SCIENTIFIC JOURNAL OF SPORT AND PERFORMANCE

ORIGINAL ARTICLE

Classification and race characteristics of all-time best male 800m runners

Zsolt Gyimes. *Hungarian University of Sports Science. Budapest, Hungary.*
Bence Kelemen . *School of Doctoral Studies. Hungarian University of Sports Science. Budapest, Hungary.*
Bálint Kovács. *Faculty of Sports Science. Ningbo University. Ningbo, China.*
Hungarian University of Sports Science. Budapest, Hungary.

ABSTRACT

Purpose: The aim of the study was to investigate all-time 80 best male 800m runners' fastest ever 800m races in tactical aspect. Methods: After classifying the athletes into subgroups, we tried to reveal general and type specific tactical elements (pacing and positioning during the race) and to identify performance determinant racing characteristics within the groups. Athletes were classed into three subgroups: speed type (ST, 800m specialists (SP), and endurance type (ET). Temporal and positional details of the races were obtained via video analysis. Results: ST runners start with a significantly faster 200m compared to SP (p = .016) and ET (p = .0035) runners but there was no difference in the later 200m split times for the rest of the race. ST runners also took a more forward intermediate field position at 200m, 400m, and 600m compared to SP and ET athletes respectively (200m p = .026, p = .032; 400m p = .018, p = .030; 600m p = .034; p = .019). Conclusion: ST 800m runners might effectively operate with a faster start and more forward field position, while SP, and ET runners can benefit more from a slower first 200m, followed by a more even pacing during the race. It was found that speed between 400-600m had the strongest positive relationship with 800m performance in all groups.

Keywords: Performance analysis, 800m running, Race analysis, Race tactics, Pacing, Positioning.

Cite this article as:
Gyimes, Z., Kelemen, B., & Kovács, B. (2025). Classification and race characteristics of all-time best male 800m runners. *Scientific Journal of Sport and Performance*, *4*(1), 92-101. https://doi.org/10.55860/XXVF3684

Corresponding author. *Hungarian University of Sport Sciences, School of Doctoral Studies, Hungary, Budapest No. 42-48. Alkotás street, Budapest 1123, Hungary.*
E-mail: bencekelemen95@gmail.com
Submitted for publication October 17, 2024.
Accepted for publication December 03, 2024.
Published December 08, 2024.
Scientific Journal of Sport and Performance. ISSN 2794-0586.

doi: https://doi.org/10.55860/XXVF3684

INTRODUCTION

800m track running has always been in the focal point of the aerobic vs. anaerobic (or the endurance vs. speed) contribution dilemma (Billat et al., 2009; Duffield et al., 2005a). It is due to the fact, that the time duration and intensity of this event is close enough to the definition of both metabolic pathways (Tanji et al., 2017).

Since 800m runners often compete on 400m or 1500m distances beside their main track event depending on their ability and needs, they are often divided by the coaches into three subgroups based on how fast these runners can run on these complementary tracks (Gamboa, 1996; Sandford & Stellingwerff, 2019). Runners having a relative fast 400m time referred as speed type (ST) runners, while those of having a relative fast 1500m time referred as endurance type (ET) runners. The third group includes 800m specialists (SP) without prominent time result in any of those events. This differentiation also highlights that to prepare for the 800m can be approached with different ways including greater (i.e., ST), or lower (i.e., ET) amount of high velocity runs relative to the weekly training volume (Haugen et al., 2021). Event like 400m requires a higher running speed under a shorter period hence the metabolic demand mostly covered through anaerobic pathways (Hanon et al., 2010), while a track event like 1500m lasts for longer time with a slower running speed and metabolic consumption of the muscles use both aerobic and anaerobic pathways (Duffield et al., 2005b; Ingham et al., 2008; Tanji et al., 2017).

Relative to the numerous studies on these divergent training approaches aiming to develop diverse metabolic pathways, very few works analysed type specific tactical behaviours between these subgroups (Bachero-Mena et al., 2017; Brandon, 1995; Haugen et al., 2021; Sandford, Kilding, et al., 2019). Moreover, despite the fact, that 800m performance is widely determined by race strategy (Hanley et al., 2019), relatively few studies were published on these tactical characteristics (pacing and positioning during the race) of international top level male 800m runners (Gyimes, 2013; Hanley et al., 2019; Reardon, 2013a; Sandford et al., 2018).

