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MOTOR ACTIVITY SPEED ZONES DETERMINATION WITH FOOTBALL PLAYERS AGED 13-14

Original scientific paper

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Abstract

Association football is characterized with a complex demonstration of motor activity. And though it could be stated that men's and women's football game have currently been the subject of serious research and analyses, this has not been the case with junior football. Our research has shown that the existing data is not enough and not convincing enough to shape the conditioning profile of players with reference to age group and duration of play. In order to bring more light on the topic, we concentrated our efforts on determining the speed zones of motor activity during official football matches of 13-14 years old football players. The research involved 28 football players from the junior team of the Levski Football Club, Sofia. The difference from the already existing data lies in the method we have used to acquire our data. It is based on sport-pedagogical tests done on the playing field which provides their objectivity. The data from our tests were processed by means of variation analysis and on these grounds we have established the following speed zones of motor activity for the age group mentioned above: walking < 2,3 m/s.; low intensity running 2,4-4,0 m/s.; middle intensity running 4,1-5,0 m/s.; high intensity running 5,1-6,1 m/s. and sprint running >6,2 m/s. Thus specified, they resolve one of the major problems connected with the use of a GPS to provide the necessary photographic material during a football meeting or in training sessions.

Keywords: *sport-pedagogical tests, variation analysis, sprint running, high intensity running, medium intensity running, Low intensity running, walking*

INTRODUCTION

Research work in the field of association football has defined motor activity during a football match as complex, full of variety, and with changing intensity (Anolli, Duncan, Magnusson, & Riva, 2005; Aguiar, Abrantes, Maçãs, Leite, Sampaio & Ibáñez., 2008; Casas, 2008). Existing research data in this respect has provided us with good reasons to claim that the profile of motor activity characterizing men's and women's football game has already been studied and defined in details (Tumillty, 1993; Garrett, Kirkendall, & Contiguglia, 1996; Mohr, Krustrup, & Bangsbo, 2003; Stolen, Chamari, Castagna, & Wisløff, 2005; Di Salvo, Baron, Tschan, Calderon Montero, Bachl, & Pigozzi, 2007; Bradley, Sheldon, Wooster, Olsen, Boanas, & Krustrup, 2009; Lago-Penas, Casais, Dellal, Rey, & Dominguez, 2011; Bangsbo, 2014).

At the same time we have discovered serious gaps in the big cycle of junior football related to the essence of the conditioning profile for this age group. We hope our knowledge in the field could enhance the quantitative objectivity of the profile framework.

These observations have led us to the aim of our research. It is focused on specifying the speed zones of motor activity during official football matches and on providing greater objectivity of the training process in terms of volume and intensity.

We have formulated the following tasks for the aim of our research:

1. To study the methods of specifying the speed zones of motor activity in football;
2. To determine the limits of these speed zones with footballers aged 13-14.

METHODS

In order to realize our objectives, we have used the following research methods: studying available literature related to the methods of specifying speed zones of mobility in football; sport-pedagogical testing; variation statistical analysis.

Our literary analysis has confirmed the conclusions of Carling, Bloomfield, Nelsen, & Reilly, 2008, about the existing variety of methods used to determine speed zones. The essential ideas of those methods could be summarized as follows:

1. Goto, Morris, & Nevill (2015a); Goto, Morris & Nevill, (2015b) suggest using a 5m flying start with a 5m run-up. Choosing an average speed of 5m flying start for the experimental group, 5 work activity zones are specified, each one of them is calculated on the basis of the standard deviation: first zone: -2 standard deviation; second zone: -1 standard deviation; third zone: average speed; fourth zone: +1 standard deviation; and fifth zone: +2 standard deviation.
2. On the basis of the 10m flying start test over a 40 m track and of Vamevall test suggested by Mendez-Villanueva, Buchheit, Simpson & Bourdon (2012), maximum anaerobic speed and maximum aerobic speed are calculated, as well as spare anaerobic speed on the model equation of Bundle, Hoyt & Weyand (2003), and then 5 work activity zones are specified: first zone: 60 % of maximum aerobic speed; second zone: about 61-80% of maximum aerobic speed; third zone: about 81-100% of maximum aerobic speed; fourth zone: up to 30 % of spare anaerobic speed; fifth zone over 31 % of spare anaerobic speed.

3. On the basis of a 10m flying start test over a 20m track, the average speed for a specific age group is determined, and also the known speed for men footballers. Harley et al. (2010) suggest 6 movement speeds to be specified by means of the following equation (V_{peak} SNR / V_{peak} GRP) * TH-S : standing on one sport, walking, jogging, running, fast running, and sprinting using the model of Bradley, Sheldon, Wooster, Olsen, Boanas & Krustrup (2009).

