

Are 800-m runners getting faster? Global competition performance trends between 1999 and 2021

KELEMEN BENCE¹, BENCZENLEITNER OTTO², TOTH LASZLO³

^{1,3} Department of Psychology and Sport Psychology, Hungarian University of Sport Science, Budapest, HUNGARY

² Department of Athletics, Hungarian University of Sport Science, Budapest, HUNGARY

Published online: September 30, 2022

(Accepted for publication September 15, 2022)

DOI:10.7752/jpes.2022.09284

Abstract

Research aim: The present study explored the trends in the global competition results of the 800-m event over the past two decades. The study tested the hypothesis that slow tactical racing has been less frequently pursued at the global competitions of the past years than previously. Materials and method: The sample included competitors participating in the World Championships and Olympic Games held between 1999 and 2021, including 16 men's events and 13 women's events ($N = 1000$). The data analysis focused on the results and seasonal bests (SB) of those proceeding from the two qualifying rounds by rank or result (Q; q) and of medal winners of the finals. Furthermore, the two indices were combined into a percentage SB index (%SB) for each participant. Mean comparisons between male and female competitors and between medal winners and non-winners were conducted with independent samples t -tests. The possible trends in the competitors' results were explored with polynomial trendlines fitted to the observed data. Results: Neither of the three indices showed an improving trend over the past two decades among either men or women. Those proceeding from the qualifying rounds and medal winners gradually approached their best performance in each round, reaching peak performance in the finals (%SB: Qualifying rounds: Men: $98.35 \pm 0.41\%$; Women: $98.31 \pm 0.80\%$; Semifinals: Men: $99.10 \pm 0.60\%$; Women: $99.52 \pm 0.89\%$; Finals: Men: $99.45 \pm 1.07\%$; Women: $100.04 \pm 1.07\%$). Conclusions: No improving trend is observable in performance at the global 800-m competitions of the past two decades. Competitors gradually approach their best performance in each round, reaching peak performance in the finals. This is probably due to the three-round procedure of global competitions held over the past two decades. In the finals, men are equally likely to pursue slow tactical racing (2000, 2009, 2021) and to achieve new records (1999, 2012, 2016, 2019), whereas women are less likely to engage in slow tactical racing (except in 2003 and 2005). All those competing in the finals possess highly equal skills, thus pursuing adequate racing tactics is indispensable for medal winning.

Keywords: athletics, global competition, performance trends, 800 meters

Introduction

The available empirical findings show that middle- and long-distance running performance has been rapidly increasing over the past years. This trend is further underlined by the ever higher qualification levels of recent global competitions. For example, while the minimum requirement for participating in the men's 5000-m event was 13:34.00 at the 2000 Sydney Olympics, the same requirement was elevated to 13:13.50 at the 2020 Olympic Games. For the men's and women's 800-m events, the qualification levels were respectively 2 and 3 seconds shorter in 2020 than in 2000 (www.worldathletics.org). This performance increase may in large part be due to recent technological developments such as tracks of ever improving quality, the so-called *light pacing system*, and running shoes manufactured with new technologies, which may contribute substantial performance increase for both track and road runners (Bermon et al., 2021). As pointed out by Wei and Liu (2019), however, the significant performance increase in athletics observed at the beginning of the past century has been followed by a long period of deceleration, particularly in middle-distance events. Performance predictions at a global competition level face several difficulties due to various influencing factors (Su, 2016; Béres, 2018).

Participants in global competitions proceed through several rounds including the qualifying rounds, semifinals, and finals. From the two qualifying rounds, the competitors ranking at the first two places (Q) and the fastest of the defeated competitors (q) proceed to the semifinals and then to the finals. Since all competitors converge into one lane after the first bend, reaching high average speed (7 to 8 m/s), the pursued racing tactics (pacing and positioning) is decisive in terms of competitive success (Renfree & Casado, 2018; González-Mohino et al., 2021; Hanley et al., 2019a). Competitors face even more serious challenges at global competitions (Olympic Games, World Championship), since they have to pursue an adequate strategy in both the short and

long term in order to meet the demands of serial workload (Hettinga et al., 2019). Specifically, they have to proceed through successive rounds, preferably by rank, while they also have to save energy for the finals, where they have to achieve their best performance. Several studies explored the pacing tactics pursued by runners achieving world records and new personal records at the 800-m event (Casado et al., 2021a; Filippas et al., 2018; Tucker et al., 2006; Kelemen et al., 2020). Most of these records are achieved by pacemakers at Grand Prix events, where it is a declared aim to complete the two laps within as short time as possible, thus new records are achieved by a fast start followed by a gradually decelerating pace (Casado et al., 2021b; Abbis et al., 2008; Filippas et al., 2018). By contrast, participants in the finals of global competitions typically pursue slow tactical racing primarily focused on achieving a desired rank rather than peak performance.

