

Tennis ball as a factor in the initial tennis training of junior high school (12-year-old) students

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Abstract

Between 2016 and 2018 in the Bulgarian school, the new syllabi in the subject "Physical Education and Sports" were introduced (5 to 12 class, as an additional area - Order number RD09-1857 from 17 December 2015), which include some individual sports games such as tennis, table tennis and badminton in addition to collective sports games. The present study aimed to establish the influence of the tennis ball on the initial acquisition of basic technical skills in tennis in 12-year-old boys and girls in secondary school. Thirty-four boys and girls aged 12 took part in the conducted sports pedagogical experiment.

Methods: Before and after the experiment sports pedagogical testing was conducted with 3 tests. To estimate the differences between the mean values, the methods of nonparametric statistics typical for small samples were applied by the tests of Wilcoxon (for dependent samples) and Mann-Whitney (for independent samples) in 2 groups. The results confirmed the hypothesis that if in the initial training in tennis a ball with reduced compression (75% - green) was used, it would contribute to faster and more correct acquisition of key tennis skills. Conclusions: The post-test results showed a good level of mastered basic sports technical skills from the game of tennis among both classes after the end of the experiment. The students from the class trained with a green ball demonstrated better results in all tested skills compared to the students from the other class who practiced with a standard /yellow/ ball. The results obtained can be important for coaches, teachers and anyone involved in tennis training and coaching.

Key words: forehand, backhand, service, "yellow" and "green" tennis balls, comparative results, secondary school students

Introduction

The inclusion of racket sports, and of tennis in particular, in the curriculum of the subject of Physical Education and Sports, gave rise to the need for curricula and methods for studying it in the conditions of the Bulgarian Secondary School (SS). The subject of "Sport" is traditional for the Higher School in the Republic of Bulgaria, not for the secondary one. And in this regard there are a large number of publications and textbooks (Tomov. D (2010) (Tomov. D (2014) (Tomov, D.) (2011) (Tomov, D. St. Ivanov. (2012) (Tomov, D. St. Ivanov. (2012) Tomov, D, Tomova. D (2013) Tomov. D., Ivanov .St. (2014) (Tomov, D. (2019)) (Yordanov, Ev. 2009) Ivanov. V. (2014). Many of them can be used to support tennis at secondary school education, too. However, the facilities and the age of the contingent of secondary school students are different from those at higher schools. This necessitates the adjustment of the devices, means and methods of motor training and organization to these different conditions. In addition, the teaching and means used should bring pleasure from tennis classes (Olivier Dieul, Clement Lena2, Isabeele, Joing3Alessandro, Porrovecchio4, Fransois Potdevin5 (2020) Athanailidis Ioannis1, Laios. Zagaslidios2 2015) Pankhurst.A (2013).

The movements in tennis are artificially created, and differ significantly from the daily movements of man. (Penchev A, T. Todorov.1980). Furthermore, the official ball (yellow) for the game features weight and compression resulting in a high flying speed and high volleys thus making the ball "hard" for controlling by the part of the beginners. (R. Cross) (2006) (Carboch, J., Blau, M., Sklenarik, M., Siman, J., & Placha, K. (2020). These peculiarities of the game are the objective reason for sports technical tennis skills to be learned much harder and longer compared to other racket sports such as table tennis and badminton. And in spite of the great interest for tennis and its attractiveness, a large number of beginners and amateur tennis players orient to another sport. ITF and major countries understand the need for coaches around the world to adapt tennis to the different levels of learners they work with. Federations, coaches and ITF have done the necessary work to improve the ability of novice players, children and adults to play and enjoy the game. This includes adapting the sizes of rackets, speed of the ball, size of the court, counting of points and other rules that make the game easier and more fun. (Jimenez-Egido Jose Maria, Ortega-Toro Enrique, Palao.Jose, M, Verdu-ConesaIsidro, Torres-LuqueGemma (2019); (ITF (1998). In year 2002, the International Tennis Federation introduced a new training