Depending on different race type, coaches often define two main pacing strategies (Kelemen, 2023). In Olympic and World Championship finals elite runners often perform notably inferior running time compared to their PB (Casado & Renfree, 2018). It is due to the fact, that they're focussing on the final part of the event where they can benefit from their higher terminal velocity (speed reserve) to outrun their competitors (winning tactics) (Kelemen, 2023). On the other hand, there are races where the aim is to perform the fastest possible running time (record tactics), making the athletes run at a higher running velocity during the whole distance (Hettinga et al., 2019; Thiel et al., 2012). Since the races we analysed brought all-time best 800m results, the chosen pacing profile will presumable be more like these later ones (Casado et al., 2021; Tucker et al., 2006). In addition, selecting the proper race tactics also depends on the abilities of the runners, therefore those would expect to be related to the abovementioned categorisation of these runners.

One of the aims of this study were to find out if there's a difference in race tactics between the subgroups of 800m runners. Beyond that, we tried to reveal general and type specific performance determinant tactical elements which had contributed to the best 800m results of all-time.

According to our expectations ST runners would tend to use a faster running speed and a more forward intermediate positioning in the first 400m compared to the other two groups, which results a higher time gap for them between the first and second 400m. ET runners to the contrary are expected to have a significantly slower start and rear intermediate position at the beginning of the race, making a faster second half with a

more active forward motion inside the field. New paragraph: use this style when you need to begin a new paragraph.

MATERIALS AND METHODS

Participants

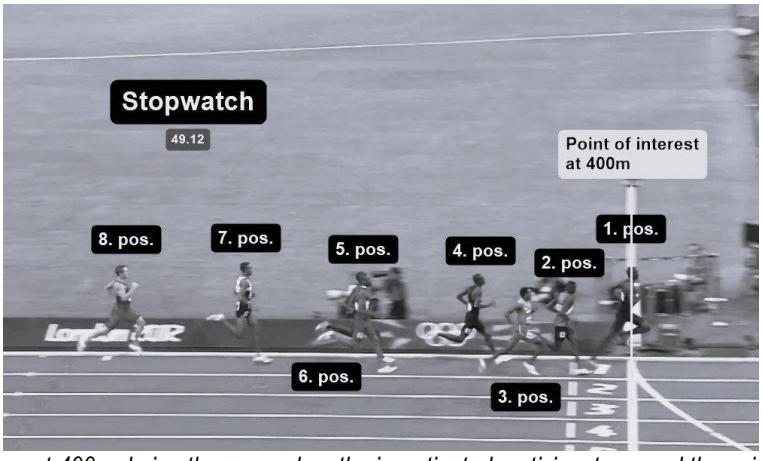
All-time best male 800m runners (n=80) were investigated in the study. The athletes were classed by their collateral 400m and/or 1500m results into three subgroups: speed type (ST - fast 400m performance: WA score points ≥ 1150 [45.43 s], n=11), 800m specialist (SP - with no outstanding performance neither in 400m, nor in 1500m: WA score points ≤ 1150, n=40), and endurance type (ET - fast 1500m performance: WA score points ≥ 1150 [3:36.82], n=23). Those athletes, who possess no documented results neither in 400m nor in 1500m (n=6) were classed into the SP group. This study was conducted with accordance the latest version of the declaration of Helsinki, and the local ethical committee of the Hungarian University of Sports Science approved it (TE-KEB/08/2024).

Data collection

All athletes' personal best (PB) in 400m, 800m, and 1500m were obtained. The individual time results of the corresponding races were extracted from the official database of the World Athletics (https://worldathletics.org/athletes) which is publicly available. The time results were converted into WA score points for easier calculation.

Video analysis

To obtain positional and split time data during the races video analysis was performed using Kinovea video software (v.0.9.5, http://www.kinovea.org/). In 11 cases out of 67 we couldn't find publicly accessible online video format on the personal best result in any shared platforms, therefore we analysed the second-best race of the athlete. The remaining 13 runners had no video records on their best or second-best performance thus, they were excluded from the video analysis.



Note. The image was taken at 400m during the race, when the investigated participant crossed the point of interest (400m). The duration of the 400m was measured via stopwatch tool in Kinovea which was initiated at the beginning of the race. Position was determined in relation to the other runners.

Figure 1. Example image from the video analysis.

