Baltic Journal of Health and Physical Activity 2015;7(4):42-50
Journal of Gdansk University of Physical Education and Sport in Gdansk
e-ISSN 2080-9999

ORIGINAL

Comparison of time-motion analysis and physiological responses during small-sided games in male and female soccer players

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

Zbigniew Jastrzębski[1 ADEFG], Łukasz Radzimiński[1 BCEF], Piotr Stępień[2 BG]

[1] Gdansk University of Physical Education and Sport, Gdansk Poland

[2] Lodz Academy of Sport, Poland

abstract

Background The main purpose of this study was to compare the physiological response and time-motion analysis of male and female soccer players during 4 vs 4 small-sided games.

Material/Methods Thirteen adult, professional, male and fifteen female soccer players participated in the study. Small-sided games (4 vs 4) were performed in an interval format: 4 x 4 min, 2 min of active recovery. The distance covered by the players during small-sided games and heart rate responses were measured.

Results The average intensity during the small-sided games was between 89.4 and 90.6% HRmax in male and between 88.9 and 90.2% HRmax in female players. The total distance covered by the male soccer players during four bouts of small-sided games was significantly ($p < 0.0009$) longer. During subsequent games the distance covered by men was 24.7%, 24.2%, 25.5%, and 24.6% longer, respectively, than in women.

Conclusions The results of this study show that intensity (% HRmax) during 4 vs 4 small-sided games is similar in male and female soccer players. Both men and women covered a comparable distance at a speed below 4 $m \cdot s^{-1}$. In contrast, the distance covered with a speed exceeding the velocity of 4 $m \cdot s^{-1}$ was significantly longer in male soccer players.

Key words gender differences, time-motion analysis, interval training, soccer training

article details

Article statistics **Word count:** 2,587; **Tables:** 2; **Figures:** 1; **References:** 35

Received: October 2015; **Accepted:** January 2016; **Published:** March 2016

Full-text PDF: http://www.balticsportscience.com

Indexation: AGRO, Celdes, CNKI Scholar (China National Knowledge Infrastructure), CNPIEC, De Gruyter - IBR (International Bibliography of Reviews of Scholarly Literature in the Humanities and Social Sciences), De Gruyter - IBZ (International Bibliography of Periodical Literature in the Humanities and Social Sciences), DOAJ, EBSCO - Central & Eastern European Academic Source, EBSCO - SPORTDiscus, EBSCO Discovery Service, Google Scholar, Index Copernicus, J-Gate, Naviga (Softweco, Primo Central (ExLibris), ProQuest - Family Health, ProQuest - Health & Medical Complete, ProQuest - Illustrata: Health Sciences, ProQuest - Nursing & Allied Health Source, Summon (Serials Solutions/ProQuest, TDOne (TDNet), Ulrich's Periodicals Directory/ulrichsweb, WorldCat (OCLC)

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interest: Authors have declared that no competing interest exists.

Corresponding author: Dr hab. prof. nadzw. Zbigniew Jastrzębski; Gdansk University of Physical Education and Sport, K. Górskiego 1, 80-336 Gdańsk, Poland; phone: +48601173768; e-mail: zb.jastrzebski@op.pl

INTRODUCTION

Soccer is one of the most popular sports in the world played by men and women [1]. Therefore, there are many publications investigating the influence of different determinants of the effectiveness of the training process in male and female soccer players. According to Stølen et al. [1], physiological demands (% of maximal heart rate – %HRmax, % of maximal oxygen uptake – %VO_2max) during a soccer match are similar for both men and women. However, time-motion analysis indicates that during a 90-minute game female players cover even 30% shorter distance in high-intensity running than male soccer players [2]. Moreover, Mujika et al. [3] stated that men obtain better results in Yo-Yo intermittent recovery test, Level 1 (Yo-YoIR1), countermovement jumps with and without arm swing, 15 m sprint, 15 m agility test and 15 m ball dribbling test. These differences are probably a consequence of greater fat mass, smaller muscle mass and worse efficiency of the cardiovascular system in women. Therefore, the question whether training loads applied to female soccer players are smaller than in male players seems to be interesting. Monitoring the volume and the intensity of the effort is one of the basic tasks enabling evaluation of the effectiveness of the training process. The most popular methods of controlling exercise intensity are heart rate monitoring and time-motion analysis [4, 5]. While HR recording is used relatively often, the analysis of kinematic factors is applied mostly in elite soccer players.

