

## THE DYNAMICS OF THE AGILITY MANIFESTATION IN BASKETBALL GAME DURING THE PHYSICAL EDUCATION LESSON

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**Abstract.** *This paper is meant to investigate the dynamics of the agility manifestation in basketball game, during the physical education lesson for 12-14-year-old students of middle school. This scientific approach entailed the organization of a confirmatory study carried out in the „Mircea cel Bătrân” Middle School of Pitești, Romania. The subjects of the research were 17 schoolgirls aged 12-14 years. The specific speed (agility) and the 5x10 m dribbling shuttle were tested by means of the „Witty” wireless timing electronic system. Measured indices: total time (sec) and time for each 10 m line (Lap). The technical training was evaluated using 3 technical tests from the basketball game. The results of the research show the dynamics of the manifestation indices of the specific speed (agility) in the basketball game for 12-14-year-old schoolgirls, highlighting: the average total time, the weight of the time at each line of 10 m (Lap) and the speed of movement calculated both totally and at each Lap. The technical training results reveal a level of 81.8% in terms of correctness of the executions (within the performed tests). About 30% of the students recorded scores below the group average (referring to the individual performances). The correlation analysis highlight strong connections at  $p < 0.001$ , with negative values between the investigated indices, which justifies the existence of a mutual influence between variables. Data are useful for physical education teachers and basketball specialists.*

**Keywords:** *agility, technical training, basketball means, correlation analysis, middle school cycle.*

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### Introduction

The physical education system in Romania includes a multitude of activities that contribute to the development of a well-balanced and harmonious body, starting from small children up to adolescents. The psychophysical and psychomotor skills, the intellectual potential, the motivational, affective and volitive sphere are turned to advantage for this purpose (Cucui, 2017). Among the most important motor skills developed in school, during the lesson of physical education, is the combination of speed, coordination and balance - called *agility* (Szabo et al., 2020).

It is a well-known fact that sports game (among all curriculum contents) is the main point of interest for students of all ages, regardless of whether they belong to a gender category or another (Savu & Pehoiu, 2018b). Sports games are key means not only for physical education but also for the intellectual, moral and aesthetic education of children. The basketball game, through all its characteristics and practicing forms, both as performance sport and grassroots sport and also as means used in the physical education lesson, has multiple formative possibilities. It has a good influence on the persons who play this sport, from a recreational and educational point of view, in terms of self-confidence, satisfaction etc. (Savu & Pehoiu, 2018a; Ciocan & Puni, 2020).

Basketball evolved significantly as for technique, tactics, speed of play and level of skill (Nae & Pop, 2022). It was found out that the basic training for developing and improving the physical qualities takes place during adolescence. The future formation of skills in the basketball players will depend on these physical qualities (Koryahin et al., 2019). The game of basketball is one of the team games characterized by speed and agility; it is a fun and exciting game due to its offensive and defensive skills (Al-Selmi et al., 2019; Hassan et al., 2022). There is a significant relationship between the agility test and the Flamingo static balance test (Acar & Eler, 2019).

Basketball game is a sport that requires high skill and physical fitness (Yuan et al., 2021) and also requires good speed of play (Daulatabad et al., 2020). Moreover, basketball is a type of sport played by two opposing teams with the purpose to put the ball into the basket of the opposing team. As it has complex movements, this sport demands speed, strength, agility and flexibility, ultimately providing an increased development of wider movement skills for players. In order to be able to play basketball, students must master the basic techniques of the game, including the dribbling, passing, pivoting, lay ups and lay up shoots (Suryadi et al., 2023).

In basketball, the participants have an adversarial relationship; they fight to win on a special playing court. Each participant tries to make more successful shots to the basket of the opposing team (Moanță et al., 2008; Predescu & Moanță, 2001). Basketball game is part of the sports activities that can be found in physical education lessons at all education cycles (Moldovan, 2015).

