INTRAINDIVIDUAL EVALUATION OF REACTION TIME AT THE WOMEN'S WORLD ATHLETICS CHAMPIONSHIPS 1999 – 2019

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Summary: The aim of the article was the intraindividual evaluation of reaction time at the Women's World Athletics Championships from 1999 to 2019. We generated the rating of sprinters from the age point of view with comparison of two periods with different false start rules. In the result section, we analysed the sprinters that took part at World Championships (WCH) at least 3 times and appeared in the final. We assessed the reaction speed from the ageing point of view, or more precisely with the changing conditions when judging the false start. The results confirm that the stricter start judging rules in sprint disciplines did not have a significant influence on the reaction speed. We also confirmed a research that the sprinters older than 30 years can achieve very low reaction time at the start.

Keywords: sprinters; reaction speed; age of competitors; change of rules at low start; World Championship

Introduction

By many experts the athletics is by considered as a queen of all sports. It has been very popular, not only between professional athletes but also among the general public. Our focus in the article was on the most popular athletic disciplines, the short distance sprints. The matter is an analysis of reaction times, which is a significant part of it (Mitašík et al. 2020/a; Mitašík et al. 2020/b). There is a simple reaction to an acoustic stimulus when speaking about short distance sprint start. In this modern ages performances of top level sprinters are differentiated only by hundredths and often hundredths are decisive of winners. Reaction speed is measurable

by technical equipment into number, which is known as reaction time. Gunfire is the starting stimulus in athletics which means the sprinters react to an acoustic stimulus. Every competitor that commits a false start (besides combined disciplines), will be disqualified, under the authority of the rule since January 2010. Before this year, the judgement of the false start was much softer (SAZ 2010).

The level of reaction time is influenced by number of factors, e.g. age (Botwinick & Thompson 1966; Fozard et al. 1994; Hultsch et al. 2002), gender (Jain, Bansal, Kumar & Singh 2015), warm-up (Magner et al. 2012), fatigue Brisswalter, Arcelin, Audiffren & Delignières (1997), training level (Jawoski, Lech, Ambrozy & Zak 2020), power of the start impulse (Germain, Smith, Maslovat & Carlsen 2020), running distance (Glesk 1986), psychological preparation (Kampmiller & Vanderka 2012), sprinters character (sport.cz).

Reaction time improves until 20th year of life, then gradually in slow pace prolongs until 60th year of life and among people over 70 years old prolongs radically (Jevas & Yan 2001; Luchies et al. 2002; Rose et al. 2002; Der & Deary 2006). The reaction time is influenced by psychological phenomenon as well, whereas older people tend to be more careful and think more (Botwinic 1966), MacDonald et al. (2002) observed adults and seniors, finding out that the variety of reaction time is possible to connect with generally slower reaction times to a specific stimulus.

Because our body is not able to keep a constant level of performance throughout the day, this fact influences reaction skills too. Štulrajter et al. (1989) focused their research on oscillation of reaction time during the day in accordance with biorhythm of the human body. The figures measured over 24 hours proved to be significantly oscillating. It shows that the shortest reaction time is in the morning before nine o'clock and in the evening after 18 o'clock. In their research, Tønnessen & Haugen (2013) analysed the reaction time of elite sprinters ($n = 1\,319$) who took part in the World Championships during 2003 – 2009 showed that women over 30 years of age achieved the fastest reaction time (0.153 ± 0.020 s).

The aim of this study is to compare the reaction time of sprinters between two different periods. In the second period was the rule for starts changed, which increased the assumption of exclusion of athletes from the competition, could cause their caution. Therefore we assumed, that their reaction time would be higher than before.

