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Innovative dimension of using telematics tools in training processes of young football players

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Abstract
Introduction. The article presents the considerations concerning the use of telematics solutions, as tools for measuring efficiency and physical fitness of modern football players. Aim of Study. The aim of the study is to show that the distance covered at various intensity thresholds is the factor defining the effort performed by the football player in match conditions. This parameter is a much more reliable measure than the total distance travelled or the maximum speed achieved by the player. Material and Methods. Data that are the subject of the research were collected using the CATAPULT system equipped with the GPS transmitters. For empirical purposes, the author's studies have been presented concerning the indicators that characterise the performance of football players' work when performing acceleration and the distances covered during slowdown at different levels of intensity The use of a suitable statistical tool in the form of Excel computer program allowed, among others, to determine the mean distance travelled by players during accelerations and slowdowns at different intensity thresholds and average total distance and average maximum speeds. Results. Among the players covered with the study it was found that the average distance travelled during the accelerations and slowdowns at different intensity thresholds drops during the next five-minute intervals in each half of the match played. However, a similar relationship does not exist for the average total distance and averaged maximum speeds. Moreover, it has been shown that after a 15-minute break the average value of the distance travelled increases significantly during accelerations and slowdowns in relation to the last measured time interval for the first half. Conclusions. Implementation of science to the world of sports made it possible to say that the distance covered at different intensity thresholds is a more reliable measure that defines the effort made by the football player in match conditions than the total distance travelled or the maximum speed achieved by the football player.

KEYWORDS: telematics, innovation, youth sport, football, training processes, physical parameters measurement.

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Introduction

As stated by the available literature, football is a sport discipline that requires a lot of physical involvement from the players in each subsequent match [17]. Modern football players cover bigger and bigger distances, at increasing speeds, while performing numerous and short-term high-intensity physical activities [15], such as acceleration, slowdown, sprinting, jumping or changing the running direction [14]. At this stage of considerations, it is worth pointing out that the players who perform key functions in their teams cover an average of 9 to 12 km during the meeting [13]. On this basis, it can be inferred that the aspects of the physical preparation of a modern football player that predispose him to being able to meet the challenges that are posed in front of him by each subsequent match are of the fundamental significance [1]. The ongoing process of technological progress has also covered football with its effect, which was strongly transformed [16]. Nowadays, the game of both the player and the whole team can be broken down into individual factors and analysed in depth [6]. All these detailed studies are conducted to gather information that will positively affect the final result of the match [2]. The authors put forward a thesis that the modern science has an increasing influence on the change in perception of the game vision, as well as the tactical or motor preparation. The modern world of sport is extremely competitive, and new technological solutions that allow monitoring of athletes during trainings or competitions may provide for the achievement of advantage over the opponent [14]. In other words, the sport discipline of football is a completely different game in today's reality than in the XX century, even though its fundamental principles have not changed. In today's football there are more and more specific parameters, or various game aspects can be measured, which is reflected in the fact that far less pitch situations are marked by the occurrence of the case, which according to many experts is determined by some sort of ignorance [12].

It is through the implementation of science to the world of sport that the possibilities of using innovative telematics tools appeared [5] in order to analyse the selected physical parameters of individual young players predisposed to play at the senior level [8].

One of the most important parameters, which can characterise work which is performed by a player during the match, is undoubtedly the distance covered during the so-called acceleration, and well as the so-called speed losses, shown at different intensity levels [9]. These parameters allow to determine the real intensity in the closest possible way, with which the given football player plays during the match [16]. Match observations show that we should expect that the values of these parameters will decrease with time of the game due to the growing level of fatigue. On the other hand, in case of total distance, or maximum speed, such a correlation may not necessarily be measurable. Whereas the so-called fatigue has long been regarded by researchers dealing with this issue as a significant factor limiting the motor performance of the given player, negatively translating into the quality of his game [4]. In addition, fatigue as an unfavourable process, can also affect the effectiveness of decision-making during the match or situations requiring focus, such as, e.g., a penalty shot [18].

It is because significant indicators that characterise the performance of the player and thus determining the level of his fatigue during the meeting, may include the distance covered during the accelerations and the distance covered during the slowdowns at different intensity levels, the research issue that gets a crucial importance is the shaping of changes in values of this type of effort in short, five-minute time intervals under the match conditions. Due to the difficulty accompanying the introduction of young players to the senior football, it is particularly important that the results of the talented youth, such as the players, who are taken into consideration in their home clubs in order to be included in the future into their first team.

