DIFFERENCES IN TIME OF START REACTION AND ACHIEVED RESULT IN THE SPRINT DISCIPLINES IN THE FINALS OF THE OLYMPIC GAMES IN LONDON AND THE WORLD CHAMPIONSHIP IN MOSCOW

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Abstract
In the sprint events a very important place take the start and start acceleration which is largely generated by the final score. Depending on the appropriate individual morphological dimension, especially motor and functional abilities of competitors, good possibility to implement these parameters is certain. However, despite the excellent results they achieve, differences in these two parameters are evident, which in terms of the final result has a certain effect. The aim of this study was to determine the differences in the starting reaction time and results in the sprint events of the finalists at the Olympic Games in London in 2012. and World Championship in Moscow 2013. The results from the finalists (48 male) and 48 (female) participants were analysed that participated in the final races in the 100m, 200m and 400m. The evaluation of starting reaction time (ms) and results in a sprint (s) based on the reports that were officially published by the International Association of Athletics Federations (IAAF). Results of the analysis of T-test have shown statistically significant differences between the reaction time female finalists of the Olympic Games and World Championships, in the running events of 100m (t= -3.103; p<0.001) and 400m (t= -4.235; p<0.001), in contrast to of the male finalists are significant differences noted in running 200m (t=2.370; p<0.001) and 400m (t= -4.437; p<0.001). Only in the final 100m (Moscow) and 200m (London) were no statistical differences between athletes. Also in the men's final 100m (London) and 200m (Mocow) and the final 100m (Moscow) and 400m (London) are not achieved statistical differences in the time of start of the reaction. The differences in results are achieved (London-Moscow) are realized only in the final race, the female athletes 200m (t=-2.041; p <0.01), while in male athletes this was not the case.

Key words: *sprint events, the Olympic Games, World Championship, the time of the start reaction, the differences.*

INTRODUCTION

Starting acceleration is relevant in all sprint athletic disciplines, as in many other branches of sports which require developing the speed in relatively short distance (tennis, volleyball, handball, basketball, soccer, etc.). However, in the sprint events start and starting acceleration, as the two major components largely generate the final result of running the 60m, 100m, 200m and 400m (Čoh & Tomažin, 2008). It is said that the starting acceleration is of one of the most complex segments of the sprint, in which can be rationalized sprint capacity that will be manifested only in the segment of maximal running speed. The most common length in start accelerating is from 25-30m, at which the top sprinters in the first 10m develop 50 to 55% of their maximum speed, and in other 10 (up to 20m) 70-80% in the third 10 (up to 30m) 85-95% (Čoh, 2001). Between 50 and 80m they achieve maximum speed, and after 80-90 meters the speed decreases. It is therefore no coincidence that many of the authors entered the biomechanical analysis of these two phases in order to explain the phenomenon of sprint speed and start acceleration based on the time of the start reaction (Coppenolle, Delecluse, Goris, Diels, & Kraayenhof, 1990; Guissard, Duchateau, & Hainaut, 1992; Mc Clements, Sanders, & Gander, 1996, Harland & Steele, 1997, Coh, Peharec & Bacic, 2007; Bračić, Peharec Bacic & Coh, 2010). The start of the sprint and start acceleration are the first two factors of sprint speed with which athlete tries to achieve maximum speed. Earlier Tom Tellez study, of the legendary coach of Carl Lewis showed that these two phases are as much as 64% of participation in the sprint result at 100 m (Téllez & Doolittle, 1984). Studies by some other authors (Schot & Knutzen 1992; Harland & Steele, 1997; Wang, 2006; Pain & Hibbs, 2007; Babic, 2008; Babic & Coh, 2010) have agreed that the result in the sprint depends from the position in the start block that from the center of gravity of the body, start reaction time and from start accelerating.

Optimal coherence between the start of the sprint start and start acceleration represent specific motor problems that athletes must integrate in terms of time and spatial parameters in the unipolar movement of cyclic character. Start acceleration is a complex cyclic motion defined mainly by progression of frequency and step length, duration of the contact phase and the phase of flight and the position of the center of gravity of the body at the moment of contact with the ground, the propulsion in phase of the flight and the forces that are handled in the first step (Hunter, Marshall, & McNair, 2005). All these parameters are conditioned by the operation of CNS, motor skills, energy processes, morphological characteristics and structure of muscle (Locatelli & Arsac, 1995; Young, McLean, Ardagna, 1995; Muller & Hommel, 1997; Coh, et al. 1998; Coh, Tomažin , and Štuhec, 2006; Mero, Kuitunen, Harland, Kyrolainen, & Komi, 2006).

