

Original Research

Influence of running wide on the bend on performance in 1500m finals at major championships

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Abstract: The aim of this study was to determine the influence of running wide on bends on performance during major championship 1500m events. Official final race 100-m split times of 1500m finalists from two World Championships (2013 and 2017) and the 2016 Olympic Games were obtained from the open-access World Athletics website. Extra distance covered on the bends was calculated using official videos from the championships and the total distance run was described as the minimum calculable distance. Based on this measure, theoretical mean speeds, theoretical finishing times and theoretical finishing positions were calculated. Theoretical finishing times were faster than official finishing times ($P < 0.001$). Men and women covered a mean extra distance on the bends of 0.31 ± 0.09 and 0.38 ± 0.17 m, respectively. Finishing positions were also influenced by extra distance covered. These findings suggest reducing extra distance run whenever possible to achieve a better finishing position during major championship races.

Keywords: athletics; middle-distance running; pacing; performance

1. Introduction

Success in competitive 1500m running requires appropriate strategic and tactical decision-making, related to both one's own running speed and race position relative to other competitors (Casado & Renfree, 2018; Hanley, Stellingwerff, & Hettinga, 2019). Therefore, decision-making within a race context is influenced by a complex array of factors specific to both the individual athlete (Renfree, Martin, Micklewright, & Gibson, 2014) and the characteristics of the

environment in which they are competing (Renfree & Casado, 2018). Indeed, the goals of middle-distance runners differ depending on the nature of the event: in athletics 'meet' events, the primary goal is often to record a fast-finishing time to ensure qualification for a subsequent global championship, e.g., the Olympic Games. However, at the global championships themselves, titles or medals are allocated on the basis of finishing position regardless of time, and this might affect the tactics adopted (Hanley & Hettinga, 2018).



A range of different strategic and tactical approaches have been observed in elite athletes. With regard to the 1500m event, a J-shaped pacing profile has been found in global competitions in qualifying rounds and finals (Casado & Renfree, 2018; Hanley et al., 2019; Mytton et al., 2015). However, these strategies do not highlight decision-making by athletes regarding how close to run to the inside rail, which could lead to being obstructed by other athletes (“boxed in”) (Martin & Coe, 1997), but which could also provide a tactical benefit with regard to optimizing physiological resources (Jones & Whipp, 2002).

As a standard 400-m track comprises two straights of 84.39 m each and two bends of 115.51 m each (Mercier, Aftalion, & Hanley, 2021), athletes must run just over half of the 1500m race on bends. It is therefore possible for a runner to be beaten by a rival whose mean speed is slower but has completed less total distance on account of running less extra distance on the bends; such an outcome is not observable from the simple analysis of intermediate 100-m split times. This outcome was observed in the Olympic Games in 2000 where the eventual men’s 800m silver medalist had a faster mean running speed than the winner but lost as a consequence of poor tactical and positional decision-making (Jones & Whipp, 2002). However, the relationship between total distance covered and eventual race outcome has not been studied in detail in the 1500m event. Therefore, the aim of this study was to determine the influence of running wide on bends during IAAF World Championship and Olympic Games 1500m events.

2. Materials and Methods

Participants. The men’s and women’s 1500m finals at two World Championships [WC] (Moscow, 2013 and London, 2017) and one Olympic Games [OG] (Rio de Janeiro, 2016) were analyzed. Official 100-m split times were obtained from the open-access World Athletics (formerly known as the IAAF) website. Because the data are publicly available on the internet, no ethics committee approval was required.

Twelve athletes were analyzed in each 1500m final except for the men’s final in 2016, which had 13 competitors.

