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ASPECTS OF SPEED AND AGILITY MONITORING IN PUPILS WHO PRACTICE TENNIS AS PHYSICAL ACTIVITY

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Abstract: *Problem statement. Tennis is a sport that lately demonstrates that the final result is not just the player's talent for handling the rocket or the ability to send the ball where it is needed. The ensemble of physical abilities represents an increasing weight in the training process, even from the beginning in tennis, all these taking into account the specific stages of growth and development of the body. Speed and agility are some of the main directions that can be addressed in the physical training of young juniors, knowing the fact that, at this age, the body development processes are evolving, the approaching of these qualities being done with obvious effects. Purpose of Study. The purpose of the research was to highlight the importance of monitoring speed and agility during tennis players' training periods, the children's category. Methods. The study has had as participants 5 tennis players aged between 10 and 12 years(±0,84years). The tests used to monitor the speed and agility were: 15 m sprint; 5 x 10 m shuttle sprint; visual stimulus reaction and running in a 3x3m square by changing direction; from the "T" running towards the net - approaching to a smart indicator and return to "T". Findings and Results. In terms of monitoring the running during 15 m, the time obtained ranged between 2.91 s - 3.21 s, while in the shuttle test, the time ranged between 12.25 s and 17.73 s. The agility tests expressed very good indicators regarding the ability of the tennis players to react, run to an indicated point and return to the start point. Conclusions. It was revealed that speed and agility monitoring in young junior tennis players is a very useful and important manner to achieve adequate, objective and proper training, especially at this age. The monitoring tests and hardware that were used proved to be motivational tools for the athletes having the chance to interact with some devices that gave them objective and smart feedback.*

Key-Words: Ability, Motor Cognitivity, Reactivity, Tennis.

INTRODUCTION

Tennis is a sport that lately demonstrates that the final result is not just the player's talent for handling the rocket or the ability to send the ball where it is needed. The ensemble of physical abilities represents an increasing tool in the training process, even from the first tennis lessons, all these taking into account the specific stages of growth and development of the body. Human potential in general and sports, in particular, wants to be put out by comparing the different time periods and exhibited in competitions, where the most valuable part. Obtaining performance level changes would create different endocrine system, respiratory, circulatory, muscular and so on, changes that the body assimilates and raised the upper limit [1]. The key feature of the model is its elaborate construction, which, however appropriate and elaborate would be, approximates linguistic reality, being but one of its assumptions of organization and functioning. According to this feature, the possibility appears justified the idea of continuous improvement and concomitant models of the same type of model [2].

It has been often said that tennis is a game of continual emergencies [3] because with every shot the opponent hits, a ball could have a different velocity, a different type and/or amount of spin, and it can be placed in many different parts of the court Tennis is known as a sport without a true off-season, especially in what concerns the junior players. There are local weekend tournaments to regional, national or high-level international-level tournaments almost every week. A limited off-season during the tennis calendar makes it difficult to implement a traditional periodization model for young tennis athletes [4]. From the optimum cost-benefit ratio perspective of training input, goals and contents during physical conditioning must be defined according to the specific workload and the most important limiting performance factors in tennis but also closely corresponding to the individual needs of each athlete [5].

After its start, practising tennis begins to "ask" the need for increased effort. It is important that this increase is achieved progressively and in accordance with the somatic and functional features of young juniors, the monitoring of how they respond to stimuli being one of the most objective ways to ensure the quality of the conditioning training process.

It is crucial to do all it takes to provide a suitable conditioning training process according to the needs and motor background of the young juniors tennis players, taking into account that they are routinely exposed to sport-specific training and extensive competitive schedules which can result in inadequate overall preparation, leading to suboptimal recovery, and a higher risk of injury [6]. Speed and agility are some of the main directions that can be addressed in the physical training performance of athletes that are involved in many sports [7], [8], [9], [10] and tennis is one of them. These physical components must be integrated with the training especially in young athletes' sports activities knowing the fact that, during this age, the body development processes are evolving, the approaching of these qualities being done with obvious effects.

