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ABSTRACT

This study describes pacing strategies adopted in an 86-km mass-participation cross-country marathon mountain bike race (the ‘Birkebeinerrittet’). Absolute ($km \cdot h^{-1}$) and relative speed (% average race speed) and speed coefficient of variation (%CV) in five race sections (15.1, 31.4, 52.3, 74.4 and 100% of total distance) were calculated for 8,182 participants. Data were grouped and analysed according to race performance, age, sex and race experience. The highest average speed was observed in males (21.8 ± 3.7 km/h), 16-24 yr olds (23.0 ± 4.8 km/h) and those that had previously completed >4 Birkebeinerrittet races (22.5 ± 3.4 km/h). Independent of these factors, the fastest performers exhibited faster speeds across all race sections, whilst their relative speed was higher in early and late climbing sections (Cohen’s d = 0.45-1.15) and slower in the final descending race section (d = 0.64 – 0.98). Similar trends were observed in the quicker age, sex and race experience groups, who tended to have a higher average speed in earlier race sections and a lower average speed during the final race section compared to slower groups. In all comparisons, faster groups also had a lower %CV for speed than slower groups (fastest %CV = 24.02%, slowest %CV = 32.03%), indicating a lower variation in speed across the race. Pacing in a cross-country mountain bike marathon is related to performance, age, sex and race experience. Better performance appears to be associated with higher relative speed during climbing sections, resulting in a more consistent overall race speed.

Key words: Performance, tactics, endurance

INTRODUCTION

Cross-country mountain biking is practiced recreationally and competitively worldwide. In contrast to road races, participants cycle on variable terrain such as gravel paths, forest roads, tracks and fields with significant elevations and descents (Union Cycliste Internationale, 2018). The International Cycling Union (UCI) recognise several specific mountain bike race disciplines, which differ with regard to rules, regulations and race characteristics. These include, but are not limited to 'Olympic' (XCO), 'Eliminator' (XCE) and 'Marathon' (XCM) variations.

Most cross-country mountain biking research is based on the XCO event, whereby participants complete a specified number of laps (4-6 km) on a circuit-like course, lasting ~80 – 100 min (UCI, 2018). Research suggests XCO elicits higher metabolic demands than road cycling (Padilla, Mujika, Orbañanos, & Angulo, 2000; Fernandez-Garcia, Pérez-Landaluce, Rodríguez-Alonso, & Terrados, 2000), with an average race heart rate of ~90% maximum (Stapelfeldt et al., 2004; Impellizzeri, Sassi, Rodriguez-Alonso, Mognoni, & Marcora, 2002), >80% of the race performed above the lactate threshold (Impellizzeri et al., 2002) and ~26% of time spent above maximal aerobic power (Granier et al., 2018). Like many endurance events, power and maximum oxygen uptake ($\dot{V}O_2$ max) when normalised to body mass, the lactate threshold and exercise economy are key determinants of success in XCO (Smekal et al., 2015; Inoue, Sá Filho, Mello, & Santos, 2012; Impellizzeri, Marcora, Rampinini, Mognoni, & Sassi, 2005). Moreover, due to the skill required to manoeuvre the bike across various terrains and descend at high speed, excellent technical ability is also paramount (Impellizzeri & Marcora, 2007).

Despite a strong research focus on the physiological determinants of cross-country mountain biking, other investigations have placed value on adopting an appropriate pacing strategy (Granier et al., 2018; Abbiss et al., 2013; Abbiss & Laursen, 2008). In many sports, the efficient distribution of workload and energetic resources is fundamental to fast race completion whilst ensuring that failure in physiological function does not occur (St Clair Gibson & Noakes, 2004). Studies suggest that unlike road or time-trial cycling that promote an even pacing strategy (i.e. constant distribution of power) (Atkinson, Peacock, & Passfleld, 2007), the less stable conditions of cross-country mountain biking (i.e. changes in elevation and terrain) warrant a variable distribution of power. Indeed, using mathematical modelling, it has been calculated that increased power during uphill or headwind race sections and reduced power during descents or tailwind sections improves race speed (Boswell, 2012; Atkinson et al., 2007; Swain, 1997). Some empirical support for this has been provided in XCO events (Abbiss et al., 2013) and simulated environments (Atkinson & Brunskill, 2000; Canley, Passfield, Carter & Bailey, 2011). However, as these studies have monitored cyclists over relatively short distances (4-39 km), our current understanding of pacing profiles in longer events is limited.

