# JUGGLING TEST BATTERY

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**Abstract**

Juggling is considered as a basic technical skill which is often ignored by soccer coaches. It provides players with the ability to control the ball after activities such as corners, free-kicks, goal-kicks, throw-ins, and crosses. Furthermore, juggling improves their coordination and balance abilities. Due to the fact that there is not any systematic study for juggling evaluation with gradual difficulty the current research project aims to develop a battery of juggling tests with increasing difficulty. In addition the researchers include movements which are similar to the game conditions such as zig zag, jumps and various body contacts. In the current study forty four players participated, twenty two of which were experienced soccer players and twenty two were recreational athletes. The results confirmed the reliability and validity of the tests. Furthermore, it was found that the difficulty of the tests was gradually increased when the researchers added limitations regarding time, distance, and contact surfaces.

**Key-words: soccer, test, skill, technical, juggling**

## 1. INTRODUCTION

The interaction among physiological, psychological, social, tactical and technical factors determines individual and team performance in soccer (Bangsbo, 1993; Little & Williams, 2006). Previous research (Açıkada, Hazır, Aşçı, Turnagöl, & Özkara, 1998; Stølen, Chamari, Castagna, & Wisløff, 2005; Stratton, Reilly, Williams, & Richardson 2004) described soccer as a physical contact game that requires movements with (controls, turns, passes, dribbles, shoots) or without ball (jogging, sprints, direction changes, tackles, jumps, ground and air challenges). Furthermore, the speed and precision of these movements has been found to determine the quality of performance (Fitts & Posner, 1967). Soccer is considered as an open game (Knapp, 1977) the techniques of which require interactions among cognitive, perceptual and moving abilities (Bate, 1996). Limitations such as time and space, as well as the presence and the number of opponents may influence these interactions. That means that the players have to apply the appropriate skill sequences and standardize their performance with the minimum time and energy outlay in order to be effective in game conditions (Sotiropoulos & Bekris, 2007). Therefore players have to practice hard to improve their skills which are defined as the acquired ability to produce predetermined results with maximum certainty often with the minimum expenditure of time and energy (Knapp, 1977).

Although juggling is considered as a main technical skill it is often ignored in soccer literature. Many coaches wondering *Why is juggling important?* or *We do not juggle the ball in the game so it is not important to practice*. Contrary to these views juggling ability is used very frequently in game conditions. Specifically, it provides players with the ability to control the ball after activities such as corners, free-kicks, goal-kicks, throw-ins, and crosses. In addition juggling improves the ability of players to read the spin of the ball, as well as their coordination and balance. Finally, players learn to use several contact surfaces of both feet to juggle the ball. Obviously juggling ability is important in soccer for improving individual possession and field position as well as for promoting attacking play. Therefore juggling tests have to include various movements and realistic conditions similar to the ones encountered in soccer games. For instance fatigue is one variable that most of the technical tests ignore (Mohr, Krustrup, & Bangsbo, 2003). Literature review about juggling tests revealed that most of these are not such realistic as soccer demands.

Nowadays, a majority of researchers have examined the juggling ability in soccer (Hoare & Warr, 2000; Malina et al., 2005; Morgan 2012; Rebelo et al., 2013; Rösch et al., 2000; Vale et al., 2009; Vanderford, Meyers, Skelly, Stewart, & Hamilton, 2004). For instance, Rösch and colleagues (2000) used a juggling test which required the players to juggle the ball with their foot, trying to manage 25 touches. Rösch and colleagues (2000) also developed three more tests in which the researcher threw the ball

from a 5 meter distance to the players who tried to play the ball with the following order "chest-foot-head", "head-left foot-right foot", and "foot-chest-head". Similarly to the 25 touches juggling test, Vale and colleagues (2009) as well as Rebelo and colleagues (2013) used the 100 touches juggling test that was developed by Kuhn (1978). The players had two trials to juggle the ball with a maximum score of 100 touches per trial. Vanderfond and colleagues (2004) limited the ball contacts with foot or knee in order to increase its difficulty. The players had to drop the ball on their foot or knee and tap it in the air as many times as possible for 30 seconds. Hoare and Warr (2000) developed a juggling test in which players were allowed to use various parts of their body (feet, knees, thighs and heels) to juggle the ball. Three coaches and one sport scientist formed an evaluation panel that assessed the players' juggling ability for 30 minutes. Malina and colleagues (2005) added a juggling test only with the head. The players had to keep the ball in the air inside a 9X9 m square using only their head. The researchers also used a juggling test with any body part inside the same 9X9 m square. The players had to keep the ball in the air without using their arms or hands. Finally Morgan (2012) used three techniques to evaluate juggling ability. For the first and the second technique the players had to juggle the ball only with one foot and keep that in the air while the other had to remain unmoved on the ground for 60 seconds. Then they had to repeat the test with the other foot. For the third technique the players had to use alternate feet to juggle the ball for 60 seconds. For all the tests the players had to use a 1.5X1.5 square. However, from our research there has not been any study which includes several juggling tests with a gradually increase of difficulty. Furthermore the validity and reliability for most of the existing tests has not been assessed.

