SUSTAINABILITY & SPORTS SCIENCE JOURNAL

ORIGINAL ARTICLE

The interaction between age and gender in ultramarathon performance times

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ABSTRACT

The predictors of ultramarathon performance remain uncertain. Although men tend to have faster finishing times, low entrance rates for women and historical rules banning women from long endurance events suggest social barriers might play a role. The objective of our study was to examine, using data from the Comrades ultramarathon how the gender gap for finishing times changed longitudinally in the various age groups. We hypothesized that this gap would show both a historical decrease, and also be less in older participants. The Comrades data set has the declared gender, age category, running time, year of the event and the direction of the event (up versus down) for each participant. The age categories are Senior (20 to 39 years old), Veteran (40 to 49 years old), Master (50 to 59 years old), and Grandmaster (age greater than 60 years old). The performance gap between women and men was less in the older as compared to the younger age groups ($F = 76.51$, $p < .001$). This difference in finishing times between men and women became less over time in our longitudinal analysis ($\beta = -0.377 \pm 0.158$, $p = .021$) and was quite small (12 minutes) in the Grandmaster age category.

Keywords: Endurance events, Sports performance, Gender, Healthy aging.

Cite this article as:
Madden, K. M., & Feldman, B. (2024). The interaction between age and gender in ultramarathon performance times. *Sustainability and Sports Science Journal*, *2*(4), 175-183. https://doi.org/10.55860/TOCY2909

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Submitted for publication April 30, 2024.
Accepted for publication June 11, 2024.
Published July 05, 2024.
Sustainability and Sports Science Journal. ISSN 2990-2975.

Identifier: https://doi.org/10.55860/TOCY2909

INTRODUCTION

The criteria for calling an event an "*ultramarathon*" is quite variable. Some organizations define an ultramarathon as any event longer than a marathon (>42.195 kilometres) while others define it as any event that takes longer than 6 hours to complete (*ULTRA Running Races & Resources*, n.d.). The exact distances (50, 100 km or miles, etc) and times (6, 12, 24 hours, etc) can also be quite heterogeneous (*ULTRA Running Races & Resources*, n.d.). In addition to being quite a unique type of event, participants are also quite different from other types of endurance competitions. Data from the ULTRA study demonstrated that participants tend to identify as men, be older in age and be more educated than other (shorter) endurance events (Hoffman & Krishnan, 2013).

The predictors of performance in ultramarathon running are also quite uncertain. Coates *et al* demonstrated that standard predictors of performance in marathon distance events (maximal uptake of oxygen, training volumes, measures of cardiovascular health) were not predictive of times in longer ultramarathon events (Coates et al., 2021). In fact, other work has suggested that pain tolerance or specific baseline psychological traits may be more important predictors of success (Freund et al., 2013). Competitors that identify as men tend to run faster than those that identify as women (Knechtle & Nikolaidis, 2017). This difference tends to reduce with increasing age, but many studies examining data going back to the 1960s still show quite a large gender difference in finishing times in the oldest age group (on the order of 0.7 h running 100 km) (Waldvogel et al., 2019). However, given that women were banned from endurance events for many years (women were not even allowed to compete in the Olympic marathon until 1984), historical lack of access to better training might be inequitably exaggerating this performance gap (Blount, 2022). The age of best performance in ultramarathon running is also quite high (Knechtle & Nikolaidis, 2017), suggesting that the interaction with age might eliminate this gender gap in older competitors.

The objective of our study was to examine, using data from the Comrades ultramarathon event (Stratton, 2019) (one of the largest in the world) how the gender gap for finishing times changed longitudinally and how it interacts with the age group of the participant. We hypothesized that this gap would show both a historical decrease, and also be less in older participants.

MATERIALS AND METHODS

Ethical approval

Since the study was conducted with the use of publicly available datasets, the University of British Columbia's Committee for the Protection of Human Subjects waived the requirement for ethical review.

The Comrades Marathon

The Comrades Marathon is an ultramarathon of approximately 89 kilometres (about 55 miles), held annually in the KwaZulu-Natal Province of South Africa. This event alternates annually between the "*up*" run, starting from Durban, and the "*down*" run, commencing in Pietermaritzburg. Established in 1921 to commemorate the South African soldiers killed during World War I, the race has evolved into one of the world's oldest and largest ultramarathons, attracting thousands of runners from across the globe (*Comrades Marathon*, n.d.). The cut-off time for this event was 12 hours from 1921 to 1927, and this was extended by an hour in 2028 (*Comrades Marathon*, n.d.). Although the race started in 1921, it was only after 1975 that women and persons of colour were allowed to participate in the event (Merrett, 2007).