4. Bangsbo et al. (1991) quoted by Di Salvo, Baron, Tschan, Calderon Montero, Bachl, & Pigozzi, (2007), specify 6 speed zones for men. It should be noted that the methods used to define them have not been clearly explained. The speed zones are as follows: walking up to 4 km/h; jogging from 4 to 8 km/h; low intensity running from 8 to 12 km/h; medium intensity running from 12 to 16 km/h; high intensity running from 16 to 21 km/h; sprinting from 21 to 30 km/h and more.

The observed variety of methods to specify speed zones is also coupled with some ambiguity and contradiction in the opinions of different researchers with reference to important aspects of the problem analyzed in our study. In this respect, we support the opinion expressed by Abt & Lovell (2009) about the necessity of using individual zones of motor activity for specific age groups, however, we cannot accept the suggestion of Siegle & Lames (2010) about the necessity of individual work zones for every single player.

On the other hand, we would like to note that, no matter the differences observed (not always supported by reliable statistics) in the motor capacity of players in terms of their positions (Molinos, 2013; Bradley, Sheldon, Wooster, Olsen, Boanas & Krustrup, 2009; Bloomfield, Polman & O'Donoghue, 2007; Di Salvo, Baron, Tschan, Calderon Montero, Bachl, Pigozzi, 2007; Pereira Da Silva, Kirkendall & De Barros Neto, 2007; Buchheit Mendez-Villanueva, Simpson & Bourdon, 2010), we consider it inappropriate for a team game to individualize training loads according to players' positions on the field (Carling, 2013) .

Taking into account all data mentioned above, we created our own methodology and our model for determining the speed zones of motor activity with football players aged 13-14. It is based on specially selected tests corresponding to the main speed zones of motor activity during an official football match. Terminologically we have defined the following five basic speed zones: I speed – *walking*; II speed – *low intensity running* (jogging); III speed – *medium intensity running* (pace running); IV speed – *high intensity running* (speed endurance) and V speed – *sprint running* (top speed). We have selected suitable tests to match those five speeds. Their choice was made according to the five zones of energy provision.

In order to determine the maximum walking speed, low intensity running and sprint running, we have measured the time needed for a group of footballers aged 13-14 to cover the distance of 20m. Although in specialized literature there are studies using a 5m distance (Goto, Morris, & Nevill, 2015a, Goto, Morris, & Nevill, 2015b) and a 10m distance (Mendez-Villanueva, Buchheit, Simpson, & Bourdon, 2013; Harley, Barnes, Portas, Lovell, Barrett, Paul, & Weston, 2010), our choice of a 20m distance was made on the conviction that it is the most informative and the most suitable one to distinguish clearly between different speeds of movement. In confirmation to our speculations, the research works of Bangsbo, Mohr, & Krustrup (2006), Haugen, & Seiler (2015), show that the average length of sprints in football varies between 10-15 m. Also according to Chamari, Hachana, Ahmed, Galy, Sghaıer, Chatard, Hue, & Wisløff (2004), research studies based on a 10 m distance are not informative enough.

With reference to walking, we have to note that we consider it as *I speed* of basic motor activity in football, no matter that a number of authors (an opinion we do not share) classify standing on the spot in the same group with walking (Bradley, Sheldon, Wooster, Olsen, Boanas, & Krustrup, 2009; Reilly et al., 1976. quoted by Stoyer, Hansen & Klausen, 2004).

When we determined *V speed – sprint running* (top speed), we used the test of 20m from a flying start, providing a 10 m acceleration zone followed by the 20 m distance in which to measure the results.

We did the tests following the standard rules and procedures for that kind of research, and we measured the time by means of an electronic photo system Newtest Powertimer, Newtest Oy – Finland, with accuracy of results 0,01s.

We determined *III speed – medium intensity running* by means of a 600m running test. It was organized on an artificial grass terrain. The running track was marked by cones placed at 10m from one another.

Determining *IV speed - high intensity running* (speed endurance) was achieved by means of a special shuttle test 3x50m. The test was done on an artificial grass football pitch, over a track measured in advance. The test consists of three 50 m distances which are covered without interruption.

