## ABSTRACT

Agility has become a major focus in sport science research in recent years. Agility includes all movements in which there is a rapid start and stop with a sudden change of direction.

This mechanical stress puts a heavy strain on the body, which, if not properly executed, results in a decline in endurance during matches. The focus of this study was to confirm if this correlation can also be verified in motor skill tests; and if yes, to what extent.

The participants in this study consisted of junior soccer players in the Topola Sport Club, in age groups U14, U16, U18, with 20 persons in each age group. The standardized agility tests – *Illinois Agility Test*, *Dribbling Test*, and *T-Test* – were recorded using the *Oxa Starter+* infrared timing gate instrument. The sport-specific endurance was measured using the *Yo-Yo IRTL 1* test with *Polar Team²* heart rate transmitter.The data were processed using *IBM®SPSS® Statistics25*statistical software, applying normality testing, linear regression, and correlation matrix analysis ($p<0.05$). The study analyzed the relationship between agility parameters and endurance. The efficiency observed in the *Yo-Yo IRTL 1* test (1551.29m) varied between teams and positions within the team.

A moderate correlation was observed between the number of meters run in the test and the time elapsed before reaching the maximum intensity zone and the amount of time spent in the maximum intensity zone ($r=0.403$; $p<0.001$ and $r=0,560$; $p<0.000$).

The performance of participants showed a weak correlation with the agility without the ball (AWOB) ($r=-0,295$; $p= 0,029$), while no correlation was found between the variables in terms of agility test with the ball (AWB) ($r=-0.223$; $p=0.103$).

No significant correlation was found with heart rate variability (hereafter, HRV) parameters.

Agility and endurance have different motorcharacteristics; they still appear in soccer in a complex way. The various abilities must be intensively developed in a coordinated manner during sensitive periods, creating positive transfer effects for efficiency.


**Keywords**: soccer, junior, agility, endurance


## ÖSSZEFOGLALÓ

Az agilitás képessége az utóbbi években került igazán a sporttudományi kutatások középpontjába. Ide sorolható minden olyan mozgás, melynél gyors megindulás, megállás történik irányváltoztatással egybekötve. Ezek a mechanikai terhelések erősen igénybe veszik a szervezetet, amelynek helytelen kivitelezése a mérkőzéseken állóképességi teljesítményromlást eredményez. Vizsgálatunk arra fókuszált, hogy ez az összefüggés a motoros pályatesztek során is kimutatható-e, és ha igen milyen mértékben.

A vizsgálat a Topolyai Sport Club utánpótlás labdarúgóinak körében történt, U14, U16, U18-as korcsoportokban, korosztályonként 20 fővel. Az agilitási standardizált pályatesztek közül a Dribbling-teszt, Illinois teszt, T-teszt került rögzítésre Oxa Starter+ infrakapus rendszerrel. A sportágspecifikus állóképesség mérésére a Yo–Yo IRTL1 tesztet alkalmaztuk Polar Team2 pulzuskontrollal. Az adatok feldolgozása IBM SPSS Statistics25 programmal történt, ahol normalitásvizsgálatot, lineáris regressziót és korrelációs mátrix elemzést végeztünk ($p<0,05$).

A vizsgálat során az agilitási paraméterek és az állóképesség együtt mozgását vizsgáltuk. A Yo-Yo tesztben megfigyelt eredményesség (1551,29m) csapatonként és posztonként eltérő mértékű.

A pályatesztben lefutott méterek száma és a maximális terhelési zónát megelőzően eltelt idő illetve a maximális intenzitási zónában való tartózkodás közepes erősségű korrelációt mutat ($r=0,403$; $p<0,001$ illetve $r=0,560$; $p<0,000$).

A labdarúgók teljesítménye a labda nélküli agilitással (LNA) mutat gyenge összefüggést ($r= -0,295$; $p= 0,029$). A labdás agilitás (LAA) szempontjából nem találtunk kapcsolatot a változók között ($r= -0,223$; $p= 0,103$).

A szívfrekvencia-változékonysági paraméterekkel (HRV) nem találtunk szignifikáns korrelációt.

