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MATCH LOAD OF SOCCER PLAYERS IN DEFENSIVE FORMATION AND ITS IMPACT ON THE LEVEL OF SPEED ABILITIES

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Abstract: The aim of this study was to investigate the impact of the match load in soccer on the level of the selected speed abilities in the playing positions of the outside defender and central defender. Speed abilities in all their demonstrations are one of the most important fitness skills in today's soccer. In our research, we assumed that the higher the match load players achieve, the greater the impact of this load on the level of the selected speed abilities would be. We carried out a cross-sectional ex post facto research. The monitored group consisted of the players of the team playing in the first league (Fortuna League). Their average age was 22.9 ± 4.5 years. We conducted the measurements in the preparation periods during pre-season matches. We carried out a total of 63 individual measurements. We measured the level of the match load and the performance in 10, 20 and 30 meter runs from a standing start before the match and after the match. Except of outside defenders in 30-meter run ($W = 12$; $p = 0.02$) we did not confirm a significant impact of the match load on the level of the selected speed (acceleration) abilities. Its effect size reached from $d = 0.1$ to $d = 0.6$. In addition, the correlations between match load and performance changes in all three tests were nonsignificant ($p \geq 0.5$). Only 0.2 to 8.5 % of the variability in speed tests was shared with the level of match load.

Key words: soccer, fitness, match load, outside defender, central defender, speed abilities

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Introduction

Based on the monitoring of the match load of players and its analyses we observe a continuous increase in the intensity of the match load, increase in the share of the sprint load and increase in the number of sections run at maximum intensity. In the most developed European leagues, we are impressed every week by players, who are fast, explosive and above all, they perform all their playing art consistently at a high pace throughout the match. For this reason, our topic aims precisely to verify the stability of speed abilities under the match load.

Edholm, Krustrup & Randers (2015) say that to achieve such stability of speed abilities during a match is one of the most important training tasks. Intensification of the game has been manifested over the past few years and it is now typical for soccer. It is a developmental trend, which is, according to Holienka (2007), manifested in:

- the rising load put on players during the match,
- a higher number of players involved both in the offensive and defensive phases of the game,
- getting control of the entire space and all the players,
- a greater volume of intense activity,
- a greater number of high-speed sections.

Based on an analysis of the final World Cup matches, Wallace & Norton (2014) consider one of the demonstrations of the intensification of the game the shortening time between individual intense game activities. The longitudinal study of Barnes et al. (2014) of English Premier League players confirms the continual intensification of soccer (Table 1).

Table 1

Developmental trends in English Premier League between 2006/2007 and 2012/2013 seasons (Barnes et al. 2014)

English Premier League	Total distance covered	Number of activities	Number of passes	Distance covered at high intensity	Number of sprints	Distance covered in sprint
Difference between 2006/2007 and 2012/2013 seasons	**-2 %**	**+ 50 %**	**+ 12 %**	**+ 30 %**	**+ 80 %**	**+ 35 %**

Di Salvo et al. (2009) relate the distance covered in a match at high speeds to the success rate of the team on the basis of their position in the Premier League table. They state that players of the last five teams in the table cover a significantly lower ($p < 0.01$) distance (885 meters) than the first five teams in the table (919 meters). Hoppe et al. (2015), based on an extensive analysis of the German

Bundesliga matches, however, say that there is no clear relationship between the match load of a player and success in the match. Player's performance in the match needs to be understood as a comprehensive whole composed of many factors. Running performance is just one of them.

We rank soccer among sports with intermittent nature of the load. Glaister (2005) also categorizes it among sports with multiple sprints. Boyle (2004) presents soccer as a series of sprints, jog and walk, where it is very important for soccer players to be repeatedly able to accelerate and decelerate during the whole match. Thadani (2015) confirmed that tactics, which the coach in the given match chooses and the tasks he gives to players in particular playing positions, have a significant impact on the load of players in matches. All of these factors result in fatigue, as an expression of the impact of the match load on the player's body. Fatigue is the greatest immediately after high intensity game activities, at the beginning of the second half and at the end of the match (Mohr, Krustrup & Bangsbo 2005).