The entry criteria for the event are designed to ensure that participants are adequately prepared for the

physical and mental demands of the ultramarathon. Runners wishing to enter must be at least 20 years old on the day of the race and must have completed an officially recognized race (distance between 42.2 and 100 km) within a specified qualifying time in the 12 months preceding the Comrades Marathon. The qualifying times vary depending on the age and gender of the participant, aligning with standard marathon categories, to ensure competitive fairness.

Data

The dataset is publicly available and all data was anonymized (Stratton, 2019). Each participant has their declared gender, age category, running time, year of the event and the direction of the event recorded. The age categories are Senior (20 to 39 years old), Veteran (40 to 49 years old), Master (50 to 59 years old), and Grand Master (age greater than 60 years old). Density plots helped identify any data skewness. Any predictors that showed skewness were subjected to logarithmic transformations (base ten) before both univariate and multivariate analyses (Crawley, 2011).

Statistical analysis

Our primary outcomes for our longitudinal analysis was running time (in minutes) and the calculated performance difference between men and women. Initial differences between men and women, age categories and age categories were determined by a one-way Analysis of Variance (ANOVA) (Crawley, 2011). Our initial models looking at both longitudinal changes in running time and performance difference used year, age group, gender, group, and direction of race (up versus down) as predictor variables. The R core software package version 4.2.2 was utilized for all statistical analyses (R Core Team, 2021), with a significance level set at $p < .05$ (Crawley, 2011). All results were expressed in the mean ± standard error format. Due to the historical race and gender-based restrictions upon entry (as well as missing data in the early years of the race), we only used data from 2000 onwards (Merrett, 2007).

RESULTS

Initial analysis

There were 445,129 entries in the dataset with no entries missing running time and 22,437 entries missing category data, leaving 422,692 entries for analysis. The missing category data was mainly in the early years of the race with only 219 incomplete entries from the year 2000 onwards. In order to avoid years with missing data, and the fact that the number of women participants were quite small historically (see Figure 1), we chose to analyse data from the year 2000 onwards.

Table 1. Running Times, Post-2000.

Group	Women (n = 44 738)	Men (n = 200 578)	All (n = 245 535)
Senior (n = 117 277)	637.0 ± 0.4	589.7 ± 0.3	598.5 ± 0.3
Veteran (n = 89 393)	642.7 ± 0.4	610.3 ± 0.3	616.7 ± 0.3
Master (n = 33 265)	659.6 ± 0.7	634.3 ± 0.4	638 ± 0.4
Grandmaster (n = 5379)	667.0 ± 2.2	655.0 ± 0.8	656 ± 0.7
Up Races (n = 122 041)	645.3 ± 0.4	608.7 ± 0.3	615.2 ± 0.2
Down Races (n = 123 494)	608.7 ± 0.3	601.3 ± 0.3	608.4 ± 0.2
All Races (n = 245 535)	642.0 ± 0.3	605.0 ± 0.2	611.8 ± 0.2

Note. Finishing times are all presented as minutes. Means are presented with standard errors. The age categories are Senior (20 to 39 years old), Veteran (40 to 49 years old), Master (50 to 59 years old), and Grandmaster (age greater than 60 years old).

For our initial analysis of the entire dataset (from 2000 onwards) men had faster times than woman (F = 7999.1, $p < .001$). Finishing times were longer for older age categories (F = 2996.9, $p < .001$) and the race was faster in the down direction (F = 436.0, $p < .001$).