Az agilitás és az állóképesség eltérő motoros karakterisztikával rendelkezik, mégis a labdarúgásban komplex módon jelennek meg. A különböző képességeket összehangoltan, a szenzitív időszakokban kell intenzíven fejleszteni, kialakítva a pozitív transzfer hatásokat az eredményesség érdekében.


**Kulcsszavak**: labdarúgás, utánpótlás, agilitás, állóképesség

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# THE CONNECTIONS BETWEEN AGILITY, ENDURANCE AND MOTOR SKILL TESTS IN SERBIAN JUNIOR SOCCER PLAYERS

*Az agilitás és az állóképesség kapcsolata motoros pályatesztekkel szerbiai utánpótláskorú labdarúgóknál*

*Povezanost testova okretnosti, izdržljivosti i motoričke sposobnosti kod Srpskih juniorskih fudbalera*

## INTRODUCTION

One of the exciting areas of research on sport-specific motor skills is the comparative analysis of the different skills and abilities. For example, the relationship between power and speed, which are two conditional abilities helping each other achieve positive transfer. This study compares agility, the relatively 'young' ability, and physical endurance, a basic physical parameter in soccer. At first glance, this pairing may seem like a paradox, but these two seemingly radically different performance factors are closely related.

There are many definitions of endurance training;however, this study would highlight the one in the summary prepared by Carter et al. (2003), which states that endurance training is a sport activity that lasts for a minimum of 20 minutes with 60 to 80% of the maximum intensity. The intensity can be measured by heart rate. In the last decade(s), short-term, but maximum intensity endurance training methods have gained ground. The technical language uses several names for this trend, and this study would use the term ultra-short interval training (Balyi, 2013). It is generally recognized that very effective physical activity can be performed in a short period of time (about 30 minutes), where the load is about 20-30 seconds, and the rest time is minimal,for example in*High Intensity Interval Training* (hereafter, *HIIT*)or *Tabata Workout*. Bravo et al. (2008) investigated the effects of sprint training(repetitive sprinting) and *HIIT* training on soccer players with a series of tests for 7 weeks. The *Yo-Yo IRTL 1* test showed that the repetitive sprinters improved by 28%, while participants in *HIIT* training improved by 12.5% in terms of distance run. However, the authors emphasize that both methods must be used combined to ensure successful adaptation. During this type of exercise, enzymatic activity in the muscles and

other fiber composition characteristics are noticeably adjusted as early as 8 to 10 days after the start of the training, whereas in case of aerobic training, the same results would occur in only 6 to 8 weeks (Coyle, 2005). According to Gibala, et al. (2009), during maximum intensity training for 20 to 30 seconds, significant mitochondrial growth can be observed.

The increased need for endurance nowadays also results from more and more intense play in soccer (Dellal, et al. 2011). Interestingly, despite this accelerated play, the total value of movements detected on the pitch has not changed in recent decades. In a single match, players make approximately 9 to 14 kilometers of movement over the 90 minutes, covering all ranges from walking to sprinting (Bradley, et al. 2009).The players perform high-intensity runs (19.8 -25.1 km/h) at intervals of approximately 70 seconds, depending on their position (Stolen,et al. 2005). The intervals between these types of runs are all about active rest, and gathering power to make another powerful energy investment. During the 90 minutes of the game, significant differences can be measured by looking at endurance. It can be stated that in the second half the distance run and the intensity of the runs decrease (Mohr, Krustrup and Bangsbo, 2003). A greater decrease in activity can be observed when more activities are performed in the first half (Rampinini, et al. 2007). The most prepared teams can perform more and more high-intensity activities even with the ball (Iaia, Rampini, and Bangsbo, 2009).Speed reached over high-intensity runs is called sprint, which includes runs above a speed of 25.1 km/h. Studies of recent years show that it is soccerwhich has had the greatest development in this regard (Barnes et al. 2014). Average heart rate values (HRmax) for professional soccer players are around the extremely high value, 87.1% during matches(Suarez Arrones, et al. 2015).HRV has become noticeable in sports science in the last decade. Nevertheless, it has a history of several decades in medical field (Matlik, 1996). HRV can be used to assess the neurovegetative regulation and autonomic function of the heart (Sáfár,et al. 2018). It has been used in sport games in recent years (Vilamitjana, et al. 2013), with a conclusion that HRV data, in addition to heart rate, may be useful in determining individualized workout-rest ratio for athletes (Bara Filho, et al. 2013).