A reaction of the player's organism to particular components of the external load is the internal load. We can register the values of the internal load on the basis of the results of functional tests, motor tests, respectively records on the response of the respiratory and circulatory system, respectively the heart rate. Through the response of the cardiovascular system, the player's organism reacts to the long-lasting muscle activity but also to the short-lasting intense load (Verstegen & Williams 2004).

The most frequently used method of tracking the internal response of the player's organism to the match load is measuring the heart (pulse) rate. In sports games, we still consider the determination of the load by measuring the heart rate a relatively accurate method that provides us with the relevant information required. Scott et al. (2013), who found a correlation ($p < 0.01$) with multiple indicators of the external load (along with the distance covered), confirmed this in the study. Measuring the heart rate as a means of determining the match load also occurs in the most recent researches (Bujnovský et al. 2015; Campos-Vazquez et al. 2016; Torreno et al. 2016).

Alexandre et al. (2012) in their study found that the most heavily burdened playing position in matches was midfielders, followed by forwards and only then outside and central defenders. The distance covered by players with maximum intensity in Champions League final matches does not always correspond with the above mentioned (Holienka 2007). Bradley et al. (2010) also achieved the same findings by monitoring both league and international matches. Given the heterogeneity and inconsistency of the data on the match load of the outside and central defenders, we also decided to acquire findings about the impact of this load on the level of speed (acceleration) abilities in these playing positions.

Methods

The aim of the research is to clarify the impact of the match load on the level of the selected speed abilities in the playing positions of the outside defender and the central defender in top-level soccer. Under the influence of the match load and the structure of game activities in present-day modern soccer, we expected in the playing position of the outside defender but in the playing position of the central defender, we did not expect a significant deterioration in the performance level in all selected speed abilities - in 10, 20 and 30 meter runs.

To determine the monitored group we used an intentional selection. The monitored group was composed of players of the top Slovak soccer competition – the Fortuna League – playing for the team of first league. The team consisted of 30 players with an average age of 22.9 ± 4.5 years, with an average weight of 79.4 ± 6.8 kilograms and an average height of 177.3 ± 9.7 centimetres. The observation was carried out during pre-season matches in the competitive years of 2013/2014 and 2014/2015 played on artificial surface. We monitored during 16 pre-season matches a total 13 outside defenders and 13 central defenders. The basic playing system preferred by the monitored team in the pre-season matches was 4 : 2 : 3 : 1.

To measure the match load we used Polar Team 2, which is a device used to record the heart rate of monitored players. We discovered the maximum heart rate based on values achieved in the Yo-Yo Intermittent Recovery test Level 2. Based on studying professional literature and long-term monitoring and adjusting the load zones in the training process we applied the following distribution of the heart rate into the load zones (Alexandre 2012):

- basal intensity 0 – 62 % HR_{max}
- low intensity 63 – 73 % HR_{max}
- medium intensity 74 – 84 % HR_{max}
- high (submaximal) intensity 85 – 95 % HR_{max}
- maximum intensity 96 – 100 % HR_{max}

Based on the distribution of the heart rate into individual load zones Polar Team 2 software automatically generates data on the overall level of the player's load. This piece of data is expressed using a figure - a point value. This number is a result of recalculation of SF values using a formula created by company Polar (Polar does not mention this formula anywhere). From this formula, each load zone is added point values based on the time spent in particular load zones. The final sum is expressed as one number - a point value.

To determine the level of selected speed abilities we conducted measurement before the match after the pre-match warm-up, and measurement at least three minutes after the match. The

measurement was made on artificial surface in soccer shoes in a 30 meter run from a standing start without changing direction. The run gave us a final time at three different distances:

- 10 meter run (first and second photocell gates),
- 20 meter run (first and third photocell gates),
- 30 meter run (first and fourth photocell gates).

In our measurement, we used wireless photocells with an accuracy of 0.01 second. The resulting time is a relevant statement about the level of acceleration (speed) abilities of the outside and central defender in soccer. We statistically analyzed the data obtained from the measurement of the match load and from the measurement of the selected demonstrations of acceleration abilities of outside and central defenders.

To determine the significance and size of differences in all the values in tests of speed (acceleration) abilities we used a nonparametric Wilcoxon sign-rank test and Cohen´s d test for single sample.

To determine the significance and size of correlation of the match load and the differences in levels of the selected demonstrations of speed (acceleration) abilities we applied the Spearman´s correlation coefficient and coefficient of determination (R^2). Statistical significance was set at $p \leq 0.05$.