This lack of investigation is somewhat surprising considering the popularity of cross-country mountain bike marathon races (60-160 km; UCI, 2018). For example, the Birkebeinerrittet (Norway), which is considered to be one of the world's largest races of this type, attracts >8,000 participants to complete its 86 km course annually. Therefore, gaining a better understanding of how effective pacing might contribute to a faster finishing time is of interest to many participants. Moreover, as many XCM races are ‘mass-participation’ events, they are well known to cater for both elite and recreational cyclists of different ages, sexes and levels of experience. These variables have been shown to affect pacing and performance in running events (Renfree, Crivoi do Carmo & Martin, 2016; March, Vanderburgh, Titlebaum & Hoops, 2011), however, nothing is known about how they might influence pacing in XCMs. This information could aid the provision of specific recommendations for individuals during races. Therefore, the aims of this study were to investigate the distribution of pace according to finish time, age, sex and previous race experience during a XCM.

METHODS

Participants

All participants (n = 8,182) who took part in the 2016 ‘Birkebeinerrittet’ mass-participation XCM consented for their data to be made publicly available (Birken, 2016) and the study was ethically approved by the Norwegian Centre for Research Data. The event was open to participants over 16.5 years of age and was completed by elite (holder of a valid licence issued by a National Federation affiliated to the UCI) and non-elite competitors. Race participants completed the course whilst wearing a backpack weighing > 3.5 kg, in-keeping with Birkebeiner tradition.

Participants were grouped according to age (16-24 [n = 382], 25-34 [n = 1,018], 35-44 [n = 2,178], 45-54 [n = 2,977], 55-64 [n = 1320], 65+ [n = 307]), sex (female [n = 1,004], male [n = 7,178]), prior Birkebeinerrittet experience (<2 [n = 1,620], 2-3 [n = 1,887], 4-9 [n = 2,952], >9 [n = 1,723]) and race speed (first fastest [n = 2,042], second [n = 2,042], third [n = 2,041], and fourth [n = 2,057]). In the case of average speed and race experience, interquartile ranges were used to determine four distinct groups.

Course Details

The 86 km 'Birkebeinerrittet' race took place on the 27th August 2016 in dry environmental conditions. Start times were staggered based on seeding according to prior Birkebeinerrittet performance or performance in a recognised XCM, resulting in 'pools' of ~150 participants beginning the race at 5 minute intervals. Each participant's start, finish and intermediate split times were recorded via a transponder timing system with participant data included if times were recorded for all five available race sections. Participants wore two passive UHF transponders fixed to their race number, which were activated upon passing exciter antennas. Antennas were placed at the start line, at 13 km (section one), 27 km (section two), 45 km (section three), 64 km (section four) and 86 km (finish). The course comprised a combination of tarmac, dirt-track and gravel paths, with flat, climbing, descending and technical elements at various stages. Pacing was determined by examining speed across five course sections measured by the transponder timing system (see figure 1). Section one was 13 km and comprised sustained climbing from an elevation of ~190 m above sea level to ~640 m. The initial 7 km were completed on tarmac, with the final 6 km on dirt track roads. Section two comprised narrow paths and the first technical race section, totalling 14 km. The section began with a climb to 700 m, before descending on narrow paths for 4.5 km to an elevation of ~418 m. Competitors then completed 1.2 km of technical climbing on trails, before finishing with 5 km of flat cycling (<3% gradient). Section three was 18 km, completed on dirt road and narrow technical trails. Participants climbed to 780 m above sea level in the first 12 km, before completing a non-technical descent to ~666 m. Section four was 19 km and reached the highest point in the course at 955 m above sea level. Here participants completed a series (~11) of short (< 0.8 km) climbs (max 10%) and descents, with a net gain of 246 m. The final race section involved 22 km of downhill cycling. The first 11 km of the final section involved technical and non-technical descents on narrow gravel trails, whilst the final 11 km were completed on asphalt and were non-technical. Each section represented 15.1%, 31.4%, 52.3%, 74.4% and 100% of the total distance completed.