Bangsbo, et al. (2003), developed the *Yo-Yo IRTL* protocol, a standardized test of soccer-specific endurance. There are two levels of the *Yo-Yo IRTL* protocol: *1* and *2*. The *Yo-Yo IRTL 1* version was used in this study. According Bangsbo,et al. (2006), test performance is predictive of match performance.

*Agility* is a Latin word for mobility and skillfulness. However, in sports terminology, it abandoned the notion of general dexterity and the meaning of the word has narrowed over the years, and has become something accurately measurable (Sporiš, et al. 2010).It is interesting to note, however, that players at the highest level of soccer do not necessarily achieve the best performance in tests (Koltai et al. 2016), which proves that agility is a soccer-specific ability.

The authors agree that agility is defined as a sudden change in the direction of body motion at a high (or maximum) speed (Bloomfield, et al. 1994). In addition, rapid start, stop (Gambetta, 1996), explosiveness (Baker and Nance, 1995) are also associated with

agility.Sport science researchers noticed the paradox that while agility tests were initially based on closed motor skills, the very essence of agility plays a major role in sports games. This is how cognitive, perceptual tests were created, where decision-making qualities have a significant impact on performance (Schandl, 2018). For decades, only the rapid start was analyzed by various cognitive studies, but stopping (braking) is an equally important skill in the set of human movements, and is an essential part of agility.

In recent years in soccer, this mechanical stress has been the focus of match analysis, due to the development of ever-finer GPS systems. In this way, certain micro injuries can be detected which can be attributed to injuries and premature fatigue, and which are the result of improper start, stop, and change of direction.

## HYPOTHESES

The relationship between endurance and agility is based on the fact that coordinated and learned execution of intense mechanical work results in profitable endurance during matches, which entails maintaining a goodperformance as long as possible. A high-level-command of both abilities is desirable in soccer.

The following hypotheses were formulated:

1. With time, there is an improvement in the success rate of endurance tests as participants navigate up the age groups;

2. Players who reach the maximum intensity zone later, and are able to stay in the maximum intensity zone longer will have better results in the *Yo-Yo IRTL 1* test.

3. Agility test with (AWB) and agility test without (AWOB) the ball as well as the endurance testsproduce different resultsin variousplayer positions;

4. Players who perform better in *Yo-Yo IRTL1* also perform well in complex agility (CAG) tests.

5. There is a relationship between HRV and meters run.

## MATERIALS AND METHODS

The participants in this study consisted of junior soccer players in the Topola Sport Club, in age groups U14, U16 and U18. Altogether N=55 players took part: 4 goalkeepers, 13 defenders, 21 midfielders and 17 strikers. The following information was required from the participants: time of birth, height, weight and resting heart rate. The personal data were collectedin line with the principles described in the *Declaration of Helsinki*on human experimentation.

The results of the motor skill tests were measured using the *Polar Team²* heart rate transmitterand the *Oxa Starter+* infrared timing gate instrument. As a result, players' heart rate values and track test results were recorded to the millisecond. The soccer play-

ers were introduced to the rules and after an individual warm-up (15 minutes), the *Polar Team²* heart rate transmitter with pre-entered individual data wasstrapped onto their chest. It can be said that the teams carried out the test with great motivation and the participants were very competitive.

The measurements performed can be divided into the following two groups:

- endurance test (*Yo-Yo IRTL1*)
- agility tests (*Illinois Agility Test*, *Dribbling Test*, and *T-Test*)

*Yo-Yo IRTL1*

The sport-specific endurance was measured using the *Yo-Yo IRTL 1* protocol. The test was developed for soccer, with the necessary equipment (Polar heart rate monitor, markers, speakers, *Yo-Yo* test application) provided by the research team. The test began by measuring a 20 m long strip. The start and end pointswere marked with markers, giving each player a zone to run. A 5 m long recovery section on the starting side was designatedwhere participants could recover. The test measured performance in km/h. The intensity increased progressively. During the exercise, when instructed by the audio player, participants had to run line to line and then immediately make a 180° turn and run back to the start marker, arriving in the 5 m long recovery area where they have 10 seconds of recovery time before the commencement of the next shuttle. The test started at 5 km/h, that is, a fast walking pace and then gradually accelerated until becoming a fast, high intensity endurance test (Figure 2). In this test, the participants were allowed two fail attempts only before they were withdrawn from the test. If the individual failed to reach the line and get back to the start marker in the allocated time, one fail was issued (yellow card). If this happened a second, consecutive time then they were eliminated (red card).