In modern athletics, the time of the start reaction becomes more and more important in the result success. It is about the top sprinters with outstanding results in both categories, that their path to success is based on good implementation of this factor. By the good realization they tend to in the first meters of shooting acquire certain advantage that they want to keep until the end of the race. Often at the major events (Olympic Games, World and European Championships, Diamond League) are observed some differences in the time of the start reaction between disciplines and depending on gender. However, sometimes these differences are not large, so for example, often, the 100m sprinters achieve almost the identical reaction time to reaction time at 400m or between the reaction time in the 100m, 200m or 400m there is no significant difference, although it is about some differences in the length of the track. These findings are in contrast to the fact that the importance of start acceleration and reaction time is more important at shorter (Moravec, Ruzicka, Susanka, et al. 1988) than in the longer sprint events. This suggests that these are elite athletes who engage most of their mental and physical capacity, regardless of the length of the track. Also, some studies have shown that certain characteristics of a sprinter and the response time were extremely good predictors of results in the sprint (Susanaka et al. 1998). Also (Martin & Buonchristiani, 1995), believe that for the final result in the sprint (100m and 200m) are more important, the length of acceleration, maximum speed achieved and speed-endurance. Moravec, Ruzicka, Susanka, et al. (1988) analyzed the sprint events at the II World Championships in Rome and confirmed the results of the research in 1982 (Dostal) and gave reaction times at larger competitions for men and women. They also confirmed that the results of the reaction time at the World Championship in 1987. were significantly different from the results obtained on large competitions held from 1978. to 1986. Duffy 2004 according to Smajlović and Kozic, 2006, in his study of reaction time at 16 top sprinters sample of top sprinters participants of the meeting of the Golden League Rome 2003, indicate that the average response time was 153ms (± 28ms) and that the average response time in the semi-final and final races of discipline the men's 100m at the World Championships from 1997 to 2003 range from 120ms to 160ms, while the correlation of reaction and results in the race is .05. Some authors (Smajlović and Kozic 2006) tried to determine the effects of change in athletic rules on time of start reaction in sprint events. In a sample of top athletes participants in the World Championships in Edmonton in 2001 and Paris in 2003, results were obtained that confirmed the differences in the starting reaction time between the two World Championships in events, 100m, 200m, 110m and 100m hurdles for men and women, while differences.

Authors (Colet 2000; Babic, 2008; Babic & Coh, 2010; Theophilos Pilianidis, Kasabalis, Mantzouranis, & al. 2012; Pavlović et al. 2013, Pavlovic et al. 2014a, 2014b) have studied this parameter in terms of sprint discipline trying to analyze the response time of start reaction and running result in sprint disciplines at major events, such as the European Championships and Olympic Games. This study is based on reasons precisely because of the importance of starting acceleration in athletic sprint events, based on the starting time of the start reaction. The main objective of this study was to identify and analyze the differences in the time of starting reaction of the finalist of Olympic Games in London 2012. and World Championship in Moscow the sprint events.

In addition to its primary objective, partial objectives are contained in
- determining the difference of time of starting reaction of male athletes in the sprint events
- determining the difference in time of starting reaction of female athletes in the disciplines of sprint events
- determining differences in time starting reactions of male athletes of different disciplines
- determining the difference in time of start of reaction athletes of female different disciplines
- determining the difference in the achieved result between male finalists for sprint events at the Olympic Games and World Championships

- determining the difference in the achieved result between female finalists for sprint events at the Olympic Games and World Championships

METHODS

The population defined in the research has included top male and female athletes in the sprint events of Olympic Games in London 2012., and World Championship in Moscow, 2013. The sample included a total of 48 finalists (24 male and 24 female competitors), who participated in the final races of sprint events (100m, 200m, 400m). Starting reaction time (ms) and the achieved result (s) are taken from the official report of the Olympic Games of 2012, and the Worl Champioship, 2013, issued by the IAAF. Data obtained in the survey were analyzed by standard descriptive methods, and the differences between groups of respondents-finalists were tested using Student's t-test for independent samples. Statistical analysis was done using the statistical program Statistica 6.0.

Table 1. The starting reaction time (RT) and the results of final in the sprint events the Olympic games in London, 2012.