Previously, many studies have shown that the distance covered by male soccer players (excluding goalkeepers) during a 90-minute match is between 9 and 13 kilometers [6, 7, 8]. The number of papers concerning female soccer players is smaller. According to Andersson et al. [9], women perform more running when playing international games compared with domestic league games. However, in both cases the total distance was no longer then 10 km. Similar findings were presented by Krustrup et al. [2], who showed that women cover between 9.7 and 11.3 km (average: 10.3 km) during a soccer match. Moreover, Mohr et al. [10] demonstrated that the total distance covered by female high-level players and top-class players is similar (10.44 km and 10.33 km, respectively). Considering high-intensity runs and sprints, the same authors reported that a significantly longer distance is covered by professional players.

It has been shown that the playing position is not a factor determining the level of aerobic [11] and anaerobic [12] capacity. This may suggest the lack of significant differences in locomotion during a match. However, in our opinion this statement needs to be confirmed by the research involving a larger population of female soccer players.

The currently available diagnostic equipment (GPS devices) used by soccer coaches allows analyzing players' locomotion during a match and training sessions. Most frequently time-motion analysis during training sessions concerns small-sided games. Based on the previous publications, it can be stated that the most popular small-sided games are 4 vs 4 and 5 vs 5. Dellal et al. [13] showed that the distance covered by elite soccer players during 4-minute game is between 598 m and 836 m. Depending on the game rules it may be longer in 5 vs 5 games. [14] There is a lack of publications investigating physiological responses and time-motion analysis in female soccer players. Gabbett i Mulvey [15] demonstrated that movement patterns of small-sided games are similar to demands of national and international competition in

elite women soccer players. It was suggested that small-sided games should be supplemented with sport-specific training to stimulate the high-intensity and repeated sprint ability.

Available review papers [16, 17, 18] described the influence of different factors of the intensity of small-sided games. The number of players, the pitch size, coach encouragement, game rules, and the work-rest ratio were analyzed. Comparing the response to small-sided games with reference to sex could be another interesting issue extending the knowledge of soccer-specific interval training. Former publications include only the comparisons of the total distance covered by male and female players during standard matches. Comparing the locomotion of both sexes players with regard to speed zones (e.g. walking, jogging, running, high-intensity running, sprinting) is particularly difficult. The inhomogeneous methodology of dividing speed zones in time-motion analysis does not include the individual potential of male and female soccer players. The majority of analyses involve five or six standard speed zones. Therefore, future research in this area should concentrate on determining individual speed zones of the players.

The purpose of this study was to compare the physiological response and time-motion analysis of male and female soccer players during 4 vs 4 small-sided games. We hypothesized that the total distance and distance covered in high-intensity running will be longer in male soccer players.

MATERIAL AND METHODS

SUBJECTS

Thirteen adult, professional, male (5 defenders, 5 midfielders, 3 strikers; mean ±SD: age, 26.8 ±6.1 y; height, 180.3 ±5.8 cm; body mass, 76.7 ±5.9 kg, HRmax = 186.8 ±8.4 b·min^{-1}), and fifteen female (6 defenders, 6 midfielders, 3 strikers; age, 22.5 ±3.5 y; height, 167.4 ±7.1 cm; body mass, 59.9 ±6.3 kg, HRmax = 192.4 ±9.9 b·min^{-1}) soccer players took part in the study. Both, male and female players were members of the teams from the same league level (first league). All the subjects had their current sportsmen medical cards. Their typical weekly training included 5-8 training sessions and one league game. The study was approved by the Ethical Committee of the Local Medical Chamber.

STUDY DESIGN

The subjects participated in 4 vs. 4 games with goalkeepers which were played on a 40 x 30 m pitch. Despite what Zubillaga et al. [19] stated that the playing area per player during small-sided games in women soccer players should not exceed 110 m^2, we decided to use the pitch of a relative size of 120 m^2/player, which is in line with other authors [20]. According to previous publications [21], small-sided games were performed in an interval format: 4 x 4 min with 2 min of active recovery.

