# TITLE: Marathon Pace Control in Masters Athletes

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## ABSTRACT

Purpose: Pacing strategies are key to overall performance outcome in distance running events. Presently, no literature has examined pacing strategies utilised by masters athletes, of all running levels, during a competitive marathon. Therefore, this study aimed to examine masters athletes' pacing strategies, categorised by gender, age and performance level.

Methods: Data were retrieved from the 2015 TSC New York City Marathon for 31,762 masters athletes (20,019 men and 11,743 women). Seven performance classification (PC) groupings were identified via comparison of overall completion time compared to current world records, appropriate to age and gender. Data were categorised via, age, gender, and performance level. Mean 5 km speed for the initial 40 km was calculated and the fastest and slowest 5 km split speeds were identified and expressed as a percentage faster or slower than mean speed. Pace range, calculated as the absolute sum of the fastest and slowest split percentages, was then analysed.

Results: Significant main effects were identified for age, gender and performance level ($p < 0.001$); with performance level the most determining factor. Athletes in PC1 displayed the lowest pace range (14.19 ± 6.66%) and as the performance levels of athletes decreased, pace range increased linearly (PC2 – PC7, 17.52 ± 9.14% – 36.42 ± 18.32%). A significant interaction effect was found for gender×performance ($p < 0.001$), with women showing a smaller pace range (-3.81%).

Conclusions: High performing masters athletes utilise more controlled pacing strategies than their lower ranked counterparts, during a competitive marathon, independent of age and gender.



Keywords: Efficiency, long distance running, performance, strategy.

## Introduction

An optimal pacing strategy during running events efficiently uses all energy resources by the end of the race whilst maintaining a steady level of rate of expenditure throughout the race.[1] Choosing an optimal pacing strategy for a specific event depends on a variety of factors such as the duration of the event,[2,3] activity type,[4] course geography,[4] ambient temperature,[5] and altitude.[1] The use of pacing strategies has been investigated in various activities such as running,[6-10] race walking,[11] cycling,[12,13] speed skating,[14] rowing,[15,16] and triathlon.[17] Within marathon running, numerous studies[5-7,10] have reported that high performing athletes, demonstrate greater pace control compared to lower ranked athletes; this has also been reported in ultramarathon events.[18]

It has been suggested that performing with a consistent pace allows athletes to achieve optimal performance,[4] although some pace variation may be necessary depending on external factors such as on course wind or gradient.[19] Utilising positive or negative pacing strategies may be detrimental to marathon running performance. For example, a positive profile results in increased $\dot{V}O_2$, a greater accumulation of fatigue and an increase in the rate of perceived exertion.[4] A positive pacing profile may therefore be attributed to an athlete failing to select an appropriate initial pace and subsequently displaying a decrease in pace as the race progresses. Alternatively, it may be a race tactic, however such a strategy is usually unsuccessful.[3,4] Athletes may also display an increase in pace during the final stages of the marathon, often described as an "endspurt", although it remains unclear if such an increase in pace improves performance outcome.[6]

Much of the previous research examining marathon pace control has been limited to elite athletes competing at the Olympics[10] or World Championships.[7,10] Santos-Lozano *et al*[6] highlighted the lack of inclusion of the non-elite athletes and examined all athletes in the New York City (NYC) Marathon between 2006 and 2011; identifying that faster athletes, for both men and women, displayed greater pace control and hypothesised that this was attributed to training, expertise and pacing strategy.

In addition to the limited research on non-elite athletes, the number of masters athletes running marathons has increased.[20,21] Lepers and Cattagni,[20] for example, highlighted dramatic increases in the numbers of total finishers and masters finishers in the NYC Marathon between 1980 and 2009. Examination of the total finishers in these three decades reported an increase of 65% between decade 1980-89 and decade 1990-99 while an increase of 25% was reported between decade 1990-99 and decade 2000-09. These increases in total finishers coincided with increases in the numbers of masters athletes; with male masters athletes representing 53% of total male finishers in the decade 2000-09 compared to 36% in the decade 1980-89, and females masters athletes representing 40% of total female finishers in the decade 2000-09 compared to only 24% in the decade 1980-89. Interestingly, this increase in participation may not be attributed to athletes maintaining lifelong participation, with Leyk *et al*[22] finding that the majority of middle-aged and elderly athletes have a training history of less than seven years of running. A need was therefore identified to examine factors which may influence pacing strategies, to provide these athletes with suitable information to improve their pacing strategies, given their possible lack of experience/expertise.