100m Men				100m Women			
Vind: 1,5m/s		Time Reaction	Result	Vind: 1,5m/s		Time Reaction	Rezultata
1.	Usain Bolt	0.165	9.63	1.	Shelly-Ann Fraser-Pryce	0.153	10.75
2.	Yohan Blake	0.179	9.75	2.	Carmelita Jeter	0.153	10.78
3.	Justin Gatlin	0.178	9.79	3.	Veronica Campbell-Brown	0.143	10.81
4.	Tyson Gay	0.145	9.80	4.	Tianna Madison	0.171	10.85
5.	Ryan Bailey	0.176	9.88	5.	Allyson Felix	0.176	10.89
6.	Churandy Martina	0.139	9.94	6.	Kelly-Ann Baptiste	0.128	10.94
7.	Richard Thompson	0.160	9.98	7.	Murielle Ahoure	0.156	11.00
8.	Asafa Powell	0.155	11.99	8.	Blessing Okagbare	0.165	11.01
200m Men				200m Women			
Vind: 0,4m/s		Time Reaction	Result	Vind:-0,2m/s		Time Reaction	Result
1.	Usain Bolt	0.180	19.32	1.	Allyson Felix	0.174	21.88
2.	Yohan Blake	0.172	19.44	2.	Shelly-Ann Fraser-Pryce	0.169	22.09
3.	Warren Weir	0.162	19.84	3.	Carmelita Jeter	0.167	22.14
4.	Wallace Spearmon	0.165	19.90	4.	Veronica C. Brown	0.176	22.38
5.	Churandy Martina	0.157	20.00	5.	Sanya Richards-Ross	0.171	22.39
6.	Christophe Lemaitre	0.153	20.19	6.	Murielle Ahoure	0.161	22.57
7.	Alex Quinonez	0.185	20.57	7.	Myriam Soumare	0.157	22.63
8.	Anaso Jobodwana	0.216	20.69	8.	Semoy Hackett	0.15	22.87
400m Men				400m Women			
Vind:---		Time Reaction	Result	Vind:---		Time Reaction	Result
1.	Kirani James	0.163	43.94	1.	Sanya Richards-Ross	0.189	49.55
2.	Luguelin Santos	0.185	44.46	2.	Christine Ohuruogu	0.174	49.70
3.	Lalonde Gordon	0.159	44.52	3.	Deedee Trotter	0.167	49.72
4.	Chris Brown	0.166	44.79	4.	Amantle Montsho	0.198	49.75
5.	Kevin Borlee	0.151	44.81	5.	Novlene Williams-Mills	0.258	50.11
6.	Jonathan Borlee	0.173	44.83	6.	Antonina Krivoshapka	0.175	50.17
7.	Demetrius Pinder	0.153	44.98	7.	Francena Mccorory	0.196	50.33
8.	Steven Solomon	0.143	45.14	8.	Rosemarie Whyte	0.184	50.79

Table 2a. The starting reaction time (RT) and the results of final in the sprint events the World Championship in Moscow, 2013.

100m Men				100m Women			
Wind: -0,3m/s		Reaction Time	Result	Wind: -0,3m/s		Reaction Time	Result
1.	Usain Bolt	0.163	9.77	1.	S.A.Fraser-Pryce	0.174	10.71
2.	Justin Gatlin	0.163	9.85	2.	Murielle Ahoure	0.165	10.93
3.	Nesta Carter	0.157	9.95	3.	Carmelita Jeter	0.156	10.94
4.	Kemar Bailey-Cole	0.186	9.98	4.	English Gardner	0.151	10.97
5.	Nickel Ashmeade	0.142	9.98	5.	Kerron Stewart	0.229	10.97
6.	Mike Rodgers	0.158	10.04	6.	Blessing Okagbare	0.154	11.04
7.	Christophe Lemaitre	0.154	10.06	7.	Alexandria Anderson	0.159	11.10
8.	James Dasaolu	0.177	10.21	8.	Octavious Freeman	0.179	11.16

Table 2b. The starting reaction time (RT) and the results of final in the sprint events the World Championship in Moscow, 2013.

200m Men				200 Women			
Wind: 0,0m/s		Reaction Time	Result	Wind: -0,3m/s		Reaction Time	Result
1.	Usain Bolt	0.177	19.66	1.	S.A.Fraser-Pryce	0.156	22.17
2.	Warren Weir	0.176	19.79	2.	Murielle Ahoure	0.180	22.32
3.	Curtis Mitchell	0.147	20.04	3.	Blessing Okagbare	0.154	22.32
4.	Nickel Ashmeade	0.145	20.05	4.	Shaunae Miller	0.146	22.74
5.	Adam Gemili	0.151	20.08	5.	Jeneba Tarmoh	0.161	22.78
6.	Anaso Jobodwana	0.172	20.14	6.	ChaRonda Williams	0.155	22.81
7.	Churandy Martina	0.138	20.35	7.	Mariya Ryemyen	0.197	22.84
8.	Jaysuma Saidy Ndure	0.145	20.37	8.	Allyson Felix	0.181	DNF
400m Men				400m Women			
Wind: 0,4m/s		Reaction Time	Result	Wind:-0,2m/s		Reaction Time	Result
1.	LaShawn Merritt	0.256	43.74	1.	Christine Ohuruogu	0.247	49.41
2.	Tony McQuay	0.155	44.40	2.	Amantle Montsho	0.273	49.41
3.	Luguelín Santos	0.350	44.52	3.	Antonina Krivoshapka	0.209	49.78
4.	Jonathan Borlée	0.224	44.54	4.	Stephanie McPherson	0.198	49.99
5.	Pavel Maslák	0.169	44.91	5.	Natasha Hastings	0.163	50.30
6.	Yousef Ahmed Masrahi	0.162	44.97	6.	Francena McCorory	0.241	50.68
7.	Kirani James	0.186	44.99	7.	Kseniya Ryzhova	0.195	50.98
8.	Anderson Henriques	0.157	45.03	8.	Novlene Williams-Mills	0.276	51.49