Therefore, the current study aimed to develop a battery of juggling tests with increasing difficulty by using only the dominant foot. In addition the researchers included movements which were similar to the game conditions. They included zig zag movements, jumps, free ball touching and moving in the soccer area as well as a standardized row to juggle the ball with various body parts. They also examined the criterion validity and reliability of these tests.

## 2. METHODS

### Participants

In the current study forty four subjects participated, twenty two of which were experienced soccer players (age 15.5 ± 0.9 years) and twenty two were recreational athletes (age 16.4 ± 0.9 years). The soccer players were members of soccer academies and adult teams while the recreational players participated in school, university and private soccer leagues. The researchers informed the participants about the aims, the ethics, the risks, and the benefits of the study before providing them or their guardians with a written informed consent. The study also received approval from the university ethics committee.

### Procedures

The researchers arranged meetings with the training staff and the players of a soccer team so as to explain the aims, the ethics, the risks, and the benefits of the research project. Similarly they invited to the study a soccer team that participated in school soccer leagues (recreational athletes). Before the juggling assessment they participated in a 15 minute standardized warming up without ball (running, sprinting and dynamic stretching) as well as a 10 minute with ball warming up. In the beginning, the researchers examined the test-retest reliability for the twenty two soccer players, number that was similar to previous research (Mirkov, Nedeljkovic, Kukolj, Ugarkovic, & Jaric, 2008; Russell, Benton, & Kingsley, 2010). They arranged two trials with a time distance of 7 days. The researchers also examined the tests' criterion validity by comparing the outcomes of soccer and recreational players. The researchers gave three attempts to the participants for each test so as to familiarize themselves to the protocol before recording the next three attempts. The highest of the attempts was used as their performance score. The researchers followed the same procedures for all the tests during both trials. Some adjusted forms of existed juggling tests were used (Malina et al., 2005; Reilly et al., 2007; Rösch et al., 2000; Vale et al., 2009).

### Skills testing

For each test the players had to use mainly the foot to juggle the ball. They started the tests by picking up the ball from the ground with their dominant foot. The researchers also added test variations so as to gradually increase their difficulty. The difficulty of the tests gradually increased due to area and time limitations, changes of the number and the order of body parts which the players used, as well as some distance variations. A 2X12m distance was used to evaluate the 24m straight juggling, the 24m zig zag juggling and the 24m hurdles' juggling tests. The researchers recorded the travelled distance as well as the required time to complete the trial.

- 24m straight juggling: Players juggle the ball only with the dominant foot for a distance of 24m (12X2 forth and back).

- 24m zig zag juggling: Players juggle the ball only with the dominant foot while they were swerving it in and out of four cones, 3m distance from each other (12X2 forth and back).

- 24m hurdles' juggling: Players juggle the ball only with the dominant foot while they were passing over the four 30cm hurdles 3m distance from each other (12X2 forth and back).

A limited 3X3m square was used for the following juggling tests. The players could touch the ball once with each part of the body according to the predetermined order. The researchers recorded the best performance of three trials for each test.

- 100 touches juggling: Players had to juggle the ball with their foot with a maximum score of 100 for each trial.

- 30s juggling: Players had to juggle the ball with their foot within 30 seconds. The researchers recorded the total number of touches during this period of time.

The last test included specific order of the body parts which tapped the ball. Each successful row evaluated with one point. The following orders were used: foot-thigh; foot-chest; foot-head; foot-thigh-head; foot-head-chest; and foot-thigh-head-chest.

**Statistical Analysis**

Descriptive statistics were performed to assess the score for each test. Then independent t-test method was used to compare whether there were any differences between the playing and recreational groups of youngsters. The researchers also performed t-test for each variable to compare if there were differences between the two trials. The reliability level between the tests was assessed by Pearson correlation and the coefficient of variation. Criterion validity was assessed by the median-split analysis for each variable. Finally, some percentages were also used to compare the performance of the players in the tests. The statistical significance level was accepted at $p < .05$.