To the current authors' knowledge, no study has examined the pacing strategies utilised by masters athletes (≥ 35 years old) of all levels. Therefore, the aims of this study were firstly to investigate the pacing strategies of master's athletes, of various running levels, during a competitive marathon. Within this, the research aimed to identify any differences in pacing strategy utilised, due to age, gender, performance level, or an interaction of the aforementioned factors. Furthermore, with the information gained from this investigation, we wished to provide pacing information tailored to gender, age and performance level, to aid lower ranked masters athletes in improving performance, more akin to their high performing counterparts.

## Methods

### Subjects

This study involved observational research of publicly available data acquired from the results of the TCS NYC Marathon in 2015. Ethical approval was obtained from the University of Limerick's research ethics committee for the access and analysis of these data. The official results were retrieved from the NYC Marathon's official website[23] and contained results for 49,595 finishers. Criteria for inclusion in the final analysis were (1) the availability of a finishing time, (2) the availability of all 5 km-split times (0 – 40 km), (3) the availability of age and gender information and (4) being classified as a masters athlete (≥ 35 years old). The athletes that fit the inclusion criteria were then classified based on gender (2 groups) and age (10 groups) resulting in 20 independent groups. Age classification was based on World Masters Athletics Standards,[24] which use 5-year age bands.

A novel classification system was then utilised where masters athletes were compared to the world record for their gender and age classification; identified as the current World Masters Athletics world records for each age and gender classification. World records (as of 31st December 2015) were obtained from the World Masters Athletics website.[25] The use of age and gender specific world records controlled for the differences in performance capabilities due to gender and age, while the use of world records, as opposed to a groups winning time, controlled for the quality of the athletes present on the day. Athletes were assigned to 1 of 7 performance classification (PC) groups based on their finish time, expressed as a percent of their groups' respective world record time. PC1 contained athletes who performed with a finishing time of 0 – 39% greater than their age and gender specific world record, while the proceeding classifications were PC2 40 – 59%, PC3 60 – 79%, PC4 80 – 99%, PC5 100 – 119%, PC6 120 – 139% and PC7 ≥ 140% greater than their respectively age and gender world records. Thirty-nine percent was selected based on analysis of the final finishers from the last three Olympics (2016, 2012 and 2008), for men and women, being compared to the current IAAF World Records (as of May 2016).[26] Calculating the mean of these six finishing times, the last finisher in an Olympic race, performs with a finishing time 39% above the world record. Therefore, in the current analysis, any athlete with a finishing time less than 40% above their respective world record was considered a PC1 athlete. Twenty percent intervals were utilised within PC's as this represented approximately a 25-minute difference in finishing time and this was considered a meaningful difference in marathon performance. PC groupings were then calculated for all gender and age classifications, resulting in 140 independent groupings (gender = 2, age = 10, performance = 7). In addition, a final inclusion criterion was added, whereby each age group was required to contain at least one athlete in each PC group, for both men and women. This resulted in all athletes within 3 age groups (70 – 74, 75 – 79 and 80+), for both men and men, being excluded, leaving a remainder of 98 independent groups (gender = 2, age = 7, performance = 7). Within each of the remaining groups, the fastest and slowest 2.5% of athletes were removed to minimise the chance individuals were placed in an incorrect PC. Only the slowest 2.5% of athletes were removed from all PC1 groups while only the fastest 2.5% of athletes were removed from all PC7 groups. This resulted in a final dataset of 31,762 athletes (20,019 men and 11,743 women), ranging in age from 35 to 69 years.

## Data Analysis

Following the grouping of athletes, data for the first 40 km and final 2.195 km were analysed.[5] The mean 5 km speed was calculated for each athlete. This was calculated by dividing the distance, 40 km, by the 40 km time, with speed being expressed as km.hr$^{-1}$. Each split time was then expressed as speed and the fastest and slowest 5 km speeds were identified, for each individual. These splits were then expressed as a percentage faster or slower than the mean 5 km speed. This allowed for normalised speed comparisons between all athletes. The fastest 5 km speed for each individual was then named “positive range”, whilst the slowest 5 km speed was named “negative range”. The absolute sum of positive range and negative range was then calculated and named “pace range”, and this was defined as the variable of interest. This variable was chosen as opposed to a variable such as coefficient of variation[27] to increase the practical applications of any findings, as coefficient of variation offers little benefit to an athlete when formulating a pacing strategy. In addition to pace range, the timing of the fastest and slowest splits were considered.

In order to examine the final 2.195 km, speed for this final segment was expressed as a percentage faster or slower than speed during the final 5 km-split (35 – 40 km).[5] This variable aimed to examine the endspurt and was named such. Means and standard deviations were then calculated for pace range and endspurt for men, women, and men and women combined, across all age groups and PC’s. All groupings and calculations were performed on Microsoft Excel 2010.