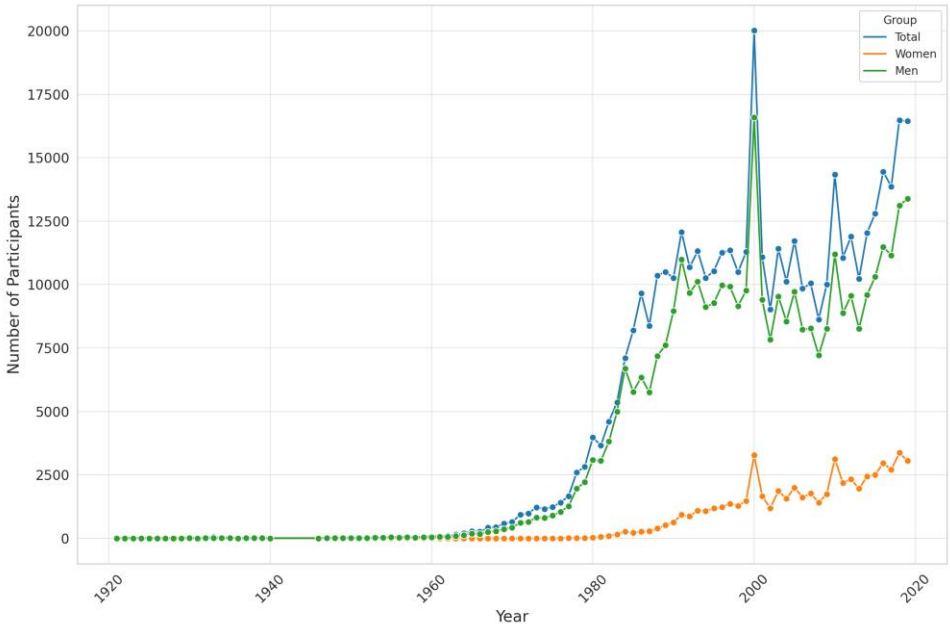
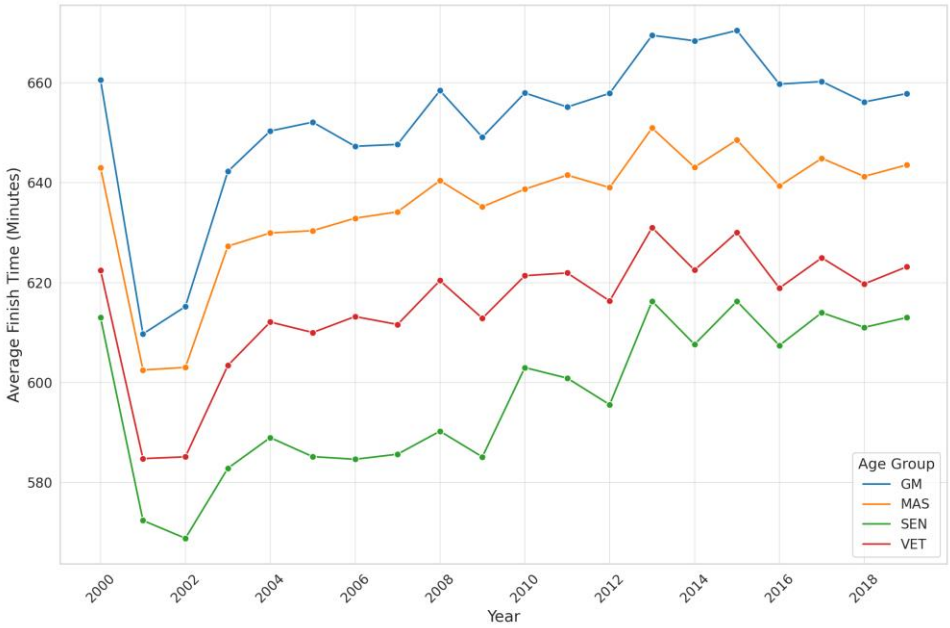
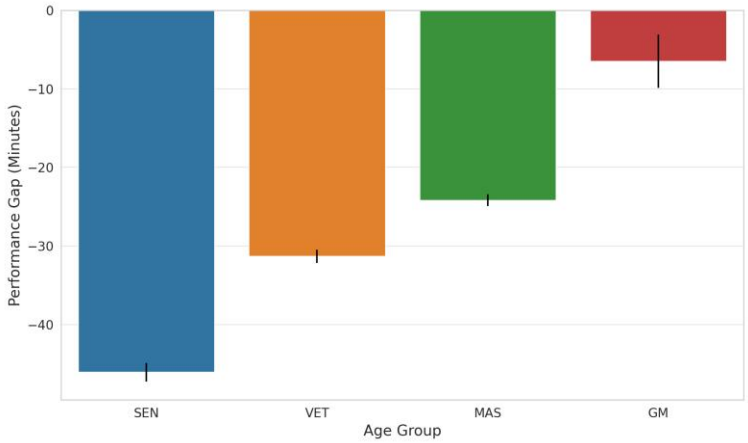


Figure 1. Longitudinal change in number of participants for the entire history of the Comrades race.