## 3. RESULTS

*Reliability*

The table 1 presents the descriptive statistics for both the trials as well as the reliability statistics of each test. Almost all the test revealed strong reliability, relative reliability as well as tight test-retest reliability. Specifically, the scores of the variables were the following: *100 touches juggling test* (ICC: .83; *r*: .84; CV: 4.3), *24m straight juggling* (ICC: .53; *r*: .55; CV: 5.8), *24m zig zag* (*juggling* ICC: .84; *r*: .84; CV: 7.3), *24m hurdles' juggling* (ICC: .88; *r*: .87; CV: 8.9), *30s juggling* (ICC: .86; *r*: .85; CV: 2.0), *foot-thigh juggling* (ICC: .83; *r*: .82; CV: 6.2), *foot-chest juggling* (ICC: .91; *r*: .90; CV: 6.9), *foot-head juggling* (ICC: .89; *r*: .83; CV: 3.7), *foot-thigh-head juggling* (ICC: .85; *r*: .85; CV: 7.2), *foot-head-chest juggling* (ICC: .69; *r*: .69; CV: 3.5), *foot-thigh-head-chest-juggling* (ICC: .87; *r*: .88; CV: 7.2). Afterwards the researchers performed t-tests to examine whether there was any significant difference between the trials.

**"Table 1 about here?"**

*Criterion validity*

The median split analyses showed that for all the tests of juggling, the majority of soccer players were above the median whereas the majority of recreational athletes were below the median (table 2).

**"Table 2 about here?"**

The following graph shows the contribution of the tests according to the level of the participants (graph 1). Soccer players performed higher levels than recreational players for all the variables: 100 touches juggling (77.32 ± 24.90 vs 30.09 ± 17.87, t= 7.228 , *p*= .000); 24m straight juggling (19.64 ± 5.611 vs 7.73 ± 3.521, t= 8.433, *p*= .000); 24m zig zag juggling (16.05 ± 7.512 vs 5.95 ± 2.516, t= 5.975, *p*= .000); 24m hurdles' juggling (10.68 ± 6.917 vs 5.27 ± 2.251, t= 3.488, *p*= .001); 30s juggling (52.36 ± 20.998 vs 22.68 ± 10.908, t= 5.884, *p*= .000); Foot thigh juggling (16.14 ± 12.635 vs 7.18 ± 4.646, t= 3.120, *p*= .003); Foot chest juggling (4.09 ± 2.348 vs 2.68 ± 1.912), t= 2.182, *p*= .035); Foot head juggling (4.86 ± 2.949 vs 2.09 ± .868, t= 4.231, *p*= .000); Foot thigh head juggling (3.32 ± 1.912 vs 2.14 ± 1.457, t= 2.306, *p*= .026); Foot head chest juggling (2.68 ± 1.287 vs 2.45 ± 1.945, t= .457, *p*= .650); Foot thigh head chest juggling (2.41 ± .734 vs 1.59 ± .796, t= 3.543, *p*= .001).

**" Graph 1 about here?"**

## 4. DISCUSSION

The aim of this study was two-fold: to examine the reliability and criterion validity of juggling tests as well as to develop a battery of juggling tests. Reliability was confirmed with test-retest method while criterion validity was confirmed by comparing players and recreational athletes. Regarding the battery of juggling tests the researchers divided these in categories according to their characteristics:

**Tests with one contact surface (foot)**

*100 touches juggling test*

Concerning the *100 touches juggling test* the results showed that more than 52% of the players performed the maximum score of the test while the 82% surpassed the average score (77 repeats). Thus, it is obvious that this test is not appropriate to evaluate juggling ability of amateur adolescents.

*30 seconds juggling test*

As far as the *30 seconds juggling test* the results revealed that the 77% surpassed the average score (52 repeats). A significant finding was that 90% of the players who achieved the maximum score in *100 touches juggling test* were above the average score of the current test, whereas the players who achieved low scores in *100 touches juggling test* performed also low scores in *30s juggling test*. Furthermore, it was found that the range of the performance was greater than the previous test. Thus *30s juggling test* better detects the level of the players as it is more difficult than *100 touches juggling test*.

*24 meter straight juggling test*

In this test the 63% of the players achieved the maximum score while the 82% were above the average score (20 meters). Remarkable though was that the 80% of the players who achieved the maximum score in the current test also performed the maximum score in the *100 touches juggling test*. Furthermore, the 77% of the players who did not complete the test had also low performance in the *30s juggling test*. Thus it is obvious that the players have to indicate high quality in 100 touches as well as in *30s juggling tests* to perform well in this test which is more difficult.

*24 meter zig zag juggling test*

Regarding the *24 meter zig zag juggling test* 37% of the players achieved the maximum score while 73% of them were above the average score (16 meters). In addition only 50% of the players who completed the *24m straight juggling test* completed also this test. Furthermore 85% of the players who completed the current test had also completed the *24m straight juggling test*, which means that this test was of greater difficulty than the previous one.