## Statistical Analysis

A three-way analysis of variance (ANOVA) was performed for pace range (gender = 2 levels, age = 7 levels, performance = 7 levels). Pairwise comparisons were then examined to inspect the nature of interactions, after a Bonferroni correction was applied. Profile plots were also examined to inspect interactions. Lastly, post hoc one-way ANOVA’s were performed between men and women for each PC. The same analysis was performed for endspurt data. Prior to analysis, the data were checked for normality and for homogeneity of variance. A significant Kolmogorov-Smirnov test indicated that the data were not normally distributed ($p < 0.001$). Levene’s Test was also significant ($p < 0.001$), implying heterogeneity of variance. As a previous study,[27] reported identical results when parametric and non-parametric tests were performed on nonparametric data, parametric tests were used on the current data. All statistical analyses were performed using IBM SPSS version 21 software and $\alpha$ was set at $p < 0.05$.

## Results

Data for 31,762 athletes were analysed (20,019 men and 11,743 women). Table 1 displays the distribution of men and women between PC groups and age groups.

** Table 1 here **

Statistical analysis of pace range identified significant main effects for age, gender and performance (all $p < 0.001$). Although a main effect was found for age, this was not consistent with an increase, or decrease in pace range due to age. The main effect for gender illustrated women had significantly less pace range compared to men (mean difference = -3.81%, $p < 0.001$). The main effect for performance identified a linear increase in pace range as performance level decreased. Significant differences were found between all PC groups (all $p < 0.025$).

A significant interaction effect was found for gender×performance ($p < 0.001$). Post hoc analysis and examination of profile plots identified an ordinal interaction for gender×performance, whereby the difference between men and women increased as PC increased (Figure 1). No significant difference was found between men and women in PC1 ($p = 0.970$). Significant differences were found for all remaining PC's (all $p < 0.001$).

** Figure 1 here **

In addition, an interaction effect was present for age×performance ($p < 0.001$). Examination of profile plots identified a disordinal interaction, where crossovers began to occur in the older age categories (55 – 59, 60 – 64 and 65 – 69), in PC's 5, 6 and 7. At this stage, it was decided not to include pacing information specific to age, as neither the main effect for age or the interaction for age×performance displayed a consistent effect, despite both reporting statistical significance (Both $p < 0.001$). No interaction effect was found for age×gender ($p = 0.080$).

Table 2 identifies the positive and negative pace ranges observed for men and women across all PC's, where PC1 is proposed as the optimal pace control strategy. For example, an average man in PC4 performs with a positive range of 10.40 ± 5.04% and a negative range of 14.99 ± 7.65%. This represents a pace range of 25.39 ± 11.75% which is significantly greater than that of a man in PC1 ($p < 0.001$), who on average performs with a pace range of 14.18 ± 6.79%. This is also significantly greater than a woman in PC4 ($p < 0.001$) who performs with a mean pace range of 21.86 ± 9.96%.

** Table 2 here **

Table 3 identifies the pace range and standard deviations for athletes of each gender, age and PC and the mean and standard deviations for each PC, across age groups. The standard deviation within PC's and across age groups for men ranged from 6.79% to 20.20%. For women, the range of standard deviation was 6.32% to 13.44%, while for men and women combined the range was 6.66% to 18.32%. Table 4 displays the timing of the fastest and slowest 5 km-splits across PC's. 96.85% of athletes ran using a positive strategy.

** Table 3 here **

**Table 4 here**

Analysis of the endspurt identified no main effects for gender or age (both $p > 0.102$). A significant main effect was reported for performance ($p < 0.001$), with all PC groups displaying an increase in speed (Figure 2). No significant difference was reported between athletes in PC's 1 and 2 ($p = 1.000$), while these groups were significantly different from all other groups (all $p < 0.002$). PC's 3 and 4 were significantly different from all other PC's (all $p < 0.002$), except for PC7 (both $p > 0.379$). No significant difference was reported between PC's 5 and 6 ($p = 1.000$) or between these groups and PC7 (both $p = 1.000$), while these groups were both significantly different from all other PC's (all $p < 0.003$). Significant interaction effects were identified for gender×performance and age×performance (both $p < 0.001$), however further examination of these effects revealed no meaningful relationships. No interaction effect was reported for age×gender ($p = 0.163$).