The timer tool in Kinovea was used to measure the split time at each 200m. When the runner's chest crossed the 200m, 400m and 600m line we stopped the timer and check the video from frame to frame to make sure

when the point of interest was reached. Position was defined in relation to the number of runners in front of and behind of the examined runner (Figure 1). Takeover was only registered when the runner was clearly ahead of another runner. Positional data was only observed at the 200-400-600m and the final placement was also included in the calculations. In 13 cases the position or time was not definable at all measurement during the races which led to some missing details in the video analysis.

Statistics

The normal distribution of the data was checked with the Shapiro–Wilk normality test. To investigate if there is any difference in 200 and 400m split times between the tree groups, we used a one-way ANOVA test, and if there was a relevant group effect then the Bonferroni post hoc test was used. In the case of the positional data Kruskal Wallis test with Dunn's post hoc test was used. To analyse the association between spatial tactical parameters a Pearson correlation was used while for positional data Spearmen rank correlation was used. The magnitude of significant correlations between time and positional variables was quantified using the thresholds recommended by Hopkins (Hopkins et al., 2009), i.e., 0–0.1 as small, 0.1–0.3 as moderate, 0.3–0.5 as large, 0.5–0.7 as very large and 0.9–1 as extremely large correlation. Statistical calculations were performed in GraphPad (Prism Inc., California, USA v. 9), and alpha level was set for 5%.

RESULTS

Collateral PB data

SP group has statistically faster mean 400m PB than ET group (p = .0013), but no difference was found in the mean 1500m results between ST and SP group. Also, no significant difference in 800m PB were found within the groups (Table 1).

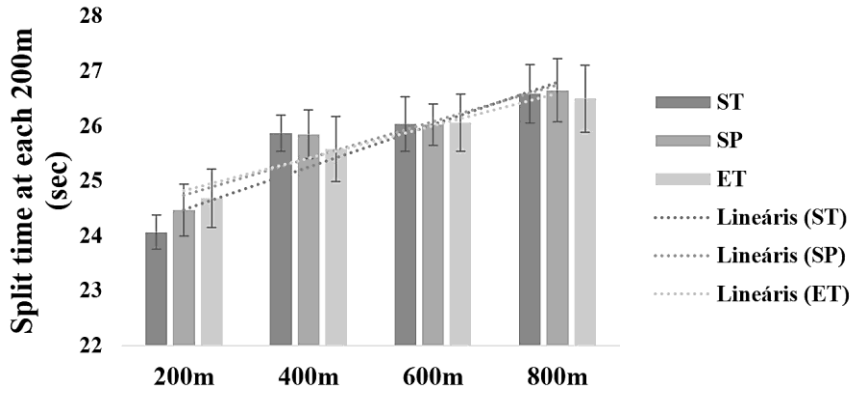
Table 1. Mean ± SD collateral PBs and intermediate split time and positional data by 200m of the three groups during the races.

Groups	ST	800 SP	ET
800m PB (s)	1:42.61 ± 0.7	1:42.96 ± 0.4	1:42.83 ± 0.4
400m PB (s)	45.00 ± 0.4[b, c]	46.77 ± 0.8[a, c]	47.99 ± 0.8[a, b]
1500m PB (s)	3:41.91 ± 5.3[c]	3:42.20 ± 5.0[c]	3:31.83 ± 2.8[a, b]
200m split time (s)	24.06 ± 0.3[c]	24.46 ± 0.4	24.68 ± 0.5[a]
400m split time (s)	49.90 ± 0.5	50.31 ± 0.6	50.26 ± 0.6
600m split time (s)	1:15.96 ± 0.9	1:16.33 ± 0.7	1:16.32 ± 0.8
800m final time (s)	1:42.62 ± 0.7	1:42.99 ± 0.4	1:42.90 ± 0.5
200m position	2.9 ± 1.5[b, c]	5.1 ± 2.7[a]	5.3 ± 2.5[a]
400m position	2.7 ± 1.2[b, c]	4.8 ± 2.5[a]	4.9 ± 2.3[a]
600m position	1.8 ± 1.2[b, c]	3.3 ± 2.1[a]	3.6 ± 2.1[a]
800m position	1.5 ± 1.0	2.3 ± 1.2	2.3 ± 1.4

Abbreviations: a: significantly different from ST; b: significantly different from 800SP; c: significantly different from ET.