************INSERT FIGURE 1 ABOUT HERE************

Data Handling

Cumulative time for each section (h:min) was converted into individual section split times (h) and then average speed (km/h) for each participant. To analyse pacing profiles (and account for any absolute differences in speed) according to each independent variable (finish time, age, sex, previous race experience), each participant's section speed was converted to a percentage of their average speed in the race ([section speed / average race speed] *100). To determine the speed coefficient of variation across each race section for every participant, participants' standard deviation (SD) of section speeds was expressed relative to the mean speed as a percentage (i.e. %CV). An individual with a higher %CV would, therefore, have a more variable speed across the race.

Statistical Analysis

All dependent variables (average speed, relative speed, %CV) are presented as means ± SD. Separate one-way ANOVAs were conducted for each independent variable (age, sex, finish time and experience) to examine differences between average speed during the race and the %CV. To explore differences in absolute and relative speed during each race section, separate two-way ANOVAs (race section [5] x independent variable [2-6]) were conducted. In instances where there was a significant effect, *post-hoc* Bonferroni comparisons were made to determine where differences lay. The alpha level for significant effects was set at 0.05. To supplement the analysis, effect sizes (Cohen's *d*) were calculated, and were considered small, moderate, large and very large when between 0.2-0.59, 0.6-1.19, 1.2.-2.0 and > 2, respectively (Hopkins et al., 2009). Only significant effects that were $d \geq 0.2$ were considered meaningful. Where several effects are described, the range of effect sizes are presented. Statistical analysis was conducted using IBM SPSS Statistics (version 23) and effect sizes were calculated using Microsoft Excel (version 2017).

RESULTS

Participants were consistently quicker in the section of the race with the largest downhill component (section 5, $P < 0.0001$, $d = 2.55$), and slowest in the first (with the largest uphill component, $P < 0.0001$, $d = 1.07$) and penultimate race section (section 4, $P < 0.0001$, $d = 1.02$).

Race Completion Time

Separation of participants via quartiles for average race speed resulted in groups possessing significant differences in average speed (1^{st} quarter = 26.12 ± 1.77 km/h, 2^{nd} quarter = 22.72 ± 0.69 km/h, 3^{rd} quarter = 20.26 ± 0.77 km/h, 4^{th} quarter = 16.51 ± 1.80 km/h, d = 1.57-1.87). Between groups comparisons demonstrated that participants with a faster race completion time also had a faster average speed across all race stages (see Figure 2).

************INSERT FIGURE 2 ABOUT HERE************

When expressed relative to participants' average speed, the fastest group exhibited a higher relative speed in sections 1 ($P < 0.0001$, $d = 0.45$) and 4 ($P < 0.0001$, d = 0.68-1.15). Conversely, the slower groups had a faster relative speed in the final section of the race ($P < 0.0001$, d = 0.64-0.98; Figure 2).

The %CV in race speed across each section was lowest in the fastest group (23.4 ± 2.6%), and sequentially increased for each slower group (2^{nd} group = 26.5 ± 2.7%, 3^{rd} group = 28.7 ± 3.7%, 4^{th} group = 32.3 ± 5.7%).

Sex

Males were significantly quicker than females in all race sections (~3.20 km/h, P < 0.0001). Males' relative speed was higher than females' in the second ($P < 0.05$, d = 0.31) and third ($P < 0.05$, $d = 0.2$; see Table 1) section of the race, whilst females' relative speed was higher than males' in the final race section ($P < 0.05$, $d = 0.26$).

The %CV in race speed for males (27.5 ± 5.1%) was significantly (*P* < 0.001, *d* = 0.27) lower than females' (28.9 ± 4.7%).

************INSERT TABLE 1 ABOUT HERE************

Age

Average speed in the race was significantly faster for the 16-24 yrs age group (~22.99 ± 4.84 km/h) compared to all others (*P* < 0.0001, *d* = 0.31–0.85). There were no significant differences between those aged 25-34 yrs, 35-44 yrs (*P* = 0.26) and 45-54 yrs (*P* = 1.0). The 65+ yrs group had the lowest average speed (~19.29 ± 2.87 km/h, *P* < 0.0001, *d* = 0.42-0.83), followed by the 55-64 yrs age group (~20.64 ± 3.23 km/h, *P* < 0.0001, *d* = 0.26–0.62).