**Figure 2 here**

**Discussion**

The main finding of the current analyses indicates that as the performance level of masters athletes decreases, pace range shows a linear increase, independent of gender. While the majority of athletes adopted a positive strategy, athletes who performed within 40% of their gender and age world record displayed greater pace control, compared to athletes who were placed in any of the remaining 6 PC's. This is supported by previous studies, which reported that higher performing individuals display more even pacing during distance running events.[5-7,10,18] Across all combinations of PC groups the higher performing athletes displayed significantly greater pace control. The increase in pace range observed in lower ranked athletes could potentially be attributed to athletes being influenced by the pace/actions of other runners,[28] while the lower pace range of high performing athletes could be a result of previous race experience[29] or expertise.[6] This lack of experience or expertise may have led to lower ranked athletes selecting an unsustainable initial pace,[3,4] which subsequently lead to a greater drop off in pace during the final 5 km-splits of the initial 40 km. Conversely, higher ranked athletes display a greater ability to regulate initial pace, minimising the drop off in pace observed and thus these athletes report greater pace control.

Another possible explanation for the greater pace range displayed by lower ranked athletes is that these athletes conserve energy during the final two 5 km-splits, which then allows them to "sprint" over the finish line.[6] In contrast to this, the final segment is of less importance to higher ranked athletes as maintaining position is the priority.[6]

Unlike previous studies, which focused primarily on examining the pacing strategies and profiles of elite athletes,[7,10] this analysis examined the wider population of marathon athletes, varying from elite to recreational. Despite this, similar results were identified, with less successful athletes, displaying less pace control compared to successful athletes, independent of age and gender. In addition, high performing masters athletes demonstrate similar levels of pace consistency, independent of age and gender.

Although the linear association between performance level and pace consistency has been reported previously, in a smaller sample of 311 marathon performances using GPS data;[27] the current study confirms this association in a much larger sample of marathon athletes and also highlights gender differences in the level of pace range increases observed in men and women.

While the linear association between performance level and pace range can be identified in both men and women, significant differences were found in pace range between genders. The greatest mean difference between men and women was identified in athletes performing at the slowest mean speeds, i.e. the lower ranked athletes (PC7). The lack of a gender difference between high performing men and women and the subsequent increasing difference as finishing time increased was also reported be Deaner *et al*[29] where pace consistency was measured by calculating the percentage change in pace observed in the second half of the marathon, relative to the first half pace.

When this finding is considered in relation to a typical pacing profile[6] and those displayed in the current study, it appears that lower ranked men begin the race too fast, resulting in a greater drop off in pace in the closing stages of the marathon. Although, various physiological factors have been suggested to explain these gender differences in pacing profiles during marathon races, such as the rate of glycogen depletion,[29] this gender difference, has more recently been reported in 5 km races when men and women of the same finishing time were compared.[30] These gender differences may therefore be attributed to psychological factors, such as men having higher levels of self-esteem compared to women,[31] resulting in men over estimating their performance capabilities.

In response to these findings, positive and negative pace ranges specific to gender and performance level are presented. It is suggested that by altering their pacing strategies, to those utilised by high performing masters athletes, lower ranked masters athletes could potentially improve their performance.

**Practical Implications**

The results of the current study demonstrate important factors that may aid in the improvement of masters athletes performance. Similar to Olympic and World Championship athletes, it is important that masters athletes adopt a controlled pace that avoids large fluctuations in running speed. This is an important consideration for all masters athletes, independent of age and gender.

To highlight the potential benefits of adopting a more controlled pace, pacing profiles were calculated to examine potential improvements in 40 km marathon time and efficiency. These pacing profiles were calculated for a typical member of the largest group, a PC4 man in the age category 40 – 44, with a 40 km time of 3 hours and 50 minutes. Firstly, individual 5 km running speeds were calculated to replicate a typical pacing profile,[6] which utilised a PC4 pace range. Work required to complete 40 km using this pace range was then calculated from first-principles. Hereafter, a pacing profile was calculated for this 40 km time (3 hours and 50 minutes) which utilised a PC1 pace range, to outline potential improvements in efficiency when using the pace range of a higher performing athlete. This pacing profile resulted in a reduction in work equal to 67.230 Kilojoules (-0.43%). Lastly, a pacing profile was calculated to show potential improvements in 40 km time, whereby the total work used in the initial pacing profile was determined to be the total work capacity. This total work capacity was then distributed to each 5 km-split, similar to a PC1 athlete. Speed was then altered to produce the desired work with new 5 km-split times being calculated from this speed, giving a new 40 km time which utilised a PC1 pace range. This pacing profile resulted in a performance improvement equivalent to 1 minute and 34 seconds (-0.70%).