No modifications or limits regarding rules (e.g., the number of contacts with a ball) were applied. During each game, the coaches actively motivated the players to increase their effectiveness [22]. When the ball went out of the playing area, assisting coaches supported the players with another ball to avoid game breaks. All the games were played on a natural pitch in similar

atmospheric conditions (i.e., wind < 1 $m \cdot s^{-1}$, temperature of 15-18°C, 40-55% humidity, and atmospheric pressure of 1004-1012 hPa). Before the games, the players performed a 10-minute warm-up followed by dynamic exercises with balls. The physical demands (GPS) and physiological responses (Heart Rate – HR) of male and female soccer players during 4 vs. 4 small-sided games were compared.

METHODOLOGY

The distance covered by the players during small-sided games was measured using previously validated [23, 24] portable GPS devices (minimaxX version 4.0, Catapult Innovations, Melbourne, Australia) with a frequency of 10 Hz and analyzed using appropriate software (Catapult Sprint 5.0, Catapult Innovations, 2010). During the games, the players wore vests with GPS units placed on the upper back. As recommended, the GPS devices were activated 15 min before starting the training session.

Values for the distance covered during sprinting (> 7 $m \cdot s^{-1}$), high speed running (5.5 – 7 $m \cdot s^{-1}$), running (4 – 5.5 $m \cdot s^{-1}$), jogging (2 – 4 $m \cdot s^{-1}$), standing and walking (0 – 2 $m \cdot s^{-1}$), and the total distance were measured. These speed zones were previously described by Rampinini et al. [25].

The heart rate responses were recorded in 5-s intervals using telemetry devices (Polar Team Sport System; Polar Electro OY, Kempele, Finland). The highest HR value observed during the small-sided games was considered as the maximal heart rate (HRmax).

STATISTICAL ANALYSES

All the results are presented as the mean ±SD. All the data sets were assessed using the Shapiro-Wilk test for normal distributions. A t-test for independent variables was used to evaluate the differences between the two sexes. The Wilcoxon signed ranks test was conducted when the normality of the data distribution was disturbed. Levene's test was used to evaluate the homogeneity of variances. Repeated-measures ANOVA was applied to assess the differences between the bouts. All statistical analyses were performed using the Statsoft, Inc. STATISTICA version 9.0 software (Statsoft, Tulsa, OK). The level of significance was set at $p < 0.05$.

RESULTS

The intensity during the small-sided games was between 89.4 and 90.6% HRmax in male and between 88.9% and 90.2% HRmax in female players (Fig. 1). The total distance covered by the male soccer players during four bouts of small-sided games was significantly ($p < 0.0009$) longer. Similar differences were noted in running ($p < 0.0000$) and high-speed running ($p < 0.0001$). Female players did not reach the speed considered as sprint. The average distance covered by male players in sprinting was very low (0.5 ±1.66 m) (Tab. 1). During subsequent games the distance covered by men was 24.7%, 24.2%, 25.5%, and 24.6% longer respectively than in women (Fig. 2).

Table 1. Total distance covered in each speed zone by male and female soccer players during applied small-sided games

	Standing + walking	Jogging	Running	High-speed running	Sprint	Total
Female [m]	735.7 ±84.49	1103.5 ±283.45	123.1 ±56.42	5.3 ±7.62	-	1967.5 ±225.81
Male [m]	722.7 ±85.17	1244.4 ±240.74	294.9 ±71.44*	37.2 ±22.64*	0.5 ±1.66	2299.7 ±188.23*
p	0.71	0.16	0.00	0.00	-	0.00
T	-0.37	1.45	7.23	5.27	-	4.26
df	26	26	26	26	-	26