Speed represents one of the specific areas that the tennis player needs, along with jumping, hopping, throwing, catching, strength, power, coordination, balance, endurance, and flexibility [9]. The way that the tennis player is able to speed up represents a crucial feature in winning the point no matter if he/she has to react in order to reach the net, to go back to the baseline or move laterally. Quick lateral movement is the key when the player must react immediately and change direction. These training targets can be achieved by performing over short distances and focusing on developing linear and lateral speed [12]. The findings by Sheppard &Young, cited by Moradi & Esmaeilzadeh [13] indicated that speed is one of the most important biomotor abilities in sports and from a mechanical point of view is expressed through a ratio between space and time. On the other hand, agility has associations with trainable physical qualities such as: strength, power and technique, as well as cognitive components.

Agility has been defined as the ability to change direction rapidly and accurately. However, this definition and similar definitions fail to recognize that cognitive skills such as anticipation and decision-making are generally involved in most movements in the sport setting [14]. The specialists divide agility in two components (simple agility and reactive agility) where the first one is defined as a pre-planned change of direction, while reactive agility is a fast change in direction to a sport-specific stimulus [15], [16].

Agility training is therefore thought to be a re-enforcement of motor programming through neuromuscular conditioning and neural adaptation of muscle spindles, Golgi-tendon organs, and joint proprioceptors. As such by enhancing balance and control of body positions during movement, agility theoretically should improve [17]. Previously, reactive agility testing has confirmed that higher-skilled players have a superior ability to extract and utilize advanced cues from opponents more quickly than lesser-skilled peers [18].

The purpose of the research was to highlight the importance of monitoring speed and agility during tennis players' training periods, in the young juniors' category.

MATERIALS AND METHODS

The study has had as participants 5 tennis players aged between 10 and 12 years (± 0,84 years), with practical experience ranging from 5 to 8 years. The tests used to monitor the speed and agility were: 15 m sprint; 5 x 10 m shuttle sprint; 4 corners agility test (4CAT) and the "T" - net - "T" test (TNT). In terms of measurement logistics we have used the Witty Electronic Timer System and the Witty SEM Intelligent Signal System from Microgate. The athletes were tested in two sessions each time using the same experimental protocol.

For the first test (15 m sprint) the tennis players had to run as fast as they could between two Witty photocell gates and the data were recorded by the Witty timer chronometer. The start of the test was recorded by the device when the athlete passed through the first gate, the end being defined when he passed the second gate.

The second test (5 x 10 m shuttle sprint) had the same infrastructure design where the athletes had to run as fast as they could for five laps of 10 m the chronometer recording the time and speed for each lap. The start and the finish of the test were established by customizing the connection between the photocells and chronometer so that after five crossings (except the one of the starting line) the recording closed.

Four corners agility test (4CAT) was performed by placing the athlete in a square (3x3 m) that had in every corner one intelligent semaphore (Witty SEM). These devices gave intermittent visual stimulus by alternating the signal (green light) for every corner in a randomly way. The athletes had to stay in the center of the square and when the visual signal appeared, they had to react and run toward the Witty SEM, each time being forced to change the direction. The test was customized for 15 visual signals.

The "T" - net - "T" test (TNT) required the athletes to start from the "T" point of the court by reacting and running towards a randomly Witty SEM stimulus planted along the net and return to the "T" point. The Witty SEM devices were customized to give 12 impulses, one impulse for each running. We used these tests in order to have objective information about the way how the tennis players are dealing with the physical conditioning considering that these tests require tasks that are specific to the effort that the athletes are working with during the game.

RESULTS AND DISCUSSIONS

The data of the tests were downloaded in a PC and integrated into an Excel workbook in order to have an E-tool for monitoring that will help us to see the dynamics of the two components of physical conditioning. At the same time, the Excel workbook allowed us to do the statistical analysis for each tennis player and compare the results from one trial to another.

The results obtained have given us the possibility of achieving objective monitoring of speed and agility, the values recorded in the applied tests reflecting the effects of physical training. Thus, in terms of monitoring the *15 m sprint test*, the time obtained by the group ranged between 2.91s - 3.21s, the best result being recorded in the second trial. This trend was observed for all the tennis players, every one of them obtaining a better result in the second trial. The average of the performances was 3.13s (± 0,06s) for the first trial and 2.89s (± 0,13s) for the second one. It was interesting to observe that, although the results were better in the second trial the variability coefficient had a better value in the first one (1.94 % vs. 4.56%).

In what concerns the speed that the tennis players reached during the running we can say that it had the same trend as time, with an average of 4.79m/s (± 0,09m/s) for the first trial and 5.20 m/s (± 0,24m/s) for the second (Figure 1). The homogeneity of the speed was higher in the first trial with a value of variability coefficient of 1.72%

compared with the one from the second trial, where although the speed was higher the variability of the results was higher too (4.09%).