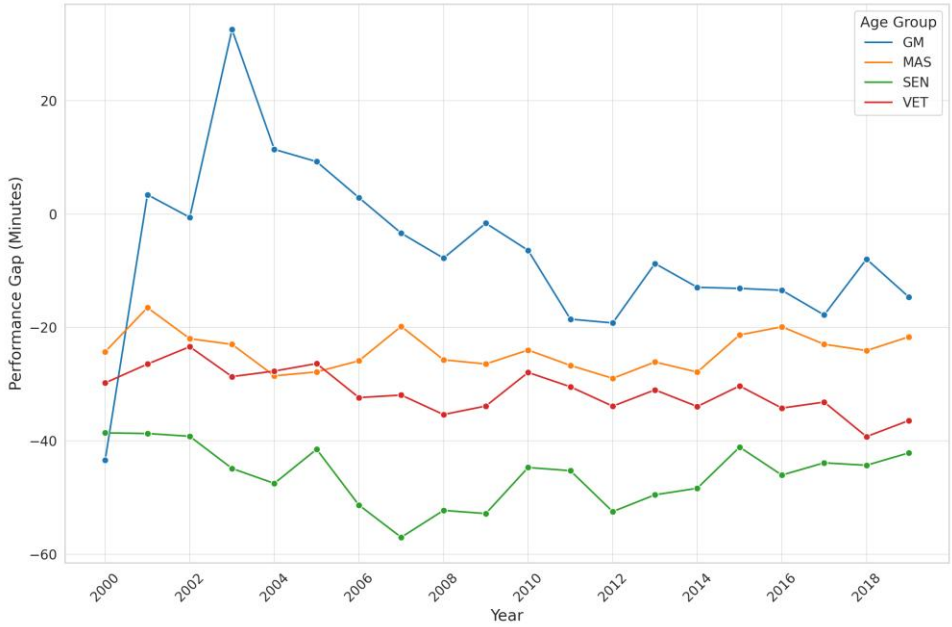
Note. The age categories are Senior (SEN, 20 to 39 years old), Veteran (VET, 40 to 49 years old), Master (MAS, 50 to 59 years old), and Grand Master (GM, age greater than 60 years old).

Figure 2. Longitudinal changes in finish time by age category.



Note. The performance gap between men and women was less in the older as compared to the younger age groups (F = 76.51, p < .001), although the small difference (12.0 ± 2.3 minutes) in the GM group was still statistically significant (F = 18.90, p < .001).

Figure 3. The age categories are Senior (SEN, 20 to 39 years old), Veteran (VET, 40 to 49 years old), Master (MAS, 50 to 59 years old), and Grand Master (GM, age greater than 60 years old).



Note. The difference in finishing times between men and women became less over time in our longitudinal analysis (β = -0.377 ± 0.158, p = .021). As compared to the GM group, the SEN (β = -39.575 ± 2.581, p < .001), VET (β = -24.823 ± 2.581, p < .001) and MAS (β = -17.67 ± 2.581, p < .001) groups all had shorter times.

Figure 4. The age categories are Senior (SEN, 20 to 39 years old), Veteran (VET, 40 to 49 years old), Master (MAS, 50 to 59 years old), and Grand Master (GM, age greater than 60 years old).

Performance gap for women and men

For all participants, men finished the race an average of 27.0 ± 1.9 minutes faster than the woman competitors. As shown in Figure 2, the performance gap between men and women was less in the older as compared to the younger age groups (F = 76.51, *p* < .001), although the small difference (12.0 ± 2.3 minutes) in the GM group was still statistically significant (Figure 3, F = 18.90, *p* < .001).

The continuous predictor (year) and the logistic predictor variables (age group, direction) were entered into a multivariate regression model that explained 82.6% (F = 12.34) of the variation in the performance gap between men and women competitors. As seen in Figure 4, the difference in finishing times between men and women became less over time in our longitudinal analysis (β = -0.377 ± 0.158, p = .021). As compared to the GM group, the SEN (β = -39.575 ± 2.581, p < .001), VET (β = -24.823 ± 2.581, p < .001) and MAS (β = -17.67 ± 2.581, p < .001) groups all had shorter times.

DISCUSSION

Principal findings

For all participants from the year 2000 onwards, men had an approximately 27 minutes (4 percent) shorter finishing time than women competitors. This performance gap lessened longitudinally over time and was quite small (12 minutes) in the oldest age categories.

