any agility test, it is observed that its highest relationship is with the Illinois test (r = -.398; p = 0.141) and it was negative.

DISCUSSION

As a result of this study, which was conducted to determine the most usable test for female and male athletes to determine the agility levels according to sports branches, the following were determined in terms of the basic motor characteristics of the athletes, when looking at the results in the measurement of leg strength, which is one of the basic motor features: The negative correlation between leg strength and the agility T-test in women indicates the decrease in agility value, which is determined as the duration of the increase in leg strength. The positive correlation between men's leg strength and the Illinois agility test indicates that the increase in leg strength will increase the agility value as the duration. Therefore, it reveals that this test should not be preferred primarily in the investigation of the agility values on the male group in strength-based sports branches. In the literature, Molenaar (2009) found a significant difference according to T-test results in his strength study on female volleyball players. In their research article, Bozdoğan and Kızılet (1997) concluded that there is a statistically positive relationship between agility and leg strength according to the T-test results they performed for agility. In their study, Hazar and Taşmektepligil (2008) concluded that muscle strength has a positive effect on agility. In his master's thesis, Bircan (2016) concluded that with the increase in strength values, agility values decrease, and with the decrease in strength values, agility values increase. In his study, Paradis (2003) stated that the T-test is a good measure of leg strength, speed and agility. These studies support the results of the present research.

Moreover, in the literature, contrary to the results of the present research, Özçelik found in the study he conducted in 2014 that strength is not a factor directly affecting agility in ice hockey. Similarly, in a study conducted in 2011 by Gilenstam et al. on athletes engaged in ice hockey, no significant relationship was found between agility values and strength values. Royer (2008) in his study conducted on 17 females found that the agility T-test results was meaningless. In his master thesis completed in 2005 Hazar concluded that there is no significant relationship between agility and strength. After eight weeks of strength training with Portuguese elite soccer players, no significant change was found in agility test values (Alves et al. 2010). Kutlu et al. (2012) found a statistically significant difference between Illinois agility test values of professional amateur soccer players and university students. In their study conducted on young football players in 2010, Hazır et al. concluded that there was a strong and significant relationship between the values obtained in the Illinois test and the anaerobic power parameters.

As a result of the present research, positive relationships were found between speed and Illinois agility test of female participants, and between speed and agility T-Test of male participants. This shows that the decrease in the speed value, which was determined as the duration, will also reduce the agility value, which was determined as the time. The literature has works which compared speed values and agility tests. Çakmak concluded in his master's thesis in 2019 that there was a statistically significant relationship between the Illinois agility test values of female footballers and 30 m speed values.

Çakmak, in his thesis entitled “Examining the relationship between static and dynamic balance and speed and agility in female football players” conduced in 2019, concluded that there were significant differences between 30 m speed values and Illinois agility test values. In his study titled “Analysis of strength, strength and agility characteristics of young national badminton players and amateur badminton players”, Güçlüöver (2012) found that there was a strong relationship between speed, agility tests, Illinois and T-test. In another study conducted by Draper and Lancaster in 1985, a significant relationship was found between 20 m speed and Illinois agility test. Another study conducted in 2009 by Jarvis et al. concluded that there was low but significant relationship between the 20 m straight speed test and the Illinois agility test. According to results of the analysis conducted by Arı et al. in 2017, a statistically significant relationship was found between running times in the agility test and average strength values. And it was found that as speed and strength values increase, running times in the agility test decrease. These studies support the results of the current research.

Contrary to the above-mentioned results, Tatlısu et al. concluded that there is no significant relationship between the Agility T-test and speed values, in their study conducted in 2019.

In terms of relationship between flexibility and agility tests, which is another motoric feature discussed in the study, it was found that there was a statistically significant and negative relationship between flexibility values of female participants and the 505 test, and a negative relationship between flexibility and Illinois agility, although it was not significant in male participants. This is an indication that the increase in flexibility value will cause a decrease in the agility value determined as time. There are studies made on the relationship between flexibility and agility. In their study Waghmare et al. (2012) concluded that flexibility had a significant effect on agility. This result supports the conclusion of the present research. However, there are studies contrary to the results the current study. Thakur and Motimath could not find a significant relationship between flexibility and agility in the results of their study done in 2014. Hazar and

Taşmektepligil (2008) concluded that there was no statistically significant relationship between the flexibility test and Illinois agility test. Finally, as a result of literature review, it was concluded that there was not much studies done in the field to determine the relationship between agility and flexibility.

CONCLUSION AND RECOMMENDATIONS

In the study, negative relationship was found between women's leg strength and T-test. Similarly negative relationship was found between flexibility values and the 505 Test even though positive relationship was found between speed values and Illinois Test. And, statistically significant and positive relationships were found between men's leg strength and Illinois Test and speed values and T-Test. In addition, a negative correlation was found with the Illinois Test although it was not significant with the flexibility values. According to these results, while agility test is preferred following points should be taken into consideration;

T-Test should be used in the following branches which require leg strength in women: athletics, cycling, surfing, swimming, football, alpine skiing, biathlon, cross-country skiing, northern combined, freestyle skiing, snowboarding, ice hockey, speed skating, judo, karate, modern pentathlon, rugby, sportive climbing, taekwondo, triathlon and tennis etc.

Illinois test should be used in the following branches which require speed in women: athletics, cycling, hockey, football, speed skating, handball, swimming, water polo, tennis and volleyball.

The 505 test should be used in the following branches which flexibility speed in women: sailing, volleyball, table tennis, karate, judo, wrestling, fencing, gymnastics, boxing, badminton, ski jumping, freestyle skiing and figure skating, T-Test should be used in the following branches which require speed in males: athletics, cycling, hockey, football, speed skating, handball, swimming, water polo, tennis and volleyball.

Illinois test should be used in the following branches which require flexibility in males: sailing, volleyball, table tennis, karate, judo, wrestling, fencing, gymnastics, boxing, badminton, ski jumping, freestyle skiing and figure skating.

Illinois test should not be used in the following branches which require leg strength in males athletics, cycling, surfing, swimming, football, alpine skiing, biathlon, cross-country skiing, northern combined, freestyle skiing, snowboarding, ice hockey, speed skating, judo, karate, modern pentathlon, rugby, sport climbing, taekwondo, triathlon and tennis.

Conflict of interest statement

The author reports no conflict of interest. The author declares that the results of the study are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation.

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