Methods

We carried out the research on a group of selected elite sprinters in the 100 m run, which took part in several final runs at the World Championships in Athletics in the years 1999 – 2019. In the first period (1999 – 2009) we watched the runners in the heats, the quarterfinals, the semifinals and in the final runs. In the second period (2011 – 2019) only heats, semifinals and final runs were realized, because quarter-final runs were excluded from the program. We obtained the figures of the starting reactions of sprinters from the mentioned periods from the official website of the IAAF (WA). We presented the results of selected athletes in pictures and tables, which show the year of the World Cup, discipline, runs, age of the athlete, the rate of reaction time and the rating of sports performance with placement (Table 1). In the final part, we analysed the competitors who participated in the World Championships at least three times and were always in the finals. How did you assess that their reaction rate in terms of increasing age, respectively, changed conditions when assessing a false start. We evaluated the reaction speed according to Gaval'a (2002), who set aside five levels: excellent (100 – 130 ms), very good (131 – 160 ms), average (161 – 185 ms), below average (186 – 210 ms) and unsatisfactory (211 and more ms).

Results

Selected competitors reached a reaction speed at a high level, regardless of their age, respectively, the period in which they ran in the final (Table 1).

In some cases (Block, Jetter, Fraser-Pryce) they had the fastest reaction at their higher age. This finding is confirmed by Tønnessen & Haugen (2013) that the reaction speed can be maintained and developed at an older age. In the table 1 above we see large intra-individual rates of reaction times of monitored sprinters not only in individual monitored years, but also in their entire compared period. Importantly the very low reaction times in the finals allowed the competitors to take advantage of it and won medals (Block 0.123 and 1st place; Thana 0.116 and 3rd place; Pryce 0.134 and 1st place; Schippers 0.129 and 2nd place).

Table 1

Reaction times of selected athletes, multiple finalists in the 100 m run at the World Athletics Championships

Year	Name	Reaction time				Time in final	Placement (finals)	Age
		Heats	Quarterfinals	Semifinals	Finals			
1999	Zhanna BLOCK	0,203	0,136	0,127	0,135	10,95	4.	27
2001	Zhanna BLOCK	0,142	0,131	0,122	0,123	10,82	1.	29
2003	Zhanna BLOCK	0,130	0,153	0,134	0,160	DQ	DQ	31
1999	Christine ARRON	0,178	0,168	0,176	0,162	10,97	6.	26
2005	Christine ARRON	0,167	0,157	0,166	0,165	10,98	3.	32
2007	Christine ARRON	0,170	0,181	0,186	0,164	11,08	6.	34
1999	Ekateríni THÁNOU	0,209	0,125	0,123	0,116	10,84	3.	24
2001	Ekateríni THÁNOU	0,159	0,127	0,143	0,145	10,91	2.	26
2003	Ekateríni THÁNOU	0,150	0,147	0,120	0,219	11,03	3.	28
1999	Chandra STURRUP	0,131	0,160	0,117	0,134	11,06	7.	28
2001	Chandra STURRUP	0,176	0,161	0,160	0,154	11,02	3.	30
2003	Chandra STURRUP	0,132	0,153	0,129	0,136	11,02	2.	32
2005	Chandra STURRUP	0,155	0,144	0,142	0,113	11,09	4.	34
2009	Chandra STURRUP	0,158	0,153	0,127	0,137	11,05	7.	38
2005	V. CAMPBELL-BROWN	0,171	0,184	0,150	0,139	10,95	2.	23
2007	V. CAMPBELL-BROWN	0,143	0,175	0,144	0,167	11,01	1.	25
2009	V.CAMPBELL-BROWN	0,138	0,156	0,148	0,135	10,95	4.	27
2011	V. CAMPBELL-BROWN	0,224		0,200	0,234	10,97	2.	29
2007	Carmelita JETER	0,200	0,286	0,181	0,189	11,02	3.	28
2009	Carmelita JETER	0,197	0,140	0,144	0,160	10,90	3.	30
2011	Carmelita JETER	0,201	-	0,191	0,167	10,90	1.	32
2013	Carmelita JETER	0,217	-	0,175	0,156	10,94	3.	34
2009	Kerron STEWART	0,182	0,149	0,155	0,170	10,75	2.	25
2011	Kerron STEWART	0,160	-	0,270	0,212	11,15	6.	27
2013	Kerron STEWART	0,189	-	0,187	0,229	10,97	5.	29
2009	Ann FRASER-PRYCE	0,187	0,191	0,156	0,146	10,73	1.	23
2011	Ann FRASER-PRYCE	0,194	-	0,174	0,194	10,99	4.	25
2013	Ann FRASER-PRYCE	0,159	-	0,193	0,174	10,71	1.	27
2015	Ann FRASER-PRYCE	0,237	-	0,151	0,161	10,76	1.	29
2019	Ann FRASER-PRYCE	0,173	-	0,133	0,134	10,71	1.	33
2011	Blessing OKAGBARE	0,180	-	0,160	0,147	11,12	5.	23
2013	Blessing OKAGBARE	0,173	-	0,181	0,154	11,04	6.	25
2015	Blessing OKAGBARE	0,146	-	0,147	0,185	11,02	8.	27
2015	Dafne SCHIPPERS	0,149	-	0,130	0,129	10,81	2.	23
2017	Dafne SCHIPPERS	0,170	-	0,150	0,155	10,96	3.	25
2019	Dafne SCHIPPERS	0,164	-	0,119	DNS	DNS		27