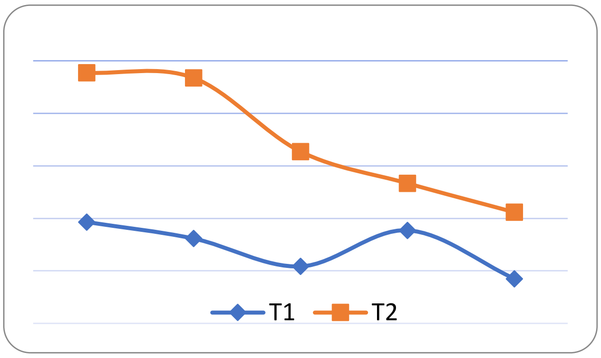

Figure 1. Dynamics of speed during 15 m sprint

Note: *1-5 represents the athletes.*

The data of the *5 x 10 m shuttle sprint test* (table 1, table 2, figure 2 and figure 3) showed us a similar dynamic of time as the one from the first test, the tennis players obtaining a better overall performance in the second trial. Analysing each lap from the speed perspective we observed that, in the first trial, the 4th lap had the lowest value, 3.23m/s (±0.65m/s) while in the second trial the lowest value was achieved in the 5th lap having the lowest mark of both trials, 3.07m/s (±0.45m/s). The overall trend was similar in both trials, the speed decreasing from one lap to another excepting the last 2 laps of the first trial.

Table 1. Speed results from 5 x 10 m shuttle sprint test - Trial 1

Athletes	L1 (m/s)	L2 (m/s)	L3 (m/s)	L4 (m/s)	L5 (m/s)	Performance (L_1-L_5)
A1	5.32	2.92	4.50	4.24	4.24	12.25
A2	4.15	3.73	3.56	3.32	3.33	13.91
A3	3.83	3.22	3.27	3.25	3.38	14.82
A4	3.21	3.58	2.78	2.80	2.96	16.44
A5	2.87	3.80	2.49	2.54	2.72	17.73
AVG	3.88	3.45	3.32	3.23	3.33	15.03
SD	0.95	0.37	0.78	0.65	0.58	2.14
CV	24.48	10.83	23.50	20.05	17.32	14.23

Table 2. Speed results from 5 x 10 m shuttle sprint test - Trial 2

Athletes	L1 (m/s)	L2 (m/s)	L3 (m/s)	L4 (m/s)	L5 (m/s)	Performance (L_1-L_5)
A1	4.93	4.65	3.95	3.85	3.77	11.96
A2	4.81	4.48	4.39	4.44	2.60	12.69
A3	3.95	3.48	3.29	3.40	3.22	14.49
A4	4.29	3.83	2.87	3.03	2.99	15.07
A5	3.30	3.17	3.08	2.87	2.80	16.49
AVG	4.26	3.93	3.52	3.52	3.07	14.14
SD	0.66	0.63	0.63	0.64	0.45	1.83
CV	15.59	16.14	18.01	18.22	14.72	12.93

From the speed homogeneity perspective of each lap, the highest one was found in the second lap of the first trial (10.83 %) while the lowest was encountered in the first one of the same trial (24.48%). Comparing the two trials we can see that in the second one, the athletes performed more closely, the difference between the highest and the lowest being smaller compared with the one from the first trial (3.5%, respectively 13.65%).