Although assumptions were made in calculating these pacing profiles, they do highlight the potential benefits of adopting a more controlled pace. The improvements in efficiency could potentially be beneficial in both training and races. Running a more consistent pace in training should reduce athletes' workload, in terms of the work required to complete runs. This reduction in work could potentially enable an athlete to carry out additional training by either increasing training volume or intensity. Conversely, if no additional training is performed an athlete may benefit from a quicker recovery process. With typical marathon training programmes lasting up to 18 weeks, with weekly running volumes ranging from 64 km for a novice athlete to over 128 km for a more advanced athlete,[32] it is important that an athlete can recover sufficiently from the stress of this training to achieve optimal performance both in subsequent training and in races.[33] Sufficient recovery is also important in reducing the injury risk associated with high weekly training distances.[34] The proposed strategies may also be of benefit to athletes whose primary goal is to finish the marathon, by allowing them to reduce the amount of work required to complete the race. The potential time improvement demonstrated, offers a straightforward method of improving performance without any additional training and this should be considered by all masters athletes, independent of age and gender. Future research should examine the application of these pacing strategies and subsequent changes in performance, which may occur.

**Conclusions**

The results of this study highlight that high performing masters athletes use more controlled pacing strategies, compared to their lower ranked counterparts, independent of age and gender. The performance level of the athlete was found to be the greatest determinant of the pacing strategy used, with pace range displaying a linear increase as the performance level of the athlete decreased, independent of gender. By adopting more controlled pacing strategies, lower ranked masters athletes, could potentially see improvements in their performances.

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**Figure 1:**

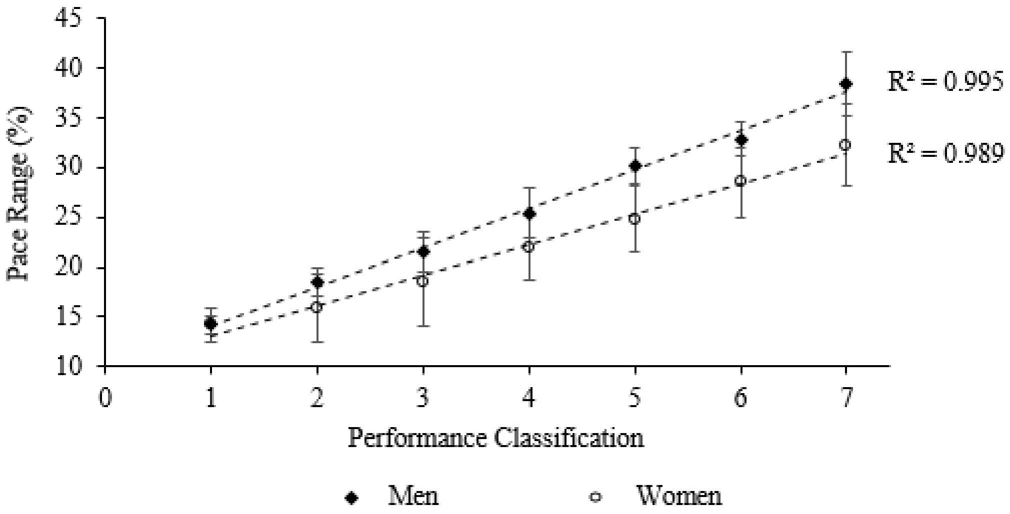


Figure 1. Comparison of pace range (%), between men and women, for each performance classification (1 – 7). * denotes a significant difference between men and women within the same performance classification. Straight lines indicate the linear trendlines across performance classifications. Error bars represent standard deviation across age groups.