Average speed during each section was fastest in the 16-24 yrs age group (*P* < 0.0001, *d* = 0.26–0.91), whilst those in the 55-64 yrs (*P* < 0.0001, *d* = 0.21–0.74) and 65+ yrs group (*P* < 0.0001, *d* = 0.37–0.91) were significantly slower than all other groups in each race section. Relative to the average speed, 16-24 yr olds were significantly slower in the final race section (*P* < 0.0001, *d* = 0.20–0.32), which was offset by being significantly faster in: the second race section compared to all groups (*P* < 0.001, *d* = 0.20–0.55) and the penultimate race section compared to all groups (*P* < 0.05, *d* = 0.22) except 25-34 yr olds. The coefficient of variation was lower in the 16-24 yr olds compared to all other age groups (*P* < 0.01, *d* = 0.22–0.37). No other differences in %CV were observed (see Figure 3).

Race Experience

Average speed during the race was significantly different between groups with different race experience. Specifically, participants who had previously completed between 4-9 and >9 races were quickest (~22.2 ± 3.4 km/h and 22.8 ± 3.3 km/h) to complete the course ($P < 0.0001$, $d = 0.37–0.92$), followed by those who had completed the race on 2-3 occasions (~20.9 ± 3.7 km/h; $P < 0.0001$, $d = 0.45$). Similarly, average speed in each race section was highest in those that had competed in 4-9 and >9 races ($P < 0.001$, $d = 0.32–0.37$), whilst the second highest average speed in each section was observed for those who had completed 2-3 races ($P < 0.001$, $d = 0.41–0.48$).

Participants who had previously completed 4-9 and >9 races exhibited a lower relative speed than all other groups in the final race section ($P < 0.0001$, $d = 0.22–0.38$; Table 1). This was offset by having a higher relative speed in: section 2 ($P < 0.0001$, d = 0.0.3-0.38) 3 ($P < 0.0001$, $d = 0.38-0.46$) and 4 ($P < 0.0001$, $d = 0.30-0.42$) compared to those who had completed <2 races. Those that had completed >9 races also had a higher relative speed than those who had completed 2-3 races in the third ($P < 0.0001$, $d = 0.22$) and fourth ($P < 0.0001$, $d = 0.26$) race sections. Those that had previously completed 4-9 and >9 races also had a lower %CV (27.0 ± 5.7% and 26.4 ± 4.4%) than all other groups (<2 races = 29.6 ± 5.7%, 2-3 races = 28.3 ± 5.1%).

DISCUSSION

To the best of our knowledge, this is the first study to investigate pacing profiles adopted in a mass participation, long-distance cross-country mountain bike event.

Our data suggest that race completion time, age, sex and race experience are related to pacing and overall race performance.

Race completion time

The fact that the quickest finishers had a faster average speed across every race section suggests possession of superior physiological and technical mountain biking characteristics to cope with demands imposed by the course. Such characteristics include superior aerobic fitness (Impellizzeri et al., 2005), anaerobic power (Inoue et al., 2012), anthropometry (Impellizzeri et al., 2005) and technical ability to manoeuvre and stabilise the bike (Impellizzeri & Marcora, 2007). Therefore, unsurprisingly, improving any of these characteristics is likely to improve performance in XCM events.

When expressed relative to average race speed, it is notable that faster competitors were relatively quicker in race sections that comprised substantial climbing (i.e. the first and fourth race section) and relatively slower during descents (i.e. the final race section). This profile, representative of variable pacing, has been observed in successful Olympic distance mountain cyclists (Abbiss et al., 2013), whilst studies using mathematical modelling to determine optimal pacing in hilly cycling time-trials have determined that greater time savings can be made by varying power output in parallel with hill gradients, such that speed is more uniform (i.e. increasing and decreasing power when cycling up- and down-hill, respectively; Boswell, 2012; Atkinson et al., 2007; Swain, 1997). The progressive increase in coefficient of variation for speed from participants finishing in the fastest group (%CV: 23%) to the slowest group (%CV: 32%) here supports the notion that maintaining a more consistent speed, likely by varying power output in accordance with course topography, is an effective pacing strategy in XCMs.

It was beyond the scope of the current study to determine the causes of different pacing profiles adopted by faster participants. However, it is possible that the greater relative speed invested in the first race section by these competitors, which contributed to less variation in speed, was a tactical approach to the race. A faster start is thought to be crucial to overall success (Stepelfeldt et al., 2004; Impellizzeri et al., 2002), and an aggressive uphill start has been observed in faster World Championship mountain bikers (Abbiss et al., 2013). The faster start adopted by the fastest group in the present study (2-3%) likely offered a strategic advantage that overcomes the potential detriment imposed by mass starts. Specifically, cyclists could gain a strong position within their 'wave' early in the race, which might prove favourable when working in groups (e.g. drafting) and reduce time losses due to congestion on narrow tracks (Abbiss et al., 2013; Impellizzeri & Marcora, 2007). Providing that it is within the physiological constraints of participants (e.g. VO_{2max}, critical power), a small increase (<5%) in power output at the start of the race, offset by reduced power output in later downhill stages, might be an effective means for XCM competitors to improve performance (Boswell, 2012).