The game of basketball demands all motor skills. The development of motor skills is closely related to both internal and external factors (Savu & Pehoiu, 2018c). In the opinion of several authors (Predescu & Moanță, 2001; Moanță et al., 2008; Ghițescu, 2013), basketball has the means and technical procedures needed to develop the coordination in the 12-15-year-old students, because the necessary conditions for functional improvement occur at this very age (Demcenco, 2017). Speed, agility and strength are essential components specific to basketball players (Abdelkrim et al., 2010; Kamandulis, 2013).

The efficiency of the game in the team sports relies on the physical abilities of the athletes to a great extent (Cortis et al., 2011). Thus, in basketball game, the muscle strength of the lower limbs is of great importance, as it determines the height of the jump and the acceleration during the short sprints (Castagna et al., 2007; Abdelkrim et al., 2007; Erculj et al., 2010; Alemdaroğlu, 2012; Power et al., 2022). The ability to move rapidly and jump as high as possible determines the performance of the player and the quality of other important technical

actions in basketball game, such as: quick transitions from defense to attack, jumps, fighting for ball recovery and defense activities (Pliauga et al., 2015).

Basketball is one of the most popular team sports in the world. It is characterized by finesse, accuracy and imagination which can be seen during the technical and tactical executions. It is also defined by the height and the special physical qualities of the athletes. In the case of the basketball players belonging to European clubs, the researchers highlighted that these athletes are distinguished by a high level of development of the general endurance and an average level of skills development: speed and speed – strength (Darvin et al., 2018; Strykalenko et al., 2020).

### *Purpose*

This research aims to investigate the dynamics of the agility manifestation in basketball game, in the middle school students during the physical education lesson.

### *Objectives and tasks*

- Knowing the dynamics of agility indices in the basketball game in pupils (12-14-year-old girls);
- Evaluation of the level of technical training of the basketball game in the middle school students;
- Highlighting the degree of connection between the indices of agility and technical training of basketball game in pupils.

### *Research questions*

- 1) What is the dynamics of the agility manifestation in the basketball game in the middle school students?
- 2) What is the relation between the indices of the specific speed (agility) and the technical training indices in the basketball game?

## **Methodology**

### *Participants*

The subjects of the research were middle school female students ( $n = 17$ ) aged 12-14 years (mean $\pm$ SD), weight  $47.46\pm 8.52$  kg, height  $161.46\pm 7.14$  cm and body mass index (BMI) –  $18.11\pm 2.21$  kg/m<sup>2</sup>; all participants have a normal mass consistent with their age. It has to be mentioned that 12 students are members of the school representative team. To participate in the research, the subjects were informed and gave their consent, respecting the Declaration of Helsinki.

### *Measures*

Agility was measured by means of the „Witty” wireless electronic timing system, in the 5x10 m shuttle test speed running with basketball dribbling. Measured indices: total time of movement (sec) and times of movement at each line of 10 m (sec). The total speed of movement and the speed at each lap were calculated using the formula: distance/ time covered (m/s). The agility measurement tool belongs to the Human Performance Research Center (C.C.P.U.) of the Physical Education and Sport Department in the University of Pitești, Romania.

Technical training tests specific to basketball:

*Test 1.* From the corner of the playing court, the student takes side steps on the baseline (the fundamental position in basketball), up to the opposite corner. There she takes the ball, starts dribbling and performs a two-handed chest pass to the teacher on the center line. Then she continues to move, catches the ball, dribbles and shoots the ball through the hoop. The scoring is calculated as follows: 1 point for moving in the fundamental position; 2 points for dribbling; 1 point for two-handed chest pass; 2 points for catching the ball; 2 points for shooting and 3 points for a successful shot; 1 bonus point. Execution mistakes: 0.1 (slight), 0.2 (moderate), 0.3 points (major mistake) for each fault.