**Figure 2:**

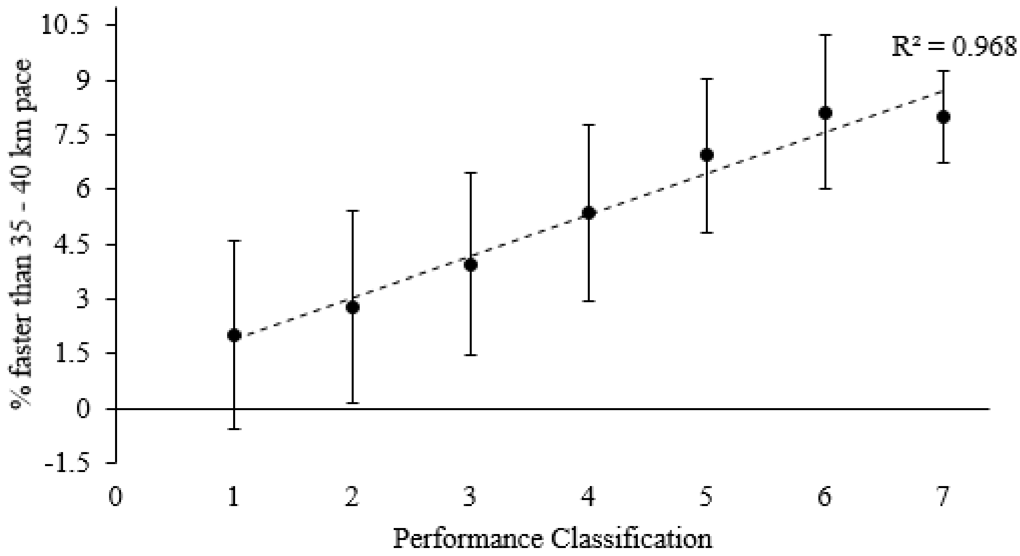


Figure 2. Comparison of endspurt across each performance classification (1 – 7). Straight line indicates the liner trendline across performance classifications. Error bars represents the standard deviation across age groups.

**Figure Captions:**

Figure 1. Comparison of pace range (%), between men and women, for each performance classification (1 – 7). * denotes a significant difference between men and women within the same performance classification. Straight lines indicate the linear trendlines across performance classifications. Error bars represent standard deviation across age groups.

Figure 2. Comparison of endspurt across each performance classification (1 – 7). Straight line indicates the liner trendline across performance classifications. Error bars represents the standard deviation across age groups.

**Table 1. Number of men and women in each performance classification and age group.**

| Age<br>Performance Classification | Gender | 35-39<br>(n) | 40-44<br>(n) | 45-49<br>(n) | 50-54<br>(n) | 55-59<br>(n) | 60-64<br>(n) | 65-69<br>(n) | Total<br>(n) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | M | 74 | 144 | 156 | 131 | 59 | 69 | 15 | ***648*** |
| | W | 28 | 36 | 43 | 23 | 75 | 34 | 4 | ***243*** |
| 2 | M | 294 | 380 | 46 | 408 | 265 | 178 | 50 | ***2,038*** |
| | W | 180 | 230 | 288 | 193 | 184 | 82 | 22 | ***1,179*** |
| 3 | M | 592 | 792 | 917 | 713 | 406 | 198 | 77 | ***3,695*** |
| | W | 456 | 537 | 469 | 343 | 183 | 94 | 28 | ***2,110*** |
| 4 | M | 877 | 1,062 | 894 | 814 | 436 | 227 | 79 | ***4,389*** |
| | W | 666 | 671 | 595 | 465 | 180 | 78 | 23 | ***2,678*** |
| 5 | M | 850 | 971 | 773 | 624 | 332 | 147 | 73 | ***3,770*** |
| | W | 689 | 730 | 455 | 341 | 116 | 47 | 20 | ***2,398*** |
| 6 | M | 686 | 669 | 451 | 359 | 230 | 68 | 46 | ***2,509*** |
| | W | 423 | 427 | 309 | 200 | 61 | 34 | 5 | ***1,459*** |
| 7 | M | 909 | 819 | 531 | 371 | 215 | 82 | 43 | ***2,970*** |
| | W | 586 | 537 | 301 | 216 | 31 | 4 | 1 | ***1,676*** |
| **Total** | ***M*** | ***4,282*** | ***4,837*** | ***4,185*** | ***3,420*** | ***1,943*** | ***969*** | ***383*** | ***20,019*** |
| | ***W*** | ***3,028*** | ***3,168*** | ***2,460*** | ***1,781*** | ***830*** | ***373*** | ***103*** | ***11,743*** |

M = men and W = women

**Table 2. Mean positive and negative ranges (%) and standard deviations for men and women across all performance classifications.**

| Performance Classification | Men | | Women | |
|---|---|---|---|---|
| | Mean Positive Range (SD) (%) | Mean Negative Range (SD) (%) | Mean Positive Range (SD) (%) | Mean Negative Range (SD) (%) |
| **1** | 5.41 (2.51) | -8.77 (4.69) | 6.08 (2.75) | -8.13 (4.08) |
| **2** | 6.95 (3.56) | -11.57 (6.57) | 6.69 (3.47) | -9.11 (5.13) |
| **3** | 8.37 (4.33) | -13.14 (7.36) | 8.14 (4.01) | -10.37 (5.72) |
| **4** | 10.40 (5.04) | -14.99 (7.65) | 10.02 (4.73) | -11.84 (6.03) |
| **5** | 12.97 (5.78) | -17.25 (7.98) | 11.85 (5.49) | -12.96 (6.42) |
| **6** | 15.01 (6.23) | -17.77 (7.95) | 14.17 (5.91) | -14.31 (5.57) |
| **7** | 19.42 (8.21) | -19.02 (8.53) | 16.92 (7.26) | -15.31 (7.73) |

