



ORIGINAL SCIENTIFIC ARTICLE

RELATION BETWEEN START REACTION TIME AND PERFORMANCE TIME AMONG WOMEN FINALIST SPRINTERS IN THE OLYMPIC GAMES 2000 TO 2020

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Abstract

Background. Success in sprinting events broadly depends on many factors. Among them, the reaction time at starting is one of the main factors that help sprinters get success by increasing their confidence and helping to avoid false starts.

Study purpose. The purpose of the study was to find out the relationship between reaction time and performance time among women finalist sprinters in six Olympic Games since 2000.

Materials and methods. Data were collected from 227 ($n = 227$) women finalist sprinters in the event of 100 m ($n = 47$), 200 m (46), 400 m (43), 100 m H (45), and 400 m H (46) in 6 Olympic Games from 2000 to 2020, based on published official reports on “worldathletics.org” and “www.olympedia.org” websites. Data were considered from 227 samples from a total of 240 finalist women, where 13 were excluded because of a false start, being disqualified for doping, or failing to finish. Descriptive statistics, the Pearson correlation coefficient and simple regression analysis were used to determine the relationship between reaction time and performance time of the finalist women sprinters. The significance level was set at 0.05. Further Gaval'a 5-point scale was used to categorize the women sprinters based on their reaction times in five sprint events.

Results. The results showed that there was a low positive correlation between reaction time and performance time among the sprinters in the 100 m ($r = 0.369$, $p < 0.05$) and 100m H ($r = 0.367$, $p < 0.05$) events, whereas no relation was confirmed in 200 m, 400 m and 400 m hurdles among women sprinters who participated in 2000-2020 Olympics. The 5-point scale revealed that 33.48% of sprinters belong to the average category, while 25.99% are in the unsatisfactory category, and only 1.32 % and 16.74% are in the excellent and very good categories, respectively.

Conclusions. The current analysis concludes that there was a low positive relationship between reaction time and performance time of the finalist women sprinters only in sprint events of 100 m and 100 m hurdles during 2000 to 2020 Olympics, and the majority of the finalists belonged to the 'Average' category as per Gaval'a 5-point scale.

Keywords: elite sprinters, Olympic sprint events, performance time, reaction time.

Introduction

‘Track and field’ is one of the most popular events in the highly competitive sports arena and embodies the spirit of mankind to challenge the limit and continue to make breakthroughs (Opar et al., 2015). Olympic sprinting is the particular focus of global audiences of all time (Geurin & Naraine, 2020). Sprint results (such as timing of the event) are approaching human limits on a daily basis as performance in sprint events improves over time (Haugen & Buchheit, 2016). For elite-level athletes in sprinting, the

physical and technical gaps are shrinking day by day, and the differences in performance are sometimes narrowed down to only 0.001 second (Zhang et al., 2021). The reaction time of sprint runners is one of the key determinants that may affect their performance and success where hundredths or even thousandths of a second decide the winner (Zhang et al., 2021; Majumdar & Robergs, 2011). Therefore, the poor reaction ability of a sprinter can make them unsuccessful as well as out of the competition because of a false start.

In the sports field, reaction ability is of great importance because every sports action starts with a reaction to a known or unknown stimulus. The sprinters start their sports action with a reaction to a gun sound, i.e., a known stimulus. The

reaction time may be defined as the time elapsed between the sensory stimulus and subsequent responses (Spierer et al., 2010). Reaction time to sensory stimuli has been widely examined in the literature in various populations (Spierer et al., 2010; Spierer et al., 2011; Pramono et al., 2023). In sprinting events, the reaction time is influenced by factors like the time required for the start signal stimulus to reach the receptors, the time for the receptors to convert the stimulus into nerve signals, neurotransmission and processing, the activation of the concerned muscles, and soft tissue adaptability (Baker et al., 2015; Zhang et al., 2021).

Apart from reaction time, performance in sprint events depends on start acceleration, block clearance, maintenance or speed endurance, and deceleration phase. However, in sprint events, the two important components, i.e., Block clearance with a proper start and gaining optimum acceleration, substantially generate the end outcome. Previous research studies revealed that start and start acceleration play a significant role in achieving maximum results in sprint disciplines (Pavlovic et al., 2014; Pavlovic, 2015). According to the available information (Babic et al., 2011), the length of the initial acceleration depends on the morpho-motor potentials, the anaerobic-lactate system, and the intensity of the sprinter's CNS excitation (Pavlovic, 2021). In the first ten meters of a 100 m sprint event, sprinters develop up to 55% of their maximum speed, up to twenty meters, 70–80%; and up to thirty meters, it goes up to 85–95%. Between 50m and 80 m, sprinters reach their maximum speed (more than 11.5 m/s), and after 80–90 m, the achieved speed decreases (Pavlovic et al., 2014; Majumdar & Robergs, 2011; Morin et al., 2012). The drop in speed at the finish of the race is a consequence of lower speed endurance, i.e., weaker anaerobic capacity in sprinters.