*Significant differences between male and female players at $p < 0.001$

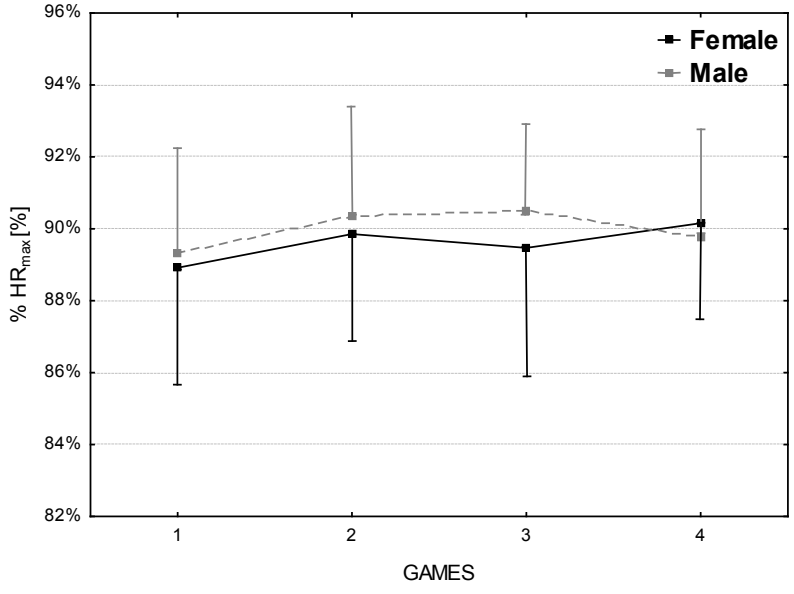

Fig. 1. Heart rate response of male and female soccer players during applied small-sided games

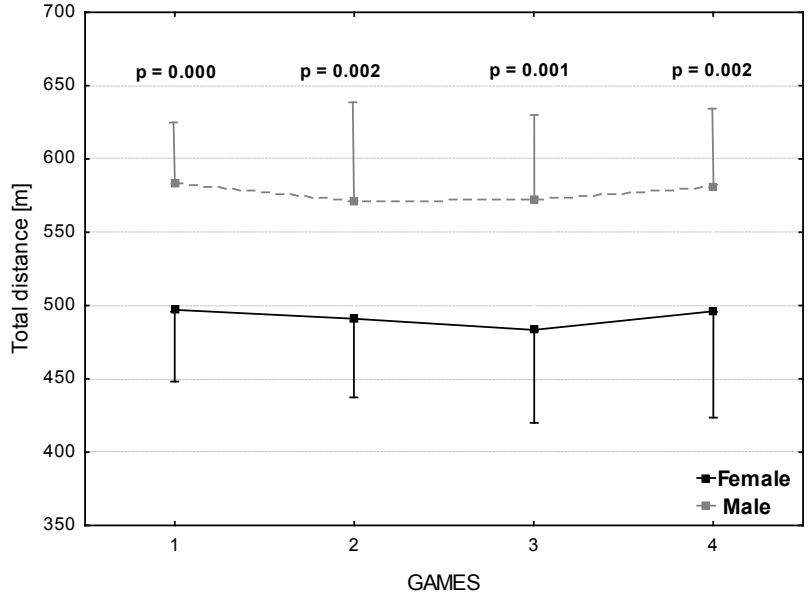

Fig. 2. Total distance covered by female and male soccer players during each applied small-sided games

DISCUSSION

The main purpose of our research was to indicate the differences in physiological responses and time-motion analysis in male and female soccer players during 4 vs 4 small-sided games. Two groups representing the same competition level preformed equal training sessions involving 4 x 4 minutes of small-sided games. The results of this study demonstrate that intensity during those games was similar and did not differ significantly between the sexes. However, the significant differences were found when comparing the locomotion factors. Although the distance covered in standing + walking and jogging was very close, the significantly higher values of the distance covered in running (4 – 5.5 $m \cdot s^{-1}$) and high-intensity running (5.5 – 7 $m \cdot s^{-1}$) were observed in male soccer players. Moreover, women did not reach the speed values considered as sprinting, while the mean sprint distance in men was only 0.5 ±1.66 m.

In our research the intensity of the game in male soccer players was between 89 – 91% HRmax. These results are in line with previous research [16, 17, 18]. This value of % HRmax is commonly considered as effective in developing aerobic and anaerobic capacity of soccer players [26, 27]. The physiological response in female players was very similar. Unfortunately, the lack of publications considering the HR response of female soccer players to small-sided games precludes comparing our results to other female groups.