RESULTS

Table 3. Basic statistical parameters finalists Olympics Game and World Championship

			Mean RT	Min.	Max.	Range	SD	Skew.	Kurt.
London 2012	100	m	0,162	0,139	0,179	0,040	0,015	-,338	-1,343
		w	0,155	0,128	0,176	0,048	0,015	-,525	,148
	200	m	0,174	0,153	0,216	0,063	0,020	1,396	2,177
		w	0,165	0,150	0,176	0,026	0,009	-,707	-,448
	400	m	0,162	0,143	0,185	0,042	0,013	,487	,081
		w	0,192	0,167	0,258	0,091	0,028	2,042	4,829
Moscow 2013	100	m	0,163	0,142	0,186	0,044	0,014	,489	,343
		w	0,171	0,151	0,229	0,078	0,025	2,072	4,696
	200	m	0,156	0,138	0,177	0,039	0,016	,476	-1,971
		w	0,166	0,146	0,197	0,051	0,018	,770	-,640
	400	m	0,207	0,155	0,350	0,195	0,068	1,577	2,207
		w	0,225	0,163	0,276	0,113	0,040	-,115	-1,187

Legend: N (number of subject; Mean RT (average value reaction time); Min (minimal result); Max (maximal result); Rang (range result); SD (standard deviation); Skew. (skewness), Kurt. (kurtosis)

Table 3 presents the basic statistical parameters of time starting reaction (RT) of male and female finalists in London and Moscow. Looking at Table 3 mainly observed normality of distribution. Smaller homogeneity is manifested in the 400m event for women in London, and the 100m in Moscow, with higher values kurtosis, and concludes that it is a larger range of the realized reaction time in this discipline that they have had a female finalists. Also increased value skjunisa is confirmation that it is a greater value of reaction time in the same discipline. On running 200m for men in London were recorded increased measures of variability in both parameters but still slightly less than the previous case of female finalists. Inspection of Table 3 it can be concluded that the medium, (at least numerically) reaction time to the London Olympics in the 100m women (0,155s) with the smallest (fastest) response time of 0,128s. and nearly coincides with the time the male finalists in the 200m in Moscow, which was reported as the fastest start reaction (0,156s). The best individual score at the World Championships in Moscow accounted for athletes at 200m (0,138s). Women are at the Olympics and world championships in the 400m race to achieve the lowest average starting reaction time, while men in the same discipline at the World Championships and had the worst individual score (0,350s). The range of the best times starting reactions to worst time in both competitions is 0,222sec. which is not a big difference if you take into account that this is the result of a single individual results and diversity length tracks (100mW: 400mm). The difference in average scores in both competitions was (0,070sec).

To identify differences in the starting time of the reaction, for male and female finalists of the Olympic Games and World Championships, as well as possible differences in the resulting time applied the t-test for independent samples.

Table 4. Differences in the time of starting the reaction female finalists

Disciplines	Reaction Time (s)		
	Mean±SD	t-value	p-level
100m London	0,155±0,015	-3,103	0,0003***
100m Moscow	0,171±0,025		
200m London	0,165±0,009	-,121	0,7314
200m Moscow	0,166±0,018		
400m London	0,192±0,028	-4,235	0,0000***
400m Moscow	0,225±0,040		

Legend: Mean (average value), standard deviation (SD), coefficient of t-test value (T-value), significance level (Sig.***p<0,001; *p<0,05)

In Table 4 are presented differences in the starting time of the reaction of female finalists of the Olympic Games and the World Championships in sprint disciplines. Looking at Table 4, differences between disciplines are evident, however all realized the differences were not statistically significant. Of a total of three events, showed significant differences in the two. A statistically significant difference was not found in the discipline 200m (p<0.7314) where the finalists were almost unified. In the remaining two disciplines recorded a statistically significant difference, in the disciplines 100m (t=-3.103***) and 400m (t=-4.235***). In both of these disciplines faster starting reaction had a female finalists of the Olympic Games in London.