Start acceleration is a complex cyclic motion determined primarily by the progression of frequency and step length, the duration of the contact phase and the phase of flight, the position of the body's center of gravity at the moment of ground contact, propulsion in the phase of flight, and the forces that are handled in the first step. But here, along with all this, the reaction time is also not avoided in any way (Majumdar & Robergs, 2011). However, these disparities are not always significant in 200 and 400-meter events, which contradict the idea that start acceleration and reaction time are more essential in shorter sprint events than in longer sprint events (Tonnessen et al., 2013; Pilianidis et al., 2012a).

Many researchers attempted to analyse biomechanically the block clearance and acceleration to explain the phenomenon of sprint speed and start acceleration based on the timing of the start reaction (Ille et al., 2013; Babic et al., 2011). Optimal coherence between sprint starts and acceleration indicates particular motor challenges that athletes must integrate in terms of time and spatial factors in the total running process (Babic et al., 2011). However, only a few researchers examined the relationship between start reaction time and total performance time.

Some researchers have focused mainly on reaction time and performance time which were mainly done on world-class athletes. Pilianidis et al. (2012b) reported no significant correlation between reaction time and performance time in sprint events among male sprinters except in the 110-meter Hurdles race in the World Athletic Championship between 1997 to 2009. Pavlovic (2021) also supported the above study

in his research, where only the 100-meter race had a significant relationship between reaction time and performance time among male sprinters at the World Championships from 2001 to 2019. Paradisi (2013) observed a significant correlation between reaction time and sprint results in the 2004 Olympic Games in Athens in the 100-meter for females and the 100-meter for male sprinters. In high-level competitions (Olympic Games, World Championships), gender differences are noticed in the timing of the start reaction (Mitasik et al., 2020; Mirkov et al., 2020). Tonnessen et al. (2013) found significant differences in reaction time in the 100 m sprint event between male and female world-class sprinters during 2003 to 2009 World Championships.

In this perspective, the current study was conducted based on large amounts of data, i.e., on 240 female finalist sprinters from five sprint events since the 2000 Olympic Games, with the purpose of finding out the relationship between reaction time and performance time among female finalist sprinters.

Materials and methods

Sample Details

The current study included 240 elite female finalist athletes in Olympics sprint events from the 2000 Sydney Olympics to the 2020 Tokyo Olympic (held in 2021 due to the pandemic situation). Only 48 female finalist athletes from each sprint event, such as 100 m, 200 m, 400 m, 100 m hurdles, and 400 m Hurdles races were considered. Their starting reaction time and final results were obtained from the International Amateur Athletic Federation (IAAF) (from 2000 to 2016) and World Athletics (from October, 2019) official reports of the Olympic Games. On 227 samples of 100 m ($n = 47$), 200 m ($n = 46$), 400 m ($n = 43$), 100 m H ($n = 45$), and 400 m H ($n = 46$), data were gathered and finally calculated by the statistical method. Thirteen ($n = 13$) samples were excluded for various reasons, including false starts, being disqualified for doping, did not start (DNS), or did not finish (DNF).

Statistical Analysis

The descriptive statistics (Mean, SD, range) were calculated. The Anderson-Darling test was used to investigate the assumptions of normality and homogeneity in exported data. The Pearson correlation of coefficient was used to measure the strength of the link between reaction time and performance time with significance level at 0.05 ($p < 0.05$). For data sorting, statistical analysis, and graphical depiction, the IBM Statistical Package for Social Sciences (SPSS-free version) version 20 and Gnumeric Spreadsheet version 1.12.52 were used. A 5-point rating scale (according to Gaval'a, 2002; Mitasik et al., 2020) was used to determine the category of the reaction time of the female athletes in different sprint events.

Variables

In the present study, reaction time and total performance time were considered as variables, and data were obtained from published official reports on the "worldathletics.org" website and "www.olympedia.org".

Results

All finalists had to meet the entry standards of the championship, which were set by the IAAF and World Athletics; thus, familiarization with the competition procedure was ensured.

Table 1 highlighted the descriptive statistics of reaction time (Mean $\pm$ SD, Fastest and Slowest, Range) of the female Olympic finalist in 100 m, 200 m, 400 m, 100 m hurdles, and 400m hurdles events from 2000 to 2020 Olympic Games

in seconds. Table 1 also presents the fastest reaction time which was seen in the 200 m event (0.104 seconds) in the year of 2016 and the slowest RT which was seen in the 400 m race (0.452 seconds) in the 2000 Olympic. But it was also observed that the RT of 100 m (0.108 s) and 400 m Hurdles (0.447 s) races were very close to the above events in 2020 and 2000 Olympics respectively. Another observation from Table 1 is that the average RT in 100 m (0.168 ± 0.033) and 100 m H (0.168 ± 0.032) were almost the same which was also the best average reaction time among the five events.