**Table 3. Mean pace range (%) and standard deviations for all performance classifications, across all age groups for men, women, and men and women combined.**

***Men***

| | Age Group | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **PC** | **35-39 Mean (SD)** | **40-44 Mean (SD)** | **45-49 Mean (SD)** | **50-54 Mean (SD)** | **55-59 Mean (SD)** | **60-64 Mean (SD)** | **65-69 Mean (SD)** | **All Mean (SD)** |
| **1** | 12.82 (7.07) | 14.19 (7.19) | 13.80 (6.89) | 15.22 (6.65) | 13.74 (5.62) | 14.73 (6.18) | 15.08 (7.89) | 14.18 (6.79) |
| **2** | 17.13 (9.09) | 17.92 (9.53) | 18.03 (9.63) | 19.14 (9.18) | 19.33 (10.23) | 19.92 (9.27) | 21.44 (10.26) | 18.52 (9.55) |
| **3** | 20.02 (11.50) | 20.91 (11.13) | 20.74 (9.97) | 21.92 (10.72) | 23.60 (10.85) | 25.29 (11.40) | 23.85 (10.96) | 21.51 (10.90) |
| **4** | 22.58 (11.45) | 23.40 (11.21) | 26.20 (11.87) | 27.07 (11.82) | 28.84 (11.38) | 29.32 (11.49) | 26.63 (11.07) | 25.39 (11.75) |
| **5** | 28.72 (12.27) | 29.64 (12.66) | 30.86 (12.43) | 30.72 (12.85) | 31.01 (12.23) | 34.33 (13.36) | 32.55 (10.43) | 30.22 (12.56) |
| **6** | 31.81 (13.24) | 32.59 (12.91) | 32.23 (12.75) | 32.98 (11.93) | 35.93 (11.73) | 35.47 (13.14) | 35.03 (15.27) | 32.80 (12.93) |
| **7** | 38.40 (14.60) | 38.03 (14.94) | 40.26 (15.21) | 38.60 (14.85) | 37.75 (14.04) | 44.94 (16.94) | 34.47 (13.99) | 38.44 (20.20) |

***Women***

| | Age Group | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **PC** | **35-39 Mean (SD)** | **40-44 Mean (SD)** | **45-49 Mean (SD)** | **50-54 Mean (SD)** | **55-59 Mean (SD)** | **60-64 Mean (SD)** | **65-69 Mean (SD)** | **All Mean (SD)** |
| **1** | 13.42 (6.49) | 13.44 (6.66) | 12.74 (6.11) | 11.19 (5.32) | 15.71 (5.78) | 16.21 (6.94) | 14.19 (5.54) | 14.20 (6.32) |
| **2** | 14.17 (6.51) | 13.44 (7.37) | 14.91 (7.51) | 14.89 (7.49) | 19.81 (8.49) | 20.76 (9.67) | 21.24 (9.79) | 15.80 (8.11) |
| **3** | 16.71 (8.13) | 16.62 (8.26) | 18.17 (9.11) | 19.71 (9.51) | 22.73 (9.29) | 23.90 (8.90) | 28.68 (9.33) | 18.50 (9.10) |
| **4** | 19.92 (8.80) | 19.84 (9.53) | 22.62 (10.12) | 23.15 (10.16) | 28.11 (10.18) | 26.65 (9.61) | 25.91 (12.45) | 21.86 (9.96) |
| **5** | 22.32 (9.84) | 23.82 (11.00) | 26.56 (10.62) | 26.95 (11.36) | 31.01 (9.95) | 29.65 (12.53) | 23.19 (12.00) | 24.81 (10.90) |
| **6** | 28.40 (10.30) | 27.17 (9.81) | 29.85 (11.48) | 29.57 (10.79) | 29.47 (11.79) | 26.74 (11.89) | 19.70 (8.03) | 28.48 (10.64) |
| **7** | 32.30 (13.15) | 32.65 (13.27) | 33.35 (14.12) | 30.70 (13.99) | 29.02 (9.60) | 30.06 (16.69) | 21.25 (n/a) | 32.23 (13.44) |