*24 meter hurdles' juggling test*

Finally, only 10% of the players completed the *24 meter hurdles' test*, while 77% of the players were above the average score (11 meter). It was notable that 22% of the players who completed the current test had also completed the *24m zig zag test*, finding which reveals the difficulty of this test. These players presented high quality in all the previous tests actually. Therefore it is obvious that the difficulty of all these tests was gradually increased.

The researchers considered the distance as the primary evaluation tool and the required time to complete the test as a more specific evaluation tool which detects the top level players. As a result, these findings constitute a guide for the coaches and soccer experts to evaluate the juggling ability of players according to their playing level. According to the findings of the current study we developed the following table (table 3) and graph (graph 2) for this series of tests.

**" Table 3 and graph 2 about here?"**

**Juggling tests with various body parts**

*Foot-thigh juggling test (two body parts)*

The results showed that in *foot-thigh juggling test* 73% of the players surpassed the average score (16 repeats). Furthermore 73% and 80% of the players who were under the average score performed also low in *100 touches* as well as in *30s juggling tests* respectively. It is obvious that players have to achieve high scores in *100 touches* and *30s juggling tests* in order to perform well in *foot-thigh juggling test*.

*Foot-chest juggling test (two body parts)*

Concerning the *foot-chest juggling test* only 55% was above the average score (4 repeats). This test seems to be of greater difficulty than the *foot-thigh* as the average score was obviously lower (4 < 16). Specifically it was found that 87.5% of the players, who were above the average score, had also the highest scores in *100 touches* and *30s juggling tests*. In addition, 77% of them had scores above the average in the *foot-thigh juggling test*. Furthermore, 75% of the players who performed the highest scores in this test indicated high scores also in *foot-thigh test*. Thus the players who presented high quality in *foot-thigh test* face greater possibilities to achieve also high scores in *foot-chest test*.

*Foot-head juggling test (two body parts)*

In *foot-head test* 73% of the players performed above the average score (5 repeats). Comparing this test with *foot-chest test* it seems that *foot-head test* was easier as the average score of the players was higher (5 > 4). Indeed the results showed that 73% of the players were above the average score comparatively to the 55% who were above the average score in *foot-chest test*.

Furthermore, 90% of the players who performed high scores in *foot-head test* performed also well in *foot-chest test*. This finding is probably due to the lack of players' quality to control the ball with the chest and their difficulty to tap the ball with the foot after the chest. However this skill is very common in soccer which may lead to lack of ball possession.

*Foot-thigh-head & Foot-head-chest juggling test (three body parts)*

The difficulty of juggling tests is increased when the players have to use several body parts to juggle the ball. Specifically, it was found that in *foot-thigh-head test* the players performed extremely lower (3.3 repeats) than in *foot-chest test* which was the most difficult test that included two body parts (4 > 3.3). Interestingly the results revealed that players who indicated high performance in *foot-chest test* performed also well in *foot-thigh-head test*. Concerning the comparison between *foot-thigh-head* and *foot-head-chest tests* (2.7 repeats) it was found that the second one was of greater difficulty (3.3 > 2.7). In total 59% of the players were above the average score of *foot-thigh-head test* while 68% were above the average score of *foot-head-chest test*. Furthermore it seems that players who indicated high performance in *foot-thigh-head test* revealed also high performance in *foot-head-chest test*. Thus the greater difficulty of *foot-head-chest test* is obvious.

*Foot-thigh-head-chest (four body parts)*

Finally, the difficulty in *foot-thigh-head-chest test* was greater because the average score was lower than the previous tests (2.4 repeats) and the percentage of players who achieved performance above the average score was lower as well (46%). Furthermore, a significant finding was that 89% of the players who did not surpass the average scores of *foot-thigh-head* and *foot-head-chest tests* performed also under the average score of *foot-thigh-head-chest test* with extremely low scores. The results confirm the greater difficulty of the players perform above the average scores in this test, finding that makes this test the most difficult. Indeed players that achieved great performance in the other tests performed also higher performance in this test compared to their teammates. According to the findings of the current study we developed the following table (table 4) and graphs (graph 3 and 4) for this series of tests.

**" Table 4 and graph 3&4 about here?"**

## 5. CONCLUSION

In summary the difficulty of these tests was gradually increased when the researchers added the following limitations:

- Time limitation (30s juggling) so as the players had to juggle the ball with a higher frequency.
- Juggle the ball while the player was moving straight, zig zag or over hurdles.
- Juggle the ball with various body parts.
- Juggle the ball with various body parts in various rows.