Table 1. Descriptive statistics of Reaction Time of female finalist in 100 m, 200 m, 400 m, 100 m H, and 400m H events from 2000 to 2020 Olympic Games and correlation between Reaction time and Performance Time

Events	Year	Total Athletes (no.)	Variables	Mean $\pm$ SD (s)	Fastest-Slowest (s)	Range (s)	Simple Regression analysis			
							R	R ²	F	Sig.
100 m	2000	7	RT	0.208 $\pm$ 0.032	0.163-0.253	0.090	0.369	0.136	7.095	0.011*
	2004	8		0.185 $\pm$ 0.020	0.154-0.212	0.058				
	2008	8		0.183 $\pm$ 0.033	0.149-0.234	0.085				
	2012	8		0.156 $\pm$ 0.015	0.128-0.176	0.048				
	2016	8		0.140 $\pm$ 0.016	0.112-0.163	0.051				
	2020	8		0.140 $\pm$ 0.016	0.108-0.158	0.050				
	2000-2020	47	RT	0.168 $\pm$ 0.033	0.108-0.253	0.145				
			PT	11.001 $\pm$ 0.199	10.610-11.800	1.190				
200 m	2000	7	RT	0.192 $\pm$ 0.026	0.151-0.235	0.084	0.046	0.002	0.094	0.761
	2004	8		0.199 $\pm$ 0.031	0.162-0.259	0.097				
	2008	8		0.186 $\pm$ 0.015	0.167-0.206	0.039				
	2012	7		0.168 $\pm$ 0.007	0.157-0.176	0.019				
	2016	8		0.145 $\pm$ 0.020	0.104-0.171	0.067				
	2020	8		0.156 $\pm$ 0.012	0.141-0.173	0.032				
	2000-2020	46	RT	0.174 $\pm$ 0.027	0.104-0.259	0.155				
			PT	22.320 $\pm$ 0.405	21.530-24.000	2.470				
400 m	2000	8	RT	0.250 $\pm$ 0.090	0.174-0.452	0.278	-0.016	0.000	0.011	0.918
	2004	8		0.245 $\pm$ 0.024	0.205-0.276	0.071				
	2008	6		0.227 $\pm$ 0.042	0.181-0.299	0.118				
	2012	7		0.195 $\pm$ 0.030	0.167-0.258	0.091				
	2016	7		0.167 $\pm$ 0.028	0.133-0.219	0.086				
	2020	7		0.155 $\pm$ 0.020	0.127-0.176	0.049				
	2000-2020	43	RT	0.208 $\pm$ 0.058	0.127-0.452	0.325				
			PT	49.991 $\pm$ 0.588	48.360-51.250	2.890				
100 mH	2000	8	RT	0.209 $\pm$ 0.043	0.156-0.294	0.138	0.367	0.135	6.683	0.013*
	2004	6		0.161 $\pm$ 0.019	0.145-0.195	0.050				
	2008	8		0.176 $\pm$ 0.031	0.138-0.239	0.101				
	2012	7		0.149 $\pm$ 0.010	0.137-0.163	0.026				
	2016	8		0.152 $\pm$ 0.015	0.130-0.179	0.049				
	2020	8		0.158 $\pm$ 0.009	0.144-0.172	0.028				
	2000-2020	45	RT	0.168 $\pm$ 0.032	0.130-0.294	0.164				
			PT	12.705 $\pm$ 0.228	12.350-13.490	1.140				
400 mH	2000	8	RT	0.282 $\pm$ 0.115	0.169-0.447	0.278	0.035	0.001	0.053	0.819
	2004	8		0.288 $\pm$ 0.066	0.184-0.408	0.224				
	2008	8		0.205 $\pm$ 0.024	0.184-0.248	0.064				
	2012	7		0.202 $\pm$ 0.040	0.163-0.270	0.107				
	2016	8		0.173 $\pm$ 0.031	0.140-0.226	0.086				
	2020	7		0.183 $\pm$ 0.033	0.136-0.235	0.099				
	2000-2020	46	RT	0.224 $\pm$ 0.074	0.136-0.447	0.311				
			PT	53.971 $\pm$ 1.106	51.460-57.550	6.090				

Note. *no = Number, s = Seconds, m = Meter; SD = Standard Deviation, H = Hurdles, RT = Reaction Time, PT = Performance Time, R = coefficient of correlation, R² = coefficient of determination, F = F-value, p = Level of significance, *p < 0.05

Table 2. Evaluation of reaction time of women finalist sprinter (event-wise) of Olympic (2000-2020) on a 5-points scale (according to Gaval'a, 2002; Mitasik et al., 2020)