The reaction speed of selected finalists compared to the average rates of all finalists (Table 2) was often lower reaction time. E.g. in 2003, Sturup had a reaction time of 0.136 s,

the average time of the finalists was 0.171 s; in 2005, this runner had a reaction time of 0.113 s and the average time of all runners was 0.139 s; in 2015 Okagbare had a reaction speed of 0.146 s, the average time of the finalists was 0.155 s.

The reaction speed of selected finalists was also often comparable to the average rates (in 1999 Block reached 0.135 s, the average of the finalists was the same; in 2011 Okagbare had a reaction speed of 0.180 s, the average time was 0.176 s; in 2007 Arron had a speed reaction 0.164 s, the average was 0.163 s), or worse (in 2011 Stewart had a reaction rate of 0.212, the average of the finalists was at the level of 0.178 s; in 2015, Okagbare reacted at a speed of 0.178 s, but the average was 0.155 s).

Table 2
Average age and reaction times of finalists at 100 m sprint in 1st and 2nd observed period

Period	WCH	Average age	Average reaction time (final) [s]
1st	1999	26.50	0.135
	2001	27.00	0.149
	2003	29.13	0.171
	2005	25.88	0.139
	2007	26.75	0.163
	2009	28.88	0.151
Average		27.36	0.151
Max.		29.13	0.171
Min.		25.88	0.135
Vr		3.25	0.033
2nd	2011	26.88	0.178
	2013	26.13	0.171
	2015	26.50	0.155
	2017	27.38	0.168
	2019	27.38	0.142
Average		26.85	0.156
Max.		27.38	0.178
Min.		26.13	0.142
Vr		1.25	0.036

The mean reaction time of sprinters in the first period and in the second period was very similar (Table 2). It seems that the new rules of starts do not affect the reactions of sprinters. In the second period, the runners had almost the same average reaction time (+0.05 s) and small differences were also in the longest and shortest reaction (+0.07 s in both cases). However, the mentioned differences in the balance of the top sprinters often mean the difference of one, resp. two places in the overall standings. E.g. WCH 2009: 1. Fraser-Pryce 10.73 s (reaction time

0.146), 2. Stewart 10.75 s (0.170); WCH 2011: 1. Jeter 10.90 s (0.167), 2. Campbell Brown 10.97 s (0.234), 3. Baptiste 10.98 s (0.151), 4. Fraser-Pryce 10.99 s (0.194); WCH 2013: 1. Fraser-Pryce 10.71 s (0.174), 2. Ahoure 10.93 s (0.165), 3. Jeter 10.94 s (0.156); WCH 2017: 1. Bowie 10.85 s (0.182), 2. Ta Lou 10.86 s (0.180).