***Men and Women Combined***

**Age Group**

| PC | 35-39 Mean (SD) | 40-44 Mean (SD) | 45-49 Mean (SD) | 50-54 Mean (SD) | 55-59 Mean (SD) | 60-64 Mean (SD) | 65-69 Mean (SD) | All Mean (SD) |
|---|---|---|---|---|---|---|---|---|
| **1** | 12.98 (6.89) | 14.04 (7.08) | 13.57 (6.73) | 14.62 (6.61) | 14.85 (5.77) | 15.22 (6.44) | 14.89 (7.32) | 14.19 (6.66) |
| **2** | 16.00 (8.32) | 16.23 (9.04) | 16.84 (9.00) | 17.77 (8.89) | 19.53 (9.55) | 20.18 (9.39) | 21.38 (10.05) | 17.52 (9.14) |
| **3** | 18.58 (10.30) | 19.18 (10.28) | 19.87 (9.76) | 21.20 (10.39) | 23.33 (10.39) | 24.84 (10.66) | 25.14 (10.72) | 20.42 (10.38) |
| **4** | 21.44 (10.47) | 22.03 (10.73) | 24.77 (11.33) | 25.65 (11.40) | 28.63 (11.04) | 28.64 (11.08) | 26.47 (11.34) | 24.06 (11.24) |
| **5** | 25.85 (11.68) | 27.15 (12.32) | 29.27 (11.97) | 29.39 (12.47) | 31.01 (11.67) | 33.20 (13.29) | 30.54 (11.39) | 28.12 (12.23) |
| **6** | 30.51 (12.31) | 30.48 (12.08) | 31.27 (12.30) | 31.76 (11.64) | 34.58 (12.01) | 32.56 (13.33) | 33.53 (15.37) | 31.21 (12.25) |
| **7** | 36.01 (14.36) | 35.90 (14.54) | 37.77 (15.19) | 35.70 (15.02) | 36.65 (13.85) | 44.25 (16.85) | 34.17 (13.97) | 36.42 (18.32) |

(Significant differences have been removed for clarity)

**Table 4. Proportion of athletes (%) in each performance classification who displayed their fastest and slowest running speeds, during each of the eight 5 km-splits, across all performance classifications.**

| Fastest Split Performance Classification | Split 0 – 5 (km) | 5 -10 (km) | 10 – 15 (km) | 15 – 20 (km) | 20 – 25 (km) | 25 – 30 (km) | 30 – 35 (km) | 35 – 40 (km) |
|---|---|---|---|---|---|---|---|---|
| **1** | 35.02 | 47.14 | 3.93 | 1.91 | 0.00 | 11.45 | 0.11 | 0.45 |
| **2** | 25.49 | 53.68 | 7.18 | 4.32 | 0.09 | 7.62 | 0.78 | 0.84 |
| **3** | 25.29 | 55.18 | 8.66 | 4.00 | 0.05 | 5.03 | 0.53 | 1.26 |
| **4** | 29.67 | 53.23 | 8.87 | 3.55 | 0.06 | 2.91 | 0.65 | 1.05 |
| **5** | 34.55 | 50.57 | 8.66 | 3.58 | 0.06 | 1.31 | 0.34 | 0.92 |
| **6** | 41.83 | 44.58 | 9.48 | 2.29 | 0.10 | 0.88 | 0.15 | 0.68 |
| **7** | 55.41 | 33.07 | 8.61 | 1.64 | 0.09 | 0.45 | 0.24 | 0.50 |
| **Slowest Split Performance Classification** | **0 – 5 (km)** | **5 -10 (km)** | **10 – 15 (km)** | **15 – 20 (km)** | **20 – 25 (km)** | **25 – 30 (km)** | **30 – 35 (km)** | **35 – 40 (km)** |
| **1** | 3.25 | 0.11 | 0.11 | 0.67 | 5.72 | 0.34 | 4.15 | 85.63 |
| **2** | 3.42 | 0.22 | 0.37 | 0.50 | 5.04 | 0.84 | 8.27 | 81.35 |
| **3** | 3.70 | 0.40 | 0.45 | 0.72 | 6.39 | 1.38 | 13.32 | 73.64 |
| **4** | 2.26 | 0.61 | 0.72 | 0.99 | 6.58 | 2.42 | 20.48 | 65.94 |
| **5** | 1.17 | 0.79 | 0.62 | 0.84 | 7.98 | 4.10 | 26.99 | 57.51 |
| **6** | 0.78 | 0.86 | 0.71 | 1.29 | 9.38 | 6.48 | 32.94 | 47.58 |
| **7** | 0.50 | 1.21 | 0.56 | 2.00 | 14.32 | 9.09 | 31.00 | 41.33 |