Rating	Number of Female Finalists in Different Olympic Events						%
	100 m	200 m	400 m	100 m H	400 m H	Total	
Excellent (0.100-0.120 s)	2	1	0	0	0	3	1.32
Very Good (0.121-0.150 s)	13	7	4	11	3	38	16.74
Average (0.151-0.175 s)	15	20	9	22	10	76	33.48
Below Average (0.176-0.205 s)	9	11	12	7	12	51	22.47
Unsatisfactory (≥ 0.206 s)	8	7	18	5	21	59	25.99
Overall	47	46	43	45	46	227	100

Note. H = Hurdles, s = Seconds; m = Meter

Table 3. Analysis of reaction time and performance time of best three reaction time holders women finalist sprinters from 2000-2020

Events (Mean RT)	Total No. of Finalists	Best Three Reaction Times (s)	Performance Time of the event	Year	Year Wise Position	Rating Scale	Mean Differences of RT
100 m (0.168 s)	47	0.108	11.12	2020	8 th	Excellent	0.060
		0.112	10.83	2016	2 nd	Excellent	0.056
		0.128	10.94	2012	6 th	Very Good	0.040
		0.104	22.69	2016	8 th	Excellent	0.070
200 m (0.174 s)	46	0.135	22.31	2016	5 th	Very Good	0.039
		0.141	21.88	2016	2 nd	Very Good	0.033
		0.141	21.94	2020	4 th	Very Good	0.033
		0.127	49.97	2020	6 th	Very Good	0.081
400 m (0.208 s)	43	0.131	49.61	2020	4 th	Very Good	0.077
		0.133	51.97	2016	6 th	Very Good	0.075
		0.130	12.74	2016	5 th	Very Good	0.038
		0.137	12.35	2012	1 st	Very Good	0.031
100 m H (0.168 s)	45	0.137	12.48	2012	3 rd	Very Good	0.031
		0.138	12.64	2008	2 nd	Very Good	0.030
		0.136	53.08	2020	4 th	Very Good	0.088
		0.140	53.13	2016	7 th	Very Good	0.084
400 m H (0.224 s)	46	0.143	54.56	2016	1 st	Very Good	0.081

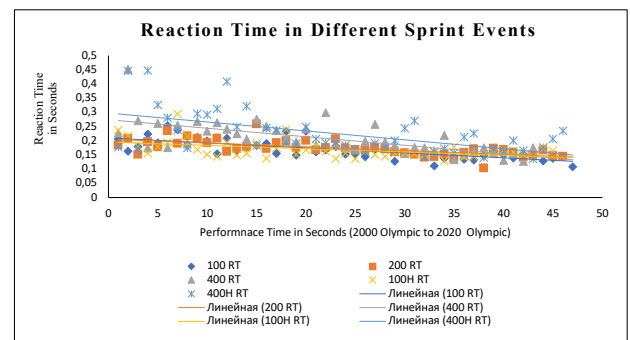
Note. H = Hurdles, RT = Reaction Time, m = Meter

Based on the data of 227 women finalist sprinters across the last six Olympics (2000 to 2020), a 5-point scale was used to assess reaction times (Table 2). The majority of the women printers were classified as "Average" (33.48%), while the percentage of athletes classified as "excellent" was very low at only 1.32%, with the first and second-best timing holders in the 100 m event and the other one in the 200 m event, whereas the second largest part of the women sprinters belongs to the unsatisfactory (25.99%) category.

Table 3 highlighted that the top three reaction times of five different sprint events (100 m, 200 m, 400 m, 100 m H, and 400 m H) lie between 0.104 s (200 m) to 0.143 s (400 m H), where a total of 17 participants were placed, and two of them had the same timing in the same events (200 m and 100 m H) each. It is also noted that only six sprinters among them got positions (medal holders) between first and third in the events except the 400 m race, where only two got first place, three got second place, and one got third place. Except for only three in the Excellent category, the remaining 14 sprinters belong to the Very Good category, where the mean difference in reaction time (0.038 s to 0.030 s for the best

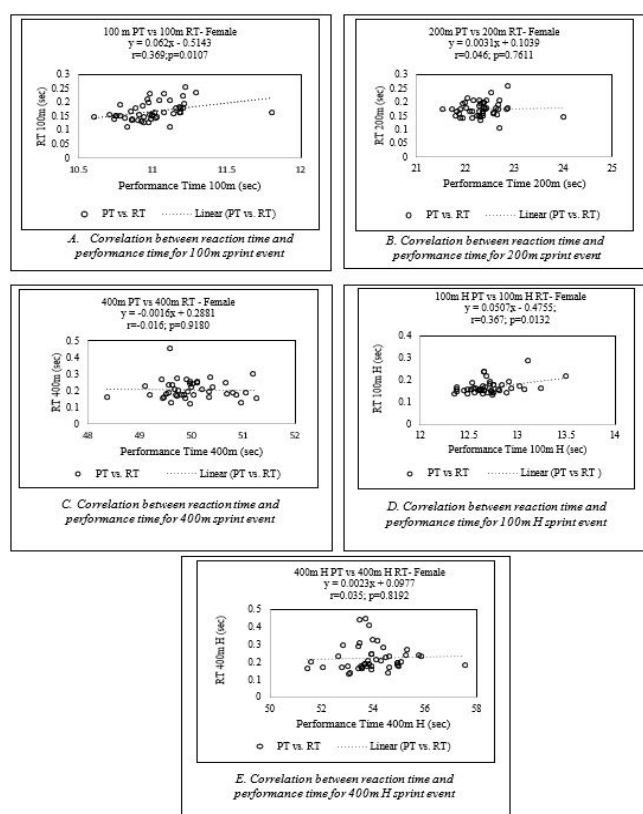
three RT) is the lowest for the 100 m hurdles and the highest for the 400 m hurdles (0.088 s to 0.081 s).