*ILLINOIS AGILITY TEST*

The *Illinois Agility Test* is the most commonly used agility test in soccer. The participants performedthe test with and without the ball. The course is 10 meters long and 5 meters wide. There are two 10-meter sections on the sides, which are the start and the end of the exercise. Between the two sprints, in the middle of the designated test area, there is a slalom run or a ball run where the cones are 3 to 3 meters apart. The infrared gates are located at the start and finish line.

*DRIBBLING TEST*

Participants performed the *Dribbling Test* without the ball, and with the ball using the dominant and the subdominant foot. The course was 10 meters long with markers placed every meter. Participants had to run a slalom ball. The test included changes of direction less than and more than 90 degrees and even 360 degrees changes of direction. The infrared gates are located at the start and finish line.

*T-TEST*

Participants performed the *T-Test* according to the standard procedure: without the ball. This test included forward, backward, and lateral movement. The course was 10 meters long and 10 meters wide. The starting position was also the finish line. From the starting position,participants ran forward 10 meters to the center cone. From there, they had to make a lateral movement to the cone 5 meters to the left of the center cone and touch it. Then they had to move 10 meters to the cone on the right with sideways movement and touch it. Then back to the center cone, and then run backwards to the starting position. The cones always had to be touched. The infrared gate is located at the start/finish line.

*DATA PROCESSING*

The data were processed using the *IBM® SPSS® Statistics25*statistical software. In addition to univariate statistics (mean, standard deviation), *analysis of variance*(ANOVA), *correlation matrix analysis* ($p<0.05$) and *linear regression* were applied.

## RESULTS

The data obtained were subjected to normality test, taking into account skewness and kurtosis.Based on this, it can be seen that the distorting effects of the distributions do not have a decisive influence on future test results;therefore, no data transformation was necessary.It was verified with analysis of variance (ANOVA) that the average results of the *Yo-Yo IRTL 1* test differ between the age groups and the difference can be statistically proved. As age progressed and players navigated up the age groups, it was assumed that the results in the endurance test would show a strictly monotonous improvement.

The results of the teams were as follows (Table 1):

On average, players made 1,659.27 meters. Due to their age, U14 players ran the least, averaging 1,534.67 meters. Overall, U16 players performed better (1,770.43m) than U18 players (1,618.82m).

One of the questions of the study was the amount of time spent in the maximal intensity zone (anaerobic) and outside the maximal intensity zone (aerobic) (Table 2). The goal was to statistically prove who was a more skilled player. Outside the maximum intensity zone, teams spent an average of 281.35 seconds during the test, which is slightly more than 4.5 minutes. The U14 team spent 176.47 seconds, or nearly 3 minutes outside the maximal intensity zone, while the U16 team spent 336.22 seconds, which is over 5.5 minutes, and the U18 team spent 299.65 seconds, or 5 minutes in this range. On average, U16 participants stayed outside the maximum intensity zone for the longest time.In the maximum intensity zone, participants spent an average of 465.16 seconds, which is nearly 8 minutes. This means that on average participants spent 60.61% of the test in this zone. It is worth examining the teams in percentage: the U14 team spent 68.15% of the test in the maximum intensity zone, which is an extremely high figure, exceeding the average by 8%. The U16

team spent 57.92%, and the U18 team spent 57.61% of the test in the maximum intensity zone.To sum up, the U14 team experienced the biggest pressure by the *Yo-Yo IRTL1*, while the U16 and U18 teams responded similarly to the endurance test.The highest individual value was 1100 seconds – more than 18 minutes – which was 92% of the total test duration, that is, this particular participant spent almost the entire test in the maximum intensity zone. A U16 player produced this result.

In conclusion, the teams spent the following percentages of the test in the maximum intensity zone:

- U14 team – 68.15%,
- U16 team – 57.92%,
- U18 team – 57.61%.