This publication aims to present the results based on the game of talented players appearing in the selected Polish junior teams in the spring round of the 2016/2017 season, who are in the transition from junior teams to senior football. In particular because the available literature of the subject lacks such analyses and studies including this subject, the right to undertake considerations in this scope is justified even more.

The presented approach has become the basis for the adoption of boundary conditions and methodology of conduct aimed at an attempt to measure the impact of telematics solutions as a tool for measuring efficiency and physical fitness by assuming the hypothesis that among the football players included by the study, the average covered distance during the accelerations and slowdowns at different intensity thresholds decreases in subsequent five-minute intervals in each halves played, despite that the similar correlation will not take place in the case of the average total distance covered and averaged maximum speeds, as well as that after the 15-minute break the mean value of the distance covered during accelerations and speed losses towards the last measured time interval for the first half significantly increases.

Aim of Study

The aim of the article is to show that the distance covered at different intensity levels is the factor that defines the effort made by the football player in match conditions. This parameter is a much more reliable measure than the total distance travelled or the maximum speed achieved by the player.

Material and Methods

Measurements of the parameters relevant for the study were performed using the Catapult optimeye G5 (10 Hz) transmitters equipped with the GPS system. This type of technology is now widely used in sports by researchers, who can use it to identify and monitor certain movement patterns of athletes [8]. Each test was performed under match conditions on a grass football pitch. The player has been qualified for the test if his game was analysed in at least 5 meetings of the spring round of 2016/2017 season. The prerequisite for the player's performance to be covered by the analysis was the compulsion to play the full 90 minutes due to the reliability of the final results.

At the very beginning, in order to maintain logical accuracy and methodological value of the research, it was assumed that the research material includes 18 football players playing at different positions in junior teams in the spring round of the 2016/2017 season of the Polish Premier League. Prior to the study, the consultation with coaches of individual teams was crucial, who indicated the most capable players in their teams. These players were expected to be included in the senior groups of their clubs in the upcoming 2017/2018 season. The mean age among the tested players was 18.1 ± 1.2 years of age, the average height recorded among the studied group of players was 178.4 ± 7.8 cm, while the average weight was around the level of 74.1 ± 7.5 kg.

The complexity of the physical processes taking place during the football match required an alternative approach from the authors. For the study, the key parameters included: the distance covered by the football players during accelerations and slowdowns (speed losses) at different intensity thresholds (low, average, high), the total distance covered, maximum speed, with which the football player was moving. During acceleration, the player's running speed increases gradually with the distance he covers [17]. When it is necessary to change the direction of the run, or the complete stop, the football player immediately or gradually loses the speed of his body [11]. All parameters studied were analysed for each five-minute match section, where the P1 period included the first five minutes of the meeting (1-5 min), P2 the second five minutes of the meeting (6-10 min), until P18 (86-90 min). The study did not include the fragments of the meeting shown as an extra time of the game due to the different numbers of such minutes in each meeting and the inability to divide that time into homogenous (five-minute) sections, which would not have a beneficial effect on the validity of the results obtained. After gathering the data that allowed the distribution of the game of each player into factors in the discussed scope in individual match fragments, the average values of the studied parameters were calculated for the total number of players, who were included in the analysis. Obviously, the average values of individual factors for each five-minute section of the game were taken into account.

The use of a suitable statistical tool in the form of Excel computer program allowed, among others, to determine the mean distance travelled by players during accelerations and slowdowns at different intensity thresholds and average total distance and average maximum speeds.

Results

Figures 1 to 3 present the study results concerning the average distance covered by the players during accelerations and slowdowns at low (1-2m/s^2), average (2-3m/s^2) and high intensity (>3m/s^2). In turn, figures 4 to 5 illustrate the average total distance and the average maximum speed achieved in each five-minute time intervals.