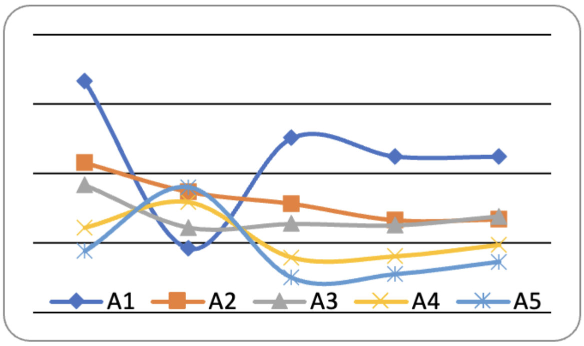

Figure 2. Dynamics of speed - 5x10 m sprint - trial 1

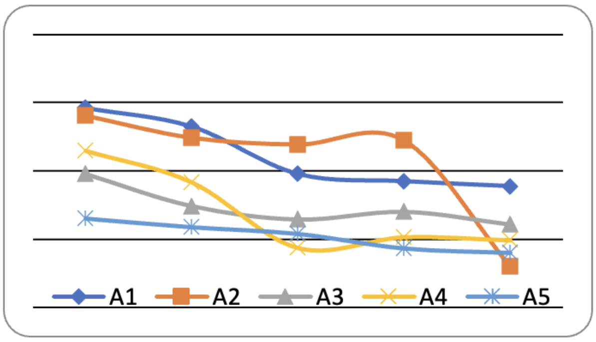

Figure 3. Dynamics of speed - 5x10 m sprint - trial 2

Note: A1-A5 represents the athletes.

The four corners agility test (4CAT) data showed that the athletes were more balanced regarding how they reacted and changed direction during the displacements that they had to do inside the 3x3m square. The Witty SEM allowed us to record each athlete's time to respond to those 15 visual stimuli and perform the entire test. So, in the first trial, although the athletes had better homogeneity compared with the second one (4.34%, respectively 7.07%), they recorded lower performance, the time being displaced from 32.4s to 36.2s with an average of 34.5s (±1.5s). In the second trial, they had higher performances framed between 28.88s and 33.89s with an average of 31.05s (±2.20s) (figure 4).

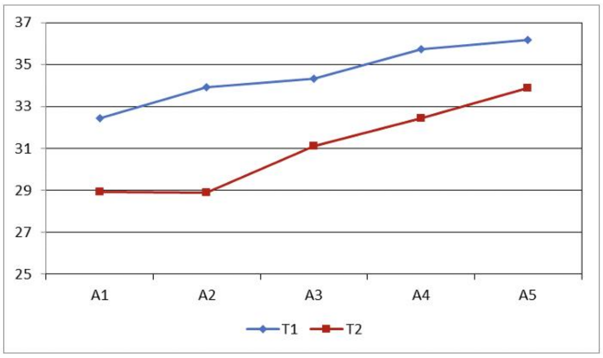

Figure 4. Dynamics of time in 4CAT for each athlete

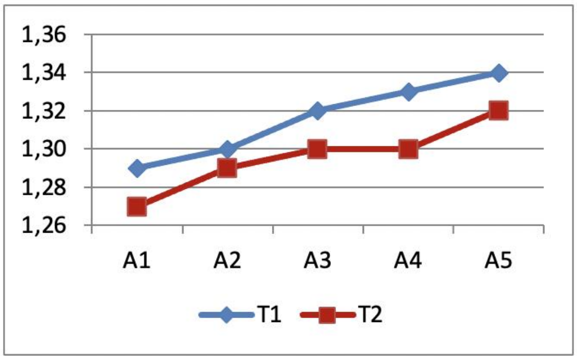

Figure 5. Dynamics of time in TNT for each athlete

Note: A1-A5 represents the athletes.

The TNT test allowed us to see how the tennis players behave when they have to react, run toward the net, change direction and go back to the start point. From the data that we collected, we observed that the second trial was better than the first one in terms of time that the athletes took to accomplish the test, with averages of 1.32s (±0.02s) for the first trial and 1.30s (±0.02s) for the second one (figure 5). From the homogeneity perspective of the results, the athletes had a better variability coefficient in the second trial (1.40%) compared with the one from the first (1.58%). These values demonstrated to us that in the case of this test, the athletes behaved pretty much the same in both trials this test having the lowest variability of the results.

PERSPECTIVE

Overall, our experimental approach proved to be a useful tool for monitoring the way that young junior tennis players express their motor behaviour connected to speed and agility, the devices that we used showed reliability in terms of efficiency, which is related to other studies [19]. Research had showed that the results of speed and agility tests are bounded by the type of direction of running and the frequency of direction changing [20].

By conducting our approach, we subscribe to other studies [17] where it was found that agility and speed require intense neuromuscular concentration related to keeping the dynamic balance at an efficient level while moving in different directions with a certain speed.

The field of speed and agility from the perspective of how these components of training conditioning are connected with other components of training has a very wide approach, knowing the fact that, especially agility can be influenced by a lot of variables. Many studies have shown that agility performance is depending on the number of sport-specific training years [19], body composition [21], [22], [23], power [24], [25], [26], [23], [27], [28], and reaction time [29], [30], [31].