The competitors run at uneven paces due to frequent pace shifts, which results in longer running times (Calvo et al., 2015; Thiel et al., 2012; Kelemen et al., 2020). However, Sanford and colleagues revealed that medal winners of the 800-m event started at faster paces after 2011 (Sanford et al., 2017). Although most previous studies analyzing racing tactics at global competitions primarily focused on the finals, more recently published studies examined the qualification strategies that helped athletes proceed to the finals (Hanley et al., 2019b; Renfree et al., 2014;). We hypothesise that championship results and season best performances progressed during the last two decades. We also hypothesise that the athletes fall short of their season bests, due to the more tactical nature of championship 800 metre running.

Research Aims

The present study explored possible improving trends in the global competition results of the 800-m event over the past two decades, including medal winners' seasonal best results. Furthermore, the study explored possible differences across genders and rounds in competitors' average preference for slow tactical racing. Finally, the study explored how successful athletes strategically coped with the demands of serial workload through successive rounds.

Materials and Method

The sample included competitors participating in the World Athletics Championships and Olympic Games held between 1999 and 2021, including 16 men's events and 13 women's events ($N = 1000$). The data analysis focused on the results and seasonal bests (SB) of those proceeding from the qualifying rounds and the semifinals by rank or result (Q; q) and of medal winners of the finals. The data were downloaded from the homepage of World Athletics (www.worldathletics.org). Furthermore, the two indices were combined into a percentage SB index (%SB) for each participant, which was used as a measure of tactical racing in each round, the lower this number, the more tactical the run was. Possible differences between genders and rounds were tested with independent samples *t*-tests. The data analysis was conducted with the IBM SPSS v. 25 software package. Statistical significance was defined as $p < .05$. Performance trends were modeled with quartic polynomial regression equations, which provided the best fit with the data and thus the highest R^2 values. The trendlines were defined with the Microsoft Excel 2016 application.

Results

Men

Men's performance trends are presented in **Figure 1 to 3**. No improving trend was found in the results of qualifying round winners up until the three most recent global competitions. The average result of those proceeding from the qualifying rounds over the past two decades was $1:46.47 \pm 0.5$ seconds. The highest performance was required by the qualifying rounds of the 2021 Tokyo Olympics ($1:45.39 \pm 0.62$ sec), while a lower performance ($1:47.01 \pm 0.84$ sec) was sufficient at the 2015 Beijing World Championships. Among the three rounds, the polynomial model calculated for the qualifying rounds produced the largest R^2 value, which is due to the improving trend that emerged over the three most recent global competitions. The respective models calculated for the semifinals and finals explained negligible amounts of variance:

Qualifying rounds: $R^2 = .41$; *semifinals:* $R^2 = .12$; *finals:* $R^2 = .17$.

The performance levels required for entering the finals showed the highest consistency over the past two decades. The highest performance was required by the 2016 Olympic Games ($1:44.25 \pm 0.32$ sec), closely followed by the 2021 Olympics ($1:44.35 \pm 0.23$ sec).

In men's 800-m finals, the athletes were equally likely to engage in slow tactical racing (2000, 2007, 2009, 2015, 2021), earning medals with running times exceeding 1:45.00 and with low %SB values (< 99), and to achieve new world records, national records and personal records (%SB > 100 ; 1999, 2012, 2016, 2019). Neither increasing nor decreasing performance trends were revealed by the regression models calculated for the finals.

A significant difference was found between the results of those who advanced from the qualifying rounds ($M = 1:46.46 \pm 0.5$ sec) vs. from the semifinals ($M = 1:45.06 \pm 0.56$ sec, $t = 7.1052$, $p < .05$). No significant difference was found between the results of medal winners and those entering the finals.