The heart rate values were as follows: the average heart rate per minute during the test was 183.51 beats per minute (hereafter, BPM), with a minimum of 82 BPM, and the maximum of 217 BPM. The average heart rate throughout the entire test was 2286.56 beats, with a minimum of 745 beats and a maximum of 3903 beats.

The results for agility test with (AWB) and agility test without (AWOB) the ball are shown in *Table* 3. The data gathered based on player position were processed by one-way analysis of variance (*Figure 1*).

The results of agility without the ball (AWOB) for an individual participant were determined by adding up the data obtained in the following tests:

- *Illinois Agility Test* without the ball,
- *Dribbling Test* without the ball,
- *T-Test*.

These movements are similar to defensive movements in soccer.

The results of agility with the ball (AWB) for an individual participant were determined by adding up the data obtained in the following tests:

- *Illinois Agility Test* with the ball,
- *Dribbling Test* with the ball, using the dominantleg,
- *Dribbling Test* with the ball, using the subdominant leg.

Agility with the ball(AWB) is fundamentally more noticeable in case of strikerswhen they carry out one-on-one solutions during attacks (Koltai, et al. 2017).

Overall AWOB results:

Goalkeepers – 36.59 seconds,Defenders – 36.59 seconds,Midfielders – 36.73 seconds,Strikers – 36.49 seconds.

Overall AWB results:

Goalkeepers – 52.22 seconds,Defenders – 49.53 seconds,Midfielders – 48.47 seconds,Strikers – 49.54 seconds.

*Yo-Yo IRTL 1* test results per player position:

Goalkeepers – 1370 meters,Defenders – 2010.77 meters,Midfielders – 1624.76 meters,Strikers – 1501.18 meters.

In terms of agility tests with and without the ball, one-way analysis of variance (ANOVA) did not statistically show significant difference between player positions.AWOB: F=0.612; p= 0.610. AWB: F=1.465; p=0.235.

The next important part of the study is the complex agility (CAG) index, which is a new agility index introduced by this study.This indexwas obtained by adding up the results of the individual agility tests with and without the ball: AWB + AWOB = CAG.

The study analyzed the relationship between the AWB and AWOB, and the relationship between the *Yo-Yo IRTL 1* test and AWB, and between*Yo-Yo IRTL 1* test and AT, and then compared the complex agility to the endurance test at the very end. In the linear regression graph, each point represents the performance of a player. The linear regression of AWOB and AWBis shown in *Figure 2*. In this regard, those participants performed consistently whose points on the graph are close to the regression line, and those close to the origin performed best. It can also be seen in the graph that the standard deviation is relatively small, so it was assumed that there is a relationship between the two abilities. This assumption was supported by statistical calculations.AWOB and AWB show a moderate, almost tight correlation, r=0.556; p=0.000.

The regression graph of the endurance test is shown separately for AWB and AWOB in *Figure 3.* As mentioned earlier, the paradox of the study is that it is looking for a relationship between two fundamentally different abilities. The aim of the endurance test is to perform the test as long as possible, whereas in agility tests, the quickest execution is desirable.However, the study introduced the concept of reciprocals used in mathematics to visually illustrate the relationship between the two variables. This can be seen on the Y-axis. This approach makes it easier to interpret the values obtained, since the inverse values of the data were obtained. At first glance, it can be seen that the standard deviation is extremely high, which suggests that there is no or only a very weak relationship between the examined indicators.Values close to the line represent similar player abilities, while those farther away show different skill levels between players. The endurance test showed a weak correlation only with AWOB, r=0.295; p=0.029. There was no correlation between AWB and the *Yo-Yo IRTL 1* test, r=0.223; p=0.103.

There was a weak correlation between endurance test and complex agility index (CAG), r=0.272; p=0.045. The *Yo-Yo IRTL 1* test was the only one showing different resultsacross player positions. Substantial differences per player positions were not observed in AWB and AWOB.

The fifth hypothesis of this study concerned HRV and the meters run. It was assumed that a trained and healthy heart would perform better in endurance tests. For this assumption, SD1 and SD2 parameterswere used, which represent the rate of fluctuation of RR intervals. This hypothesis was not confirmed, there was no correlation found between the two variables: *Yo-Yo IRTL 1*– SD1: r=081 p=0,555;*Yo-Yo IRTL 1*– SD2: r=119 p=0.388.