Hodson et al. [28] in their study applied 5 vs 5 small-sided games (including goalkeepers, 4 x 4 min, pitch: 40 x 30 m). The total distance covered during 4 games was 1941 m. This value is lower than achieved by female (1968 m) and male (2300 m) players in our research. However, Hodson et al. [28] tested university-level soccer players who were performing only two training sessions per week and one competition match per week. Interestingly, university-level soccer players covered a longer distance in sprinting (11 m) than our players. This may be caused by a different division of the speed zones. In our study sprint was defined as running at speed > 7 $m \cdot s^{-1}$, while in Hodson's et al. study sprint threshold was set at 6.7 $m \cdot s^{-1}$. These results confirm the need of an individual division of the speed zones in time-motion analysis in soccer.

The total distance covered during small-sided games and the distance covered in running and high-intensity running may be determinated by the level of the maximal oxygen uptake (VO_2max). Many researchers suggest that VO_2max ranges between 58–65 $ml \cdot kg^{-1} \cdot min^{-1}$ [29, 30], and sometimes reaches 70 $ml \cdot kg^{-1} \cdot min^{-1}$ [31]. Available data indicate that VO_2max in female soccer players is dependent on the training period, the level of competition, and the playing position and the range between 45 $ml \cdot kg^{-1} \cdot min^{-1}$ and 55 $ml \cdot kg^{-1} \cdot min^{-1}$ [1, 11, 32].

Lower aerobic potential in women may be one of the factors determining the total distance covered during small-sided games. Our research suggests that this value is 25% lower when compared with men. An interesting comparison of locomotion between sexes was made by Bradley et al. [33]. These authors analyzed the locomotion of female soccer players who participated in UEFA Champions League. They found that both men and women cover a similar distance during a soccer match with a speed of 0–12 $km \cdot h^{-1}$ and 12–15 $km \cdot h^{-1}$. However, the distance covered with a speed above 18 $km \cdot h^{-1}$ (> 5 $m \cdot s^{-1}$) was significantly ($p < 0.01$) longer in male soccer players.

These results registered during a 90-minute soccer match are in compliance with our findings in small-sided games. There were no significant differences between sexes in two lowest speed zones; standing, walking (0–2 $m \cdot s^{-1}$) and jogging (0–4 $m \cdot s^{-1}$). Substantial differences were noted between men and women in running 4–5.5 $m \cdot s^{-1}$ (14.4–19.8 $km \cdot h^{-1}$) and high speed running 5.5–7 $m \cdot s^{-1}$ (19.8–25.2 $km \cdot h^{-1}$), where male soccer players covered a longer distance than females. This probably resulted rather from greater physical aerobic and anaerobic capacity than by the level of soccer-specific technical skills, because both groups represented the same competition level.

According to applied speed zones division, there were no sprints performed by women in small-sided games. The distance covered with this speed by male players was less than 1%. Such low values are probably the effect of a small pitch area (40 x 30 m) or setting too high a speed threshold for sprints. Buchheit et al. [34] reported that players over 18 years old achieve their maximal running speed between 20 and 40 metres of the sprint. It is very difficult to perform such a long run on a pitch of 40 x 30 m in size. Therefore, both men and women were unable to reach the speed of 7 $m \cdot s^{-1}$. In our opinion the sprint threshold of 7 $m \cdot s^{-1}$ is too high for female soccer players. Vescovi [35] demonstrated that elite women soccer players during a soccer match playing on a full-size pitch cover only 1.1% of the distance with the speed exceeding 25 $km \cdot h^{-1}$ (6.94 $m \cdot s^{-1}$). Moreover, the average distance indispensable to reach this velocity was 29 m. Bradley et al. [33] showed that during UEFA Champions League games the mean distance covered by female soccer players in sprinting (> 25 $km \cdot h^{-1}$, 6.94 $m \cdot s^{-1}$) was 59 m (0.5% of total distance). The distance covered at this speed zone by males was longer (200m, 2%). All these data strongly confirm the need of individually setting the speed thresholds for sprinting according to the maximal speed of each player [14].