In the individual assessment of changes in reaction time, we analysed the competitors who participated in the World Championships four or more times, always participating to the finals.

Figure 1

Intra-individual evaluation of the Shelly-Ann Fraser-Pryce reaction time at the World Championships in the 100 m run

The competitor achieved a reaction rate of less than 0.2 s on all MS. The only exception was r. 2015 in the heats, in which she probably believed that she would proceed to the next run without any problems and did not take any risks. Its reactions ranged mostly from average to below average (according to Gaval'a 2002). It is interesting that she recorded the most balanced performances at the last World Championships at the age of 33 and came closest to the evaluation of the excellent reaction speed. After tightening the rule, the runner reached the same or better reaction speed.

Figure 2

Intra-individual evaluation of the reaction time Carmelita Jeter at the World Championships in the 100 m run

The sprinter had a fairly large variance in reaction rate (unsatisfactory level to very good). It is interesting that in the last two World Championships (at an older age) she had the shortest reaction time in the final compared to previous runs and with the finals at previous World Championships. There is practically no difference in the speed of the reaction between the first and the second period.

Figure 3

Intra-individual evaluation of the reaction time of Veronica Campbell-Brown at the World Championships in the 100 m run

When analysing the reaction speed of this competitor, you can see the stability of the speed on the first three MS, on which the reaction speed was close to excellent, resp. very good level. The exceptions are the last World Championships (below-average to unsatisfactory level, which could have been affected by the stricter rule and the competitor did not cope with the change). The reaction above the 0.2 s limit was the cause of its 2nd place (time 10.97). The winning Jeter (10.90) was by 0.067 s faster at the start.

Figure 4

Intra-individual evaluation of the reaction time of Chandra Sturup at the World Championships in the 100 m run

The reaction times of the competitors were stable at a high level throughout the 10-year period. It approached significantly or achieved an excellent level of reaction speed. Most of the times were very good and only two times were in the average category. The athlete only competed in the first period, so we can't compare how she would react after tightening the rule. From tab. 3 it can be seen that the age of the competitors did not affect the reaction speed in the final runs. At an average age of about 26 years, we recorded an average reaction time of 0.135 and 0.163 s, respectively, at about 27 years of age 0.142 and 0.168 s.

Table 3

The average age and reaction time of sprinters at the World Championships in the final of the 100 m run in individual years

	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017	2019
Average age (years)	26.50	27.00	29.13	25.88	26.75	28.88	26.88	26.13	26.50	27.38	27.38
Average reaction time [s]	0.135	0.149	0.171	0.139	0.163	0.151	0.178	0.171	0.155	0.168	0.142

The speed of the reaction, as we mentioned, is influenced by many factors, and even in older age it is possible to achieve an excellent level of reaction speed. The correlation between these two parameters is shown in fig. 5.

Figure 5

Development of the average reaction time of women in the 100 m run at the World Championships in the final runs in correlation with age

Conclusions

1. By analysing the starting reaction speed of the top runners at 100 m at the World Championships in Athletics, we found that two different rules for judging a failed start did not have effect on prolonging the reaction speed even after tightening the rule.
2. Despite the conclusions of some authors about the slowing down of the reaction rate with increasing age, some competitors refuted them and achieved the best reaction times over the age of 30. They confirmed that training can not only maintain but also improve this indicator.
3. Although we analysed the top competitors, only a few of them achieved an excellent level of reaction speed (100 – 130 ms) according to the Gaval'a scale (2002).
4. We assumed in addition to the above, the reaction speed is influenced by other important factors - the time zone in which the competitor moved to the race; the weather; quality of opponents.
5. An interesting judging factor for female sprinters would be observation of reaction time change, if any of them had become a mother and how the reaction speed changed in this period.

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