methodology. One of the biggest advantages is the use of balls of different sizes and with lower pressure, which slows down their flying speed and reduces their rebound in height. This increases the reaction time of the beginner tennis player, who has more time available to prepare the shot. The ball bounces low, at a comfortable height, which is a prerequisite for improving control of the ball (more balls fall within the court) (Hammond John, Smith Christina, (2006) "Beginner players often find it difficult to play on an entire court with a normal ball due to the size of the court, the speed of the ball, the height of the rebound and the lack of a steady technique to control the ball, "it is important that coaches working with beginners use at least one of the slower types of balls as a means of introducing beginners to the game "Play tennis" FOR LEVEL COACHES (P 18). These factors should make coaches strive to change the playing environment for beginners to help them achieve their goal, and namely, to start playing the game (serve, play and score points) as early as possible. This goal is defined as the main goal of the game-based approach (ITF, 2005a). The introduction of low-compression tennis balls has radically changed the way children and adults learn to play tennis. These are light balls that are easy to hit, they are "soft" (inflated to a lower pressure than normal - colored red, orange or green), so that the flight of the ball is slower and the rebound is lower.

This gives the novice player a longer time to return the ball, prolongs the play and greatly improves the overall experience of the individual. (Dr. Babette M Pluim (2014) (Kach Kim, Busard Tim, Reid Machar. (2015) (Andrew 1, JW Chow, DV Knudson, Dr. Tillman. (2003). The ITF believes that the green ball, which is about 25% slower than the yellow one, has significant advantages, especially for those playing for entertainment with an ITN score 10-7. It is also used successfully in some youth competitions, in secondary school competitions, as well as in university indoor events. It is also used successfully in some youth competitions, in high school competition, and also in university indoor wall events. (Damian Farrow & Machar Reid (2010.) Based on our many years of practice as teachers and coaches in tennis and as a result from multiple studies of ours and others in the field of methodology of teaching and training in tennis in the educational system (Tomova, D Tomov. D. (2006) (Tomov, D. (2017) (Tomov, D. (2012)) (Anastasov .I, Tomov.D, Tomova.D (2016) Tomov.D. (2017) Katsarova, R. (2002) Larson Emma Jay, Guggenheimer Joshua D (2013) Kozina Janeta, Evtifieva Irina, Muskkieta Radoslav, Krisztow Prusik, Podstavsk Robert (2020) (Mitchell, S, Stanbridge, K. (2000) Chalakov, M. (2012), we decided to develop a system of exercises and methodology of organization and teaching tennis at Secondary School. Then we conducted a course of training for two groups of school students using different tennis balls. To establish the results from training we applied exercises (tests) for directing the ball in service, forehand and backhand. The steadiness and accurate targeting (placement) of the ball are the main criteria for well-mastered sports technical skills (strokes) of tennis. These tests, which diagnose the level of mastery of sports technical and tactical skills are standard in tennis (BusardTim, Damyan Farrow, Machard Reid, MastersRichard SW(2014) (Maksym Suprunenko (2019). *The aim of the experiment* was to compare the level of acquired basic technical skills in tennis of the two groups (study classes), where one class was trained with a ball with reduced compression, (75% - green) and the other class - with a standard (yellow) ball, which was to confirm or reject our hypothesis

Material and methods

Participants: 34 boys and girls aged 12 took part in the sports-pedagogical experiment. Conditions were created for acquaintance, research and study of this contingent, which gave us the opportunity to select two classes of relatively homogeneous groups of 17 children.

The lessons were held twice a week in the yard of the Secondary School "Yane Sandanski" in Sandanski, and each training / lesson / lasted 45 minutes. The experiment lasted 18 weeks, from 11.02.2019 to 15.06.2019. At the beginning of the experiment (the second week of February 2019) three weeks before and after its completion (the second week of June 2019) we conducted a sports-pedagogical control with a set of 3 (three) tests, with the same for both studied groups of conditions. Sports-pedagogical experiment

The first week was used as an introductory stage for the initial testing. With these two classes we worked on a pre-designed program, as in one class (group 1), the subjects used a standard tennis ball (yellow) and the students from group 2 with a lightweight (green) tennis ball. Three weeks before the end of the training, we conducted a test in which the subjects used the ball with which they trained. The last three weeks of the experiment, we changed the balls of the groups and until the end they continued training and conducted the last testing with this ball (different from the one they trained with during the first 15 weeks).