Previous work

Previous studies of ultramarathon results have shown conflicting results with respect to the gender difference in performance. A study of a Greek ultramarathon showed no effect of gender in results from 2011 to 2019, but this is an unusual event in that it is at quite a high altitude (Knechtle et al., 2022). A previous analysis of the Comrades dataset showed more than two times the gender difference found in our analysis (Nikolaidis et al., 2021); however this analysis used data going back to 1921. No women were allowed in the race until 1975, and there were very few women competitors for many years following this date (Figure 1). Previous work has shown that gender differences increase in endurance events when there are fewer women in the race (Senefeld et al., 2016), which would explain our much lower (27 minutes) gender difference in our analysis. Our study also showed a longitudinal decrease in the gender gap with increasing year, which is congruent with previous studies of the Luaf Biel dataset (ultramarathon in Switzerland) (Knechtle et al., 2020) and other ultramarathon events (Stöhr et al., 2021). Our study, by confining our analysis to more recent years, has demonstrated that while the gender gap in ultramarathons is statistically significant, it is quite small.

The literature is mixed on the interaction between age and gender performance differences. Nickolaidis *et al.* showed previously that the age of peak performance in ultramarathon events is later in men (45 to 49 years old) than in women (40 to 44 years old) (Nikolaidis & Knechtle, 2020). Other work has shown no age effect in a Greek ultramarathon (the Spartathalon) (Knechtle et al., 2022) or in the Luaf Biel dataset (Knechtle et al., 2020), although both have included historical data when the number of both older and women competitors were very small (or not allowed at all). Other work has shown an attenuation of the gender gap with increasing age; however even this group found in the oldest age group that the gap was still quite large (about 0.7 hours in the GM category) (Waldvogel et al., 2019). Again, this dataset uses data going back to 1964, which we feel exaggerates the gender difference due to the historical lack of access to training (as well as other barriers). Our analysis also showed that the performance gap with increasing age in the highest age category to be quite negligible (a 12 minute difference in a 55 mile race) when looking at a dataset only containing the years from 2000 onwards.

Potential mechanisms

Biological sex based differences in muscle strength are well known (Nuzzo, 2023), leading to different employment standards for women and men in the military (East, 2013) and firefighting (East, 2013). In addition, although it is known that men have higher endurance training effects on maximal oxygen intake (Diaz-Canestro & Montero, 2019) the difference in muscle endurance between men and women remains unclear (Billaut & Bishop, 2009).

On the basis of misogynous pseudoscientific theories about the effects of endurance running on women's reproductive organs, women were not allowed to compete in the Olympic marathon until 1984 (Cooper, 1995); in fact, early women athletes considered entering the competition a form of feminist political activism (Schultz, 2019). The proportion of women competing in ultramarathons has increased from none to approximately 10 to 20 percent of competitors (Senefeld et al., 2016) in recent years–higher rates of women participating in endurance events is predictive of better performance for women athletes (Senefeld et al., 2016). This increase in the participation rates of women in the Comrades Ultramarathon (Figure 1) likely explains some of the reduction in the performance gap between men and women. Previous work has shown differences between woman and men in terms of both training volume and reliance on external resources; perhaps historical changes in social constraints affecting women might be an explanation for the longitudinal closing of the performance gap between men and women in the Comrades event (Tanous et al., 2022).

Training implications

A meta-analysis of coaching at an organizational level (not only in athletics), has shown that correct goal direction is the highest predictor of achieving desired individual-level outcomes (Theeboom et al., 2014). The narrowing of the ultramarathon performance gap over the years, especially in the older age groups (12 minutes on average) suggests that appropriate training goals for women athletes could be higher than what historical ultramarathon race results would suggest.

Limitations and future research

The Comrades dataset, while having the advantages of being quite large, unfortunately only contains the variables of gender and age category–there are many other variables such as training volume, diet, race support on the route etc that are not available for analysis.

CONCLUSIONS

Women and older age groups had slower finishing time on average in the Comrades ultramarathon–however, the performance gap between women and men showed a longitudinal decrease since 2000 and was quite small (12 minutes) in the GM age category.

AUTHOR CONTRIBUTIONS

KM-protocol design, data collection, data analysis, writing of manuscript, editing of manuscript, study funding. BF-database management.

SUPPORTING AGENCIES

This work was supported by the Allan M. McGavin Foundation.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors. All methods in this study comply with the current laws of the country in which they were performed.

DATA STATEMENTS

All data is available from the authors upon reasonable request.

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