Table 5. Differences in the time of starting the reaction male finalists

Disciplines	Reaction Time (s)		
	Mean±SD	t-value	p-level
100m London	0,162±0,015	1,221	0,7364
100m Moscow	0,163±0,014		
200m London	0,174±0,020	2,370	0,0000***
200m Moscow	0,156±0,016		
400m London	0,162±0,013	-4,437	0,0000***
400m Moscow	0,207±0,068		

Legend: Mean (average value), standard deviation (SD), coefficient of t-test value (T-value), significance level (Sig.***p<0,001; *p<0,05)

Table 5 contains the numerical parameters of the difference in time starting reactions of male finalists in sprint disciplines. After examining in Table 5 were recorded also significant differences in reaction time discipline 200m (t=2.370***) in favor of the finalists in Moscow and discipline 400m (t=4.437***) in favor of the finalists in London. Mean difference that is not statistically significant in running 100m (p<0.7364). This distribution results can be confirmed the great importance of the starting reaction time, regardless of the length of track works. Also, these results are final race reject earlier assertions that the reaction time slower in the shorter distances, and that the length of the track loses its significance (Moravec et al. 1988), and also that the length of the track is linearly increases and reaction time (Baumann, 1980 Babic & Delalija, 2009).

Table 6. Differences in the time of start of the reaction between female finalists different disciplines

Disciplines	Reaction Time (s)		
	Mean±SD	t-value	p-level
100m London 200m Moscow	0,155±0,015 0,166±0,018	-1,534	0,0016**
100m London 400m Moscow	0,155±0,015 0,225±0,040	-3,274	0,0000***
200m London 400m Moscow	0,165±0,009 0,225±0,040	-4,567	0,0000***
100m Moscow 200m London	0,171±0,025 0,165±0,009	-,512	0,1211
100m Moscow 400m London	0,171±0,025 0,192±0,028	-2,170	0,0002***
200m Moscow 400m London	0,166±0,018 0,192±0,028	-3,464	0,0000***

Legend: Mean (average value), standard deviation (SD), coefficient of t-test value (T-value), significance level (Sig.**p<0,01;***p<0,001)

In Table 6. presented the differences in time of start of the reaction of women's finalists of the Olympic Games and World Championships in various sprint disicplinama. Inspection tables, are recorded differences in all disciplines. However, statistical significance was achieved in five of six cases (83%) with high statistical significance (p<0.01 and 0.001). The only statistical difference was found between disciplines 100m (Moscow) and 200m (London). Something small but statistically significant difference was observed in the 100m and 200m London Moscow (t = -1.534 **), unlike the other three that have recorded a high level of statistical difference (p<0.001). Comparing the recorded reaction time can be concluded that in almost all cases women finalists Olympics had faster time of the World Cup finals. Next one can ask for any cause, although they are almost the same competitors. However, probably could be a determining factor in the motivation of competitors when it comes to the Olympic Games, where the stronger the desire to win.

Table 6. Differences in the time of start of the reaction between male finalists different disciplines

Disciplines	Reaction Time (s)		
	Mean±SD	t-value	p-level
100m London 200m Moscow	0,162±0,015 0,156±0,016	1,294	0,0611
100m London 400m Moscow	0,162±0,015 0,207±0,068	-2,079	0,0000***
200m London 400m Moscow	0,174±0,020 0,207±0,068	-2,481	0,0017**
100m Moscow 200m London	0,163±0,014 0,174±0,020	-1,624	0,0024**
100m Moscow 400m London	0,163±0,014 0,162±0,013	,471	0,7177
200m Moscow 400m London	0,174±0,016 0,162±0,013	-2,060	0,0001***

Legend: Mean (average value), standard deviation (SD), coefficient of t-test value (T-value), significance level (Sig.**p<0,01; ***p<0,001)

In Table 7. presented the differences in time of the start of the reaction of male finalists of the Olympic Games and the World Championships in sprint disicplinama. Examination of the table, the differences between disciplines are evident, however all realized the differences are not statistically significant. Of the total number, revealed significant differences in four relations (66%). A statistically significant difference was not found in the 100m and 200m London Moscow (p<0.0611) and the 100m and 400m London Moscow (p<0.7177) where the finalists were almost unified. In the other disciplines recorded a statistically significant difference at a high level (p <0.001; p<0.0001).