There were 2 lessons (trainings) per week for the period of the research. In the proposed model of the lesson / training /, exercises for the development of the reaction speed, special running exercises, relay exercises, for developing the speed and speed endurance, different types were used. jumps, exercises with a ball and a racket for the development of agility, a large number of mobile and relay games with emotional saturation, etc. Along with these basic tools, we used the tennis-specific exercises performed on the court - without and with a racket. the basic technique of tennis. The learning process was focused on the technical study of movements, amplitude and pace of movements, proper running, proper jumping, getting acquainted with the phases of the following tennis strokes - palm and back flat kick on a bounced ball, palm and back flat kick from the air, flat starting In the initial study of sports and technical skills, we used the frontal, flow and group form of organization and respectively verbal, visual, kinesthetic, holistic and dissected teaching methods. In

consolidating and improving the sports-technical and tactical skills, we worked mainly with the game and competitive training methods. In our work for physical training we applied athletic exercises, mobile and sports-preparatory games. In each lesson / training / we used carefully selected exercises to form sports and technical skills and to develop the motor skills of students. These exercises are selected in order to maintain children's interest in the game of tennis and at the same time to be applicable in the conditions at school. It should be noted that in the classes we applied mixed training methods, traditional and ITF. The classes used static and game methods of motor training, which occupied 50% of the duration of the main part of the lesson. In structural terms, the classes retained their three traditional parts - preparatory, basic and final. During the pedagogical experiment in the 18 working weeks were planned 36 school hours lasting 45 minutes.

Description of the tests and methodology for their measurement:

Test №. 1 Forehand and backhand : To assess the stability and accuracy of the palm and backstroke on a bounced ball. Test of the test: The coach stands 2 m behind the net and passes 10 balls in a row (the first on the forehand, the second on the backhand, the third on the forehand, etc.) to the performer who has taken a position behind the baseline. There are four zones in the opposite court. The playing field for single, between the end and the service line is divided into 3 equal parts, with a width of 1.87 m. The players perform one palm stroke, one reverse, one palm, etc., trying to direct the ball near the back line. (zone - №4). The middle zone is zone №3, the zone next to the service line, zone №2. 1 point. The maximum number of points - 40. First zone - 1 point; second zone - 2 points; third zone - 3 points; fourth zone - 4 points.

Test № 2 Service: To assess the stability and accuracy of the initial stroke. How to perform the test: The subject performs a total of 6 initial strokes, the first three balls are directed diagonally, and the second three on the straight lines. the server receives 3 points, when hitting the court - 2 points, when landing outside the court and in the fillet of the net 1 point, when hitting the net 0 points. The kick-off can be performed from the left or from the right. Maximum possible number of points - 12 points.

Test № 3 Playing with a coach on the court: - to keep the ball as long as possible in the game. The subject is entitled to 2 attempts, taking into account the better result. The number of balls hit by the student is estimated. Number of hits: 1 point. - 3 strikes over the net; 2т. - 5 strikes over the net; 3т. - 7 strikes over the net; 4т. - 10 strikes over the net; 5т. - over 10 over the network. Maximum possible number of points - 5 points.

Statistical methods

In processing the data obtained in the present study, the following statistical approaches and calculation techniques were used: Variation analysis to calculate the mean values, standard deviation and coefficient of variation. Most of the parameters are presented as $X + SD$, together with their associated coefficients of variation . The arithmetic mean (X) at $n < 40$ is equal to: $X = \sum X/n$; where $\sum X/n$ is the sum of the values and n is the number of subjects or sample size.