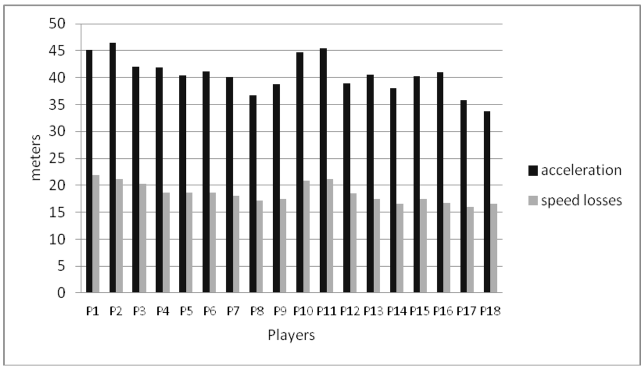

Figure 1. The average distance [m] covered during accelerations and speed losses at low intensity [1-2m/s^2]

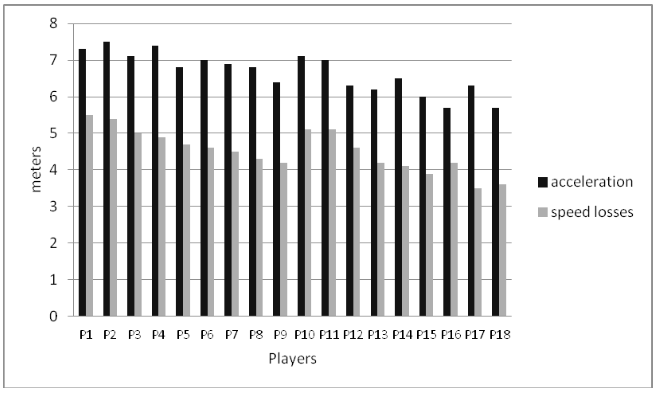

Figure 2. The average distance [m] covered during accelerations and speed losses at average intensity [2-3m/s^2]

The analysis of collected data allowed to show that the average distance covered by the tested players during accelerations at low intensity was 40.6 ± 18.54 m. The highest average value was achieved by football players between 6-10 minute [P2] (46.4 ± 20.11 m), and the lowest between 86-90 minute [P18] (33.7 ± 18.79 m). When it comes to accelerations with average intensity, they shaped in such a way that the average distance for all tested subjects was equal 6.67 ± 5.45 m, the average

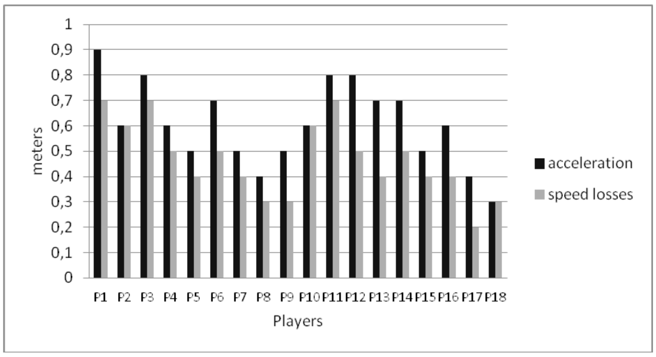

Figure 3. The average distance [m] covered during accelerations and speed losses at high intensity [>3m/s^2]

maximum value was measured between 6-10 minute [P2], and the distance determining it was 7.5 ± 4.88 m, while the recorded average minimum value was 5.7 ± ± 5.14 m measured between 86-90 minute [P18]. Among accelerations performed at the highest intensity (> 3m/s^2), the average value was at the level of 0.61 ± 0.88 m, the highest averaged value (0.9 ± 1.1 m) was recorded in the time interval between 6-10 minutes [P2], while the average minimum values was 0.3 ± 0.67 m, this was the last tested time interval [P18] (86-90 minute).

The next analysed parameter included the slowdowns (speed losses). The average distance covered during this type of activity with the lowest intensity for the studied group of football players was at the level of 18.5 ± ± 7.89 m. The mean maximum value was 21.9 ± 8.50 m and was recorded between 1-5 minutes [P1], while the mean minimum value was between 81-85 minutes [P17] and amounted to 16 ± 10.18 m. The mean value of the slowdowns at the average intensity was equal 4.52 ± 2.80 m. Between 1-5 minutes [P1] the average highest value was recorded (5.5 ± 2.72 m), and in the penultimate range [P17], the group of football players covered by the study achieved the average lowest value (3.5 ± 1.72 m). The mean value of the tested parameter at the high intensity level achieved the level of 0.47 ± ±0.66 m. The extreme values were recorded in intervals of 1-5 minutes [P1], 11-15 minutes [P3], and 51-55 minutes [P11] (average maximum value was 0.7 ± 0.82 m), as well as the range between 81-85 minutes [P17] (average minimum value was 0.2 ± 0.42 m).