Thus the researchers developed a battery of juggling tests which are more realistic and adapted to soccer requirements. Soccer coaches and experts may use this guide to prepare training programs aimed to improve the balance, the coordination and therefore the juggling ability of their players (Bekris et al., 2012). A significant finding of the current study is the variety on the players' performance in the different tests. This fact confirms the sensitivity of these test series as it makes possible to detect any performance change (Currell & Jeukendrup, 2008). It is now apparent that high juggling ability improves the playing ability in soccer games. In conclusion the current study provides reliable, valid and sensitive tools for assessing the juggling ability of the players. Soccer coaches may use these test series to monitor the progress of their players. Finally, future research should focus on developing reliable and valid test batteries for all the technical skills.

## 6. REFERENCES

Açıkada, C., Hazır, T., Aşçı, A., Turnagöl, H., & Özkara, A. (1998). Physical and physiological profiles of a second league division soccer team during preparation period. Hacettepe. *Journal of Sports Science and Technology*, *1*, 3-14.

Bangsbo, J. (1993). The physiology of soccer--with special reference to intense intermittent exercise. *Acta Physiologica Scandinavica. Supplementum*, *619*, 1-155.

Bate, D. (1996). Soccer skills practice. *Science and soccer. London: E & FN Spon*, 227-241.

Bekris, E., Kahrimanis, G., Anagnostakos, K., Gissis, I., Papadopoulos, C., & Sotiropoulos, A. (2012). Proprioception and balance training can improve amateur soccer players' technical skills. *Journal of Physical Education & Sport*, *12*(1).

Currell, K., & Jeukendrup, A. E. (2008). Validity, reliability and sensitivity of measures of sporting performance. *Sports Medicine*, *38*(4), 297-316.

Fitts, P. M., & Posner, M. I. (1967). *Human performance*. Brooks/Cole, Belmont, CA.

Hoare, D., & Warr, C. R. (2000). Talent identification and women's soccer: An Australian experience. *Journal of Sports Sciences*, *18*(9), 751-758.

Knapp, B. (1963). *Skill in sport: The attainment of proficiency*. Routledge.

Kuhn, W. (1978). *Zur Leistungserfassung im Sportspiel: Entwicklung einer Fussballspezifischen Testbatterie*. Hofmann.

Little, T., & Williams, A. G. (2006). Suitability of soccer training drills for endurance training. *The Journal of Strength & Conditioning Research*, *20*(2), 316-319.

Malina, R. M., Cumming, S. P., Kontos, A. P., Eisenmann, J. C., Ribeiro, B., &Aroso, J. (2005). Maturity-associated variation in sport-specific skills of youth soccer players aged 13-15 years. *Journal of Sports Sciences*, *23*(5), 515-522.

Mirkov, D., Nedeljkovic, A., Kukolj, M., Ugarkovic, D., & Jaric, S. (2008). Evaluation of the reliability of soccer-specific field tests. *The Journal of Strength & Conditioning Research*, *22*(4), 1046-1050.

Mohr, M., Krustrup, P., & Bangsbo, J. (2003). Match performance of high-standard soccer players with special reference to development of fatigue. *Journal of Sports Sciences*, *21*(7), 519-528.

Morgan, O. J. (2012). *The use of skill, physiological and anthropometric variables to predict soccer ability in elite youth soccer players*. Unpublished MRes Thesis. Coventry: Coventry University.

Rebelo, A., Brito, J., Maia, J., Coelho-e-Silva, M. J., Figueiredo, A. J., Bangsbo, J., Malina, R. M. & Seabra, A. (2013). Anthropometric characteristics, physical fitness and technical performance of under-19 soccer players by competitive level and field position. *International Journal of Sports Medicine*, *34*, 312-317.

Reilly, T., Atkinson, G., Edwards, B., Waterhouse, J., Farrelly, K., & Fairhurst, E. (2007). Diurnal variation in temperature, mental and physical performance, and tasks specifically related to football (soccer). *Chronobiology International*, *24*(3), 507-519.

Rösch, D., Hodgson, R., Peterson, L., Graf-Baumann, T., Junge, A., Chomiak, J., & Dvorak, J. (2000). Assessment and evaluation of football performance. *The American Journal of Sports Medicine*, *28*(suppl 5), S-29.

Russell, M., Benton, D., & Kingsley, M. (2010). Reliability and construct validity of soccer skills tests that measure passing, shooting, and dribbling.*Journal of sports sciences*, *28*(13), 1399-1408.

Sotiropoulos, A. & Bekris, E. (2007). *Proponisiologia Podosfairou*. Athens, Telethrio Publications.

Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. (2005). Physiology of soccer. *Sports Medicine*, *35*(6), 501-536.

Stratton, G., Reilly, T., Williams, A. M., & Richardson D. (2004). *The growth of the physiological systems*, Youth Soccer. New York: Routledge.

Vale, P., Ramos, A., Salgado, B., Correia, P., Martins, P., Brito, J., Oliveira, E., Seabra, A. & Rebelo, A. (2009). Differences in technical skill performance of Portuguese junior soccer players according to competitive level and playing position. In *International Research in Science and Soccer The Proceedings of the First World Conference on Science and Soccer* (pp. 13-20).

Vanderford, M. L., Meyers, M. C., Skelly, W. A., Stewart, C. C., & Hamilton, K. L. (2004). Physiological and sport-specific skill response of olympic youth soccer athletes. *The Journal of Strength & Conditioning Research*, *18*(2), 334-342.

**Table 1. Reliability of juggling tests.**

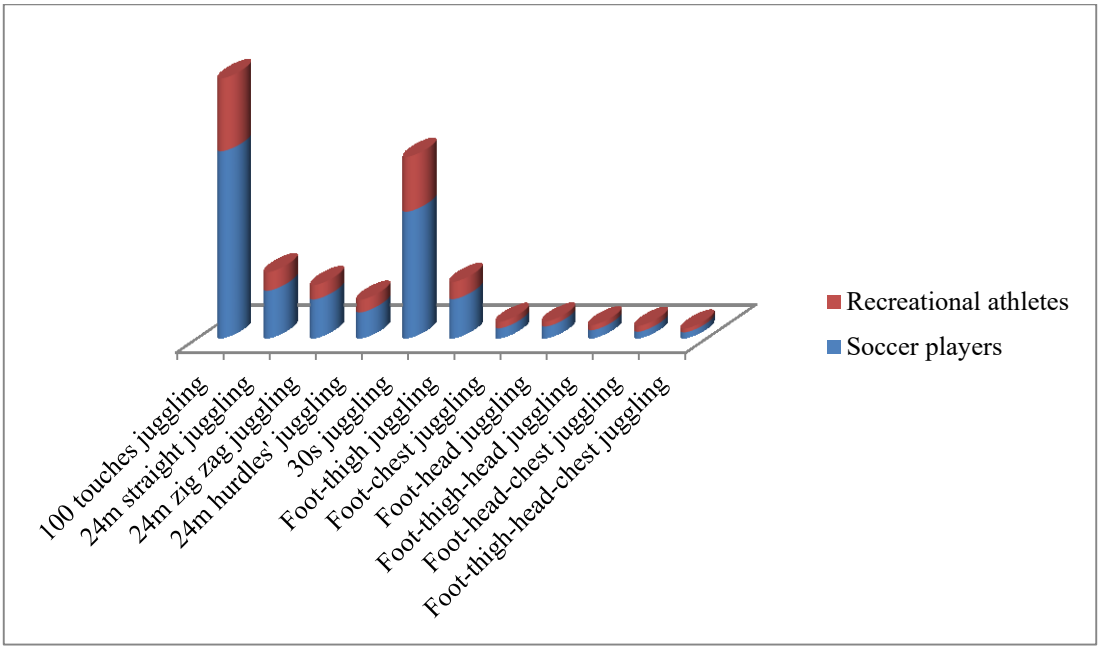
| Variable | Trial 1 | Trial 2 | t-test | r | ICC | CV (%) |
|---|---|---|---|---|---|---|
| 100 touches juggling | 77.32 (*24.90*) | 82.17 (*26.74*) | ns | .84*** | 0.83*** | 4.3 |
| 24m straight juggling | 19.64 (*5.61*) | 21.32 (*6.28*) | ns | .55* | 0.53* | 5.8 |
| 24m zig zag juggling | 16.05 (*7.51*) | 17.82 (*6.94*) | ns | .84** | 0.84** | 7.3 |
| 24m hurdles' juggling | 10.68 (*6.92*) | 12.13 (5.84) | ns | .88*** | .87*** | 8.9 |
| 30s juggling | 52.36 (*21.00*) | 53.91 (*18.63*) | ns | .86** | .85*** | 2.0 |
| Foot-thigh juggling | 16.14 (*12.64*) | 17.61 (*13.55*) | ns | .83*** | .82*** | 6.2 |
| Foot-chest juggling | 4.09 (*2.35*) | 4.51 (*2.87*) | ns | .91*** | .90*** | 6.9 |
| Foot-head juggling | 4.86 (*2.95*) | 5.12 (*3.69*) | ns | .89** | .83** | 3.7 |
| Foot-thigh-head juggling | 3.32 (*1.91*) | 3.00 (*1.47*) | ns | .85** | .85*** | 7.2 |
| Foot-head chest juggling | 2.68 (*1.29*) | 2.55 (*1.69*) | ns | .69* | .69** | 3.5 |
| Foot-thigh-head-chest juggling | 2.41 (*.73*) | 2.67 (*1.04*) | ns | .87** | .88*** | 7.2 |