Table 1. Variability of sport pedagogical indexes (tests) characterizing the specific speed zones of motor activity with football players aged 13-14

Tests	N	R	x_{min}	x_{max}	X	m_o	S	V%	As	Ex
20 m walking – (I speed)	28	2,84	7,98	10,82	9,64	0,24	0,85	8,82	-0,84	-0,19
20 m jogging – (II speed)	28	1,98	4,64	6,62	5,49	0,17	0,54	9,83	0,607	0,55
600 m pace running – (III скорост)	28	17,60	127,6	145,2	136,6	2,23	6,7	4,98	-0,07	-1,97
3x50 m shuttle style running (IV speed)	28	4,70	24,3	29	26,6	0,28	1,19	4,47	-0,16	0,34
20 m from flying start (V speed)	28	0,63	2,57	3,20	2,85	0,04	0,16	5,61	0,24	0,39

Table 2. Speed zones of motor activity with 13-14 years old football players

Type of running activity	Speed zones			
	m/s		km/h	
Sprint running	> 6,2		over 22,1	
High intensity running	from 5,1	to 6,1	from 8,1	to 22,0
Medium intensity running	from 4,1	to 5,0	from 4,5	to 18,0
Low intensity running	from 2,4	to 4,0	from 8,4	to 14,4
Walking		to 2,3		to 8,3

In the last two tests time was measured with an electronic hand chronometer Q&Q, with an accuracy of 0.01 s. All data from the field tests were processed by means of variation analysis, using a statistical program (SPSS Inc v.19, Chicago, USA).

The research involved 28 football players from the junior team of Levski Football Club, Sofia.

RESULTS AND DISCUSSION

Data from the separate tests have been summarized and presented in table 1.

The table shows that the variation coefficient figures (V%) range from 4, 98 to 9, 83. These values determine the subjects of our research as a very homogenous group, i.e. we can state with confidence that the conclusions drawn from the research data are objective and statistically reliable.

The acquired mean time values in the individual tests were transformed into speed values (m/s) by mathematical calculations using the formula V = S/t. The normal distribution shown on table 1, allows us to use the statistical range R (the difference between x_{max} and x_{min}) as a zone which, we could claim, relates a specific speed with a specific energy provision for the studied age group. In order to specify the respective speed zones more precisely, we used half the range value (R/2), adding it to or subtracting it from the mean value of the respective test thus receiving the range of the respective speed zones. For their final determination we used the so called statistical smoothing, which does not affect final data. For greater precision we have defined the more ambiguous low intensity running range (II speed) as the difference between walking range (I speed) and pace running range (III speed).

We have summarized and presented the respective speed zones in table 2. They are statistically processed and presented in two columns, corresponding to the two different measuring units - (m/s) and (km/h).

After an additional analysis of available literature on the topic it was established that the problem of determining individual speed zones for various types of mobility attracts a lot of interest at present. The most appropriate method to determine them is sought, avoiding any statistical predetermination (Goto, Morris & Nevill, 2015a, Goto, Morris & Nevill, 2015b; Mendez-Villanueva et al., 2013; Harley et al.,, 2010) The model we have offered meets the requirements of football, and at the same time it uses simple tests which can be applied by any team without great financial expenses and time loss. It is based on determining 5 work zones, as well as the greater part of others describing motor activity. They can be used in every qualification with the respective age group and they reflect the real state of the team no matter of its level of preparation.

CONCLUSIONS

Taking into account the research data we can make the following conclusions:

1. The current existing models for determining the speed zones of motor activity in football are the result of complex and continuous research work and in most cases they do not give direct (terrain) information, but mostly indirect. This fact decreases their objective information value.
2. The new method we have created for determining speed work zones is of practical application and it reflects the real condition of the football team according to its level of preparation for the specific age group.
3. The objectively determined speed zones present a solution to an important problem in junior football connected with the application of a GPS in the age group 13-14.

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REFERENCES

Abt, G., & Lovell, R. (2009). The use of individualized speed and intensity thresholds for determining the distance run at high-intensity in professional soccer. *Journal of Sports Sciences, 2*(9), 893–898.

Aguiar, M., Abrantes, C., Maçãs, V., Leite1, N., Sampaio, J, & Ibáñez, S. (2008). Effects of intermittent or continuous training on speed, jump and repeated-sprint ability in semi-professional soccer players. *The Open Sports Sciences Journal, 1*(15)-19 15.

Anolli, L.S., Duncan, Jr., Magnusson, M.S., & Riva, G. (2005). *The hidden structure of interaction: From neurons to culture patterns,* Amsterdam: IOS Press.

Bangsbo, J. (2014). Physiological demands of football, *Sports Science Exchange*, *27*(125), 1-6.

Bangsbo, J., Mohr, M., & Krustrup, P. (2006). Physical and metabolic demands of training and match-play in the elite football player. *Journal of Sports Sciences*, *24*(7), 665-674.