Tactical behaviour (pacing and positioning)

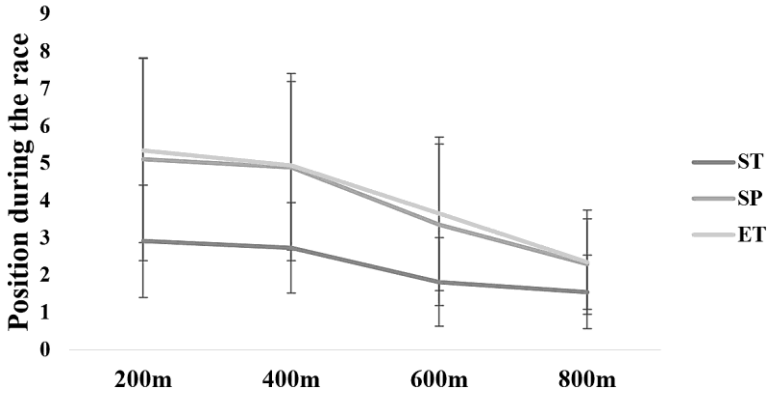
ANOVA test results showed a significant group effect on 200m split time (F=5.213, p=0.008). Post hoc test revealed a significantly faster 200m split time for ST compared to ET group (p=0.0056), but no statistical difference between the other comparisons. ANOVA test failed to detect significant effect on 400m (F=1.55, p=0.18), 600m split times (F=1.78, p=0.41) and 800m final time (F=2.17, p=0.12) (Figure 2).



Note. Light grey line represents the endurance trained group (ET), mild grey line represents the specialist group (800Sp) and the dark grey line represents the sprint trained group (ST). Horizontal black lines indicate the corresponding ±SD values. Dotted color matched lines demonstrate the decline in 200m time as increased duration indicate decreasing running speed. The steeper the slop of the dotted line the greater the decline in running speed.

Figure 2. Mean and ±SD spilt times for each 200m during the races.

Intragroup differences in 200m split times were found varied in each subgroup. The first 200m split time in ST runners were found significantly faster than the next three 200m ($F=53.83$, $p < 0.0001$), but no further significant time increasement were found between those ones. Each 200m split time in SP athletes were found significantly faster than the next one ($F=115.2$, $p < 0.0001$) except the second 200m split time did not differ from the third 200m split time ($p=0.252$). Similarly, to the other two groups, significantly faster first 200m were found in ET athletes compared to the next three 200m ($F=24.21$, $p < 0.0001$), but no further significant time increasement were detected between the next two consecutive 200m ($p=0.79$; $p=0.27$ respectively). Increased 200m split times (which indicate a speed decline) from 200m to 800m were found significantly less in ET than in ST athletes ($p=0.032$), but SP runners had no difference from the other two groups in this variable.

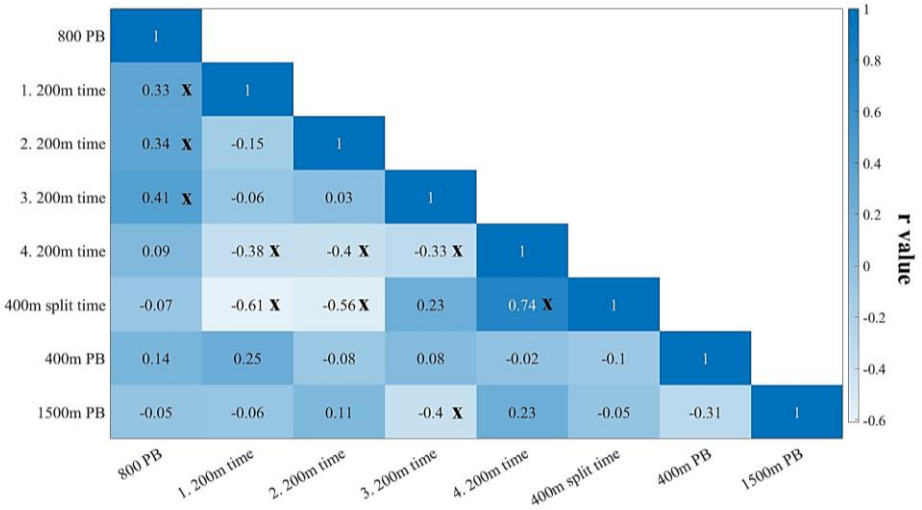


Note. Light grey line represents the endurance trained group (ET), mild grey line represents the specialist group (SP) and the dark grey line represents the sprint trained group (ST). Horizontal black lines indicate the corresponding ±SD values.

