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The Effect of Record Versus Rank Competition on the Performance of Male Marathoners

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Abstract

We examined the performance differences in elite male marathoners when competing for record times versus ranks. Data of the top 300 male marathoners in 2019 were obtained from the World Athletics website for comparison and analysis. All competitions approved by the World Athletics were rated in the order of OW, GL, A, B, C, D, E, and F. Time comparisons were performed using one-way ANOVA and then the Bonferroni post-hoc test. Higher-grade competitions consist of top athletes with competitive qualifying record whose central motivation is to achieve the best records. Lower-grade competitions are often preliminary measures of qualification for larger competitions, motivating athletes to compete for ranks rather than records. The average time difference for each competition was statistically significant. GL's average time was the fastest at 2:13:42 (±00:03:15). From A to F, the average finishing time tended to increase from 2:09:51 (±00:03:27) to 2:14:48 (±00:03:24). The average end time at F was the slowest at 2:14:48 (±00:03:24). When comparing the athletes' relative performance, the times for large international competitions, such as GL, A, and B, were also faster than smaller competitions, such as E and F ($p<0.05$). These results are interpreted to mean that competing to achieve record times is better for marathon performance than competing for ranks.

Key words: marathon, athletic performance, record competition, rank competition, performance analysis

Introduction

On October 12, 2019, Kenyan marathoner and Olympic gold medalist Eliud Kipchoge broke down a two-hour barrier known to be the human limit at the INEOS 1:59 Challenge (INEOS, 2021). This historical feat was made possible partly due to the INEOS team having optimized several factors that affect marathon performance. According to the INEOS website (www.ineos159challenge.com), factors that affect performance, such as running formation, accurate pace control, weather, and course selection, were controlled to create optimal running conditions. World-class

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marathoners served as pacemakers and ran in formation to minimize air resistance for Kipchoge, who followed behind. The specially developed electric car also played an important role in pace control. Accurate pacing must be provided in long-distance running events such as marathons since even a slight variation in speed results in a significant difference over the span of two hours. Since humans cannot provide such an accurate pace, the INEOS team developed an electric car with enough precision to help Kipchoge finish within one second of the goal. It also shot lasers on the ground to help pacemakers keep accurate positions that minimize air resistance. Adverse temperatures and humidity levels require additional energy to be consumed by the athlete to maintain body temperature, while precipitation can wet athletes' attire, expediting their exhaustion. Therefore, data analysis experts analyzed 15 years of weather data to select the best location for the event. The course was selected within the International Association of Athletics Federation's rules, with optimal altitude, wide turning radii, and even surfaces; the length of the course was measured to be less than 2cm longer than 42.195km by a sophisticated GPS device. This challenge sparked the interest of many sports professionals as it demonstrated the value of determining and adjusting the factors that affect performance.

The INEOS 1:59 Challenge demonstrates that the slightest adjustments can have profound effects. This study examined another factor that may significantly affect marathon performance: whether the race is a record or a rank competition. Prior studies have suggested that there are competitions in which participating marathoners perform better compared to other competitions (Scheer et al., 2021). However, there has thus far been a lack of samples and data analysis methods to draw conclusions about the types of competition. There have also been unsubstantiated claims that participating in rank competitions hinders marathoners from improving their records. As a result, this study was the first to scientifically verify such claims through data analysis. Unlike previous studies that only conducted simple record comparisons on female marathoners (Ryoo et al., 2021), our study comparatively analyzed the season's best and personal best records of the top 300 male marathoners in 2019 for a more comprehensive analysis.