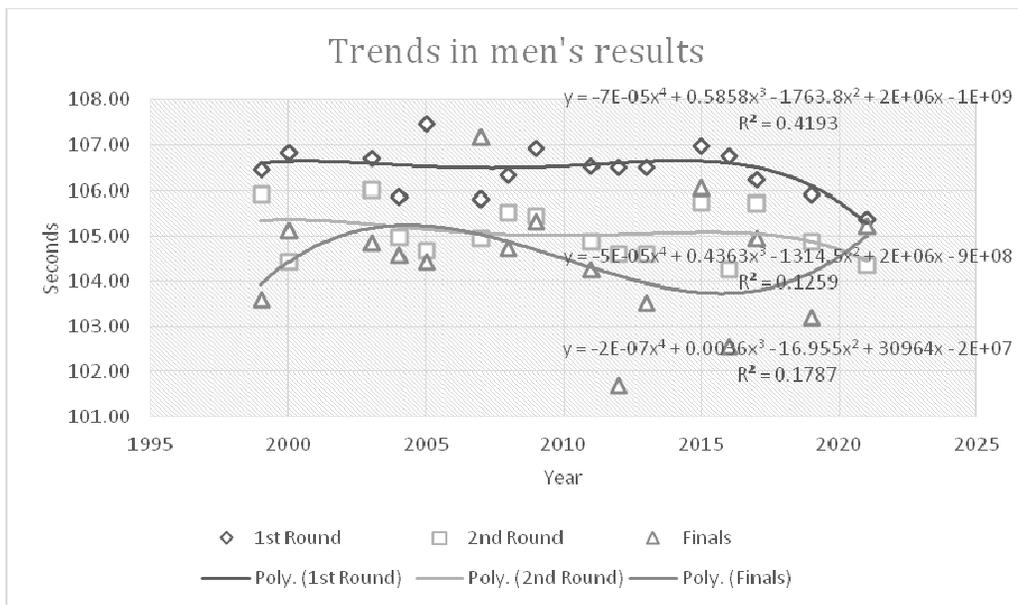


Figure 1 Trends in men's results in the 800 meters at global championships between 1999 and 2021.

Seasonal bests showed slightly improving trends over the past two decades, particularly among those entering the semifinals and finals (*qualifying rounds*: $R^2 = .50$; semifinals: $R^2 = .48$; finals: $R^2 = .31$). On average, the latter's seasonal best was $1:44.15 \pm 0.37$ seconds, while the former's was $1:43.82 \pm 0.61$ seconds.

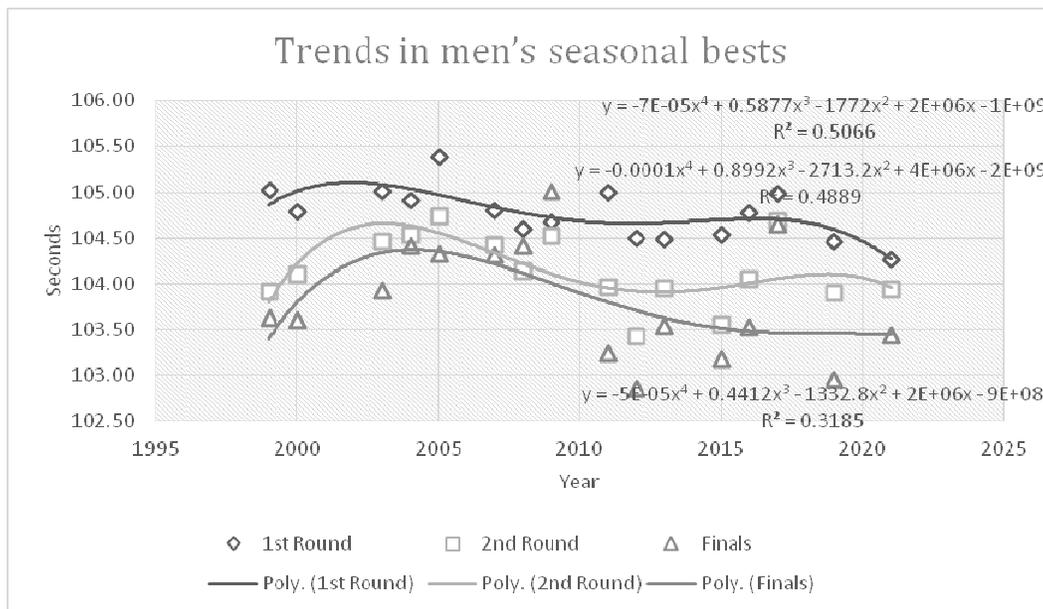


Figure 2 Trends in man's seasonal best performances in the 800 meters at world championships between 1999 and 2021.