Figure 1 presents the event-wise reaction time and performance time of all individual data with trend lines



Note. PT=Performance Time, RT=Reaction Time

Fig 1. Reaction Time in Different Sprint Events (100 m, 200 m, 400 m, 100 m H, 400 m H)



Note. PT = Performance Time, RT = Reaction Time, sec = Seconds, r = coefficient of correlation, p = Level of significance

Fig 2. Scatter plots (ABCDE) illustrate the relationship between Reaction time and Performance time in 100 m, 200 m, 400 m, 100 m H, and 400 m H events

since the 2000 Olympics. Here it is also seen that most of the data is spread between 0.1 to 0.3 seconds.

The results of a correlation analysis (Figure 2) were examined for each sprint event. The Pearson correlation coefficient and simple regression were calculated to determine the relationship between reaction time and sprint performance time. Figure 2 revealed that for most sprint events, there was no statistically significant correlation ($P < 0.05$) between reaction time and sprint performance time. However, among female finalists, a significant correlation was observed between reaction time and sprint performance time in the 100 m flat ($R = 0.369$, $p < 0.05$) and 100 m hurdles ($R = 0.367$, $p < 0.05$), with a significance level of $p < 0.05$ (Figure 2).

Discussion

The top performance of sprinters is the result of the integration of several factors (genetic potential, training, health condition of the athlete, etc.). In athletics, the time of the (starting) reaction is becoming more and more significant in the result performance of sprint disciplines. The aim of the study was to observe and analyse the relationship between reaction time and performance time among female sprinters.

The current analysis examined 240 female finalists who qualified to participate in the Olympic Games from 2000 to

2020 across five different sprinting events. Finally, the data were collected from 227 participants for the data analysis.

The results showed that there was a linear increase in the average reaction time and average performance time as the length of the event increases (Table 1). There was a disparity in reaction time between events, indicating that athletes responded differently to various events. As the distance of the events increases, the reaction time also gradually increases in sprint events (Table 1). The current analysis demonstrated a total reaction time variation (100 m to 400 m H) of 0.056 s among the five selected events.

Pioneer researchers have shown in their analysis (Pilianidis et al., 2012b; Haugen et al., 2019; Pavlovic, 2021) that short-distance sprinting events, such as the 100 meters, women sprinters have a significantly better reaction time than other sprints event like 200 m and 400m. These studies support our findings, particularly in the 100 m ($r = 0.369$, $p < 0.05$) and 100 m hurdles ($r = 0.367$, $p < 0.05$) events, with a correlation between the mean value of performance time and reaction time. Despite the weak correlation observed in our current analysis for 100 m and 100 m hurdles events, it may be said that reaction time has a significant impact on total performance time in 100 m flat sprint and 100 m hurdles.

Furthermore, it is worth mentioning that the least reaction time has a productive outcome on the first three-step movement, acceleration, maintenance of speed, and overall performance time, as supported by prior investigations (Haugen & Buchheit, 2016; Morin et al., 2012).

However, it has been argued that reaction time does not always have a significant impact on total performance time or the length of the event (Pilianidis et al., 2012a). It is also seen in our study that in the Tokyo 2020 Olympics, the mean reaction time in the 400 m race was lower (mean: 0.155 s; fastest: 0.127 s) compared to the 2020 Olympic Games in the 100 m H (mean: 0.158 s; fastest: 0.144 s), 200 m (mean: 0.156 s; fastest: 0.141 s), and 400 m H races (mean: 0.183 s; fastest: 0.136 s).

It is also important to note that other factors such as genetic potential, training, health condition of the athlete, movement time, CNS system, position of the center of gravity, initial acceleration, loco-motor phase, time of deceleration, and body's ability play a more active role in running and contribute to the improvement of total performance time (Haugen et al., 2012).