Design and Procedures. The study was designed as observational research in quantifying the extra distance covered on bends by athletes at global championships. The methodology used has been previously described by González-Mohino, Casado, Renfree, González-Ravé, and Hanley (2021). To calculate the extra distance covered by the athletes on bends, official videos were downloaded via YouTube and analyzed on Kinovea® software (v. 0.8.25 for Windows) using a frame-by-frame method, previously validated and with a measurement error of 0.02 s (Mytton, Archer, Thompson, Renfree, & Gibson, 2013). A 400-m track features two equal bends and two parallel straights. Lane 1 is measured 0.30 m from the outer edge of the inside kerb, whereas in all other lanes the distance run is measured 0.20 m from the outer edge of the inside lane marking. The distance involved in completing one lap is the length of the straights plus, for the bends, $2\pi r$ (lane width = 1.22 m). Thus, an athlete runs 407.04 m per lap in lane 2 rather than 400 m if on the rail in lane 1 (Jones & Whipp, 2002). Three zones (outside lane 1, lane 2 and lane 3) were observed and the time the athletes spent running in each zone while on the bends was measured; on no occasion did an athlete run any wider than lane 3. These times were expressed as a percentage of the 100-m split time of each athlete. Athletes’ split times were used to calculate mean speed during each 100-m segment. The first 100-m segment (0-100 m) was ignored from the calculation as is a straight. Once the 100-m split was completed, the time spent in each zone was multiplied by 1.76 m, 3.52 m and 7.04 m (for outside lane 1, lane 2 and lane 3), respectively, and the extra distance of each 100-m split was added. In all competitions analyzed, a 400-m standard track was used, which has a radius of 36.5 m, bends of length 115.51 m, and straights of length 84.39 m (Mercier et al., 2021; Wilson D, 2003). For that

reason, our calculations are made for each 100-m segment and the extra distance in the straight 100-m segments includes approximately 15 m of bend.

Statistical Analysis. The data are presented as means and standard deviations (mean $\pm$ SD). A paired samples t-test ($P < 0.05$) was used to test for statistical differences between the official and theoretical finishing times in the 1500m event for all samples. Effect sizes for differences between theoretical and actual finishing times for men and women were calculated using Cohen's d (Cohen, 1988) and considered to be either trivial ($d < 0.20$), small ($0.21 - 0.60$), moderate ($0.61 - 1.20$), or large ($1.21 - 2.00$) (Hopkins, Marshall, Batterham, & Hanin, 2009).

3. Results

The results are presented in Table 1 and 2. Overall, theoretical finishing time was faster in these 1500m races than the official finishing times by 1.11 ± 0.98 s and 1.46 ± 1.13 s for men and women, respectively ($P < 0.001$). The effect sizes were trivial for men ($d = 0.16$) and small for women ($d = 0.36$). On the bends, the men and women covered a mean extra distance of 0.31 ± 0.09 m and 0.38 ± 0.17 m per bend, respectively. For each straight, the mean extra distances run by men and women were 0.05 ± 0.02 m and 0.05 ± 0.03 m, respectively, without differences between sexes.

4. Discussion

This study aimed to determine the influence of running wide on bends in global championships finals. The main finding of this study was that there was a considerable effect of running extra distance on finishing positions in the 1500m finals. Four of the six gold medalists were not the theoretical fastest athletes in their race. In the most extreme case, the men's 2016 Olympic Champion was only the 10th fastest in his race when extra distance was taken into account. The context of this race is important to consider with regard to the tactics

adopted: it was the slowest 1500m Olympic final since 1932 (Hanley & Hettinga, 2018) with the eventual winner running the entire race in lane 1 and who led for practically the entire race. Although this champion was capable of much faster running speeds, the approach he took to force his rivals to adopt much longer running distances (including approximate extra distance of 12 and 10 m extra for the silver and bronze medalists, respectively) shows a superior tactical approach. Given that the eventual gold medalist was already leading the race at the start of the final lap, any athlete hoping to overtake him would have needed to run even faster (and likely farther) to do so. This could explain previous observations that in championship events it is important to be in a position close to the lead as the race enters its closing stages (Casado & Renfree, 2018), and that the ability to run a fast final lap is an important determinant of the ability to win a medal in middle-distance races (800m and 1500m) (Casado & Renfree, 2018; Mytton et al., 2015).

The other 1500m finals were run relatively faster (in the men's cases, by more than 13 s faster for the winners). For example, in the men's 2013 final, the three theoretically fastest athletes actually finished outside the top 5 positions, running between 10 and 21 m more distance than the eventual medalists. Indeed, the medalists (who included the aforementioned 2016 Olympic Champion) each ran less than 3.5 m extra distance during the entire race. Positional changes based on theoretical finishing times were less dramatic in the women's 1500m finals: two of the three gold medalists were also the theoretically fastest athletes, even though their extra distance run was approximately 18 m (in 2013) and 10 m (in 2016). The women's final in 2017 differed from these races in that the theoretically fastest athlete finished only 0.31 s behind the winner but ran a theoretical distance more than 10 m longer.