A significant difference was observed in %SB between the qualifying rounds ($M = 98.40 \pm 0.41$) and the semifinals ($M = 99.13 \pm 0.58$, $t = 3,9365$, $p < .05$). Neither increasing nor decreasing performance trends were revealed by the regression models calculated for each round (*qualifying rounds*: $R^2 = .28$; semifinals: $R^2 = .19$; finals: $R^2 = .08$).

The largest *SD* was obtained for %SB in the finals ($\pm 1,06$), which is in line with the observation that male athletes participating in the 800-m event during the past two decades were equally likely to engage in slow tactical racing ($M = 97 \pm 0,13$ in 2007) and to achieve new records ($M = 101,12 \pm 0,34$ in 2012).

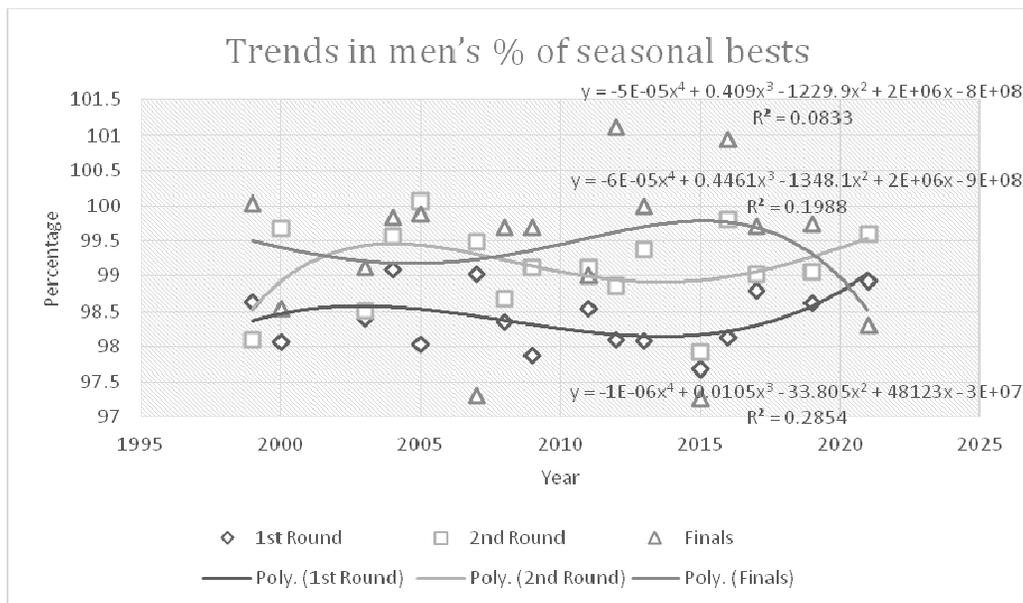


Figure 3 Trends in man's % of seasonal best performances in the 800 meters at world championships between 1999 and 2021.

Women

Women's performance trends are presented in **Figure 4 to 6**.

Similarly to men's results, no significant performance trends emerged over the past two decades in women's results at the 800-m event (qualifying rounds: $R^2 = .10$; semifinals: $R^2 = .32$; finals: $R^2 = .38$). The relatively high R^2 value obtained for the finals is due to the lower performance levels reached at two competitions held at the beginning of the 2000s ($M = 2:00.12 \pm 0.16$ sec in 2003 and $1:59.28 \pm 0.33$ sec in 2005), compared to which female athletes reached consistently higher performance levels subsequently.

Similarly to men's results, a significant difference was found in the results of female athletes advancing from the qualifying rounds ($M = 2:01.48 \pm 0.95$) vs. in the semifinals ($M = 1:58.96 \pm 0.67$, $t = 7.4538$, $p < .05$). Furthermore, a significant difference was also found between the results of the latter vs. medal winners ($1:57.21 \pm 1.30$, $t = 4.1296$, $p < .05$).