* p<.05 ** p<.01 *** p<.001

**Table 2. Criterion validity of juggling tests.**

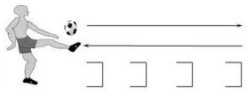
| Test | Means | Median % | |
|---|---|---|---|
| | | Above | Below |
| **100 touches juggling** | | | |
| Soccer players | 77.32 (*24.90*) | 82 | 18 |
| Recreational athletes | 30.09 (*17.87*) | 18 | 82 |
| **24m straight juggling** | | | |
| Soccer players | 19.64 (*5.61*) | 82 | 18 |
| Recreational athletes | 7.73 (*3.52*) | 3 | 19 |
| **24m zig zag juggling** | | | |
| Soccer players | 16.05 (*7.51*) | 73 | 27 |
| Recreational athletes | 5.95 (*2.52*) | 5 | 95 |
| **24m hurdles' juggling** | | | |
| Soccer players | 10.68 (*6.92*) | 77 | 23 |
| Recreational athletes | 5.27 (*2.25*) | 18 | 82 |
| **30s juggling** | | | |
| Soccer players | 52.36 (*21.00*) | 77 | 23 |
| Recreational athletes | 22.68 (*10.91*) | 18 | 82 |

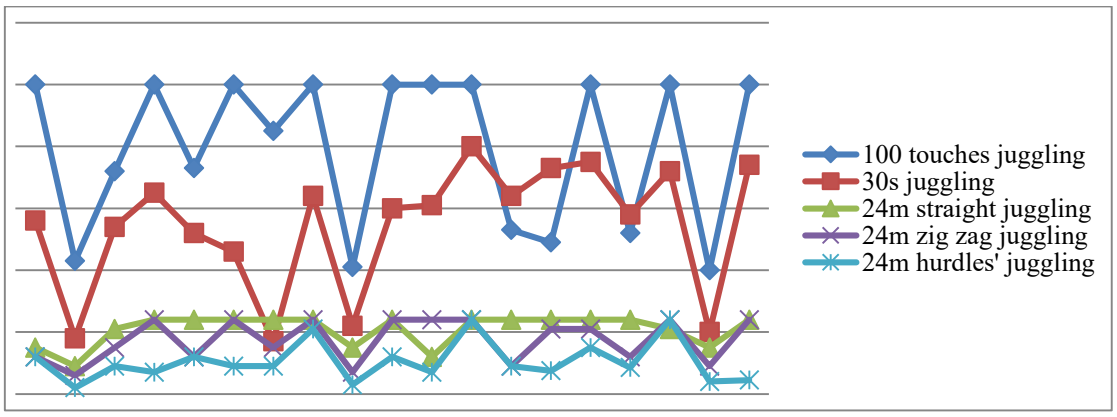
| | | | |
|---|---|---|---|
| **Foot-thigh juggling** | | | |
| Soccer players | 16.14 (*12.64*) | 73 | 27 |
| Recreational athletes | 7.18 (*4.65*) | 23 | 77 |
| **Foot-chest juggling** | | | |
| Soccer players | 4.09 (*2.35*) | 55 | 45 |
| Recreational athletes | 2.68 (*1.91*) | 23 | 77 |
| **Foot-head juggling** | | | |
| Soccer players | 4.86 (*2.95*) | 73 | 27 |
| Recreational athletes | 2.09 (*.87*) | 5 | 95 |
| **Foot-thigh-head juggling** | | | |
| Soccer players | 3.32 (*1.91*) | 59 | 41 |
| Recreational athletes | 2.14 (*1.46*) | 27 | 73 |
| **Foot-head-chest juggling** | | | |
| Soccer players | 2.68 (*1.29*) | 68 | 32 |
| Recreational athletes | 2.45 (*1.95*) | 27 | 73 |
| **Foot-thigh-head-chest juggling** | | | |
| Soccer players | 2.41 (*.73*) | 46 | 54 |
| Recreational athletes | 1.59 (*.80*) | 18 | 82 |