The average total distance covered by the group of players covered by the study (Figure 4) and the average maximum speed achieved in each of the 18 time periods (Figure 5) were subjected to the analysis. The average value of the first parameter was 512.8 ± 70.94 m, the average maximum value was recorded between 41-45 minutes [P9] and it was 549.17 ± 33.62 m, while the average minimum values for the whole group was equal 458.33 ± 105.81 m and it ranged between 31-35 minute [P7]. In terms of the second of the aforementioned parameters, i.e. the maximum speed, the studied group of football players has achieved the average value at the level of 6.65 ± 1.10 m/s. The highest average speed was recorded between 11-15 minutes of 7.58 m/s ± 1.11 m/s. The lowest mean value of this factor was equal 5.77 ± 0.71 m/s, and it was shown in the range of 16-20 minutes.

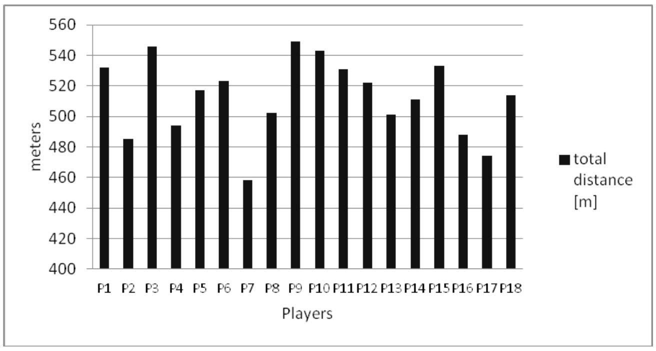

Figure 4. The average total distance [m] covered during the match

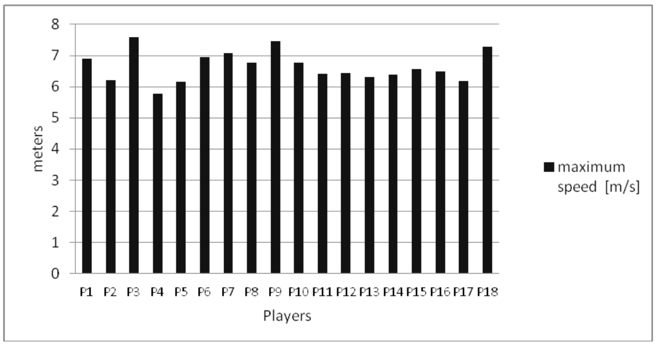

Figure 5. The average maximum speed [m/s] recorded during the match

Figures 1-3 also contain information showing that, with some exceptions, the average distance covered during accelerations and speed losses at different intensity thresholds drops with the duration of the half. In each case, this distance is relatively much lower at the end of each half than at its beginning, but at the end of the second halves, it constitutes a higher value that in the last fragments of the first halves. It should also be noted that in the initial time intervals of the second half, the average values of the mentioned parameters are higher than in the decay interval of the first part of the game. What is significant, the correlation was observed between the intensity of the discussed activities (accelerations, slowdowns), and the number of consecutive time periods in the second half, where the averaged values are higher than in the last fragment of the game in the first half. The higher the intensity of these events, the higher the number of five-minute time segments measured after the match break, where the average higher values occur than in the segment subjected to analysis directly before ending the first half. It is also worth noting that similar dependencies are impossible to be found in the average distance covered by the players and the average maximum speeds achieved by them.

Discussion

The aim of the study was to analyse the selected physical parameters by showing the differences between the mean values of the tested parameters, which include the distance covered during accelerations, slowdowns, the total distance covered and the maximum speed achieved by the talented Polish players during matches in each five-minute game segment. The football players involved in the study were in the transition from junior teams in their clubs to senior teams. As indicated by the observations of the match reality, the distance that is covered by players during accelerations and speed losses, especially at the high intensity levels, may be an important measure of the real match effort. Such data, at least in principle, should be by far the more decisive determinant of the work done on the pitch than the total distance covered during the meeting, or the maximum speeds achieved under the discussed conditions [12]. On the other hand, an interesting aspect was the fact of changing the values of the analysed parameters during the football matches, in particular on the example of young players appearing in different pitch positions, excluding goalkeepers, due to the restricted nature of the game for that position, which significantly limits the mobility on the pitch.