Table 1. Minimum calculable distance, theoretical speed and finishing time and positions for the men's 1500m events at the 2013 and 2017 IAAF World Championships and 2016 Olympic Games

Finishing race position	Finishing time (min:s)			Minimum calculable distance (m)			Theoretical speed (m/s)			Theoretical finishing time (min:s)			Theoretical finishing race position		
	2013	2016 Rio	2017	2013	2016 Rio	2017	2013	2016	2017	2013		2017	2013		2017
	Moscow		London	Moscow		London	Moscow	Rio	London	Moscow	2016 Rio	London	Moscow	2016 Rio	London
Men															
1	3:36.28	3:50.00	3:33.61	1503.33	1500.00	1501.76	6.95	6.52	7.03	3:35.80	3:50.00	3:33.36	4	10	2
2	3:36.78	3:50.11	3:33.99	1502.76	1512.18	1504.90	6.93	6.57	7.03	3:36.38	3:48.26	3:33.29	6	2	1
3	3:36.83	3:50.24	3:34.53	1500.00	1509.84	1502.71	6.92	6.56	7.00	3:36.83	3:48.72	3:34.14	7	4	3
4	3:36.87	3:50.29	3:34.71	1500.26	1508.32	1503.34	6.92	6.55	7.00	3:36.83	3:49.02	3:34.23	7	5	4
5	3:37.03	3:50.58	3:34.89	1503.84	1515.36	1502.51	6.93	6.57	6.99	3:36.48	3:48.24	3:34.53	8	1	5
6	3:37.11	3:50.87	3:35.81	1521.27	1506.28	1506.91	7.01	6.52	6.98	3:34.07	3:49.91	3:34.82	1	9	6
7	3:37.21	3:51.06	3:36.02	1513.71	1501.99	1501.66	6.97	6.50	6.95	3:35.24	3:50.75	3:35.78	2	11	7
8	3:37.52	3:51.09	3:36.82	1500.17	1510.00	1500.97	6.90	6.53	6.92	3:37.50	3:49.56	3:36.68	9	6	11
9	3:38.08	3:51.39	3:37.24	1516.53	1503.97	1504.78	6.95	6.50	6.93	3:35.70	3:50.78	3:36.55	3	12	8
10	3:38.09	3:51.45	3:37.56	1512.58	1511.69	1506.15	6.94	6.53	6.92	3:36.28	3:49.66	3:36.67	5	7	10
11	3:39.17	3:51.68	3:37.72	1510.05	1520.98	1507.62	6.89	6.56	6.92	3:37.71	3:48.48	3:36.62	10	3	9
12	3:46.04	3:51.73	3:38.28	1509.15	1512.37	1500.98	6.68	6.53	6.88	3:44.67	3:49.83	3:38.14	11	8	12
13		3:56.76			1525.30			6.44			3:52.83			13	

Theoretical finishing positions differing from actual finishing positions are highlighted in bold

Table 2. Minimum calculable distance, theoretical speed and finishing time and positions for the women’s 1500m events at the 2013 and 2017 IAAF World Championships and 2016 Olympic