CONCLUSIONS

The results of this study demonstrate that the physiological response during 4 vs 4 small-sided games is similar in male and female soccer players. During these games both men and women covered a comparable distance at a speed below 4 $m \cdot s^{-1}$. In contrast, the distance covered with speed exceeding velocity of 4 $m \cdot s^{-1}$ was significantly longer in male soccer players.

PRACTICAL APPLICATIONS

Comparing the physiological responses of male and female soccer players during small-sided games is an interesting issue, which may be useful in planning training programs for soccer according to sex. To our knowledge, this is the first paper comparing the physiological responses and time-motion analysis of male and female soccer players during 4 vs 4 small-sided games.

Presented in our study differences in locomotion of male and female soccer players indicate that during 4-minute small-sided game male players cover 25% longer distance than females. Most of the disparities concerned running at high-intensity.

REFERENCES

[1] Stølen T, Chamari K, Castagna C, and Wisløff U. Physiology of Soccer An Update, Sports Med. 2005;35(6):501-536.

[2] Krustrup P, Mohr M, Ellingsgaard H, Bangsbo J. Physical demands during an elite female soccer game: importance of training status. Med Sci Sports Exerc. 2005;37(7):1242-1248.

[3] Mujika I, Santisteban J, Impellizzeri FM, Castagna C. Fitness determinants of success men's and women's football. J Sports Sci. 2009;27(2):107-114.

[4] Achten J, Jeukendrup AE. Heart rate monitoring. Applications and limitations. Sports Med. 2003;33(7):517-538.

[5] Carling C, Bloomfield J, Nelsen L, Reilly T. The role of motion analysis in elite soccer: contemporary performance measurement techniques and work rate data. Sports Med. 2008;38(10):839-862.

[6] Di Salvo V, Baron R, Tschan H, Calderon Montero FJ, Bachl N, Pigozzi F. Performance characteristics according to playing position in elite soccer. Int J Sports Med. 2007;28:222-227.

[7] Bradley PS, Sheldon W, Wooster B, Olsen P, Boanas P, Krustrup P. High-intensity running in English FA Premier League soccer matches. J Sports Sci. 2009;27(2):159-168.

[8] Mohr M, Krustrup P, Bangsbo J. Match performance of high-standard soccer players with special reference to development of fatigue. J Sports Sci. 2003;21:519-528.

[9] Andersson HA, Randers MB, Heiner-Moller A, Krustrup P, Mohr M. Elite female soccer players perform more high-intensity running when playing in international games compared with domestic league games. J Strength Cond Res. 2010;24(4):912-919.

[10] Mohr M, Krustrup P, Andersson H, Kirkendal D, Bangsbo J. Match activities of elite women soccer players at different performance levels. J Strength Cond Res. 2008;22(2):341-349.

[11] Ingebrigtsen J, Dillern T, Shalafi SAI. Aerobic capacities and anthropometric characteristics of elite female soccer players. J Strength Cond Res. 2011;25(12):3352-3357.

[12] Nikolaidis PT. Physical fitness in female soccer players by player position: a focus on anaerobic power. Hum Mov. 2014;15(2):74-79.

[13] Dellal A, Lago-Penas C, Wong DP, Chamari K. Effect of the number of ball contacts within bouts of 4 vs. 4 small-sided soccer games. Int J Sports Physiol Perf. 2011;6:322-333.

[14] Jastrzębski Z, Radzimiński Ł. Individual vs general time-motion analysis and physiological response in 4 vs 4 and 5 vs 5 small-sided soccer games. Int J Perf Analysis in Sport. 2015;15:397-410.

[15] Gabett TJ, Mulvey MJ. Time-motion analysis of small-sided training games and competition in elite women soccer players. J Strength Cond Res. 2008;22:543-553.

[16] Aguiar M, Botelho G, Lago C, Macas V, Sampaio J. A review on the effects of soccer small-sided games. J Hum Kin. 2012;33:103-113.