Methods

The top 300 records of male marathoners in 2019 were obtained from the World Athletics website (www.worldathletics.org) and used for the present study. The number of athletes by nationality is presented in Table 1. The categorized competitions only include those approved by World Athletics. The categories are set in the order of OW, GL, A, B, C, D, E, and F, depending on the number of participants and their competitiveness. OW is the highest-class competition, including the Olympic Games and the World Championships. The next class, GL, includes the European Athletics Championships and the IAAF Gold Label Marathons, such as the Boston Marathon, Berlin Marathon, and Chicago Marathon. A includes the African Games, Asian Games, Commonwealth Games, Pan American Games, and IAAF silver label marathons. B includes IAAF bronze label marathon competitions and national competitions. C includes the IAAF World

Table 1. Number of athletes by nationality

Nationality	Number of athletes	Percentage of total
KEN	115	38.33%
ETH	86	28.67%
JPN	21	7.00%
ERI	9	3.00%
MAR	8	2.67%
BRN	7	2.33%
UGA	7	2.33%
ESP	6	2.00%
USA	5	1.67%
Others	36	12%
Total	300	100%

Athletics Series, third-tier, and other regional competitions and championships. D includes other regional international championships, games and cups, and fourth-tier championships. F includes other international marathons, while E includes national competitions.

Higher-grade competitions consist of top athletes whose primary goal is to achieve record times. In contrast, athletes compete in lower-grade competitions to qualify for larger competitions, motivating them to compete for ranks rather than achieving record times. Among the 633 competitions that the top 300 athletes participated in, 38 were excluded. One was an informal competition (Kipchoge's INEOS project), while the other 37 records were DNF. Category C was excluded from analyses because there were only two data records. Therefore, the total number of competitions analyzed was 593.

The data are presented as means (± standard deviation). The results of the races were collectively converted to 'seconds' for statistical analysis. Brown-Forsythe and Welch ANOVA tests were used to analyze the performance differences of marathoners by category. Games-Howell *post-hoc* test was used to correct for multiple comparisons. In order to compare relative performance, each runner's record was divided by the season's best record. Additionally, it was also divided by the runner's personal best record. The average performance in each category was analyzed, and a t-test was conducted to compare the difference in the record of the same runner by the marathon category. The statistical significance of the mean difference was set to $\alpha = 0.05$ (Hopkins et al., 2009). SPSS (v25, IBM) was used for analysis, and visualized statistics were obtained using Graph-Pad Prism software (v9, GraphPad software).

Results

Among the top 300 runners, the absolute number of participants in the different competition categories, as well as the relative distribution of participation (in percentages), were as follows: 13(3.17%) participated in OW, 241(58.78%) participated in GL, 39(9.51%) participated in A, 38(9.27%) participated in B, 2(0.49%) participated in C, 70(17.07%) participated in E, and 7(1.71%) participated in F.

The average time of male marathoners ranked in the top 300 by competition category is shown in Figure 1A. The average time in GL [2:08:57 (±0:03:32)] was the fastest. Average times showed a tendency to become progressively slower from 2:09:22 (±0:02:43) in A to 2:15:49 (±0:03:49) in F. The difference in the average times for each category was statistically significant ($p<0.05$).

There were two relative performances. The first relative performance (SB; Season's Best) was the record of each competitor divided by their season's best record. The second relative performance (PB; Personal Best) was the record of each player divided by their personal best record. The relative performance (SB) of GL was 0.000 (±1.012). From A to F, the relative performance tended to increase from 1.011 (±0.017) to 1.062 (±0.036) (Figure 1B). The relative performance (PB) in GL was 1.018 (±0.024). From A to F, relative performance tended to increase from 1.018 (±0.024) to 1.067 (±0.033) (Figure 1C). The difference in the average relative performance (both SB and PB) of the male marathoners for each competition category was statistically significant ($p<0.05$).

Discussion

This study aimed to examine the performance differences in male marathoners when competing for ranks versus competing for records. The difference between average and relative records in each competition category was identified. Key findings include the following: (a) There was a difference in the completion time for each category of competition, and the highest-performing competitors tended to participate in large international competitions such as GL. (b) OW had the slowest average completion times among the