The standard deviation SD is a criterion for statistical scattering. Shows the degree of scattering of values around the arithmetic mean. The coefficient of variation ($V\%$) is calculated by the following formula. $V = S / X \cdot 100$, where S is the standard deviation and X is the arithmetic mean. It provides information on the scattering of the trait and uses a comparison of the variation of traits assessed in different units of measurement. To assess the differences between the mean values, we used the methods of nonparametric statistics, typical for small samples, through the tests of Wilcoxon (for dependent samples) and Mann-Whitney (for independent samples) in 2 groups and descriptive statistics. This was done in order to compare, once, the results of the three tests between the two groups, and the second time, the results of the initial and final testing in the groups themselves.

Results

The ascertaining stage of the research made it possible to establish the initial level of the studied indicators in the students. The analysis of the results showed that a very large percentage of students do not have the necessary skills related to the game of tennis. The results of the statistical processing of the test data showed that the distributions of the random variables characterizing the achievements of the students from the two groups did not differ significantly. This is a reason for the selected classes of students to be used to obtain reliable information from approbation of methodology. for initial tennis training in the conditions of Sofia University.

Table 1. Data from the conducted test - forehand and backhand.

subjects (cipher)	Group 1 Home Green Ball	Group 2 Home Green Ball	Group 1 yellow ball group	Group 2 green ball	Group 1 ball change green	Group 2 laugh ball yellow
\bar{X}	12,18	12.12	22.06	28.88	24.47	26.41
$\pm SD$	2.74	2.0	3.54	3.08	3.22	2.62
$V (\%)$	22,54%	16.47%	16.07%	10.66%	13.17%	9.93

Table №1 shows the test results of group 1 and group 2 at the beginning of the experiment, three weeks before the end, and from the third, at the end of the experiment testing. In the first test, both groups of subjects used a green ball. both groups are approximately the same and relatively low, as their average values in group 1 - X -

12.18 and for group 2 - X - 12.12. The coefficient of variation (V) of both groups exceeds 10% (AUTHORS), group 1 - V - 22.54%, group 2 - V - 16.47%, which shows that the groups are not homogeneous. The results of the second test (3 weeks before the end of the experiment) in which the subjects use a ball with which they were trained - group 1 yellow ball, and group 2 green, are higher in both groups. The average values for group 1 - X - 22.06, for group 2 - X - 28.88. As can be seen from the data in Table 1, the coefficients of variation of both groups decrease and approach 10%, in group 1 - V - 16.07% and in group 2 - V - 10.66%. In the third final test, we swapped balls, group 1 used a green ball and group 2 a yellow one. The average value of the results obtained in group 2 is again higher than the average value in group 1. The average values of group 1 - X - 24.47, and of group 2 - X - 26.41. Verification with the Wilcoxon test (for dependent samples) at the beginning of the experiment proved that the differences between the two groups were statistically insignificant, at $p < 0.05$, ie the two groups did not show high differences in the forehand and backhand targeting test. The test with the Mann-Whitney test proves that there are significant differences between the two groups, as group 2 training with a green ball shows better results. Comparing the results of the final testing between the two groups we report relatively higher results in group 2 training with green ball compared to group 1 training with a yellow ball. In the second test, the Mann-Whitney test used proved the differences between the two groups again in favor of the group training with green balls, group 2.

Table 2. Data from the initial impact test (service).

subjects (cipher)	Group 1 Home Green Ball	Group 2 Home Green Ball	Group 1 yellow ball group	Group 2 green ball	Group 1 ball change green	Group 2 laugh ball yellow
X	7.41	8.18	12.88	22.41	16.65	20.06
±SD	+1.62	+1.94	+1.8	+2.62	+1.94	+1.52
V (%)	21.89%	23.78%	13.96%	11.71%	11.62%	7.58%