Results and discussion

Impact of the match load on speed abilities

In the section with results, we present an evaluation of the impact of the match load in the playing positions of the outside defender and the center defender on the level of its selected speed (acceleration) abilities. Table 2 shows performance of outside defenders in all three runs before and after the match, the difference in the performance, and the match load that was achieved in the monitored matches.

The results indicate that performance was impaired in all three tests, in a 10 m test on average 0.03 ± 0.05 s, in a run at 20 m 0.04 ± 0.08 s and in a run at 30 m 0.06 ± 0.09 s. While in the run of 10 m and 20 m there was a statistically nonsignificant deterioration ($p = 0.09$, respectively 0.13), in a run of 30 m the performances of the players decreased statistically significantly ($p = 0.02$). Cohen's d coefficient ($d = 0.06$) indicates that the match load had medium effect on the performance in all three tests.

Table 2

Values measured in the playing position of the outside defender

	10 m run (s)			20 m run (s)			30 m run (s)			Match load (points)
	Before	after	difference	before	after	difference	before	after	difference	
x	1.82	1.85	0.03	2.53	2.57	0.04	4.35	4.41	0.6	239.23
Sd	0.047	0.047	0.049	0.069	0.086	0.080	0.097	0.124	0.094	46.149
Me	1.82	1.84	0.03	2.51	2.53	0.02	4.34	4.38	0.06	227
max	1.89	1.99	0.11	2.71	2.78	0.21	4.59	4.77	0.32	345
Min	1.71	1.81	-0.07	2.45	2.47	-0.11	4.22	4.29	-0.05	152
Vr	0.18	0.18	0.18	0.26	0.31	0.32	0.37	0.48	0.37	193
T-test	**W = 17.5**			**W = 24**			**W = 12**			
P	**p = 0.091**			**p = 0.1336**			**p = 0.0193**			
Cohen´s d	**d = 0.6**			**d = 0.6**			**d = 0.6**			

The average value of the load at outside defenders we monitored was 239 ± 46 points. In Figure 1 we can see graphical representation of the values of the match load achieved by outside defenders and their level relative to the average value of the load achieved by all outside defenders. As many as 8 players reached a load value lower than the average load. The lowest value of the match load reached was 152 points, while the highest value was 345 points.

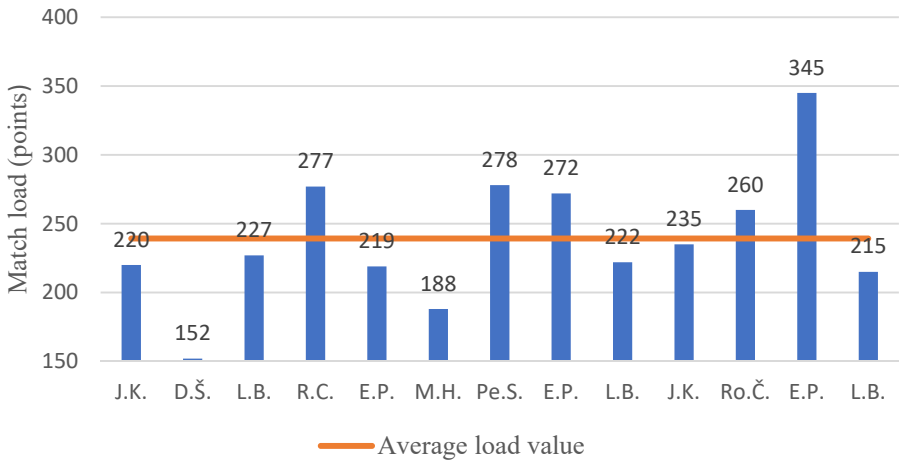

Figure 1

Match load of outside defenders

Figure 2 shows us more clearly, what direction developed the performance of the outside defenders in the tests of speed abilities before the match and after the match. We see that the individual performance improved for some players, deteriorated for others or some achieved the same performance. However, there is not a relationship between them that if the player improved or worsened in one distance, he also improved or worsened in the next one too. In total, outside defenders reached in 67 percent worse performance in the runs after the match than before the match.