Finishing race position	Finishing time (min:s)			Minimum calculable distance (m)			Theoretical speed (m/s)			Theoretical finishing time (min:s)			Theoretical finishing race position		
	2013		2016 Rio	2017	2013		2016 Rio	2017	2013		2016 Rio	2017	2013		2017
	Moscow			London	Moscow		London		Moscow	2016 Rio	London		Moscow	2016 Rio	London
Women															
1	4:02.67	4:08.92	4:02.59	1517.75	1509.62	1508.59	6.25	6.06	6.22	3:59.83	4:07.33	4:01.21	1	1	2
2	4:02.99	4:10.27	4:02.76	1501.76	1505.21	1501.73	6.18	6.01	6.19	4:02.71	4:09.40	4:02.48	5	3	4
3	4:03.86	4:10.53	4:02.90	1509.48	1513.79	1519.17	6.19	6.04	6.25	4:02.33	4:08.25	3:59.84	3	2	1
4	4:04.98	4:11.05	4:02.97	1500.00	1508.49	1502.00	6.12	6.01	6.18	4:04.98	4:09.64	4:02.65	7	4	6
5	4:05.08	4:11.23	4:03.34	1516.64	1506.78	1502.67	6.19	5.99	6.17	4:02.39	4:10.10	4:02.91	4	6	7
6	4:05.77	4:12.59	4:04.11	1501.76	1517.48	1509.84	6.11	6.01	6.18	4:05.48	4:09.68	4:02.52	8	5	5
7	4:05.99	4:12.88	4:04.16	1523.39	1508.80	1502.00	6.19	5.97	6.15	4:02.21	4:11.40	4:03.83	2	8	8
8	4:06.01	4:13.14	4:04.35	1519.21	1510.87	1502.63	6.17	5.97	6.15	4:02.90	4:11.32	4:03.92	6	7	9
9	4:07.19	4:13.58	4:04.76	1501.63	1507.34	1517.86	6.07	5.94	6.20	4:06.92	4:12.34	4:01.88	10	9	3
10	4:09.16	4:14.72	4:05.87	1522.51	1500.13	1502.76	6.11	5.89	6.11	4:05.48	4:14.70	4:05.42	8	12	11
11	4:10.18	4:14.95	4:06.22	1507.23	1504.76	1500.00	6.02	5.90	6.10	4:08.98	4:14.14	4:06.22	11	11	12
12		4:15.16	4:06.72		1510.32	1510.65		5.92	6.12		4:13.42	4:04.98		10	10

Theoretical finishing positions differing from actual finishing positions are highlighted in bold

Conversely, the theoretically sixth-fastest women in 2013 managed to win silver by running less than 2 m more than the 1500m official distance, and all of these examples reiterate the crucial role that running the minimum possible distance plays in world-class competition (Fukuba & Whipp, 1999), alongside athletes' energetic potential and pacing strategies (Jones & Whipp, 2002).

The other 1500m finals were run relatively faster (in the men's cases, by more than 13 s faster for the winners). For example, in the men's 2013 final, the three theoretically fastest athletes actually finished outside the top 5 positions, running between 10 and 21 m more distance than the eventual medalists. Indeed, the medalists (who included the aforementioned 2016 Olympic Champion) each ran less than 3.5 m extra distance during the entire race. Positional changes based on theoretical finishing times were less dramatic in the women's 1500m finals: two of the three gold medalists were also the theoretically fastest athletes, even though their extra distance run was approximately 18 m (in 2013) and 10 m (in 2016). The women's final in 2017 differed from these races in that the theoretically fastest athlete finished only 0.31 s behind the winner but ran a theoretical distance more than 10 m longer. Conversely, the theoretically sixth-fastest women in 2013 managed to win silver by running less than 2 m more than the 1500m official distance, and all of these examples reiterate the crucial role that running the minimum possible distance plays in world-class competition (Fukuba & Whipp, 1999), alongside athletes' energetic potential and pacing strategies (Jones & Whipp, 2002).

Finally, this study faced some limitations. The main one could be the reliance on publicly available video footage and split times for calculating the extra distance covered on bends. While these methods are validated and widely used, potential measurement inaccuracies and variations in video quality may have influenced the precision of the calculated

distances and split times. Future research could benefit from integrating high-resolution tracking technologies to provide more precise and consistent measurements of athletes' trajectories.

5. Conclusion.

This study highlights the significant impact of running extra distances on bends in 1500m finals during major championships. Athletes who minimized their extra distance on bends often achieved better theoretical finishing times and positions compared to their official outcomes. Tactical decisions, such as maintaining an optimal position close to the rail, played a crucial role in determining race outcomes, sometimes outweighing raw speed advantages.

6. Practical Applications.

Athletes and coaches should prioritize maintaining an inner lane position on bends to reduce extra distance, as this can lead to faster times and better race positions at major competitive 1500m events. Coaches are encouraged to incorporate drills that improve bend position and analyze race footage for tactical adjustments, helping athletes refine their trajectory and minimize unnecessary drift during races.

Supplementary Materials: The following are available online at <http://eurjhm.com/index.php/eurjhm>, Figure S1: title, Table S1: title, Video S1: title.

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