Table №2 presents the results of group 1 and group 2, respectively, when performing an initial impact test (service). As in the input forehand and backhand test, so in this test the initial results of both groups are low. For group 1 - X - 7.41 and for group 2 - X 8.18. The coefficient of variation (V) and in both groups it is high, in group 1 - V - 21.89%, in group 2 - V - 23.78%. The differences between the subjects range from 5 to 12 points. In the second test, higher results were shown by the students from group 2, with average values of X - 22.41 hits in the goals, against the average values of group 1 from X - 12.88. At the end of the experiment, higher results were again shown by the subjects from group 2 - mean values X - 20.06, against X - 16.65 in group 1. The test with the Wilcoxon test (for dependent samples) at the beginning of experiment, proved that the differences between the two groups were statistically insignificant, at $p < 0.05$, ie the two groups did not show high differences in the conducted serving test. Examination with the Mann-Whitney test of the results of the last two tests proves that there are significant differences between the two groups at $p < 0.0001$.

Table№ 3. Test data game with a coach on the court

subjects (cipher)	Group 1 Home Green Ball	Group 2 Home Green Ball	Group 1 yellow ball group	Group 2 green ball	Group 1 ball change green	Group 2 laugh ball yellow
X	1,94	2,12	2,82	3,82	3,47	3,77
±SD	+0,56	+0,49	+0,88	+0,73	+0,87	+0,66
V (%)	28,63%	22,91%	31,27%	19,03%	25,20%	17,64%

The data in Table № 3 of the test, played with a coach on the court, show that the group training with green balls demonstrates a higher score. The average values at the beginning of the test in group 1 are - X - 1.94, and in group 2 - X - 2.12. The coefficient of variation (V) of both groups is again high above 10%, group 1 - V 28.63% and group 2 - V 22.91%. The test with the Wilcoxon test (for dependent samples) at the beginning of the experiment proves that the differences between the two groups were statistically insignificant, at $p < 0.05$, ie the two groups did not show large differences in this test.

To check the differences in the forehand and backhand scores of group 1 at the beginning and end, and of group 2 at the beginning and end, we use the Wilcoxon test (for dependent samples) and descriptive statistics.

Table№ 4- forehand and backhand in both groups at the beginning and end of the experiment.

subjects (cipher)	Group 1 Home Green Ball	Group 1 yellow ball group	subjects (cipher)	Group 2 Home Green Ball	Group 2 laugh ball yellow
X	12,18	22,06	X	12,12	28,88
±SD	+2,74	+3,54	±SD	+2,00	+3,08
V (%)	22,54%	16,07%	V (%)	16,47%	10,66%

The data in Table № 4 show differences at the beginning and end of the experiment in both group 1 and group 2. At the beginning, the arithmetic mean value in group 1 is (X) is 12.18, at standard deviation (SD) +2, 74. The values of the arithmetic mean and standard deviation of the final test are (X) 22.06 and (SD) + 3.54, 2748-----

respectively. The coefficient of variation is (V) - 22.54% at the beginning and 16.07% at the end. data show that most of the subjects showed close results and the group became more homogeneous. In the subjects of group 2, the arithmetic mean was (X) - 12.12, with a standard deviation (SD) +2.00. At the end, the arithmetic mean (X) is 28.88 and the standard deviation (SD) is +3.08. The coefficients of variation (V) 16.47% at the beginning and 10.66% at the end indicate a more homogeneous group at the end, which shows that the training methodology applied by us has its effectiveness in mastering basic sports technical skills from tennis. in both groups.

The results of the sports pedagogical control show a good level of mastered basic sports technical skills from the tennis game from both classes after the end of the experiment. The students from the class, who were trained with / green / ball, demonstrated higher results in all tested skills, in comparison with the students from the class that conducted the training with / yellow / ball. In the implementation of the control norm with / yellow / ball, the subjects from group 2 / green / ball, performed better than group 1, trained with / yellow / ball. The children from group 1 / yellow / ball, demonstrated higher results in the control norms, using / green / ball, compared to the points obtained from the same tests with / yellow / ball, despite the fact that during the sports pedagogical experiment, they trained with a standard / yellow / ball.