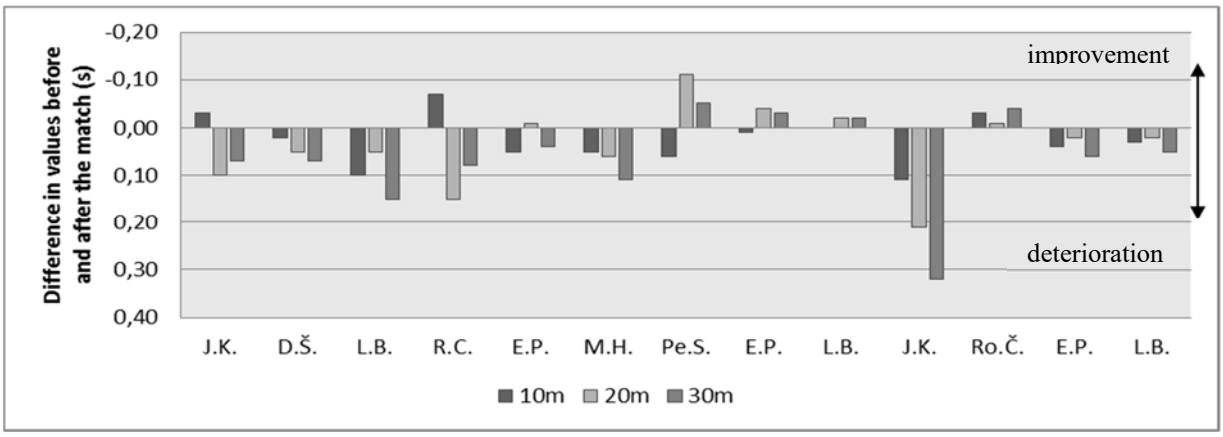

Figure 2

Heading of the differences in the performance of outside defenders in the tests of speed abilities before the match and after the match

In table 3 we present an overview of the measurement results of all central defenders in the tests of the selected speed abilities and values of their match load. From the summary of the results of the central defenders we can see that the average load value in this playing position reached a value of 270±46 points (median 266 points). The central defenders thus achieved a higher average load than the outside defenders. The central defenders had worse results on average in all three runs. In the 10 meter run from a standing start we recorded an average deterioration by 0.01 ± 0.07 s, in the 20 meter flying run by 0.04 ± 0.08 s, and in the 30 meter run from a standing start by 0.05 ± 0.12 s. The performance deterioration in all three tests was statistically nonsignificant (p = 0.16 to 0.90). As far as the effect size of the match load on the performance in tests, in a 10 m and 30 m run it was a small effect (d = 0.1, resp. 0.4) and in a run at 20 m it was a medium effect (d = 0.06).

Table 3

Values measured in the playing position of the central defender

	10 m run (s)			**20 m run (s)**			**30 m run (s)**			**Match load (points)**
	before	**after**	**difference**	**before**	**after**	**difference**	**before**	**after**	**difference**	
x	1.82	1.83	0.01	2.56	2.60	0.04	4.39	4.44	0.05	269.62
Sd	0.069	0.070	0.074	0.082	0.094	0.084	0.123	0.148	0.120	45.690
Me	1.82	1.84	0	2.57	2.55	0.03	4.37	4.4	0.09	266
max	1.93	1.91	0.16	2.71	2.78	0.21	4.64	4.69	0.27	341
Min	1.68	1.7	-0.09	2.44	2.5	-0.11	4.16	4.24	-0.14	178
Vr	0.25	0.21	0.25	0.27	0.28	0.32	0.48	0.45	0.41	163
T-test	**W = 37.5**			**W = 25.5**			**W = 30**			
p	**p = 0.9045**			**p = 0.1615**			**p = 0.2801**			
Cohen´s d	**d = 0.1**			**d = 0.6**			**d = 0.4**			

As we can see from the graphic representation of the match load of the central defenders (Figure 3), the highest load value achieved in the match was recorded at 341 points. The lowest value of the load was at the level of 178 points. As many as 7 of 13 monitored central defenders reached load values below the average of this playing position. No pair of the monitored players reached the same level of the load in the match.