On the other hand, another finding from this study (Table 1) was that the reaction time of women finalists increased from 0.104 s (fastest by a sprinter in 200 m) to 0.452 s (longest by a sprinter in 400 m), which ranged 0.348 s in where event-wise average reaction time variation was quite low, only 0.056 s (see Table 1). Particularly this occurs when an athlete has differences in their ability, race technique, motivation during the race, recovery phase, etc., and this affects their performance (Haugen et al., 2019; Tonnessen et al., 2013). Another fact that was highlighted in Table 2 was that most of the data was spread in the "Average" category (33.48). However, out of this, 75% of this category data was available on 100 m, 200 m, and 100 m H races, and only 25% was from 400 m and 400 m H races. This type of similarity is also seen in the "Very good" category (16.74%), where only 18.42% of athletes belong to the 400 m and 400 m H races. But the opposite scenario has been

seen in the “Unsatisfactory” category, where most of the data (66.10%) lies in the above-mentioned two events. The prediction behind this phenomenon is that reaction time plays a more important role in short-distance running than in long-distance events as we see in the above finding.

Reaction time is considered one of the most complex issues in sprinting, and it cannot be ignored, particularly in elite athletes’ performance and top international circuits where recovering from a poor start is challenging (Haugen et al., 2019; Tonnessen et al., 2013). However, there are exceptional athletes like Usain Bolt, Justin Gatlin, and Veronica Campbell-Brown who have achieved remarkable results despite having poor reaction times in the last two decades. Usain Bolt, for instance, consistently secured first position in the 100 m and 200 m events in the Olympics, with reaction times of ≤ 160 milliseconds (five times) and ≤ 180 milliseconds (six times), respectively (Pavlovic, 2021; Mitasik et al., 2020). Besides that, Justin Gatlin secured a position 12 times with an average reaction time of 159 milliseconds, and Veronica Campbell-Brown won medal for 15 times with an average reaction time of 165 milliseconds at the World Championship (Mitasik et al., 2020; Pavlovic, 2021; worldathletics.org). This kind of performance is only possible by working properly and doing it together with other factors.

Therefore, it can be concluded that reaction time is not always the sole predictor of performance in longer-distance running events, such as the 400 m or 400 m hurdles. However, apart from reaction time, other factors and aspects play a significant role in overall performance, such as correct block clearance technique, speed endurance, start acceleration, confidence level, race strategy, ability to fight back, perception, and pacing skills (Pilianidis et al., 2012a; Pilianidis et al., 2012b; Majumdar & Robergs, 2011). An example of Wayde van Niekerk’s performance in the men’s 400 m race at the 2016 Olympic Games, where his reaction time (0.181) ranked fifth among the finalists, but there was no difficulty in setting the World Record with a timing of 43.03 seconds (worldathletics.org). Also in this study it was found that, while the push-off phase from the blocks is vital for the athletes competing in the 200 m, 400 m, and 400m hurdles events, but the other factors (technique, stride length, stride frequency, maintaining phase, deceleration phase) can compensate this drawback. Apart from this, the curve of the track during the start is one of the valid reasons behind the reaction time deterioration that is seen in the above-said events.

Although here in Table 3, it is reflected that, despite the athletes’ reaction timing being quite good (first, second, and third best reaction time holders in five different events), about 65% of the athletes failed to win medals over the years. The above-mentioned results indicate that RT is not only the primary indicator of winning a medal in different sprint events. So, despite the limitations of the RT as a performance indicator, still it is an advantageous issue to improve performance in sprints for developing confidence and avoiding false start.

Conclusions

The findings of this study, based on a thorough analysis and persuasive arguments, lead to the conclusion that starts reaction time does not provide any additional advantages

and plays a negligible role in sprinting performance, with the exception of the 100 m ($r = 0.369$, $p < 0.05$) and 100 m H ($r = 0.367$, $p < 0.05$) races. These results indicate that having a faster start reaction time does not necessarily correspond into improved overall performance times in Olympic women’s sprint events. It is important to note that while reaction time alone cannot guarantee exceptional performance at an elite level, as exemplified earlier, other factors such as a combination of supportive tools and areas also contribute to enhancing overall performance time. Nevertheless, it is worth mentioning that athletes and coaches can still strive to enhance their performance by focusing on improving their response time through effective training. By correctly employing strategies to improve reaction time, athletes can potentially see an improvement in their overall performance. Therefore, this study can provide valuable insights to coaches, performance analysts, sports scientists, and even active athletes, facilitating a better understanding of the role of start reaction time and enabling further analysis and exploration of performance enhancement strategies.

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Conflict of interest

The authors declare that there was no conflict of interest.