Sex

Males were significantly quicker than females in all race sections (3.2 km/h), translating to a ~15% difference between sexes. This difference is in-keeping with studies showing that females are ~10-16% slower than males in endurance events (Deaner, 2013; Hunter, Stevens, Magennis, Skelton, & Fauth, 2011). Reasons for this sex difference likely include an elevated aerobic capacity in males, facilitated by a greater heart size, haemoglobin concentration and lean body composition (Joyner, 2017). However, as current knowledge on sex differences in XCM is limited, it is possible that differences could extend to variation in other physiological components, as well as technical abilities and risk-taking behaviours (Micklewright et al., 2015; Deaner, Lowen, Rogers, & Saska, 2015). Future research should therefore seek to address sex differences in XCM to inform training and competition strategies.

Males invested a significantly greater proportion of their relative speed during race sections two and three, with a lower relative speed in the final section, compared to females (see Table 1); resulting in a lower %CV in race speed for males (27.5%) compared to females (28.9%). This is the second study in cross-country mountain biking indicating a tendency for males to adopt a variable pacing strategy via an alteration of relative speed in uphill and downhill sections (Abbiss et al., 2013). While physiological differences are likely contributors to the superior performances of males during the first three race sections, more recent suggestions for pacing differences between sexes have included decision making, risk-taking and motivation orientations (Schiphof-Godart & Hettinga, 2017; Deaner et al., 2015). For example, males are more likely to adopt a competitive, rather than a recreational orientation towards a race, which can change the level of risk they are willing to take (Deaner et al., 2015; Gill, 1986). Therefore, males might be more likely to initiate a faster relative speed during the first half of the race in pursuit of a quick performance time (Deaner et al., 2015). Such a strategy is considered ‘risky’, as catastrophic slowing in later race stages is more likely. Indeed, males are ~1.5 x more likely to slow markedly (>30%) in the second half of marathons (Deaner et al., 2015; March et al., 2011). However, in contrast to events with minimal changes in terrain and gradient, it appears that the greater speed invested in early (and climbing) stages is an advantageous pacing strategy in XCMs, which might be well-suited to those more willing to tolerate risk.

Age

The youngest (16-24 yrs) group were significantly faster than all others in the present study. This is consistent with age-related reductions in central and peripheral physiological function, such as VO_{2max}, after the age of 25 (Heath et al., 1981; Tanaka & Seals, 2003), but contrasts to studies demonstrating that peak endurance performance might occur up to 35-40 years (Haupt et al., 2013). However, it should be noted that the fastest male and female were in the 25-34 and 35-44 year age group, respectively. Furthermore, there is evidence that younger recreational endurance athletes are more likely to be motivated by performance compared to their older counterparts (Stults-Kolehmainen, Ciccolo, Bartholomew, Seifert, & Portman, 2013), which might alter their approach to a race and explain the higher speed in the younger age group on average.

Interestingly, similar average speeds were observed between the subsequent three age categories spanning from 25 to 54 years old. This finding is comparable to studies in cycling (as part of a triathlon) (Lepers et al., 2013; Lepers, Sultana, Bernard, Hausswirth, & Brisswalter, 2010) and running (Leyk et al., 2007; Jokl, Sethi, & Cooper, 2004), which contend that endurance performance can be maintained, and in some cases improved, until 50-55 years. Furthermore, age-related declines in cycling are lower than those observed in running (Lepers & Stapley, 2011), which might further explain the similar performance between age categories up to 54 years here. It should also be noted that there is an interaction between age-related declines in endurance and training (Tanaka & Seals, 2008), the latter of which was not accounted for in this study. Therefore, investigation of the training status and age-related performance in XCM events is warranted.