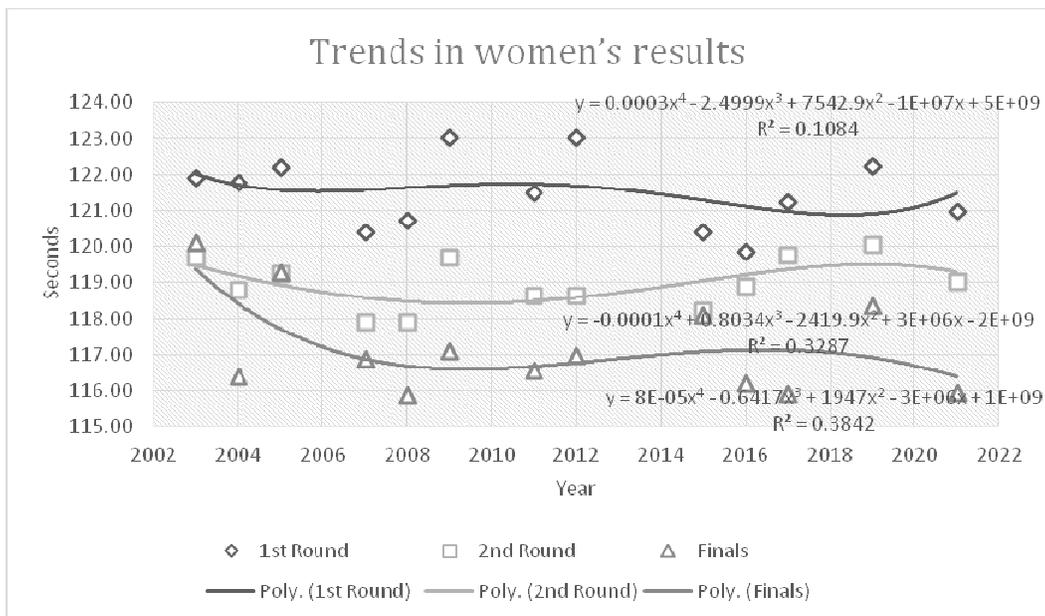


Figure 4 Trends in women's seasonal bests in the 800 meters at global championships between 2001 and 2022.

Women’s seasonal bests showed no significant trend over the past two decades, as reflected in the R^2 obtained for the three rounds, ranging from .18 to .60 ($M = 1:59.40 \pm 0.27$, $1:58.29 \pm 0.66$, and $1:57.36 \pm 0.77$ for those winning top ranks in the qualifying rounds, in the semifinals, and in the finals, respectively).

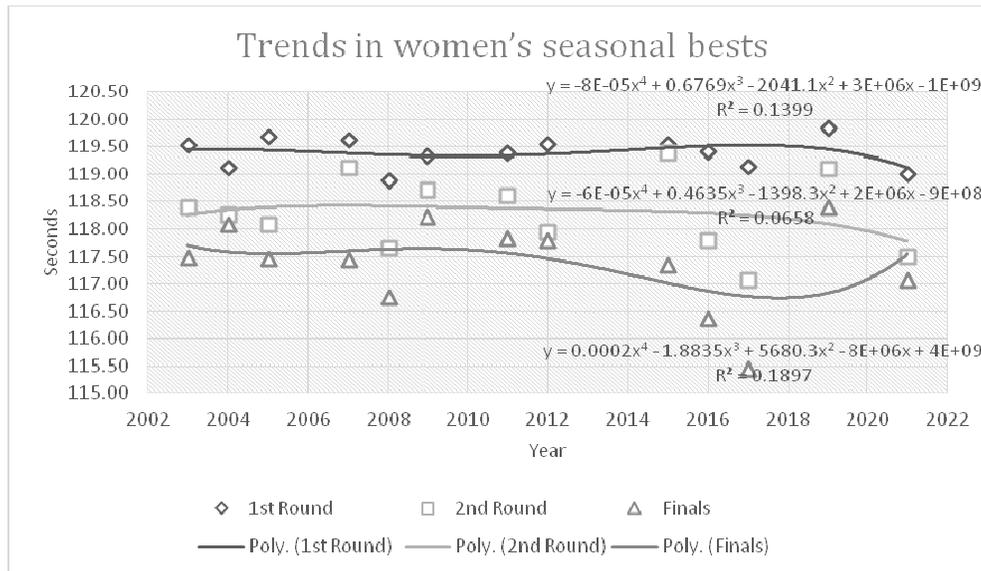


Figure 5 Trends in women’s seasonal bests in the 800 meters at global championships between 2001 and 2022.

No marked trend emerged in the %SBs of the qualifying rounds or the semifinals ($R^2 = .15$ and $.25$, respectively), while the %SBs of the finals showed a more substantial trend ($R^2 = .42$). Similarly to male athletes, female athletes showed consistently increasing performance round by round, in most cases exceeding their seasonal bests in the finals (qualifying rounds: 98.30 ± 0.74 ; semifinals: 99.44 ± 0.84 ; finals: 100.11 ± 1.02). However, while not less than 69% of female athletes achieved a new seasonal best in the finals, only 25% of male athletes did so.