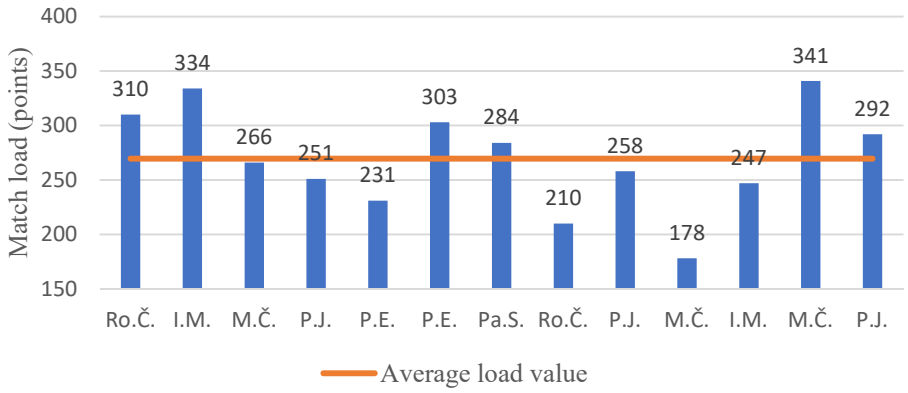

Figure 3
Match load of central defenders

The graphical representation of the heading of the differences in the performance in the speed tests (Figure 4) offers us a clear depiction of how individual central defenders improved or worsened on specific distances. We have an opportunity to observe again that all the three types of differences - deterioration, improvement and the same performance - occurred in both tests. In terms of proportionality of the differences in the performance, the central defenders achieved in 54 percent worse performance after the match, in 44 percent the performance was better after the match, and in 2 percent the central defenders reached the same performance before and after the match. The values measured did not confirm a significant impact of the match load on the level of the performance in the tests.

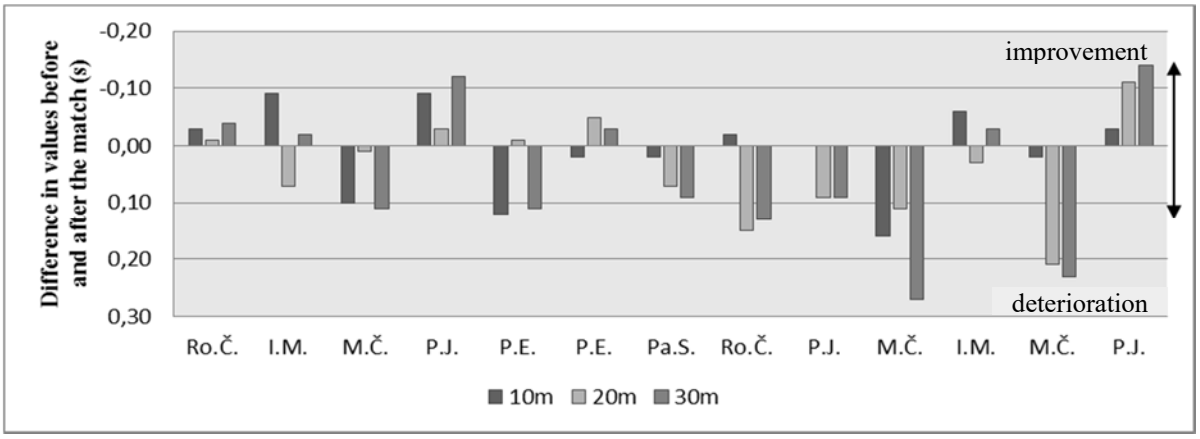

Figure 4
Heading of the differences in the performance of central defenders in the tests of speed abilities before the match and after the match

The complex nature of the match load in soccer also has a variety of differentiated demands on the player's organism. These various complex demands result in fatigue of the player's body. The fatigue of the player is a natural consequence of the load on the musculoskeletal system, which is temporarily reflected in the reduction in the performance of its various functions and systems. Fatigue in the match is greatest immediately after high-intensity activities, at the beginning of the second half and at the end of the match. The match fatigue results in the reduction of the standby condition of the organism and its ability to perform activities of maximum intensity in such a quality as it was in the time before fatigue.

Player's position decides on the different requirements on the player, who holds it. These requirements are closely related to assigned tactical tasks, the nature of the match, or coach's conceptions. To a large extent, the requirements on a player within particular playing positions are also affected by the team's basic system of play, the method (system) of the team's play in defence and attack, the strengths and weaknesses of the opponent as well as individual skills of the player. Given the different roles of players in individual playing positions, different demands on fitness requirements appear too. In our opinion, they also have a different impact on the level of fatigue of players and thus on the different level of their speed abilities.