Figure 3. Mean and ±SD positional data of the three groups during the races.

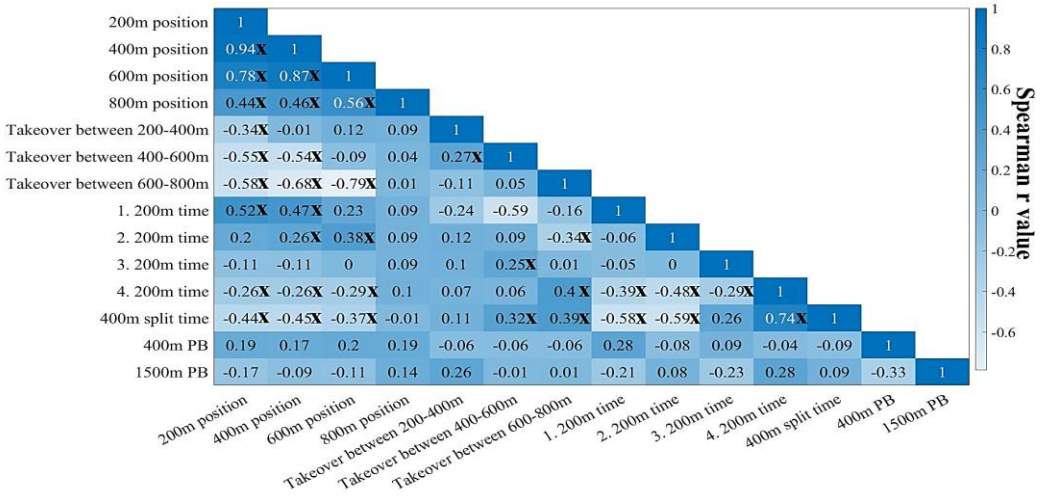
Significantly more forward intermediate field position was measured at 200m, 400m, and 600m in ST athletes compared to the SP and ET athletes respectively (200m ST vs. SP; $p=0.026$, ST vs. ET; $p=0.032$; 400m: ST vs. SP; $p=0.018$, ST vs. ET; $p=0.030$; 600m ST vs. SP; $p=0.034$; ST vs. ET; $p=0.019$). However, no statistical

differences in the final position at 800m was shown between the three subgroups. Also, no statistical difference in intermediate field positions between SP and ET runners were found throughout the race (Figure 3).



Note. Darker grey shade show positive and lighter grey shade negative correlations; colour saturation is proportional to the magnitude of the correlation. X beside the r values indicates significant correlations (p < 0.05).

Figure 4. Correlation matrix plot. Results of the Pearson correlation analysis.



Note. Darker grey shade show positive and lighter grey shade negative correlations; colour saturation is proportional to the magnitude of the correlation. X beside the r values indicates significant correlations (p < 0.05).

Figure 5. Correlation matrix plot. Results of the Spearman rank correlation analysis.

Correlation with 800m performance in groups

It was revealed, that the first three 200m split times have a significant positive relationship with the 800m performance in total subjects (1st 200m: r = 0.33 200m p < 0.01; 2nd 200m: r = 0.34 p < 0.01; 3rd 200m: r = 0.41 p < 0.001). However, no correlation between the split time of the last 200m and the final result were found. In ST athletes the split time of the 1st and 3rd, in SP runners the split time of the 2nd and 3rd 200m were in positive correlation with the 800m result (ST r = 0.65 p < 0.05; r = 0.71 p < 0.01; SP r = 0.35 p < 0.05; r = 0.48 p < 0.001 respectively). In ET group no significant correlation between the single 200 split times and

the final result were found. Out of the four 200m speed values, the third 200m were found in the strongest relationship with the final 800m result in total subjects ($r = 0.41$, $p < 0.001$) (Figure 4).

Significant positive correlation between field position at 200m, 400m, 600m and the final performance were found only in case of ET runners (200m $r = 0.66$ $p < 0.01$; 400m $r = 0.64$ $p < 0.01$; 600m $r = 0.54$ $p < 0.05$). No significant relationship between changing of field position during the race and 800m performance were found in groups (Figure 5).