Discussion. The experiment confirmed our hypothesis that if a / green / ball is used in the initial tennis training, it will contribute to the faster and correct acquisition of key tennis skills. Applications from us, a model for initial tennis training in the conditions of Sofia University showed good results. As a result of the sports-pedagogical experiment, the children in both classes demonstrated mastery above the average level of basic sports - technical skills in tennis. From the results of the tests conducted after the end of the experiment it is evident that the children from group 2 / green / ball, show better results compared to their classmates from group 1 on each of the evaluated elements, including when performing them with / yellow / ball..Despite the satisfactory results of the applied model of training, none of the children achieved the maximum number of points from all tests. highly motivated participated in the learning process. One third of the children included in the experiment participated in tennis classes in their free time.

Conclusion

Although, according to the ITF training methodology, the "green" ball is used by 9-10 year old tennis players. With the present study we proved the effectiveness of primary education in 12-year-old students. This is confirmed by other authors. John Hammond, Christina Smith (2006). Kim Kachl, Tim Busard, Machar Reid. (2015) (Emma Jay Larson 1, Joshua D Guggenheimer Unfold 2013); Farrow D., Reed M. (2010). Regarding the impact of low compression balls (LCBs) on learners' performance, coaches believe that LCBs have the most positive effects on complete beginners and youngest players. Coaches suggest that players are assisted by the rebound if they have no experience playing with standard balls. The ITF believes that the green ball, which is about 25% slower than the yellow ball, has significant benefits, especially for ITN 10-7 entertainment players. It is also used successfully in some youth competitions, in high school competition, and also in university indoor wall events.

We recommend to the coaches and teachers who work with children at this age to use in the initial training in tennis with an advantage / green / ball, which will lead to the accelerated acquisition of basic sports and technical skills in tennis. training in the conditions of Sofia University, showed a good result, which is why we recommend its application in the subject FVS.

Conflict of interest - The authors do not declare a conflict of interest.

References

- Andrew 1, JW Chow, DV Knudson, Dr. Tillman. (2003) Influence of the size of the ball on the player's reaction and the acceleration of the racket during *tennis J Sci Med Sport*; 6 (1): 102-12.doi: 10.1016 / s1440-2440 (03) 80013-0.
- Athanailidis Ioannis1, Laios. Athanasios2, Zaggelidis Gioros3(2015) The educational system of coaching schools in tennis. The case of Greece.Published online: June 26,2015(Accepted for publication April 26, 2015)DOI:10.7752/jpes.2015.02032
- Babette M Plum. (2014)The evolution and impact of science in tennis: eight advances for achievement and health, <http://dx.doi.org/10.1136/bjsports-093434> .https://bjsm.bmj.com/content/48/Suppl_1
- Busard Tim, Farrow Damyan , Reid Machard , Richard Masters SW(2014) Modification of equipment in the early development of skills: a perspective for tennis *Quarterly Exercise and Sports Surveys* 85 (2): 218-225 *Follow the diary* DOI: 10.1080 / 02701367.2014.893054 Project: Scaling of tasks and equipment in youth sports
- Busard Tim, Reid Machard , SW Masters Richard ,Farrow Damyan(2016) *Scaling of tennis rackets during physical education in primary school to improve the acquisition of motor skills. Res Q Exerc Sports*; 87 (4): 414-420. doi: 10.1080 / 02701367.2016.1216653.
- Carboch, J., Blau, M., Sklenarik, M., Siman, J., & Placha, K. (2020). Ball change in tennis: How does it affect match characteristics and rally pace in Grand Slam tournaments?. *Journal of Human Sport and Exercise*, 15(1), 153-162. doi:<https://doi.org/10.14198/jhse.2020.151.14>