Relationship between the match load and the level of the selected speed abilities in the playing position of the outside defender

The playing position of the outside defender in today's systems of play is gaining importance also in the offensive phase of the game. While in the past these were only players dedicated exclusively to the defence, in today's modern soccer we increasingly see outside defenders making final passes into the penalty area from the outside vertical or even finishing attacks of their teammates or their own. That is why we expected that this very challenging playing style of outside defenders will have a significant impact on the level of their speed capabilities. However, none of our anticipated assumptions in the playing position of the outside defender was confirmed and using a statistical analysis we did not find a significant correlation of the load of players in this position with their performance in the 10-meter run ($R = -0.0496$; $p = 0.87$), 20 m run ($R = -0.251$; $p = 0.40$), or 30 m run ($R = -0.292$; $p = 0.33$). For this reason, only 0.2 % of the variability in 10 m run, 6.3 % variability in 20 m run and 8.5 % variability in 30m run are shared with the level of match load.

The position of the differences in the performance in the individual runs varies, despite the gradually increasing values of the match load. The inversely proportional relationship - the higher the match load, the greater the deterioration in running - does not apply. The improvement or deterioration in the performance in the tests is accidental in the relation to the match load.

Many authors (Mall et al. 2015; Bradley et al. 2009; Rampinini et al. 2007) confirm in agreement that the load of players in the playing position of the outside defender is one of the highest, especially with regard to high-intensity activities. They point to the high level of fatigue and thus to a possible decrease in the performance level during the match, however, in their research works they do not mention a decrease in the level of speed abilities.

Relationship between the match load and the level of the selected speed abilities in the playing position of the central defender

The playing position of the central defender is generally considered the playing position with the lowest rate of load in the game (Bujnovský et al. 2014; Bradley et al. 2009; Holienka 2007; Rampinini et al. 2007; Mohr-Krustrup-Bangsbo 2003), if we do not take into account the playing position of the goalkeeper. Differences in today's soccer between particular playing positions are, however, very minimal. Despite this, our assumption was that players in this playing position will not deteriorate significantly under the influence of the match load in any of the tested distances this means, that the relationship between the match load and the performance in the speed tests will not be significant. This assumption was confirmed. The correlations between the level of match load and deterioration in 10-meter run ($R = -0.280$; $p = 0.35$), in 20 m run ($R = -0.143$; $p = 0.64$) and 30 m run ($R = -0.326$; $p = 0.28$) were weak and nonsignificant. That means that only 2.1 % (20 m run) to 7.8 % (10 m and 30 m run) of the variability of test performance is shared with the level of match load.

Conclusion

In our research, we tried to reveal the impact of the match load on outside and central defenders expressed through the heart rate on the level of their performance in tests of the selected speed (acceleration) abilities. In examining this impact, we found in both outside and central defenders the following:

- With the exception 30 m run of outside defenders match load had no statistically significant impact on the level of their performance in the speed tests.
- Correlations between match load and performance changes in all three tests were nonsignificant and weak. Only 0.2 to 8.5 % of the variability in speed tests was shared with the level of match load.

Despite of the results we suppose that the level (quality) of speed abilities is one of the determining factors of game performance. The player will reach it with an appropriate content focus of the long-term training and gradual growth of the sports performance under the influence of the match load. Within the specialized training based on the playing positions, exercises to develop the selected speed abilities and speed endurance, which are directly related to the performance of the

player in the given playing position in the match, should be carried out. This content of the training process will help ensure maximum readiness of the selected demonstrations of speed capabilities of the player on his performance in the match. For more complex monitoring of the examined issue, we plan to apply in the future of the monitored as well as other playing positions a test with a change of direction, a speed endurance test, and we want to supplement the knowledge from the internal load with findings from the external load of players in the match.