DISCUSSION

Tactical behaviour

The main aim of this research was revealing type specific characteristics in tactical behaviour (pacing and positioning during the race) of all-time best male 800m runners. Beyond that, it was examined which pace and positional variables are in an associative relationship with top-level 800m result. Classification of 800m runners as ST, SP and ET athletes has been a prevailing approach in recent studies (Gamboa, 1996; Sandford & Stellingwerff, 2019). It was found that this categorization of elite male 800m runners is evidently manifested in race tactic differences between the subgroups. We have no doubtless knowledge whether these race tactics are intentionally planned and executed or habitually occurred, but we prefer the idea, that coaches and runners are choosing the tactics based on their dominant physical abilities (ST, SP, ET). Race tactics in middle distance running as a performance determinative factor has always been the subject of interest. Studies, revealing differences in tactical behaviour are commonly focussing on the variant characteristics of record and winning tactics (Hanley et al., 2019; Kelemen, 2023; Sandford et al., 2018; Thiel et al., 2012). These findings revealed, that record tactics in 800m is mostly accompanied with a beneficial pacing of 2-3 second positive split between the two 400m (Hanon & Thomas, 2011; Reardon, 2013b), while winning tactics is usually characterized by a less, or occasionally negative split time. Since the current study analysed the best eighty 800m time performances achieved mostly in Grand Prix races, it had been presumed that it would provide information on record tactics rather than winning tactics. Paragraph: use this for the first paragraph in a section, or to continue after an extract.

Since ST runners had nearly 0.3 second faster mean time in all-time best 800m races and 0.8 place more forward mean position at the end of these races (table 1.), it suggests, that possessing a relatively high sustainable speed correlates with top level 800m efficiency. This finding is in good alignment with recent works which revealed strong correlation between anaerobic speed reserve and 800m performance (Sandford, Allen, et al., 2019; Sandford, Kilding, et al., 2019).

It was demonstrated that ST athletes are more disposed to start faster and taking a more forward place at the beginning of the race (Hanon & Thomas, 2011). On the other hand it was also found that the greatest speed decline occurs in the second 200m in all groups with a significantly higher value in ST runners compared to the other two groups (table 1), which indicates that this early high speed in ST group is probably aiming a better position taking, and not a fast pacing throughout the whole distance. Whether this fast start and sudden speed drop is a tactical decision or coming instinctively, could be a subject of further investigations.

The significantly slower first 200m and less total speed decline from 200-800m in ET athletes, than in ST group indicates that using a more even pace throughout the race can be more suitable for endurance based elite 800m runners.

It is further supported by our findings in the positional data with a significantly more rear position in ET and SP as in ST athletes till 600m (Figure 3.). Contrary to the significant differences in intermediate field positions, the moving inside the field during the race (number of overtakes) were not found varied between the subgroups. Nevertheless, the greatest activity in overtaking were found in the third 200m in all athletes. Considering this, and the fact, that significantly lower speed decline was found in the third 200m compared to the other 200m sections in all three groups, but especially in ST and SP runners, suggest that the 400-600m race segment is probably the most critical in top level male 800m racing.

Limitations

The methodology used in this study has limitations that must be addressed. The quality of the video records was not all high definition, and the frame rate was also varied which influenced the accuracy of the video analysis. To increase the reliability of the measurements all races which were included in the analysis were measured two times separately by two authors. When there was a difference in measurement data then the video records were checked by two authors and a consensus was made about key video frame which from time and positional data was acquired. We are aware, that the runners of the subgroups are uneven in numbers, however, those numbers validly represent the athletes' distribution among the three groups in.

CONCLUSION

Our findings support that to develop tactical skill how to take a good position at the start and how to preserve energy for the final part of the race in ST athletes and how to maintain a relatively constant speed throughout the whole race in ET athletes seems productive in top level 800m racing. We concluded, that ST 800m runners might effectively operate with a faster start and more forward field position aimed at achieving an excellent time result. In a contrary, 800Sp, but especially ET runners can benefit more from a slower first 200m, followed by a more even pacing during the race. It was found that speed between 400-600m had the strongest positive relationship with 800m performance in all groups. In addition, most overtaking occurs in the same race segment, so we concluded that focussing on the 3rd 200m in top-level male 800m races can be beneficial.

AUTHOR CONTRIBUTIONS

Zsolt Gyimes: Conceptualization, data curation, investigation, visualization, writing – original draft, writing – review & editing. Bence Kelemen: Conceptualization, formal analysis, writing – original draft, writing – review & editing. Bálint Kovács: Formal analysis, software, writing – original draft, writing – review & editing.

SUPPORTING AGENCIES

No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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