*Test 2.* The student takes side steps on the baseline (the fundamental position in basketball) from the corner of the playing court up to the opposite corner. She takes the ball, starts dribbling with speed (the dribbling performed in speed being the difference compared to the first test), performs a two-handed chest pass to the teacher standing on the center line; she continues to move, catches the ball, dribbles and shoots to the hoop (2/3 points). The scoring and the execution mistakes as well (points lost at each fault) are similar to Test 1.

*Test 3.* The student stands at the corner of the playing court; she starts dribbling through the cones (2 points), performs a bounce pass to the teacher (2 points), receives the ball again (2 points) and shoots (3 points). Points are scored as follows: 2 points for dribbling; 2 points for a bounce pass; 2 points for catching the ball; 3 points for a good shot; 1 bonus point. Execution mistakes: 0.1- 0.3 points for each fault.

### *Procedure*

The research was carried out from March 29 to March 31, 2023 throughout physical education lessons and basketball extracurricular activity, within the „Mircea cel Bătrân” Middle School of Pitesti, Romania.

This scientific approach led to a correlation study.

### *Statistical analysis*

The statistical analysis was carried out with the KyPlot 6.0 (KyensLab Inc) software, calculating the usual descriptive indices: minimum, maximum, mean, SEM –standard error of the mean, SD – standard deviation, Cv % – coefficient of variation, Range, Confidence Level of Mean (0.95). The correlation analysis was performed using the Pearson coefficient between the agility indices and the technical tests specific to the basketball game. Significant data were reported at  $p < 0.05$ .

## Results

The results of the manifestation of agility indices and the technical training specific to basketball game in the 12-14-year-old students are shown in Tables 1 and 2.

Table 1. *Results of descriptive statistics indices – agility in the 12-14-year-old students*

Descriptive Statistics	Time (s)	Lap L1 (s)	Lap L2 (s)	Lap L3 (s)	Lap L4 (s)	Lap L5 (s)
Mean (in sec)	17.19	2.75	3.56	3.69	3.62	3.57
S.E.M.	0.46	0.09	0.09	0.15	0.08	0.10
S.D.	1.89	0.37	0.40	0.63	0.35	0.42
Coef. Var. (%)	10.98	13.32	11.31	17.08	9.72	11.89
Min	14.39	2.19	2.87	3.00	3.11	3.02
Max	21.73	3.53	4.37	5.07	4.50	4.73
Range	7.34	1.33	1.49	2.07	1.39	1.71
Conf. Level of Mean (0.95)	0.97	0.19	0.21	0.32	0.18	0.22

The analysis of the statistical calculations highlights an average total time of 17.19 sec for completing the test, and a value of 7.34 sec - the size of the interval between minimum and maximum values. As for the weight of the time needed to cover each line (Lap) -  $L_n$ , one can notice a higher value at L3, (representing 21.5% of the total time - 17.19 sec), an average speed of movement of 3.64 m/s (L1), a decrease by 0.83 m/s (L2) and a slight increase of 0.04 m/s at L5 compared to L4 (2.76 m/s). All these values show the dynamics of the agility manifestation in the students aged 12-14 years.

Table 2. *Results of descriptive statistics indices - technical training specific to basketball game in the 12-14-year-old students*

Descriptive Statistics	Test 1 (points)	Test 2 (points)	Test 3 (points)
Mean (in points)	8.16	8.21	8.16
S.E.M.	0.22	0.22	0.22
S.D.	0.88	0.91	0.92
Coef. Var. (%)	10.76	11.09	11.33
Min	6.6	6.6	6.6
Max	9.2	9.3	9.3
Range	2.6	2.7	2.7
Conf. Level of Mean (0.95)	0.45	0.47	0.48

The analysis of the statistical calculations regarding the technical training specific to basketball game in the female students aged 12-14 years reveals the exactness of movements execution. Thus, it was found out a mean of 8.18 points between the tests and a value of 2.6 points for the size of the interval between the minimum and maximum values. In terms of individual values of the performances achieved in the technical tests, it can be observed that 29.4% of the research subjects had scores under the average of the group (schoolgirls who are not part of the representative team of the school), which shows the technical training level of the subjects.