CONCLUSIONS

In conclusion, it was revealed that speed and agility monitoring in young junior tennis players is a very useful and important manner to achieve adequate, objective and proper training, especially at this age. From the logistics perspective of speed and agility monitoring, we can say that it is very important to have a wide range of means to look at and find those aspects of the physical training that need to be improved. The monitoring tests and hardware that were used proved to be motivational tools for the athletes having the chance to interact with some devices that gave them objective and smart feedback. Keeping continuous monitoring of these two conditioning training components provides real support for the coaches to manage and conduct the training in accordance with the athlete's response to the performance stimulus.

REFERENCES

1. *Plastoi, C. (2014). The Increase Sports Performance Skiers with Modern Audiovisual Technology Contribution, Annals of "Dunarea de Jos" University of Galati. Fascicle XV, Physical Education and Sport Management, 1, pp. 139-141.*
2. *Popescu-Bradiceni, I. and Plastoi, C. (2014). Synchronization and the performance sports model subjected to the philosophical interference. The Proceedings of the International Conference*

Globalization, Intercultural Dialogue and National Identity, vol, 1, issue 1. Available: https://old.upm.ro/gidni/GIDNI-01/Cpr/Cpr%2001%2011.pdf.

3. *Groppel, J. L. and Roetert, E. P. (1992). Applied physiology of tennis. Journal of Sports Med., 14(4): pp. 260 -268. DOI: 10.2165/00007256-199214040-00004.*
4. *Ochi, S. and Kovacs, M. S. (2016). Periodization and Recovery in the Young Tennis Athlete in The Young Tennis Player, vol.6, A. Colvin, J. Gladstone (eds) Contemporary Pediatric and Adolescent Sports Medicine, Ed. Springer Basel: Springer, Cham. DOI:10.1007/978-3-319-27559-8_5.*
5. *Ferrauti, A. et al. (2018). Assessment of Physical Performance for Individualized Training Prescription in Tennis, in Tennis Medicine. G. Di Giacomo, T. Ellenbecker, W. Kibler (eds), Ed. Springer Basel: Springer Cham. DOI:10.1007/978-3-319-71498-1_12.*
6. *Fernandez-Fernandez, J. and Kovacs, M. (2018). Strength and Conditioning in Developmental Tennis Players. in Tennis Medicine. G. Di Giacomo, T. Ellenbecker, W. Kibler (eds), Ed. Springer Basel: Springer Cham. DOI:1007/978-3-319-71498-1_38*
7. *Fox, E. L. and Mathews, D. K. (1974). Interval Training: Conditioning for Sports and General Fitness. Philadelphia: W. B. Saunders.*
8. *Harman, E. A., Rosenstein, M. T., Frykman, P. N., & Rosenstein, R. M. (1990). The effects of arms and countermovement on vertical jumping. Medicine and science in sports and exercise, 22(6), 825–833. https://doi.org/10.1249/00005768-199012000-00015.*
9. *Hoolahan, P. Agility. (1990). NSCA J. 12(3):22 - 24.*
10. *Semenick, D. (1984). Anaerobic testing: practical applications. NSCA J, 6(5): 44 - 73.*
11. *Kovacs, M. S. (2016). Strength and Conditioning for the Young Tennis Player. In: The Young Tennis Player, vol.6, A. Colvin, J. Gladstone (eds) Contemporary Pediatric and Adolescent Sports Medicine, Ed. Springer Basel: Springer, Cham. DOI: 10.1007/978-3-319-27559-8_4*
12. *Parsons, L. S. and Jones. M. T. (1998). Development of Speed, Agility, and Quickness for Tennis Athletes. J of Strength and Conditioning, vol. 20 (3): 14 - 19; Available at: https://www.researchgate.net/publication/232162553_Speed_Quickness_and_Agility_Training_for_Senior_Tennis_Players*
13. *Moradi, A. and Samad, E. (2015). Association between reaction time, speed and agility in schoolboys. J of Sport Sciences for Health, 11: 251-256.*
14. *Sheppard, J. M. and Gabbett, T. J. (2012). Agility, in Encyclopedia of Exercise Medicine in Health and Disease, Mooren F.C. (eds). Springer, Berlin, Heidelberg. DOI: 10.1007/978-3-540-29807-6*
15. *Gabbett, T. and Benton, D. (2009). Reactive agility of rugby league players. Journal of Science and Medicine in Sport, 12, 212-214.*
16. *Sheppard, J. M., Young, W.B., Doyle, T.L.A., Sheppard, T.A. and Newton, R.U. (2006). An evaluation of a new test of reactive agility and its relationship to sprint speed and change of direction speed. Journal of Science and Medicine in Sport, 9, 342-349.*