We observed relatively few differences in pacing profiles between different age groups. However, better overall performances in the 16-24 year age group were accompanied by a lower coefficient of variation in speed compared to other age groups, with no differences between all other ages. Although comparable research in mountain biking is scarce, an ultra-marathon running study recently reported no differences in pacing profiles between any age category (senior to >60 years) (Renfree et al., 2016). In our study, the ability for participants from 25-54 years to maintain overall speed with minimal variations in pace suggests that age does not hinder the ability to pace effectively.

Race Experience

Those finishing with the highest average speed in each section had previously completed the race over four times (categories: 4-9 and >9), followed by those who had completed it on two or three occasions. This is in-keeping with previous studies showing that lower levels of experience result in poorer performance (Hoffman &

Parise, 2015; Micklewright et al., 2010). At least for this race, it appears that repeated participation leads to improvement in performance time up until the fourth attempt, after which an individual's knowledge of the course is likely sufficient to enable them to appropriately regulate responses to the 'known' external demands.

Those who had between four and nine years and over nine years of race experience showed the lowest coefficient of variation in speed (%CV: 27.0% and 26.4%), whilst the least experienced group had the slowest times and highest coefficient of variation in speed (%CV: 29.6%). In-keeping with the pacing of faster participants overall, the lower %CV in participants with between four and nine and over nine previous races was explained by a greater relative speed in climbing sections (apart from section 1) and a lower relative speed in the final descent. These results support various empirical and theoretical works identifying prior experience as an important determinant of optimal pacing (Mauger, Jones & Williams, 2010; Deaner et al., 2015). As such, our results are consistent with others suggesting that pacing is a process that can be improved via repeated exposure to the exercise environment (Maugher et al., 2010; Micklewright et al., 2010). In this case, prior course knowledge, such as the upcoming terrain and elevation, and the remaining duration to the exercise end-point, potentially enabled experienced participants to make more accurate anticipatory judgements that led to better regulation of effort (Pargeaux, 2014). Future work might also assess the effect of experience on pacing in other XCM competitions.

This study was not without its limitations. It is possible that some riders exhibited a slower speed during the race due to mechanical faults or collisions with other riders, which might have influenced their distribution of pace but for which we had no control over. Furthermore, it is noteworthy that categorising the course into more than five race sections could improve the resolution of information relative to pacing, although the nature of the research design meant that this was not possible. Future research should seek to continuously monitor internal (heart rate, power output, perception of effort) and external (average speed, relative speed, %CV) variables in line with the course profile to obtain a more detailed insight into how pace might be regulated during XCM events.

CONCLUSION

These data demonstrate that performance in an XCM differs according to sex, age and previous race experience, which in most cases is underpinned by differences in pacing. Indeed, faster race performance was associated with a more stable average speed across the race due to a higher relative speed invested when going uphill at the expense of relative speed going downhill. Given the observational nature of this study, it is not clear whether faster performers adopted a variable pacing profile as a tactical strategy, or indeed the causes of this pacing profile; future studies should explore this in XCM events. However, based on our observations, it would seem that any method that increases relative speed whilst climbing is likely to be beneficial. With this in mind, findings could be used by participants and coaches to inform specific training and pacing strategies that could enhance performance time and improve the overall race experience.

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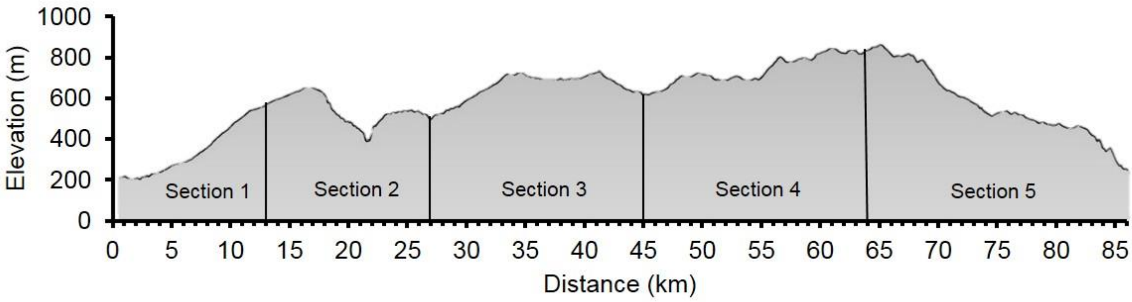
FIGURE LEGENDS AND TABLES

Figure 1. Profile of the 86 km course, outlining the race sections that were used for pacing analysis.