## DISCUSSION

It can be stated that endurance does not increase steadily among the age groups, as it was hypothesizedby this study. There was fluctuation and halt between the teams (U14: 1534.67meters; U16: 1770.43meters; U18: 1618.82meters). This may be explained by the

use of different training methods, number of trainings, quality differences between the age groups, and the personal habits and philosophy of the coaches.The players' individual, systematic development is a guarantee of maturing into a professional soccer player. This hypothesis was rejected.

The second hypothesis aimed at verifying which of the following yields better performance in the endurance test: the time spent outside the individual heart frequency zone (aerobic, <90%), or the time spent in the maximum intensity zone (90 to 100%).A clear answer to this question could not be found, as players with adequate aerobic endurance (average 281.35 seconds) and players with adequate anaerobic endurance (average 465.16 seconds) both were able to perform well in the test, so the hypothesis was partially true.

Next, the focus was on the results of the agility tests per player position. During the agility tests, it was assumed that some type of movements would favor the defenders (for example *T-Test*), and certain tests would favor the strikers (*Dribbling Test*). After running analysis of variance, it can be concluded that thehypothesiswas not proved, neither in terms of the distribution of the positions, nor in terms of the measurements with the ball and without the ball. It can be stated that the players' starting and stopping ability did not depend on the positions occupied on the pitch.

The fourth hypothesis was about the enduring and agile soccer player. Pearson's correlation was sought between the two abilities. A weak relationship was found between the distance run and the agility tests without the ball (*Yo-Yo IRTL 1*(m) – AWOB: r=0.295; p=0.029), while the agility tests with the ball and the *Yo-Yo IRTL 1* test show no correlation at all (*Yo-Yo IRTL 1*(m) –AWB: r=0.223; p=0.103). This hypothesis was not clearly substantiated, which may be because the technical execution of the ball tests required a more complex task for the participants, so even a good shape and stamina can often be accompanied by a lower technical quality.

The last hypothesis was about HRV and distance run in the *Yo-Yo IRTL 1* test. The relationship between effective endurance and a trained heart was investigated. The HRV variables SD1 and SD2 served as a basis. No relationship was found between variables, the rate of fluctuation of RR intervals is independent of the number of meters performed.

## CONCLUSIONS

In this study, Serbian junior soccer players (U14, U16, U18) were assessed for their endurance and agility. Complex soccer players are characterized by good stamina and agility. However, these two qualities have opposing components; at the same time, both qualities combined is the recipe for becoming a successful soccer player. Based on the results of the endurance test, it is recommended to conduct enhanced development in both, basic endurance and advanced endurance; to have a unified club philosophy regarding training work; to progressively increase the load as players move up the age groups; to have regular control measurements every eight weeks to check endurance development.

Based on the results, it can be stated that agility is defined as an independent and complex ability. The movements that make up agility are very significant: start, stop, change of direction. Match analysis systems also reinforce the notion that these movements are essential elements of modern, preventive performance enhancement. The study allowed for the emergence of several important professional ideas, which may form the basis for further research. The significance and special place of mobility in periodization can be the subject of deeper elaboration. Conscious teaching of directional change (for example, developing a proper 'take-off') can yield time efficiency and movements that are more fluid. The proportion of AWOB and AWB exercises was an essential information. There was a moderate correlation between the samples of the two modes of execution. This study asserts that agility must be developed both directly and indirectly. Direct development refers to change of direction exercises with or without the ball, in which there is a minimal deceleration. Indirect development can be for instance mobilization and stabilization exercises, one-leg exercises to improve balance, movement coordination and speed stimulation.In addition, intensity, and in particular maximum intensity is also a fundamental performance component. These sub-areas contribute to the qualitative development of this complex ability, agility.

Clubs should be encouraged to consider agility as a crucial aspect when choosing a player.

The study has the potential to extend to further areas. It could be worthwhile to take these tests at another academy where they work with different professional concepts and periodization. Doing so might help get closer to the solution and could provide valuable information. It would be useful to apply the tests to lower age soccer players where agility and coordination skills are less developed, and to develop these skills in a combined, intensive way through a specific training program.