In order to highlight the relationship of the indices of agility manifestation and the level of technical training specific to basketball game in the 12-14-year-old students, a correlation analysis was performed. The results are presented in Figure 1.

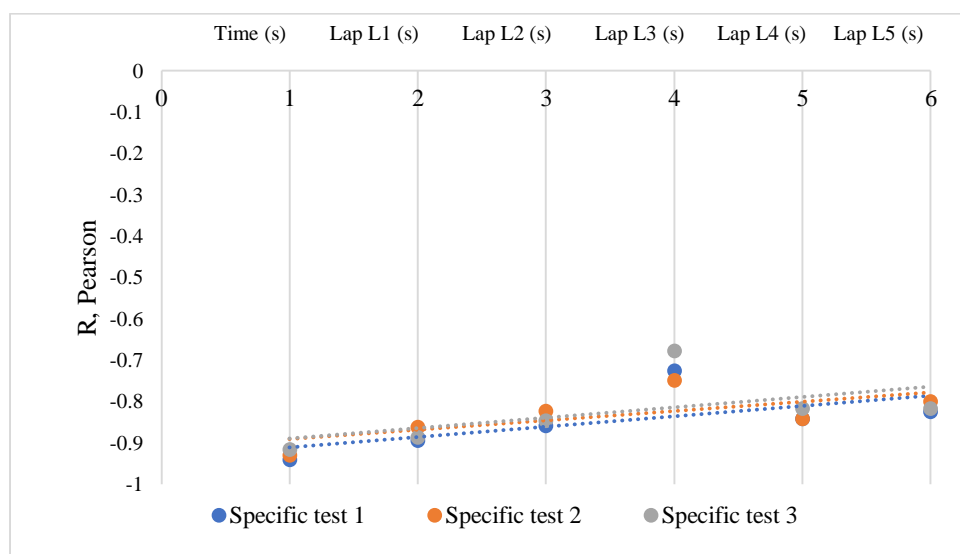


Figure 1. Correlation analysis between the agility indices and the technical tests specific to basketball game in the 12-14-year-old students

The results of the correlation analysis highlight 18 connections; due to the inverse performance relationship between these ones, the values are negative (a high value in the case of one variable is associated with a low value in the case of the other variable). In other words, a good performance (time) in the 5x10 m shuttle test speed running with basketball dribbling is linked with better results in the case of the technical tests specific to basketball game. Regarding the correlations made between the technical tests (points) and the indices of agility (sec), very strong connections can be (generally) observed ( $p < 0.001$ ) as follows:  $r$  between -0.916 and -0.942 (in the case of the total time);  $r$  between -0.800 and -0.895 (Lap1, Lap2, Lap4 and Lap5);  $r$  ranging from -0.679 ( $p < 0.01$ ) to -0.75 (Lap3). The effect size (coefficient of determination  $r^2$ ) ranges from the value 0.46 to 0.89, which reflects a strong, respectively very strong connection between variables (Predoiu, 2020). As for the confidence limits, it must be stated that the value 0 does not exist in the confidence interval (95%).

## Discussions and Conclusion

The purpose of the current research was to investigate the dynamics of the agility manifestation, in the basketball game, during the physical education lesson in pupils (12-14-year-old schoolgirls). Various world organizations suggested that physical education should play a central role in increasing the physical activity level of the adolescents (Lonsdale et al., 2009).

Basketball fulfills an important formative function (Ciocan & Puni, 2020). The improvement of the teaching process in the physical education classes and the psycho-motor development of the middle school 13-14-year-old students, by using the basketball specific

means, lead to the acquisition of new knowledge, qualities and skills and also to better physical and motor capacity of the students (Savu & Pehoiu, 2018b, 2018c). In addition, the basketball game leaves a special imprint on the personality and will of children through the need of self-control and control of emotions, the desire to win and the efficient solution of game situations by initiative, cooperation and appropriate motivational actions (Moroianu & Dumitru, 2013). Researchers draw attention to the need to continuously look for new and more efficient means of technical and physical training in the case of the basketball players (Koryahin et al., 2019).