- Chalakov, M. (2012). Study of the constancy, accuracy and speed of forehand and backhand performance in 12-year-old tennis players. *Sports & Science*, no. 5
- Crespo Miguel , Miley Dave (1998)Advanced Coaches Manual, *Published by the International Tennis Federation, ITF Ltd, ISBN 1-903013-32-1* .
- Cross R. (2006) Physics Department, Dynamic properties of tennis balls University of Sydney, Sydney, NSW 2006, Australia
- Elderton (2001) 21stCenturyCoaching: Student-Oriented Principles of the Game-Base Approach, www.acecoach.com
- Farrow Damian & Reid Machar (2010) The effect of scaling the equipment on the acquisition of skills of beginner tennis players *Sports Sci*; 28 (7): 723-32.doi: 10.1080 / 02640411003770238
- FFT (2004) Adult Tennis Program; teaching and experiencing tennis in a different way. *DVD of the French Tennis Federation 1415*.
- Fitzpatrick Anna , Davids Keith, Stone Joseph (2018) Effects of scaling task constraints on emerging behavior in children's racket sports performance. *Hum Mov Sci* 58: 80-87. PMID: 29353094 DOI: 10.1016 / j.humov.2018.01.007
- French Tennis Federation. (1999) The child comes first! *ITF Coaches Review, Issue 19, November (9-10)*
- Iordanov, Ev. Study of a model for improving tennis education, (2009)Sofia University Press. S., 2009
- Ivanov. V., (2014) "Optimization of the methodology of training students in tennis in the conditions of the profiled educational process in physical education and sports in universities". Dissertation. Sofia
- Jimenez-Egido Jose Maria , Ortega-Toro Enrique , Palao Jose M , Verdu-Conesa Isidro , Torres-Luque Gemma (2019); Effect of the rules for modification in the competition on the technical and tactical actions of young tennis players (under 10 years) *Frontiers in Psychology* PMID: 31956317 PMCID Stk #: PMC6957469 DOI: 10.3389 / fpsyg..02789 2019; 10: 2789
- Kach Kim , Busard Tim , Reid Machar . (2015)The effect of ball compression on the characteristics of the match. *LTA (2004) Development Coach Award Handbook, CD-ROM version 2004 game of elite tennis players in adolescents J Sports Sci* 33 (3): 320-6.doi: 10.1080 02640414.2014.942683.2
- Katsarova, R. (2002) Tennis in school, Sofia
- Kozina Janeta , Evtifieva Irina , Muskkietia Radoslav , Krisztow Prusik , Podstavsk Robert (2020) General and individual factor structure of complex training of young tennis players from 10-12 years. *Published online: April 30,. Journal of Physical Education and Sport ® (JPES), Vol 20 (Supplement issue 2), Art 173 pp 1242 - 1249* Hammond John , Smith Christina , (2006)Low Compression Tennis Balls and Skills Development *J Sports Sci Med*. 575–581.Dec.; 5 (4): 575–581.PMCID: PMC3861758 PMID: 24357952online ISSN: 2247 - 806X; p-ISSN: 2247 - 8051; ISSN - L = 2247 - 8051 © JPES DOI: 10.7752 / jpes.2020.s2173
- Larson Emma Jay , Guggenheimer Joshua D (2013) The effects of scaling tennis equipment on children's forehand performance on the ground. *J Sports Sci Med* 12 (2): 323-31.: 24149812 PMCID: PMC3761839
- Mitchell, S , Stanbridge, K. (2000) Equipment characteristics and skills acquisition in young tennis players. *Sports Technology Research Group. Loughborough University.*.
NetGeneration. (n.d.). *School Team Tennis Manual* . USTA, <https://www.nfhs.org/media/1020196/high-school-manual.pdf>
- Maksym Suprunenko (2019) Flat shots analysis of tennis players Kiev National University of Culture and Arts, Ukraine udc 796.012.46 Published online: September 30, 2019 (Accepted for publication: August 17, 2019) DOI:10.7752/jpes.2019.03223
- Olivier Dieu1 , Clement Llana2 , Isabeelle Joing3 , Alessandro Porrovecchio4 , Francois Potdevin5(2020) Fun to engage or engage to have fun? Study of different teaching formats in physical education. 1,4, Univ.Littoral Côte d’Opale, Univ. Artois, Univ. Lille, ULR 7369 - URePSSS - Unité de Recherche Pluridisciplinaire Sport Santé Société, F-59140 Dunkerque, FRANCE. 2,3,5Univ. Lille, Univ. Artois, Univ. Littoral Côte d’Opale,ULR 7369 - URePSSS - Unité de Recherche Pluridisciplinaire Sport Santé Société, F-59000 Lille, FRANCE. Published online: May 30, 2020 (Accepted for publication: May 18, 2020) DOI:10.7752/jpes.2020.03184
- Pankhurst. A (2013); I How tennis players learn motor skills:Some considerations *ITF Coaching and Sport Science Review* 2013; 60 (21): 6 - 7TF *Coaching and Sport Science Review* 2013; 60 (21): 6-7
- Penchay A, T. Todorov.(1980) *Tennis, S., Medicine and Physical Education*, (p.23)
- Play+stay ™. PLAY+STAY ™ - Serve-Rally-Score. (n.d.). Retrieved September 24, 2021, from <http://www.tennisplayandstay.com/news/articles/important-changes-to-the-green-stage-1-ball.aspx>
- “Play tennis” FOR LEVEL COACHES (PAGE 1) *ITF*
- Stuart Miller, Rod Cross. Equipment and Advanced Performance January (2003) (pp.179-200) Biomechanics of Advanced Tennis Edition: 1. *International Tennis Federation B. Elliott, M. Reed, M. Crespo anuary 2003J Sports Sci Med. March 2015; 14 (1): 194–202*
- Timmerman Ewout , Water, Joel De, Kachl Kim, Reed Machar, Farrow Damian,Savelsberg Gert(2015) *The effect of scaling equipment on children's athletic performance: the case of tennis* *J Sports Sci*; 33 (10): 1093-100. doi: 10.1080 / 02640414.2014.986498. Epub 2014 23 dec