**Graph 1. Recreational and soccer players' performance in juggling tests.**

**Table 3. Difficulty of juggling tests (dominant foot).**

| Tests (dominant foot) | Figure | Difficulty | Average | High Scores |
|---|---|---|---|---|
| **100 touches juggling** |  | 1 | 77.32 touches | >100 touches |
| **30s juggling** | | 2 | 52.36 touches | 70-80 touches |
| **24m straight juggling** |  | 3 | 19.64 meter | 24m or 9-10 sec |
| **24m zig zag juggling** |  | 4 | 16.05 meter | 24m or 16-18s |
| **24m hurdles' juggling** |  | 5 | 10.68 meter | 24m or 22-25s |

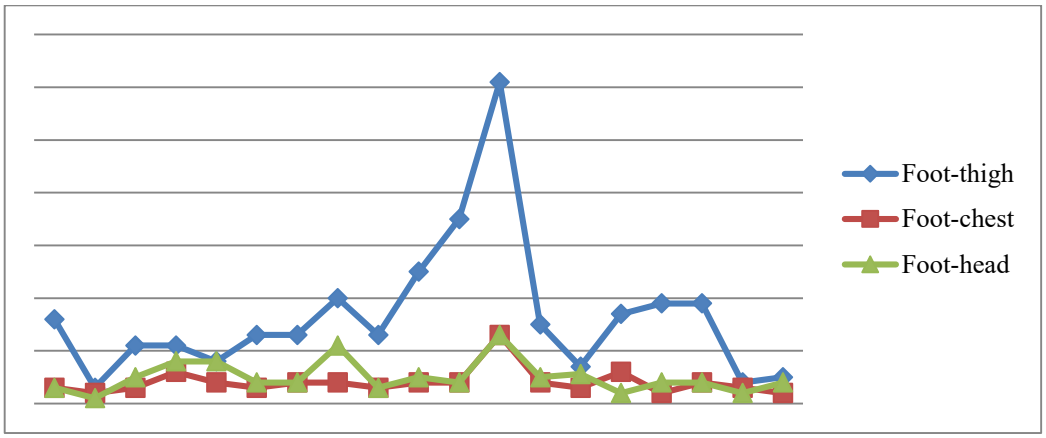



**Graph 2. Players' performance in juggling tests (dominant foot).**

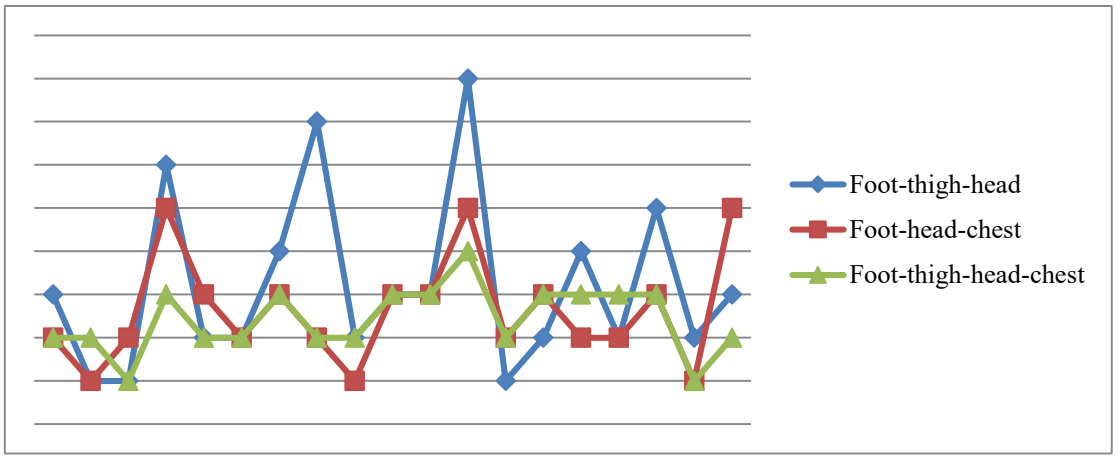
**Table 4.Difficulty of juggling tests (various body parts).**

| Tests (various body parts) | Figure | Difficulty | Average | High Scores |
|---|---|---|---|---|
| **Foot-thigh** |  | 1 | 16.14 | 35-60 repeats |

| | | | | |
|---|---|---|---|---|
| **Foot-head** |  | 2 | 4.86 | 10-13 repeats |
| **Foot-chest** |  | 3 | 4.09 | 6-12 repeats |
| **Foot-thigh-head** |  | 4 | 3.32 | 6-8 repeats |
| **Foot-head-chest** |  | 5 | 2.68 | 4-5 repeats |
| **Foot-thigh-head-chest** |  | 6 | 2.41 | 3-4 repeats |




**Graph 3. Players' performance in juggling tests (various body parts).**




**Graph 4.Players' performance in juggling tests (various body parts).**