Table 8. The differences in the achieved result female finalists

Disciplines	Time (s) Mean±SD		t-value	p-level
100m	London	10,87±0,989	-1,081	0,4471
	Moscow	10,98±0,135		
200m	London	22,36±0,323	-2,041	0,0011**
	Moscow	22,57±0,285		
400m	London	50,01±0,415	-1,032	0,0466*
	Moscow	50,26±0,752		

Legend: Mean (average value), standard deviation (SD), coefficient of t-test value (T-value), significance level (Sig.**p<0,01; * p<0,05)

Differences on the results achieved are always interesting for analysis regardless of which disciplines working. In this case, it is interesting and important in practice to determine the differences in the result of women at the Olympics and World Championships, as they are the two most important sports events. Inspection of of Table 8 were observed statistically significant differences in the disciplines 200m (t=-2.041**) and slightly smaller, but significant differences in the discipline 400m (t = -1.032*). Based on the presented results we can conclude that the better results in the final races achieved athletes at the Olympic Games in London.

Table 9. The differences in the achieved result male finalists

Disciplines	Time (s) Mean±SD		t-value	p-level
100m	London	10,09±0,774	,852	0,3344
	Moscow	9,98±0,134		
200m	London	19,99±0,485	-,126	0,3744
	Moscow	20,06±0,245		
400m	London	44,68±0,373	,039	0,6316
	Moscow	44,64±0,439		

Legend: Mean (average value), standard deviation (SD), coefficient of t-test value (T-value), significance level (Sig.**p<0,01; * p<0,05)

In Table 9 presents the results of t-test for the male finalists in London and Moscow. Despite the differences that are observed in sprint disciplines, these differences are not recorded statistical significance, compared to the female contestants. Here are recorded better results athlete in Moscow in the 100m and 400m, as opposed to the discipline of 200m where the finalists of the Olympic Games have recorded better times.

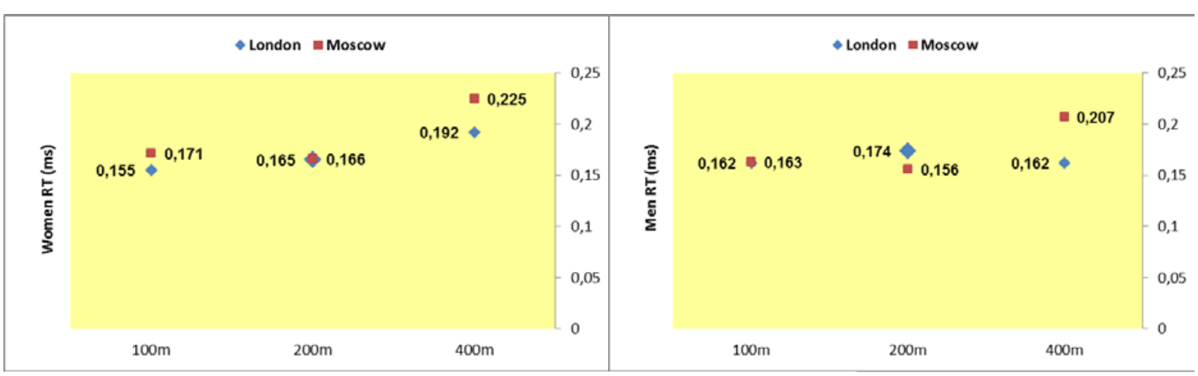

Figure 1. Mean in the achieved results of female and male finalists

DISCUSSION

Starting acceleration is one of the most complex segments of the sprint, in which can be rationalized sprint capacity that will be manifested only in the segment of maximal running speed. The time lost due to poor start reaction, poor start and, ineffective start progression and late reaching speed, it is difficult or impossible to make it up in the rest of the race (Smajlović and Kozić, 2006). However, in recent times it also happens that a poor start, starting with a lower reaction does not necessarily mean the failure of the race, and weaker result. This conclusion is supported by the planet's fastest man, Usain Bolt, who in the finals of the Olympic Games in London achieved the fifth time of starting reaction (160ms) in the 100m and sixth in the 200m (180ms) and still took first places. These remarks confirm earlier studies which claim that for the final score in the sprints (100m and 200m) are more important length of acceleration, reached maximum speed and speed-endurance (Martin & Buonchristiani, 1995). It is believed that the execution of the contact phase after the start and during the race one of the most important generators of success in the implementation of sprint speed (Lehmann & Voss, 1997). Contact phase should be as short as possible with an optimal phase of reflection and phase of flight, while step frequency depends on the functioning of the CNS and is genetically determined (Mero, Kuitunen, Harland, et al.2006), increased step frequency, shorter step and vice versa (Mero, Komi and Gregor, 1992,). The high performance of sprinters are the result of a complex mixture of many factors such as genetic potential, training and health of athlete. From the anthropological point of view, the reaction time is the ability to quickly respond to stimulation. Higher reaction rate gives better response time, which is only one of several factors that influence the success of modern athletics (Brüggemann & Glad, 1990; Pain & Hibbs, 2007). In the sprint events start reaction time is the time interval (ms) of pistols signal and movement of athlete when he will put pressure on the starting blocks. Steinbach and Tholl (1969) were once published a study stating that elite athletes have a faster and more stable response from novice athletes. In addition, the reaction speed shows decreased result when athlete did not train (Doherty, 1985), so the initial reaction time affects about 1 to 2% of the total score of sprinter (Helmick, 2003). Contrary to the above, the reaction time in the sprint can not predict the final time in the 200m, compared to the 100 and 110m hurdles, because of the long run at finish line (Collet, 2000, Komi, Ishikawa, & Jukka, 2009). Time of 200ms represents only 2% of the 100m sprint in 10.00 s duration, or 0.4% of the 400m sprint, which takes about 45 seconds (Martin, & Buonchristiani 1995). However, research (Stevenson, 1997, Michel and Järvere, 2002; Henson, Cooper, and Perry, 2002) have shown that athletes with better response time to the beginning of the sprint had the psychological edge over their opponents, which in many races may be important on the target plane.