The results of the research show the dynamics of the manifestation indices of the basketball specific speed (agility) in the 12-14-year-old schoolgirls. Data analysis highlights the average total time, the share of time at each 10 m line (Lap), L1 (best time) representing, for example, 16% of the total time. Following a comparison of the research results with the data provided by the specialized literature, a connection was observed between the applied coordination skills of the middle school students and the special means of basketball (Demcenco, 2017). An attempt was made to identify how much the sports level is determined by the individual factors in a group of young basketball players aged from 12.5 to 13.5 years. This sports level is determined (to the greatest extent) by weight, height and special physical fitness, which highly depends on speed and strength skills (Karpowicz, 2006). The relationship between the physical capacity of athletes and their performance during the game was studied in the junior basketball players. The results highlight the fatigue that players feel as the playing time progresses. That is why the benefit of aerobic conditioning and agility is suggested (Abdelkrim et al., 2007). Investigating the impact of balance exercises (done during the lessons of physical education throughout 8 weeks) on speed and agility in 10-12-year-old children pointed out a positive effect on speed, agility and performance (Acar & Eler, 2019). The importance of general coordination for improving the specific skills remains at high level during the skills refinement stage and decreases when the sport-specific skills are mastered close to perfection (Kamandulis, 2013). The implementation of a motor program centered on the development of the coordination skills in the 12-14-year-old female basketball players leads to their improvement and could have a significant impact on future results/performances (Epure & Bădău, 2021).

The results of the basketball technical training of the schoolgirls aged 12-14 years show a level of 81.8% in terms of correctness of movements execution during tests. The analysis of the individual performances reveals that approximately 30% of the subjects in the research have scores below the average of the group (students who were not members of the school representative team). In this regard, some experimental researches focused on a methodology meant to improve - through extracurricular basketball activities - the physical fitness of the 12-14-year-old students who live in high radiation conditions (Halaidiuk et al., 2018). The influence of basketball-specific means on the speed of repetition, reaction and execution was highlighted in the case of the students who participated in extracurricular activities, by comparison with students who did not take part in extracurricular activities; significant progress was recorded for the experimental group (Vlăsceanu & Cosma, 2014).

The results of the correlation analysis reveal strong connections with negative values between the indices of the specific speed (agility) and the basketball technical tests in the 12-14-year-old schoolgirls, which justifies the mutual influence between them. There are also other concerns that complement this relation between motor skills and the contents of the

basketball game. A study carried out throughout a school year, within the lessons of physical education and sport of the 7<sup>th</sup> grade, where „Standard Fitness Test” was performed, revealed that the basketball game (taught in the physical education classes) has a substantial contribution to the development of motor skills and the achievement of physical education objectives (Popa & Mester, 2013). In another study, the EUROFIT test battery was used to evaluate the contribution of the basketball-specific methods during the physical education lessons (Moldovan, 2015).

Despite extensive data on the demands of the basketball game, the relative importance of the factors that cause fatigue and muscle damage has only been temporarily explored and remains unclear (Pliauga et al., 2015).

The evaluation of the agility and technical training in the basketball game in the middle school students highlighted the dynamics of the investigated indices and the correctness of the execution of the movement. Also, the correlation analysis determined the degree of connection between the investigated variables in the case of pupils. These data are useful for physical education teachers and basketball specialists.

In the future, research can focus on establishing the level of manifestation of agility in the basketball game (norms can be created), for pupils aged 12-14 years.

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**Informed Consent Statement:** The participants provided their written informed consent to participate in this study.

**Data Availability Statement:** Data are available upon request to the contact author.

**Conflicts of Interest:** The authors declare no conflict of interest.

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