Figure 2 Race pacing according to speed. * = Sig. and meaningful (d > 0.20) difference between 1st and 2nd fastest participant group. ** = Sig. and meaningful (d > 0.20) difference between 2nd and 3rd fastest participant group. *** = Sig. and meaningful (d > 0.20) difference between 3rd and 4th fastest participant group.

Figure 3. Speed coefficient of variation (%CV) for each race section according to age groups. * = Sig. and meaningful (d > 0.20) difference compared to all other groups.

Table 1. Absolute and relative (in brackets) speed of participants according to sex, age and race experience



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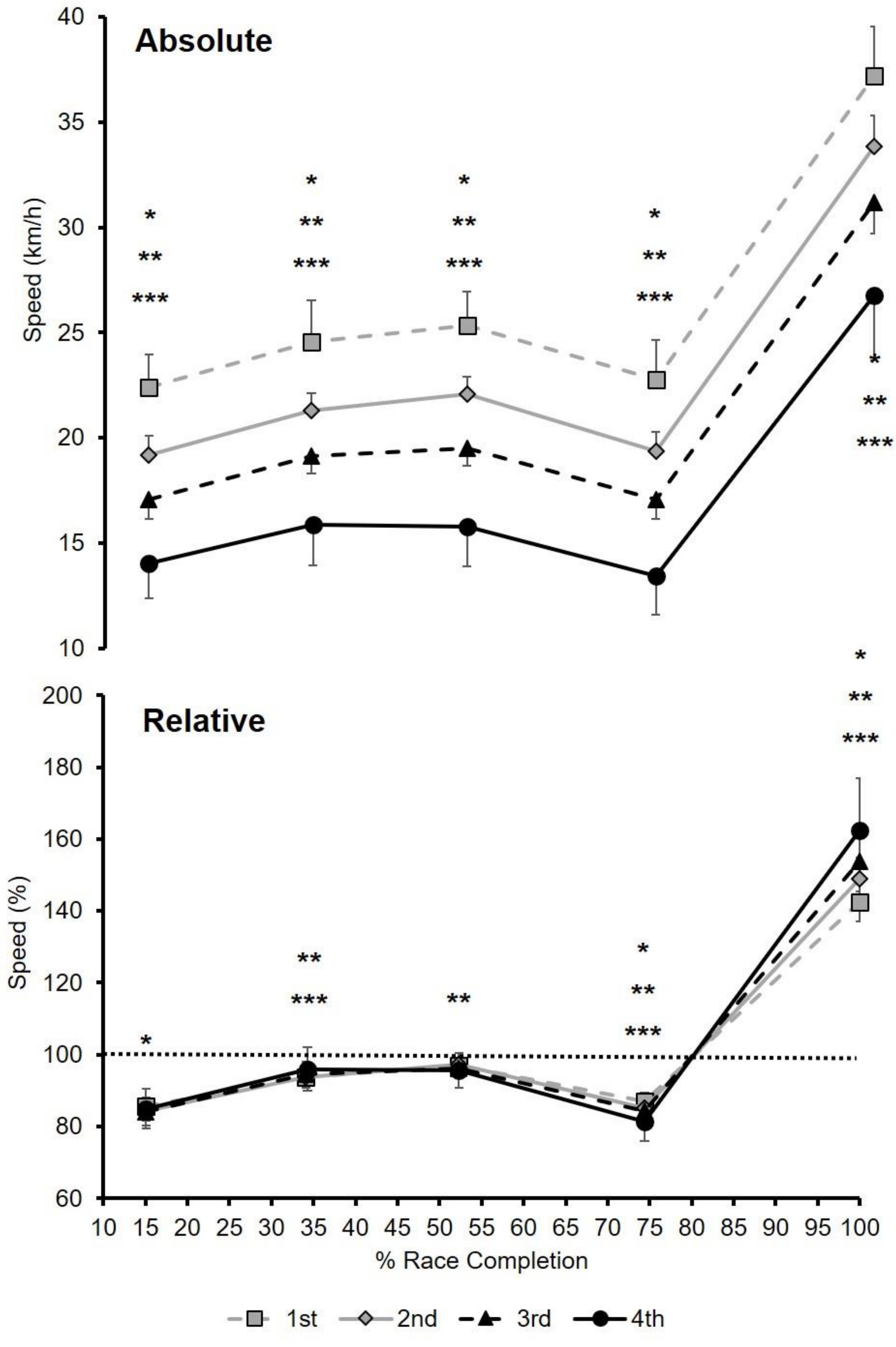