Comparing the results of this study with previous (Colet 2000; Duffy, 2004 Smajlović and Kozić 2006; Babic, 2008) it can be concluded that these are the results achieved almost of the same level in all disciplines. The study Theopilos Pilianidis, et al. 2012. found that both men and women were significantly better in the discipline of running on 100m in Beijing in 2008. than in Sydney in 2000. Similarly, the times of starting reaction in the disciplines of running 100/110m hurdles were significantly better in Athens in 2004. than in Sydney in 2000. Finally, in the men's 100m final race at the Beijing in 2008. Both the time of start reaction and overall score of running's were better than the results of competitors that participated in Athens in 2004. and in Sydney in 2000. Also the results of this research in the discipline of 100m are slightly weaker from the results of the Rome Golden League meeting in 2003. Average response time finalist in Rome 2003rd amounted to 153ms (± 28ms). Comparing the results of the London Olympics with the results of the World Championships in Edmonton in 2001 and Paris 2003 it can be concluded that the results obtained have confirmed the differences in starting reaction time between these competitions. Average achieved time during the men's 100m finalists in the discipline at the World Championships in Edmonton in 2001 was 10.19 sec, with a response time 145ms, and in World Cup final in Paris in 2003 10.20 sec with a response time 159ms. At the Olympic Games in London in 2012. average time in the final race was 10.09 sec. with reaction time 162 ms_which is less than the average time achieved at the World Championships in Moscow 9,98sec. Less time was recorded in London in the 400m race although finalists achieved faster start reaction (162ms). Only in the discipline 200m finalists of the Olympic Games were successful in that result from the World Cup finalists, although they had less time starting reactions (174ms).

In the women's World Cup in Edmonton the mean time was 11.15 sec with a reaction time of 146ms and at WC in Paris in 2003 11.13 sec with a response time 157ms. Female finals in London has been completed with an average time of 10.87 seconds and response time 155ms. Comparing the the results achieved the London Olympics and the World Championships in Moscow, it can be concluded that the athletes were successful at the Olympics in all three disciplines, as evidenced by statistically significant difference. Also, during the start of the reaction athletes in London was faster than in Moscow (Table 8).

Previous results have shown that the Olympics with extending tracks , increases linearly also the time of the starting reaction in world-class sprinters (Baumann, 1980; Babic & Delalija, 2009). Also, in some studies it was confirmed that the time reaction of male sprinters is better than women. However, the results of this study are in contrast to studies that have confirmed that there is no difference in the time of the starting reaction between male and female sprinters (Martin & Buonchristiani, 1995).

Almost identical results were obtained by Smajlović and Kozic (2006) in their study of world championships in Edmonton in 2001 and in Paris in 2003 and Pavlović et al. (2014) in World Champioship in Moscow. The results indicate that it is about superb athletes, with good performances and the differences are almost impossible or minimal. The differences are evident not only in the reaction time, but also in some mental and physical abilities only in cases if it is about selected, and non-selected categories. Also with this goes that only a good selection, the technology of the training process, with of course naturally predisposed there could be success (Meckel, Atterborm, Grodjinovsky, Ben-Sira, & Rotstein, 1995). Significant impact on the response time in sprint and the implementation of starting acceleration is in dependence of the force manifestation of isometric and isotonic muscle contraction on the starting blocks, the position and angle of the knee joint, the horizontal and vertical impulses (Young, McLean, & Ardagna 1995; Hunter, Marshall, & McNair, 2005). In their study (Coh, Tomažin, and Štuhec, 2006) analyze and identify the main kinematic parameters in the phase of the sprint and starting acceleration that affect the overall result. The research has shown that the optimum distance of blocks, the speed of leaving the starting blocks, the length of the first step, height of center of gravity of the body in the first three meters of acceleration, the optimal ratio between length and step frequency key success factors in the two-stage sprint.