In light of this information, the key issue of the research is undoubtedly the manner in which the values of the discussed factors change in the five-minute time intervals during the football meetings. Author's studies, as well as the thorough analyses, the results of which were presented in this article, were the basis for the reference to the hypotheses presented in the publication. The research results confirmed these hypotheses, according to which the average distance covered during accelerations and slowdowns at different intensity thresholds among the football players involved in the study decreases in the subsequent five-minute intervals in each half played, despite that the similar correlation will not take place for the average total distance and the average maximum speed achieved, also that after the 15-minute break for the players between the halves of the meeting, the average value of the football players' distance covered during accelerations and speed losses significantly decreases in relation to the last measured time interval during the first half.

The studies show that the overall distance covered by the players during the match is not a suitable measure of the work done by the football players, as well as their fatigue due to its various values, which are not subject to constant changes under the influence of the elapsed time [18]. Both the mean maximum values of the distance covered and the corresponding minimum values were reached by the studied group of football players still in the first half, while the highest one was recorded only in the last interval of the first half, played just before going to the locker-room. What's more, just after the break, the average value of the distance covered proved to be lower than in the last studied fragment of the first part of the game. The results achieved are confirmed by other studies [19]. So, it should be noted that a considerable rest in the scale of the meeting, lasting 15 minutes, did not affect the number of meters covered by the football players in any way. Thus, the total distance that the football players covers at different phases of the match cannot be used as a measure of the body's fatigue, as there is no correlation between this parameter and the duration of the meeting. This conclusion is also confirmed in other studies [20]. The tactics selected for the match probably is of greater importance for shaping of this factor, its corrections during the game, the result of the meeting, which can determine the attitude of the football players, or the quality of the opponent's game in the particular fragment of the match. As in this case, the results of the tests do not show the relationship between the player's fatigue, which should increase during the match, and the achieved average maximum speed. Its highest average value was noted between the 11 and 15 minute [P3], while the lowest average value is in the next scope, that is, including the 16-20 minutes [P4]. Therefore, just after the break, the average value of this parameters turned out to be relatively low, so the rest did no determine its increase in any way.

The analysis of data indicates that the different situation concerns the average distance that was covered during the accelerations and slowdowns performed by the players at each intensity level. It was found that on all three thresholds in both categories (accelerations, slowdowns), the average extreme values of these parameters among the football players covered in the study were achieved at the beginning of the match [3]. With the duration of the first half, these values gradually decreased in successive time intervals, of course with some exceptions. However, in each case, the value at the end of the first half was clearly lower than in its initial phases. The same situation took place in the second part of the game. In the initial time interval after the break [P10] (46-50 minute), the average number of meters covered during the discussed activities was higher than in the final fragments of the first half in case of each of the analysed intensity levels. This has to do with the fact that this kind of physical effort is a measure of the player's fatigue, as well as his actual pitch activity, and thus the work that he does and is able to perform under match conditions. On the other hand, the occurring break is a stimulus for the body to increase the effort with such characteristics at the initial phases of the second half. On this basis, the authors conclude that the rest has a positive influence on the results achieved immediately after the start of the game in the second half, so we are dealing with a situation that is quite different than in the case of the analysed maximum speed, as well as the total distance, where such a correlation certainly did not take place. The decrease of the average values of these parameters (accelerations, slowdown), therefore, to such extent do not depend on the change in tactics, the quality of the opponent's game, or the result of the game itself, as they drop with the duration of the match, as opposed to other factors, which were included in the study in this publication. The results are a contradiction of the thesis promoted in the literature of the subject as a change of tactic influenced this parameter [21].

Practical Application

The presented research in the future can be used to develop modern training methods in order to make the best use of the physical potential of young players practising this discipline at the professional level.

Conclusion

The study confirmed the hypothesis that among the players in the study the average distance travelled during accelerations and slowdowns at different intensity thresholds drops in the next five-minute intervals in each half played. However, a similar relationship was not found for the mean total distance and average maximum speeds. Moreover, it has been shown that after a 15-minute break, the average value of the distance travelled during accelerations and slowdowns significantly increases in relation to the last measured time interval for the first half. On this basis, the authors agree with the conclusion that the distance covered at different intensity thresholds is a more reliable measure that defines the effort that is made by the football player in match conditions than the total distance travelled or the maximum speed achieved by the player.

To sum up, as the authors have shown in this article, it is worth using the opportunities offered by modern science in order to understand many aspects of the game, which have not been identified clearly so far. Current technological solutions offer great opportunities in terms of making measurements related to the movement patterns, which are carried out by modern football players, and what is extremely important, they guarantee their increasing accuracy [19]. The process of evolution, and thus the implementation of science to this sports discipline is inevitable. Such a state of affairs is guaranteed by the continuous development of technology, which makes the ever-increasing spectrum of factors become measurable, so the fortuity will play the smaller and smaller role in the game itself [7]. The presented author research has confirmed that this kind of solutions can find a practical use in this sports discipline from among all team sports [6].