References

- Opar, D., Drezner, J., Shield, A., Williams, M., Webner, D., Sennett, B., ... & Cronholm, P. F. (2015). Acute injuries in track and field athletes: A 3-year observational study at the Penn relays carnival with epidemiology and medical coverage implications. *The American Journal of Sports Medicine*, 43(4), 816-822. <https://doi.org/10.1177/0363546514562553>
- Geurin, A. N., & Naraine, M. L. (2020). 20 years of Olympic media research: trends and future directions. *Frontiers in Sports and Active Living*, 2, 572495. <https://doi.org/10.3389/fspor.2020.572495>
- Haugen, T., & Buchheit, M. (2016). Sprint running performance monitoring: Methodological and practical considerations. *Sports Med*, 46, 641-656. <https://doi.org/10.1007/s40279-015-0446-0>
- Zhang, J., Lin, X. Y., & Zhang, S. (2021). Correlation analysis of sprint performance and reaction time based on double logarithm model. *Complexity*, 2021, 1-11. <https://doi.org/10.1155/2021/6633326>
- Majumdar, A. S., & Robergs, R. A. (2011). The science of speed: Determinants of performance in the 100 m sprint. *International Journal of Sports Science & Coaching*, 6(3), 479-493. <https://journals.sagepub.com/doi/pdf/10.1260/1747-9541.6.3.479>
- Spieler, D. K., Petersen, R. A., Duffy, K., Corcoran, B. M., & Rawls-Martin, T. (2010). Gender influence on response time to sensory stimuli. *The Journal of Strength & Conditioning Research*, 24(4), 957-963. <https://doi.org/10.1519/JSC.0b013e3181c7c536>
- Spieler, D. K., Petersen, R. A., & Duffy, K. (2011). Response time to stimuli in division I soccer players. *The Journal*

- of *Strength & Conditioning Research*, 25(4), 1134-1141.
<https://doi.org/10.1519/JSC.0b013e3181d09e4c>
- Pramono, B. A., Mustar, Y. S., Sumartiningsih, S., Marsudi, I., Hariyanto, A., Sidik, M. A., & Kusuma, I. D. M. A. W. (2023). Analysis of reaction time, split time and final time records of swimming athletes in the Olympic Games on 2008-2021. *Physical Education Theory and Methodology*, 23(3), 346-352. <https://doi.org/10.17309/tmfv.2023.3.05>
- Baker, S. A., Hennig, G. W., Ward, S. M., & Sanders, K. M. (2015). Temporal sequence of activation of cells involved in purinergic neurotransmission in the colon. *The Journal of Physiology*, 593(8), 1945-1963.
<https://doi.org/10.1113/jphysiol.2014.287599>
- Pavlovic, R., Idrizovic, K., Vrcic, M., & Mosurovic, M. (2014). Razlike u vremenu startne reakcije i postignutom rezultatu u sprinterskim disciplinama u finalu olimpijskih igara u Londonu//Differences in time of start reaction and achieved result in the sprint disciplines in the finals of The Olympic Games in London. *Sports Science and Health*, 7(1). <https://doi.org/10.7251/SSH1401005P>
- Pavlovic, R. (2015). 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. *Sport Scientific & Practical Aspects*, 12(1). <http://sportspa.ftos.untz.ba/images/june2015/Article-04-june-2015.pdf>
- Babic, V., Coh, M., & Dizdar, D. (2011). Differences in kinematic parameters of athletes of different running quality. *Biology of Sport*, 28(2).
<https://doi.org/10.5604/946493>
- Pavlovic, R. (2021). The importance of reaction time in athletics: Influence on the results of sprint runs of World Championships finalists. *Central European Journal of Sport Sciences and Medicine*, 34, 53-65.
<https://doi.org/10.18276/cej.2021.2-05>
- Morin, J.-B., Bourdin, M., Edouard, P., Peyrot, N., Samozino, P., & Lacour, J.-R. (2012). Mechanical determinants of 100-m sprint running performance. *European Journal of Applied Physiology*, 112(11), 3921-3930.
<https://doi.org/10.1007/s00421-012-2379-8>
- Tønnessen, E., Haugen, T., & Shalfawi, S. A. (2013). Reaction time aspects of elite sprinters in athletic World Championships. *The Journal of Strength & Conditioning Research*, 27(4), 885-892.
<https://doi.org/10.1519/JSC.0b013e31826520c3>
- Pilianidis, T., Kasabalis, A., Mantzouranis, N., & Mavvidis, A. (2012a). Start reaction time and performance at the sprint events in the Olympic Games. *Kinesiology*, 44(1), 67-72.
<https://core.ac.uk/reader/14450630>
- Ille, A., Selin, I., Do, M. C., & Thon, B. (2013). Attentional focus effects on sprint start performance as a function of skill level. *Journal of Sports Sciences*, 31(15), 1705-1712.
<https://doi.org/10.1080/02640414.2013.797097>
- Pilianidis, T. H., Mantzouranis, N., & Kasabalis, A. (2012b). Start reaction time and performance at the sprint events in World Athletic Championships. *International Journal of Performance Analysis in Sport*, 12(1), 112-118.
<https://doi.org/10.1080/24748668.2012.11868587>
- Paradisis, G. P. (2013). Reaction time and performance in the short sprints. *New Studies in Athletics*, 28(1/2), 95-103. <http://centrostudilombardia.com/wp-content/uploads/IAAF-Corsa-Velocita/2013-Reaction-time-and-performance-in-the-short-sprint.pdf>
- Mitasik, P., Vavak, M., Dolezajova, L., Lednický, A., & Vegh, D. (2020). Changes in the start reaction times of male and female sprinters in world athletic championships. *Journal of Physical Education and Sport*, 20, 2253-2257.
<https://doi.org/10.7752/jpes.2020.s3302>
- Mirkov, D. M., Knezevic, O. M., Garcia-Ramos, A., Coh, M., & Sarabon, N. (2020). Gender-related differences in mechanics of the sprint start and sprint acceleration of top national-level sprinters. *International Journal of Environmental Research and Public Health*, 17(18), 6447.
<https://doi.org/10.3390/ijerph17186447>
- Haugen, T., Seiler, S., Sandbakk, Ø., & Tønnessen, E. (2019). The Training and Development of Elite Sprint Performance: An Integration of Scientific and Best Practice Literature. *Sports Medicine - Open*, 5(1), 44.
<https://doi.org/10.1186/s40798-019-0221-0>
- Haugen, T. A., Tønnessen, E., & Seiler, S. K. (2012). The difference is in the start: Impact of timing and start procedure on sprint running performance. *The Journal of Strength & Conditioning Research*, 26(2), 473-479.
<https://doi.org/10.1519/JSC.0b013e318226030b>
- World Athletics. (2023, February 10).
<https://worldathletics.org/>
- Olympedia. (2023, February 10).
<https://www.olympedia.org/results/302235>