Bloomfield, J., Polman, R., & PO'Donoghue, P. (2007). Physical Demands of Different Positions in FA Premier League Soccer. *Sports Science Medicine*, *6*(1), 63-70.

Bradley, P.S., Sheldon, W., Wooster, B., Olsen, P., Boanas, P., & Krustrup, P. (2009). High-intensity running in English FA Premier League Soccer Matches. *Journal of sports sciences, 27*(2), 159-68.

Buchheit, M., A. Mendez-Villanueva , B. M. Simpson, P., & Bourdon, C. (2010). Match Running Performance and Fitness in Youth Soccer. *International Journal of Sports Medicine, 31*(11), 818-25.

Bundle, M.W., Hoyt, R.W., & Weyand, P.G. (2003). High-speed running performance: a new approachto assessment and prediction. *Journal of Applied Physiology, 95(*5), 1955-1962.

Carling, C., Bloomfield, J., Nelsen, L., & Reilly, T. (2008). The role of motion analysis in elite Soccer: Contemporary performance measurement techniques and work rate data. *Sports Medicine*, *38*(10), 839-862.

Carling, C. (2013). Interpreting physical performance in professional soccer match-play: should we be more pragmatic in our approach? *Sports medicine*, *43*(8), 655-663.

Casas, A. (2008). Physiology and methodology of intermittent resistance training for acyclic sports. *Journal of Human Sport & Exercise, 3*(1), 23-52.

Chamari, K., Hachana, Y., Ahmed, Y.B.,Galy, O., Sghaıer, F., Chatard, J-C., Hue, O., & Wisløff, U. (2004). Field and laboratory testing in young elite soccer players. *British Journal of Sports Medicine, 38*(2), 191-196.

Di Salvo, V. R., Baron, H., Tschan, F. J., Montero, C., Bachl, N., & Pigozzi, F. (2007). Performance characteristics according to playing position in elite soccer. *International Journal of Sports Medicine, 28*(3), 222-227.

Goto, H., J. G. Morris & J.G., & Nevill., M. E. (2015a). Match Analysis of U 9 and U 10 English Premier League academy soccer Players using a Global Positioning System. *Journal of strength and conditioning research*, *29*(4), 954-63.

Goto, H., Morris, J.G., & Nevill, M.E..(2015b). Motion analysis of U11 to U16 elite English Premier League academy Players. *Journal of Sports Sciences*, *33*(12), 1248-1258.

Harley, J.A., C.A.Barnes, C.A.,Portas, M. Lovell, R., Barrett, S., Paul, D., & Weston, M. (2010). Motion analysis of match-play in elite U12 to U16 age-group soccer players. *Journal of Sports Sciences, 28*(13), 1391-1397.

Haugen, T., & Seiler, S. (2015). Physical and Physiological Testing of Soccer Players: Why, What and How should we Measure?. *Sportscience*, 19(1), 10-26.

Lago-Penas, C., Casais, L., Dellal, A., Rey & Dominguez, E. (2011). Anthropometric and physiological characteristics of young soccer players according to their playing positions: relevance for competition success. *Journal of Strength and Conditioning Research, 25*(12), 3358-67.

Mendez-Villanueva, M. Buchheit, B. Simpson, P., & Bourdon, C. (2013). Match play intensity distribution in youth soccer. *International Journal of Sports Medicine, 34*(2), 101-10.

Mohr, M., Krustrup, P., & Bangsbo, J. (2003). Match performance of high-standard soccer players with special reference to development of fatigue. *Journal of Sports Sciences, 21*(7), 519-528.

Molinos, A. (2013). Evaluation of movement and physiological demands of full-back and center-back soccer players using global positioning systems. *Journal of Human Sport and Exercise, 8*(4), 1015-1028.

Pereira Da Silva, N., Kirkendall, D.T., & Leite De Barros Neto, T. (2007), Movement patterns in elite Brazilian youth soccer. *Journal of Sports Medicine Physical Fitness, 47*(3), 270-5.

Siegle, M., & Lames, M. (2010). The relation between movement velocity and movement pattern in elite soccer. *International journal of performance analysis of sport, 10*(3), 270-278.

Stoyer, J., Hansen, L., & Klausen, K. (2004). Physiological Profile and Activity Pattern of Young Soccer Players during Match Play. *Medicine and Science in Sports Exercise, 36*(1), 168-74.

Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. (2005), *Physiology of soccer: An Update, Sports Medicine, 35*(6), 501-536.

Tumilty, D. (1993). Physiological characteristics of elite soccer players. *Sports Medicine, 16*(2), 80-96.

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