Researches (Dostal, 1982 by Smajlović and Kozić 2006; Moravec, et al. 1988) have confirmed that the starting time of the reaction in the sprint is not directly correlated to the final result neither in male nor in female sprinters. Similar research in ten leading sprinters conducted Paradisis et al. 2006 and obtained conflicting results. They found that the time of starting reaction is closely related to the results in the sprint. This is particularly important, given that in the final race in London in 2012. men achieved a mean time of starting reaction 162ms and a total score of 10.09 sec. Also, in the final of the Beijing Olympics in 2008, male sprinters had an average response time of starting reaction (146ms) and achieved a total score of 9.89 sec. and they were better than in the final race of the OG in Athens in 2004 and in Sydney in 2000. At the World Championship in Berlin 2009.there has been, so to speak, an explosion of the results. In 2009. The average reaction time of male finalists was better than in Beijing and Moscow (138ms with the achieved result 9.91 sec.). Perhaps the presence of Jamaican Usain Bolt in all the finals, with the reaction times of 165ms and a world record time of 9.69 sec. in Beijing, then 146ms and 9.58 sec. in Berlin, and finally 165ms and 9.63 sec. in London in 2012. and World Championship in Moscow, 163ms and 9,77sec. had a strong influence in all three starting reactions and performances of these final races.

Also, the observation that the response time is linearly increasing with the lengthening of the section (Baumann, 1980; Babic 2008; Babic & Delalija, 2009) can not be fully accepted. As an argument against this conclusion are less average values of response time achieved in the final 400m in London for men (161ms) compared to 100m (162ms) and 200 (174ms).

The results of this study indicate that in the modern track and field, the time of starting reaction and total running time are equally improved, that there is difference by gender and there are evident statistically significant differences by the disciplines Olympic games in London and World Championship in Moscow.

The results are in contrast to research of some authors who state that the time of reaction in female sprinters response is slower than in male sprinters, and that it increases with the length of the section. Also research findings are consistent with the results of Babic (2008) who analyzed the participants of qualification groups, the semi-final and final at the Athens Olympics in 2004. in sprint events and hurdles for women, where she received the results that in almost all disciplines were achieved statistically significant differences.

In general, these results partially confirm the results of previous researches in the sprint events related to the World Championships in Rome, 1987 (Susanaka et al.1988), Stuttgart, 1993 (Martin & Buonchristiani, 1995), in Edmonton, 2,001. and Paris, 2003 (Smajlović & Kozic, 2006) and the Olympic Games in Seoul in 1988 (Brueggemann, & Glad, 1988) and Athens 2004 (Smajlović and Kozic 2006; Theophilos Pilianidis et al. 2012), London 2012 (Pavlovic, et al. 2014), World Championship in Moscow 2013 (Pavlović et al. 2013). In short, this study showed that there is difference between the Olympic games in London and World Championship in Moscow in the time of starting reaction, that if the reaction time is better, the assumption is that the running performances will be better, and it was confirmed that the reaction time is an important segment in achieving the overall results.

CONCLUSION

The sample included a total of 48 (24 male and 24 female) athletes who took part in the final of the Olympic Games (London, 2012) and World Champioship (Moscow, 2013) of 100m, 200m and 400m. The study was aimed to determine possible statistically significant differences in the starting time of the reaction and in the results achieved in the Olympic sprint disciplines of the Games and World Champioship. The results of reaction time and the result achievement that they have achieved are at the same or at a higher level of previous studies on the superb athletes. The probability distribution slightly better results of this research lies in the fact that it is a final competition where performed only the best in both categories.

Results of the analysis of T-test have shown statistically significant differences between the reaction time female finalists of the Olympic Games and World Championships, in the running events of 100m ($t = -3.103$; $p < 0.001$) and 400m ($t = -4.235$; $p < 0.001$), in contrast to of the male finalists are significant differences noted in running 200m ($t = 2.370$; $p < 0.001$) and 400m ($t = -4.437$; $p < 0.001$). Only in the final 100m (Moscow) and 200m (London) were no statistical differences between athletes. Also in the men's final 100m (London) and 200m (Mocow) and the final 100m (Moscow) and 400m (London) are not achieved statistical differences in the time of start of the reaction. The differences in results are achieved (London-Moscow) are realized only in the final race, the female athletes 200m ($t = -2.041$; $p < 0.01$), while in male athletes this was not the case.

The results showed that the training technology is on high level, that the potentials of top sprinters are getting better, that they are getting smaller or even there are no differences in response time regardless of the length of the track. Also, the results showed that though the Olympic Games gave rise better results, and faster starting reaction, especially in the women's competition in all disciplines.

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