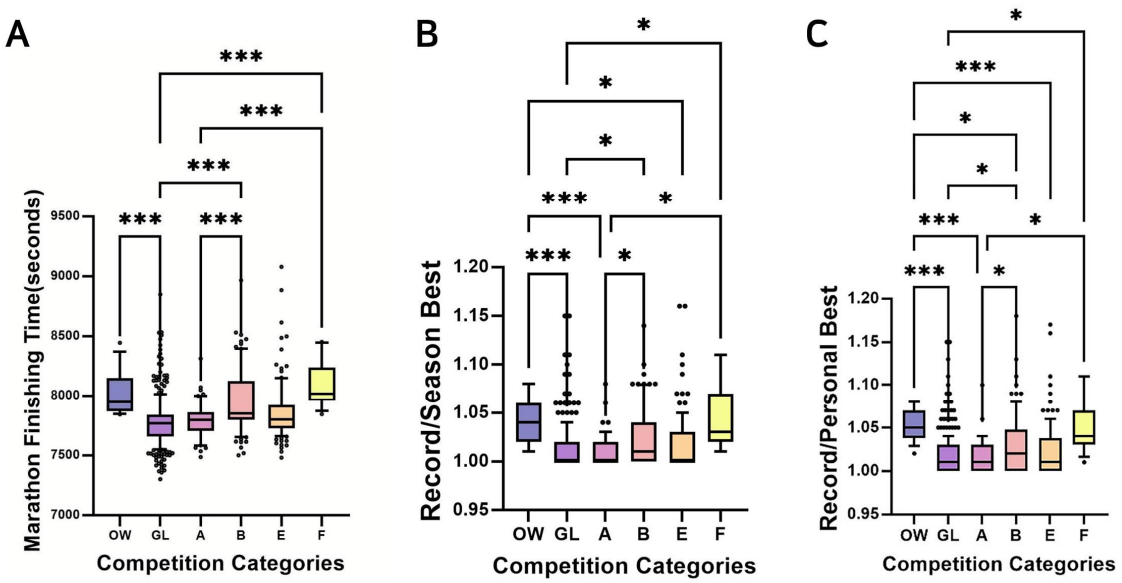


Figure 1. *Box plot comparing marathon finishing times (A), the relative performance of season best (B), and relative performance of personal best (C) of the top 300 male athletes for each category. (Boxes indicate the 25th and 75th percentiles. Whiskers indicate the 10th and 90th percentiles with the middle horizontal line representing the mean. The outliers are indicated by black dots. Of the total 593 race results, 18 were OW, 317 were GL, 51 were A, 80 were B, 12 were E, and 15 were F. OW includes Olympic games and world championships, GL includes IAAF gold label marathons and area senior outdoor championships, A includes major games and IAAF silver label marathons, B includes IAAF bronze label marathons, C includes IAAF world athletics series and area third tier championships, E includes other international marathons, and F includes national competitions. *Significantly different, p<0.05; **Significantly different, p<0.01; ***Significantly different, p<0.001.)*

marathon categories, while GL had the fastest. (c) The relative performances of male marathon runners were better when participating in competitions corresponding to GL, A, B, and C than in competitions corresponding to E or F.

Our research is the first to analyze whether marathoners' records vary depending on whether they participated in competitions for records (record competition) or better rankings (rank competition). Since a marathon is a highly demanding road race, major and seemingly minor factors can significantly affect an athlete's performance over the course of more than two hours (Kim et al., 2010). Thus, many previous studies have focused on such factors, including body composition (Zouhal et al., 2011), physical abilities, such as cardiopulmonary function and lactate threshold (Noble et al., 1979; Tanaka & Matsuura, 1984), environmental factors, such as temperature and humidity (Knechtle et al., 2019; Vihma, 2010), training methods (Hamstra-Wright et al., 2013), psychological factors (Sin et al., 2015; Stellingwerf, 2012), and strategies such as pace control (Diaz et al., 2018; Diaz et al., 2019). The excellent marathon performances by East African athletes may be attributed to factors such as high VO_2 max from lifelong running, high hematocrit levels, quality nutritional intake from traditional diets, anatomical advantages, as well as economic motivation (Eichner, 2015; Marc et al., 2014; Wilber & Pitsiladis, 2012). Factors affecting marathon performance include internal factors such as physique, fitness, and psychological state, as well as external factors such as coaching, team management, support systems, and the

type of competition (Kim et al., 2010). One representative study demonstrated that genetic factors also affect marathon performance (Puthucheary et al., 2011). Among 14 genes, 16 single nucleotide polymorphisms were shown to be associated with marathon performance (Moir et al., 2019).