17. *Sandeep, B. (2011). Effect of agility training on tennis, Performance J Med Sci Tennis, 16(1): 21-25.*
18. *Henry, G., Dawson, B., Lay, B., & Young, W. (2011). Validity of a reactive agility test for Australian football. International journal of sports physiology and performance, 6(4), 534–545. https://doi.org/10.1123/ijspp.6.4.534.*
19. *Paul, D. J., Gabbett, T. J., & Nassis, G. P. (2016). Agility in Team Sports: Testing, Training and Factors Affecting Performance. Sports medicine (Auckland, N.Z.), 46(3), 421–442. https://doi.org/10.1007/s40279-015-0428-2*
20. *Pasquarelli, B.N., Santos, A.L., Frisselli, A., Dourado, A.C. and Stanganelli L.C.R. (2010). Relationship between the Bansgsbo Sprint Test with sprint, agility, lower limb power and aerobic capacity tests in soccer players. Rev Andal Med Deporte, 3(3): 87-91.*
21. *Mujika, I., Santisteban, J., Impellizzeri, F. M., & Castagna, C. (2009). Fitness determinants of success in men's and women's football. Journal of sports sciences, 27(2), 107–114. https://doi.org/10.1080/02640410802428071.*
22. *Nimphius, S., McGuigan, M. R., & Newton, R. U. (2010). Relationship between strength, power, speed, and change of direction performance of female softball players. Journal of strength and conditioning research, 24(4), 885–895. https://doi.org/10.1519/JSC.0b013e3181d4d41d*
23. *hultz, S. J., Perrin, D. H., Adams, M. J., Arnold, B. L., Gansneder, B. M., & Granata, K. P. (2001). Neuromuscular Response Characteristics in Men and Women After Knee Perturbation in a Single-Leg, Weight-Bearing Stance. Journal of athletic training, 36(1), 37–43.*
24. *Djevalikian, R., (1993). The relationship between asymmetrical leg power and change of running direction, Master"s thesis, University of North Carolina, Chapel Hill, NC, North Carolina.*
25. *Myer, G. D., Ford, K. R., Palumbo, J. P., & Hewett, T. E. (2005). Neuromuscular training improves performance and lower-extremity biomechanics in female athletes. Journal of strength and conditioning research, 19(1), 51–60. https://doi.org/10.1519/13643.1.*
26. *Pauole, K., Madole, K.D., Garhammer, J.J., Lacourse, M.G., & Rozenek, R. (2000). Reliability and Validity of the T-Test as a Measure of Agility, Leg Power, and Leg Speed in College-Aged Men and Women. Journal of Strength and Conditioning Research, 14, 443–450.*
27. *Sporiš, G., Milanović, L., Jukić, I., Omrčen, D., & Molinuevo, J.S. (2010). The effect of agility training on athletic power performance. Kinesiology: International journal of fundamental and applied kinesiology, 41, 65-72.*
28. *Young, W. B., James, R., & Montgomery, I. (2002). Is muscle power related to running speed with changes of direction?. The Journal of sports medicine and physical fitness, 42(3), 282–288.*
29. *Linford, C. W., Hopkins, J. T., Schulthies, S. S., Freland, B., Draper, D. O., & Hunter, I. (2006). Effects of neuromuscular training on the reaction time and electromechanical delay of the peroneus longus muscle. Archives of physical medicine and rehabilitation, 87(3), 395–401. https://doi.org/10.1016/j.apmr.2005.10.027.*

30. *Shaji, J. and Saluja, I. (2009). Comparative analysis of plyometric training program and dynamic stretching on vertical jump and agility in male collegiate basketball players. Al Ameen Journal of Medical Science, 2, 36-46.*
31. *Wojtys, E. M., Huston, L. J., Taylor, P. D., & Bastian, S. D. (1996). Neuromuscular adaptations in isokinetic, isotonic, and agility training programs. The American journal of sports medicine, 24(2), 187–192. https://doi.org/10.1177/036354659602400212.*