Accordingly, the most striking gender difference in the preference for tactical racing was found in the results of the finals (Male: 99.39 ± 1.02 vs Female: 100.11 ± 1.06 %, $t = 1,7749$, $p < .05$). While male athletes were equally likely to engage in slow tactical racing and to reach peak performance, female athletes achieved new seasonal bests in almost all cases after 2005 except at two competitions where they only approached their best ($M = 99.36 \pm 0.25$ in 2015 and 99.61 ± 0.40 in 2017).

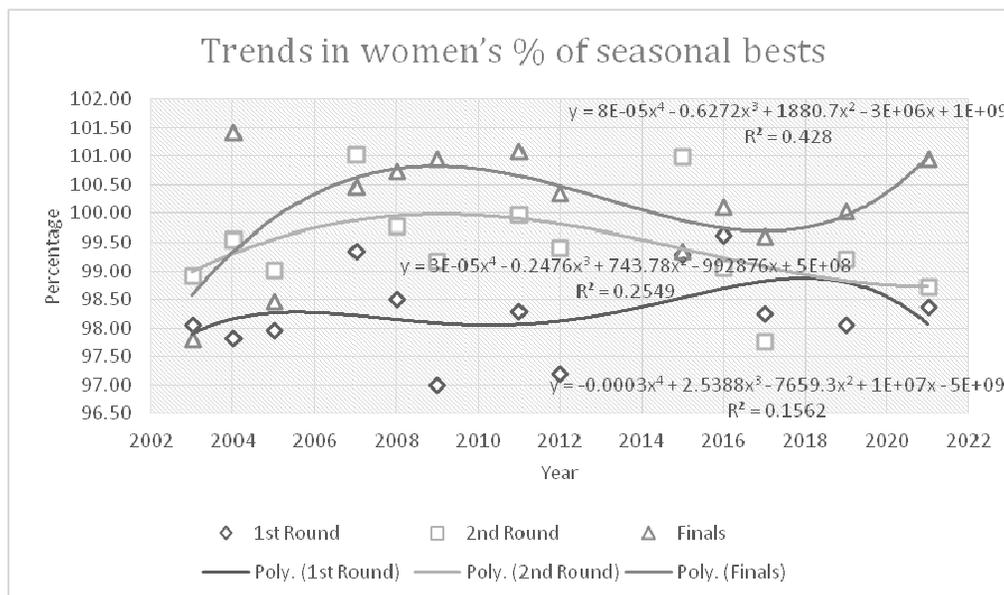


Figure 6 Trends in women’s % of seasonal best in the 800 meters at global championships between 2001 and 2022.

Discussion and Implications

The results of the present study did not confirm the expectation that 800-m runners had shown consistently increasing performance at global competitions over the past two decades. Male athletes showed a slightly improving trend across the qualifying rounds of three the most recent global competitions, whereas no comparable trend was obtained for either the semifinals or the finals. Nor female athletes showed an improving trend across either the qualifying rounds or the semifinals. Furthermore, female medal winners showed consistent performance levels in the finals, apart from two World Championships in the early 2000s where relatively low average performance was reached by women. A slightly increasing performance trend was observed over the past decade in the seasonal bests of male athletes winning in either of the three rounds, while no comparable trend was found for female athletes.

These latter findings are in line with the results reported by Wei and Liu (2019), who observed deceleration in middle-distance performance increase over the past decades.

The findings of the present study are also consistent with the previous finding that runners generally show lower performance levels at global competitions compared to Grand Prix competitions where new records are often achieved (Thiel et al., 2012; Hanley & Hettinga, 2018; Renfree et al., 2014). This difference is possibly explained by runners' uneven paces, frequent pace shifts, and serial workload characteristic to global competitions, which is supported by the finding that both male and female athletes proceeding from the first two rounds performed 98 to 99% of their seasonal bests, that is, they consistently pursued slow tactical racing (González-Mohino et al., 2020; Casado et al., 2020). While Sandford and colleagues (2018) observed that male 800-m runners presented fast starts and increasing performance at the finals of global competitions held between 2011 and 2018 (as opposed to the previous period), the findings of the present study show that this trend discontinued subsequently (between 2017 and 2021).