- Tomov, D. (2011) Influence of students' tennis education on the dynamics of development of speed and strength endurance, Sat with reports "The modern view of the doctoral student to science", Blagoevgrad1 p132-136
- Tomov, D. (2019) The role of additional work for physical training in the acquisition of sports and technical skills in the initial training in tennis for 10-12 year old boys, Sports and Science, extraordinary number 3p 105-110
- Tomov, D. D.Tomova (2013) Survey of Student opinion on the means and methods employed in tennis education at South-West University Neofit Rilski, Activities in Physical Education and sport Скопје Macedonia, Vol. 3 № 2, p (199-202)
- Tomov, D. St. Ivanov. (2012) Methodology of teaching and training tennis in classes of Physical Education at Higher schools , Activities in Physical Education and sport Скопје Macedonia – Vol. 2 № 1, p (57-62)
- Tomov. D (2010) Initial training in tennis / for students and pupils /, ISBN 978-954-680-726-7, University Publishing House "Neofit Rilski", Blagoevgrad, 2010
- Tomov. D (2014)Tennis education in higher education., ISBN 978-954-680-926-1, University Publishing House "Neofit Rilski", Blagoevgrad, 2014 Study guide
- Tomov. D. St.Ivanov (2014). Examination to the level of the sport-technical skills of the students from SWU “Activities in Physical Education and sport Скопје Macedonia – Vol. 4 № 2, p (184-187)
- Tomova, D Tomov. D. (2006) Aspects of conducting the third lesson in physical education - module "Tennis on the court" at school. Sat. with reports from the Scientific Conference "Physical Education and Sports in the Education System", Blagoevgrad, (63-66)
- Tomov, D. (2017) Rocket sports (tennis, table tennis, badminton) opportunities for updating and improving the new curricula in "Physical Education and Sports" Physical Education, Sport, Kinesitherapy Research Journal (PESKRJ) –Vol 2 issue 1 , ISSN 2534-8620