Summing up, the presented attempt to discuss the innovative dimension of using telematics tools in the training processes of young football players is merely an attempt to signal the complexity of the analysed subject matter concerning the impact of the use of these tools in sport and it certainly requires further analysis and research in order to use them in the scope of developing modern methods for measuring efficiency and physical fitness of individual players in the match reality.

References

1. Akenhead R, Hayes P, Thompson K, French D, Diminutions of acceleration and deceleration output during professional football match play. J Sci Med Sport, 2013; 16: 556-561.
2. Bangsbo J. The Proceedings of the Eight World Congress on Science and Football, London and New York, Routledge Taylor & Francis Group, 2017; 1-2.
3. Barbero-Álvarez JC, Coutts A, Granda J, Barbero--Álvarez V, Castagna C. The validity and reliability of a global positioning satellite system device to assess speed and repeated sprint ability (RSA) in athletes. J Sci Med Sport, 2010; 13: 232-235.
4. Brewer C. Movement pattern comparisons in elite (AFL) and sub-elite (WAFL) Australian football games using GPS. J Sci Med Sport, 2010; 13: 618-623.
5. Buchheit M, Mendez-Villanueva A, Simpson BM, Bourdon PC. Match running performance and fitness in youth soccer. Int J Sports Med. 2010; 31: 818-825.

6. Burgess D, Naughton G, Norton K. Quantifying the gap between under 18 and senior AFL football: 2003 and 2009. Int J Sports Phys Perform. 2012; 7: 53-58.
7. Coutts AJ, Duffield R. Validity and reliability of GPS devices for measuring movement demands of team sports. J Sci Med Sport, 2012; 13: 133-135.
8. Cummins C, Orr R, O'Connor H, West C. Global positioning systems (GPS) and micro-technology sensors in team sports: A systematic review. Sports Med. 2013; 43: 1025-1042.
9. Foster C, Florhaug JA, Franklin J, Gottschall L, Hrovatin LA, Parker S, Doleshal P, Dodge C. A new approach to monitoring exercise training. J Strength Cond Res. 2001; 15: 109-115.
10. Gabbett TJ, Domrow N. Relationships between training load, injury, and fitness in sub-elite collision sport athletes. J Sports Sci. 2007; 25: 1507-1519.
11. Hewit J. Understanding deceleration in sport. Strength Cond J. 2011; 33(1): 47-52.
12. Huges M et al. Moneyball and soccer – an analysis of the key performance indicators of elite male soccer players by position. J Hum Sport Ex. 2012; 7(2): 402-405.
13. Impellizzeri FM, Rampinini E, Coutts AJ, Sassi A, Marcora SM. Use of RPE-based training load in soccer. Med Sci Sports Ex. 2004; 36: 1042-1047.
14. James D. The application of internal sensors in elite sports monitoring. Engineering Sport 2006; 7: 289-294.
15. Jennings D, Cormack S, Coutts AJ, Boyd L, Aughey RJ. The validity and reliability of GPS units for measuring distance in team sport specific running patterns. Int J Sports Phys Perform. 2010; 5: 328-341.
16. Kellis E, Katis A, Vrabas I, Effects of an intermittent fatigue protocol on biomechanics of soccer kick performance. Scand J Med Sci Sports, 2006; 16(5): 334--344.
17. Kent M. Oxford dictionary of sports science and medicine. Third edition. Oxford University Press, 2006; 56.
18. Thomson K, Watt A, Liukkonen J. Differences in ball sports atlethes speed discriminations skills before and after exercise included fatigue. J Sports Sci Med. 2009; 8(2): 259-264.
19. Varley CM, Fairweather IH, Aughey RJ. Validity and reliability of GPS for measuring instantaneous velocity during acceleration, deceleration, and constant motion. J Sport Sci. 2012; 30(2): 121-127.
20. Wisbey B, Montgomery PG, Pyne DB, Rattray B. Quantifying movement demands of AFL football using GPS tracking. J Sci Med Sport, 2010; 13: 531-536.
21. Wrigley R, Drust B, Stratton G, Scott M, Gregson W. Quantification of the typical weekly in-season training load in elite junior soccer players. J Sports Sci. 2012; 30: 1573-1580.