ЗВ'ЯЗОК МІЖ ЧАСОМ РЕАКЦІЇ НА СТАРТ І ЧАСОМ ВИКОНАННЯ ЗАБІГУ СЕРЕД ЖІНОК-ФІНАЛІСТОК У СПРИНТІ НА ОЛІМПІЙСЬКИХ ІГРАХ 2000–2020 РОКІВ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 8 с., 3 табл., 2 рис., 25 джерел.

Історія питання. Успіх у спринтерських змаганнях багато в чому залежить від багатьох факторів. Серед них час реакції в момент старту є одним із головних факторів, які допомагають спринтерам досягати успіху, підвищуючи їхню впевненість і допомагаючи уникати фальстартів.

Мета дослідження. Метою дослідження було з'ясування зв'язку між часом реакції та часом виконання забігу серед жінок-фіналісток у спринті на шести Олімпійських іграх із 2000 року.

Матеріали та методи. Дані збирали з показників 227 ($n = 227$) жінок-фіналісток у спринті в забігах на 100 м ($n = 47$), 200 м (46), 400 м (43), 100 м із бар'єрами (45) і 400 м із бар'єрами (46) на 6 Олімпійських іграх із 2000 по 2020 рік на основі опублікованих офіційних звітів на веб-сайтах "worldathletics.org" і "www.olympedia.org". Дані були враховані з 227 вибірок із загальною 240 жінок-фіналісток, із яких 13 були виключені через фальстарт, дискваліфікацію через допінг або неспроможність добігти до фінішу. Для визначення зв'язку між часом реакції та часом виконання забігу жінок-фіналісток у спринті використовували описову статистику, коефіцієнт кореляції Пірсона та аналіз простої регресії. Рівень значущості був заданий на рівні 0,05. Далі використовували 5-бальну шкалу Гавалья для класифікації жінок-спринтерів за їхнім часом реакції в п'яти спринтерських змаганнях.

Результати. Результати показали низьку позитивну кореляцію між часом реакції та часом виконання забігу серед спринтерів у забігах на 100 м ($r = 0,369$; $p < 0,05$) і 100 м із бар'єрами ($r = 0,367$; $p < 0,05$), тоді як на дистанціях 200, 400 та 400 метрів із бар'єрами серед жінок-спринтерів, які брали участь в Олімпійських іграх 2000-2020 років, зв'язок не підтверджено. За 5-бальною шкалою виявилось, що до середньої категорії належать 33,48% спринтерів, тоді як 25,99% належать до незадовільної, і лише 1,32% і 16,74% належать до відмінної та дуже доброї категорій відповідно.

Висновки. Даний аналіз дозволяє дійти висновку, що під час Олімпійських ігор 2000-2020 років низький позитивний зв'язок між часом реакції та часом виконання забігу жінок-фіналісток у спринті спостерігався лише в спринтерських забігах на 100 м та 100 м із бар'єрами, при цьому за 5-бальною шкалою Гавалья більшість фіналісток належали до «Середньої» категорії.

Ключові слова: елітні спринтери, Олімпійські спринтерські змагання, час виконання забігу, час реакції.

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