Additionally, several studies in the past have focused on analyzing athletes' world records or personal best records of major marathon events such as the Boston, New York, Berlin, and Chicago marathons (Maffetone et al., 2017). However, this study was the first to analyze all the marathon categories that the top 300 male marathoners participated in during 2019.

Experts argue that providing an environment where athletes compete for records contributes to short-term performance improvements. However, there is little scientific evidence to support this argument. Participating in record competitions improves the runner's results by providing an environment where they compete among the best athletes, which is most often observed in higher category competitions (GL, A, B, C). Diaz et al. (2019) attributed the benefits of such an environment to the participants' roles as pacemakers for one another. World record performances were achieved, with top athletes pacing each other at an even or more competitive pace. Konings and Hettinga (2018) further demonstrated the importance of external settings in which athletes compete. Athletes tend to adjust their pace to the behavior of other contenders in competitions. While the exclusive participation of top athletes makes it a challenge to earn a medal, many athletes benefit from competitive pacemakers to achieve their personal best records. Not having to qualify for the next stage motivates athletes to compete for record times in higher-category competitions. In lower-grade competitions, athletes target qualification for the next stage via finishing position. Therefore, their central motivation is often to win the race regardless of their record.

A comparative analysis of Korean and Japanese marathoners revealed a significant difference in performance (IAAF, 2021). Reasons for Japan's excellent marathon performance included the introduction of a world-class training method for long-distance running, a system to foster coaches, and hosting local mid- to long-distance competitions to improve the speed of athletes (JAAF, 2019). However, a continuous long-term effort is required to see substantial results. On the other hand, Kim et al. (2010) noted that records were broken in prestigious overseas marathons by Japanese athletes who actively participated in major international competitions, suggesting that a similar strategy can be immediately applied to Korean athletes by having them participate in the most competitive marathons. While the data presented in this study was limited in supporting such a specific claim, it nevertheless confirmed the significance of competing in record competitions versus rank competitions, as shown in Figure 1.

Results revealed that the average completion time of the competition progressively slowed from GL to F, which can be explained in two ways. Large-scale international marathon competitions involving many high-performing athletes generally have faster average records than lower-level competitions because they tend to compete for the fastest times. Another explanation is simply because higher-performing athletes participated in more competitive marathon categories. There may be a clear performance difference between athletes who participate in the most competitive marathons and those who participate in competitions with relatively low barriers for qualification. Therefore, since a simple comparison of records for each marathon category does not adequately show the significance of competing in record competitions, the difference in relative records was further analyzed. However, due to the nature of marathons, performances may be affected by other factors that were unaccounted for in this study, such as temperature, humidity, and road conditions. In order to more clearly identify the extent that competition types have on marathon performance, additional performance-affecting factors should be considered in

follow-up studies.

Practical Implications

- For elite male marathoners, competing in record competitions rather than rank competitions can result in better performances, particularly their season's best performances.
- Coaches can promptly adopt and implement a strategy of having their athletes participate in large-scale international competitions to improve their marathon times.
- Countries looking to improve their results and status in the marathon arena can recruit coaches from nations recognized for outstanding marathon performances to prepare their athletes for record competitions.

Conclusion

We categorized and analyzed all the marathon records of the top 300 male runners in 2019 for all competition categories. The average time in GL was the fastest, and the average time from A to F tended to increase. The records in OW competitions were observed to be the slowest. We were able to confirm that higher-performing athletes frequently participated in large international competitions, such as those categorized as GL, A, and B, and that record competitions mediated by their competitive environments aided them in achieving the best or close to the best performance of the season.

Our results and analyses conclude that: 1) Competitors who perform well tend to participate in large-scale international competitions, and 2) Record competitions positively affect marathon performance compared to rank competitions.

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