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## TABLES AND FIGURES

**Table 1**: Number of meters run in *Yo-Yo IRTL 1* test by age group

| Yo – Yo (m) | Mean | Minimum | Maximum | Std. Deviation |
|---|---|---|---|---|
| U14 | 1534,67 | 960 | 2240 | 395,002 |
| U16 | 1770,43 | 960 | 2760 | 502,679 |
| U18 | 1618,82 | 1000 | 2360 | 468,640 |
| Total | 1659,27 | 960 | 2760 | 467,507 |

**Table 2**: The percentage of time spent outside the maximum intensity zone and in the maximum intensity zone by age groups

| **Topolya** | <90% | | | | 90-100% | | | |
|---|---|---|---|---|---|---|---|---|
| Agegroup | Mean | Minimum | Maximum | Std. D. | Mean | Minimum | Maximum | Std. D |
| U14 | 176,47 | 54 | 331 | 93,602 | 68,15 | 13 | 92 | 19,181 |
| U16 | 336,22 | 95 | 1250 | 277,086 | 57,92 | 0 | 92 | 28,167 |
| U18 | 299,65 | 78 | 558 | 148,812 | 57,61 | 2 | 85 | 22,974 |
| Total | 281,35 | 54 | 1250 | 211,082 | 60,61 | 0 | 92 | 24,428 |

**Table 3**: AWOB and AWB results

| | Mean | Minimum | Maximum | Std. Deviation |
|---|---|---|---|---|
| Agility without ball (sec) | 36,49 | 33,61 | 40,88 | 1,514 |
| Agility with ball | 49,32 | 43,01 | 57,79 | 4,426 |

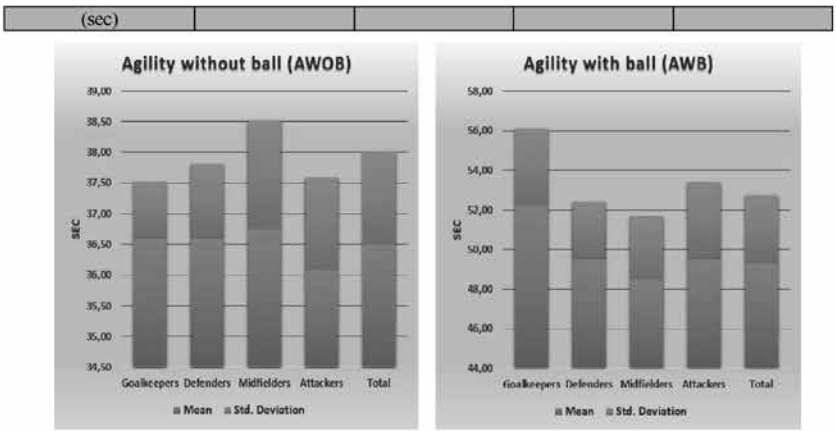


**Figure 1**:AWOB and AWB results per player position

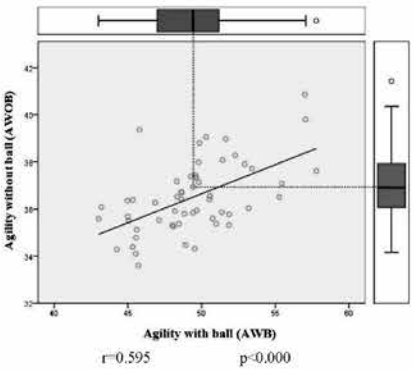


**Figure 2**: Linear regression of AWOB and AWB

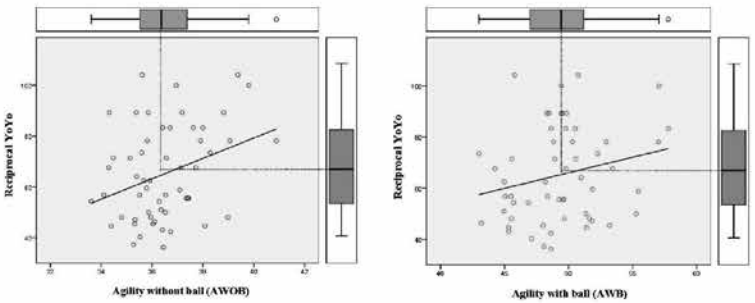


**Figure 3**:Regression of reciprocal *Yo-Yo IRTL 1* with AWOB and AWB