In general, the results of men's 800-m finals are hard to predict (Liu et al., 2012; Béres, 2018), since slow tactical racing and achieving new records are equally likely, depending on the composition of the specific group of competitors. Participation of a so-called front runner in the final has a large impact on the overall results, which observation is clearly supported by the participation and victory of Kenyan world recorder David Rudisha in the finals of both global competitions that produced the highest average performance in a final over the past two decades (2012, 2016). The most interesting gender difference was found in the results of the finals over the past one and a half decades (after 2005), which show that women as opposed to men are highly likely to achieve new seasonal bests in the final. The present study provides an insight into the special tactical requirements that athletes face in a multi-round global competition, enabling athletes and coaches to prepare purposefully during training and mental preparation.

Conclusions

The qualifying rounds and semifinals of global competitions are characterized by slow tactical racing. Successful athletes are able to evenly allocate their capacity to successive rounds in order to achieve their best performance in the final. This characteristic pattern of effort investment is probably due to the three-round procedure of global competitions held over the past two decades. In the finals, men are equally likely to pursue slow tactical racing (2000, 2009, 2021) and to achieve new records (1999, 2012, 2016, 2019), whereas women are less likely to engage in slow tactical racing (except in 2003 and 2005). All those competing in the finals possess highly equal skills, thus pursuing adequate racing tactics is indispensable for medal winning. While no significant increasing performance trend is observable in the 800-m results of the global competitions held over the past two decades, male runners showed consistently improving seasonal bests over the past decade.

Disclosure statement

The authors report there are no competing interests to declare.

References

- Abbiss, C. R., & Laursen, P. B. (2008). Describing and understanding pacing strategies during athletic competition. *Sports Medicine (Auckland, NZ)*, 38(3), 239–252. <https://doi.org/10.2165/00007256-200838030-00004>
- Amo, J., Planas-Anzano, A., Zakythinaki, M., & Ospina-Betancurt, J. (2021). Effort distribution analysis for the 800 m race: IAAF World Athletics Championships, London 2017 and Birmingham 2018. *Biomedical Human Kinetics*, 13(1), 103–110. <https://doi.org/10.2478/bhk-2021-0013>
- Béres, S. (2018). The trends of best results of sprint and jumping events of Track and Field World Championships (1983-2017). *Testnevelés, Sport, Tudomány*, 3(1-2), 33–44. <https://doi.org/10.21846/TST.2018.1-2.4>
- Bermon, S., Garrandes, F., Szabo, A., Berkovics, I., & Adami, P. E. (2021). Effect of advanced shoe technology on the evolution of road race times in male and female elite runners. *Frontiers in Sports and Active Living*, 3, Article 653173. <https://doi.org/10.3389/fspor.2021.653173>
- Casado, A., & Renfree, A. (2018). Fortune favors the brave: Tactical behaviors in the middle-distance running events at the 2017 IAAF World Championships. *International Journal of Sports Physiology and Performance*, 13(10), 1386–1391. <https://doi.org/10.1123/ijsp.2018-0055>