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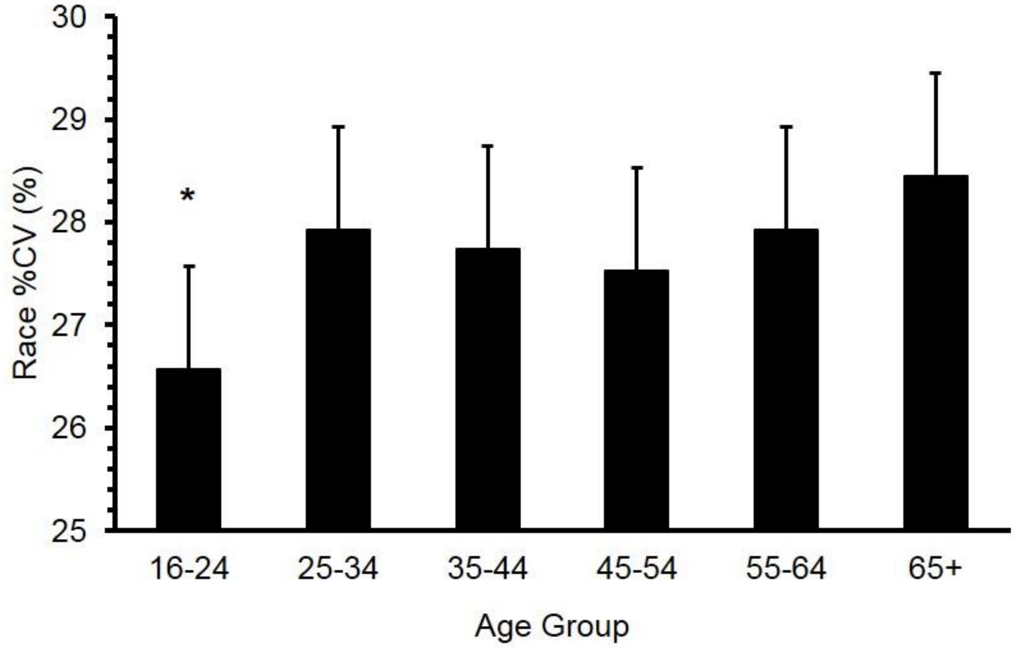

Figure 3. Speed coefficient of variation (%CV) for each race section according to age groups. * = Sig. and meaningful ($d > 0.20$) difference compared to all other groups.

Table 1. Absolute and relative (in brackets) speed of participants according to sex, age and previous race experience

Gender					
Female	15.7 (84.4%)	17.4 (93.4%)	17.9 (96.0%)	15.8 (84.6%)	28.6 (154.6%)
Male	18.5 (84.9%)	20.6 (94.7%)	21.1 (96.6%)	18.5 (84.4%)	32.8 (151.5%)
Age					
16-24	19.5 (84.8%)	22.0 (96.0%)	22.1 (95.9%)	19.7 (85.2%)	33.9 (149.4%)
25-34	18.1 (84.7%)	20.3 (95.0%)	20.6 (96.3%)	18.2 (84.4%)	32.2 (152.5%)
35-44	18.4 (84.7%)	20.6 (95.0%)	21.0 (96.5%)	18.4 (84.3%)	32.7 (152.1%)
45-54	18.3 (84.9%)	20.3 (94.2%)	20.8 (96.6%)	18.3 (84.5%)	32.4 (151.6%)
55-64	17.5 (84.9%)	19.4 (93.9%)	20.0 (96.6%)	17.5 (84.4%)	31.2 (152.4%)
65+	16.3 (84.8%)	18.0 (93.5%)	18.7 (96.8%)	16.3 (84.3%)	29.4 (153.3%)
Race Experience					
<2	16.2 (84.7%)	18.3 (95.5%)	18.3 (95.6%)	16.1 (83.4%)	29.6 (156.3%)
2-3	17.7 (84.6%)	19.7 (94.7%)	20.1 (96.4%)	17.6 (84.1%)	31.7 (153.3%)
4-9	18.9 (85.0%)	20.9 (94.2%)	21.5 (96.9%)	18.9 (84.7%)	33.1 (150.4%)
>9	19.4 (85.0%)	21.4 (93.9%)	22.1 (97.0%)	19.5 (85.1%)	33.8 (149.0%)