References

1. ALEXANDRE, D., 2012. Heart Rate Monitoring in Soccer: Interest and Limits During Competitive Match Play and Training, Practical Application. In: *Journal of Strength & Conditioning Research*. 26(10), pp. 2890-2906.
2. BARNES, CH. et al., 2014. The Evolution of Physical and Technical Performance Parameters in the English Premier League. In: *International Journal of Sports Medicine*. **35**(1-6).
3. BOYLE, M., 2004. *Functional Training for Sports: Superior Conditioning for Today's Athlete*. USA: Rodale. ISBN 9780736046817.
4. BRADLEY, P. S. et al., 2009. High-intensity running in English FA Premier League soccer matches. In: *Journal of Sports Science*. London: Routlege: year. **27**(2): 159-168, ISSN 0264-0414.
5. BRADLEY, P. S. et al., 2010. High-Intensity Activity Profiles of Elite Soccer Players at Different Performance Levels. In: *Journal of Strength and Conditioning Research*. **24**(9): 2343-2351.
6. BUJNOVSKÝ, D. et al., 2014. Analysis of physical load among professional soccer players during matches with respect to field position. In: *Journal of Physical Education and Sport*. **14**(1): 569-575. ISSN 2247-8051.
7. CAMPOS-VÁZQUES, M. A. et al., 2016. Comparación de la carga interna entre partidos amistosos y un juego condicionado en jugadores profesionales de fútbol. (A comparison of internal load between friendly matches and a conditioned game in professional football players). In: *CCD. Cultura_Ciencia_Deporte*. **11**(31): 67-73. e - ISSN 1989-7413.
8. DI SALVO, V. et al., 2009. Analysis of high intensity activity in Premier league soccer. In: *International journal of sport medicine.* Stuttgart: GT Verlag. Year **30**(3): 205-212, ISSN 0172-4622.
9. EDHOLM, P., P. KRUSTRUP & M. B. RANDERS, 2015. Half-time re-warm up increases performance capacity in male elite soccer players. In: *Scandinavian Journal of Medicine & Science in Sports*. **25**(1): e40-e49.

10. GLAISTER, M., 2005. Multiple sprint work: physiological responses, mechanisms of fatigue and the influence of aerobic fitness. In: *Sports Medicine*. Auckland: **35**(9): 757-777.
11. HOLIENKA, M., 2007. *Kondičný tréning vo futbale*. 2. vyd. Bratislava: PEEM. ISBN 978-80-89197-67-5.
12. HOPPE, M. W. et al., 2015. Match Running Performance and Success Across a Season in German Bundesliga Soccer Teams. In: *International Journal of Sports Medicine.* **36**(7): 563-566.
13. MALLO, J. et al., 2015. Physical Demands of Top-Class Soccer Friendly Matches in Relation to a Playing Position Using Global Positioning System Technology. In: *Journal of Human Kinetics*. **47**(1): 179–188. ISSN 1899-7562.
14. MOHR, M., P. KRUSTRUP & J. BANGSBO, 2003. Match performance of high - standard soccer players with special reference to development of fatigue. In: *Journal of Sports Sciences,* London: Routlege. Year 21: 519-528. ISSN 1746-1391.
15. MOHR, M., J. BANGSBO & P. KRUSTRUP, 2005. Fatigue in soccer: a brief review. In: *Journal of sport science*. Londýn: Routlege. **23**(6): 593-599. ISSN 1746-1391.
16. RAMPININI, E. et al., 2007. Variation in top level soccer match performance. In: *International journal of sports medicine*. **28**(12): 1018-1024.
17. SCOTT, B. R. et al., 2013. A comparison of methods to quantify the in-season training load of professional soccer players. In: *International Journal of Sports Physiology and Performance*. 8: 195-202.
18. THADANI, S., 2015. *Soccer Conditioning*. London: Bloomsbury Publishing Plc, 163 p. ISBN 978-0-7136-7673-0.
19. TORRENO, N. et al., 2016. Relationship Between External and Internal Load of Professional Soccer Players During Full-Matches in Official Games Using GPS and Heart Rate Technology. In: *International Journal of Sports Physiology and Performance*.
20. VERSTEGEN, M., P. WILLIAMS, 2004. *Core performance: The revolutionary workout program to transform your body and your life*. USA: Rodale. ISBN 1–57954–908–X.
21. WALLACE, J. L., & K. I. NORTON, 2014. Evolution of World Cup soccer final games 1966–2010: Game structure, speed and play patterns. In: *Journal of Science and Medicine in Sport*. **17**(2): 223-228.