[17] Clemente F, Couceiro MS, Martins FML, Mendes R. The usefulness of small-sided games on soccer training. J Phys Ed Sport. 2012;12(1):93-102.

[18] Hill-Haas SV, Dawson B, Impellizzeri FM, Coutts AJ. Physiology of small-sided games training in football. Sports Med. 2011;41:199-220.

[19] Zubillaga A, Gabbett TJ, Fradua L, Ruiz-Ruiz C, Caro O, Ervilla R. Influence of ball position on playing space in Spanish elite women's football match-play. Int J Sports Sci Coach. 2013;8(4):713-722.

[20] Kelly D, Drust B. The effect of pitch dimensions on heart rate responses and technical demands of small-sided soccer games in elite players. J Sci Med Sport. 2009;12(4):475-479.

[21] Impellizzeri F, Marcora S, Castagna C, Reilly T, Sassi A, Iaia FM, Rampinini E. Physiological and performance effects of generic versus specific aerobic training in soccer players. Int J Sports Med. 2006;27:483-492.

[22] Rampinini E, Impellizzeri FM, Castagna C, Abt G, Chamari K, Sassi A, Marcora SM. Factors influencing physiological responses to small-sided soccer games. J Sports Sci. 2007;25:659-666.

[23] Castellano J, Casamichana D, Calleja-Gonzalez J, San Roman J, Ostojic SM. Reliability and accuracy of 10 Hz GPS devices for short-distance exercise. J Sports Sci Med. 2011;10: 233-234.

[24] Varley MC, Fairweather IH, Aughey RJ. Validity and reliability of GPS for measuring instantaneous velocity during acceleration, deceleration, and constant motion. J Sports Sci. 2012;30(2):121-127.

[25] Rampinini E, Coutts AJ, Castagna C, Sassi R, Impellizzeri FM. Variation in top level soccer match performance. Int J Sports Med. 2007;28:1018-24.

[26] Ferrari Bravo D, Impellizzeri FM, Rampinini E, Castagna C, Bishop D, Wisloff U. Sprint vs. Interval Training in Football. Int J Sports Med. 2008;29(8):668-674.

[27] Radzimiński Ł, Rompa P, Barnat W, Dargiewicz R, Jastrzębski Z. A comparison of the physiological and technical effects of high-intensity running and small-sided games in young soccer players. Int J Sports Sci Coach. 2013;8(3):455-465.

[28] Hodson C, Akenhead R, Thomas K. Time-motion analysis of acceleration demands of 4v4 small-sided soccer games played on different pitch sizes. Hum Mov Sci. 2014;33:25-32.

[29] Helgerud J, Engen LC, Wisløff U, Hoff J. Aerobic endurance training improves soccer performance. Med Sci Sports Exerc. 2001;33(11):1925-31.

[30] Reilly T, Bangsbo J, Franks A. Anthropometric and physiological predispositions for elite soccer. J Sports Sci. 2000;18:669-683.

[31] Chamari K, Hachana Y, Kaouech F, Jeddi R, Moussa-Chamari I, Wisløff U. Endurance training and testing with the ball in young elite soccer players. Br J Sports Med. 2005;39:24-28.

[32] Miller TA, Thierry-Aguilera R, Congleton JJ, et al. Seasonal changes in VO2max among Division 1A collegiate women soccer players. J Strength Cond Res 2007;21(1):48-51.

[33] Bradley PS, Dellal A, Mohr M, Castellano J, Wilkie A. Gender differences in match performance characteristics of soccer players competing in the UEFA Champions League. Hum Mov Sci. 2014;33:159-171.

[34] Bucheit M, Simpson BM, Peltola E, Mendez-Villanueva A. Assesing maximal sprinting speed in highly trained young soccer players. Int J Sports Physiol Perf. 2012;7:76-78.

[35] Vescovi JD. Sprint profile of professional female soccer players during competitive matches: Female Athletes in Motion (FAiM) study. J Sports Sci. 2012;30(12):1259-1265.

Cite this article as:
Jastrzębski Z, Radzimiński Ł, Stępień P. Comparison of time-motion analysis and physiological responses during small-sided games in male and female soccer players. Balt J Health Phys Act. 2016;8(1):42-50.