- Casado, A., Hanley, B., Jiménez-Reyes, P., & Renfree, A. (2021a). Pacing profiles and tactical behaviors of elite runners. *Journal of Sport and Health Science*, 10(5), 537–549. <https://doi.org/10.1016/j.jshs.2020.06.011>
- Casado, Arturo & González-Mohino, Fernando & Gonzalez Rave, Jose Maria & Boullosa, Daniel. (2021b). Pacing Profiles of Middle-Distance Running World Records in Men and Women. *International Journal of Environmental Research and Public Health*. 18. 12589. 10.3390/ijerph182312589.
- Casado, Arturo & Renfree, Andrew & Maroto-Sánchez, Beatriz & Hanley, Brian. (2020). Individual performances relative to season bests in major track running championship races are distance-, position- and sex-dependent. 44. 146-161. 10.21134/eurjhm.2020.44.526.
- Filipas, L., Nerli Ballati, E., Bonato, M., La Torre, A., & Piacentini, M. F. (2018). Elite male and female 800-m runners' display of different pacing strategies during season-best performances. *International Journal of Sports Physiology and Performance*, 13(10), 1344–1348. <https://doi.org/10.1123/ijsp.2018-0137>
- González-Mohino, Fernando & Casado, Arturo & Renfree, Andrew & Gonzalez Rave, Jose Maria & Hanley, Brian. (2021). The influence of running wide on the bend on finishing times and positions in men's and women's 800 m finals at major global championships. *Kinesiology*. 53. 280-287. 10.26582/k.53.2.13.
- González-Mohino, Fernando & Santos del Cerro, Jesus & Renfree, Andrew & Yustres Amores, Inma & Gonzalez Rave, Jose Maria. (2020). The Relationship Between Tactical Positioning and the Race Outcome in 800-M Running at the 2016 Olympic Games and 2017 IAAF World Championship. *Journal of Human Kinetics*. 71. 299-305. 10.2478/hukin-2019-0090.
- Hanley, B., & Hettinga, F. J. (2018). Champions are racers, not pacers: An analysis of qualification patterns of Olympic and IAAF World Championship middle distance runners. *Journal of Sports Sciences*, 36(22), 2614–2620. <https://doi.org/10.1080/02640414.2018.1472200>
- Hanley, B., Stellingwerff, T., & Hettinga, F. J. (2019a). Successful pacing profiles of Olympic and IAAF World Championship middle-distance runners across qualifying rounds and finals. *International Journal of Sports Physiology and Performance*, 14(7), 894–901. <https://doi.org/10.1123/ijsp.2018-0742>
- Hanley, Brian & Casado, Arturo & Renfree, Andrew. (2019b). Lane and Heat Draw Have Little Effect on Placings and Progression in Olympic and IAAF World Championship 800 m Running. *Frontiers in Sports and Active Living*. 1. 19. 10.3389/fspor.2019.00019.
- Hettinga, Florentina & Edwards, Andrew & Hanley, Brian. (2019). The Science Behind Competition and Winning in Athletics: Using World-Level Competition Data to Explore Pacing and Tactics. *Frontiers in Sports and Active Living*. 1. 10.3389/fspor.2019.00011.
- Kelemen, B., Béres, S., Szalma, L., & Gyimes, Z. (2020). Férfi középtávfutás versenytaktikai szempontú összehasonlítása [A comparative analysis of male middle-distance track events in tactical terms]. *Magyar Sporttudományi Szemle*, 21(85), 58–59.
- Liu, Y., & Schutz, R. W. (1998). Prediction models for track and field performances. *Measurement in Physical Education and Exercise Science*, 2(4), 205–223. https://doi.org/10.1207/s15327841mpee0204_2
- Liu, Yuanlong & Paul, Stanley & fu, Frank. (2012). Accomplishments and Compromises in Prediction Research for World Records and Best Performances in Track and Field and Swimming. *Measurement in Physical Education and Exercise Science*. 16. 167-182. 10.1080/1091367X.2012.700252.
- Renfree, A., Mytton, G. J., Skorski, S., & St Clair Gibson, A. (2014). Tactical considerations in the middle-distance running events at the 2012 Olympic Games: a case study. *International Journal of Sports Physiology and Performance*, 9(2), 362–364. <https://doi.org/10.1123/ijsp.2013-0020>
- Renfree, Andrew & Casado, Arturo. (2018). Athletic Races Represent Complex Systems, and Pacing Behavior Should Be Viewed as an Emergent Phenomenon. *Frontiers in Physiology*. 9. 10.3389/fphys.2018.01432.
- Sandford, G. N., Pearson, S., Allen, S. V., Malcata, R. M., Kilding, A. E., Ross, A., & Laursen, P. B. (2018). Tactical behaviors in men's 800-m Olympic and World-Championship medalists: A changing of the guard. *International Journal of Sports Physiology and Performance*, 13(2), 246–249. <https://doi.org/10.1123/ijsp.2016-0780>
- Su, R. (2016): Track and field athletics performance prediction using layered condensed and temporal gradient similarity. *International Journal of Simulation: Systems, Science & Technology*, 17(42), 1–5. <https://doi.org/10.5013/IJSSST.a.17.42.25>
- Thiel, C., Foster, C., Banzer, W., & De Koning, J. (2012). Pacing in Olympic track races: competitive tactics versus best performance strategy. *Journal of Sports Sciences*, 30(11), 1107–1115. <https://doi.org/10.1080/02640414.2012.701759>
- Tucker, R., Lambert, M. I., & Noakes, T. D. (2006). An analysis of pacing strategies during men's world-record performances in track athletics. *International Journal of Sports Physiology and Performance*, 1(3), 233–245. <https://doi.org/10.1123/ijsp.1.3.233>
- Wei, R., & Liu, Y. (2019). Examination of athletic best performance trends in track and field over one hundred years' history. *The Sport Journal*, 21. Retrieved April 14, 2022, from <https://thesportjournal.org/article/examination-of-athletic-best-performance-trends-in-track-and-field-over-one-hundred-years-history>