Senior men's pacing profiles at the IAAF World Cross Country Championships

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ABSTRACT

The aim of this study was to describe pacing profiles used by senior men competing in the World Cross Country Championships. Lap times were collated for 1273 competitors across 10 races. Each individual's lap times were expressed as a percentage of the eventual winner's lap times, and athletes grouped according to finishing position. Most athletes started the race by following the pace set by the leaders but slowed relative to the winner with each successive lap. The gold medallists were faster than the other medallists only after the final lap ($P < .001$). Most athletes who dropped out (61%) had completed the first lap within 105% of the winner's lap time. The medallists used a strategy of running close to the front from an early stage, but did not separate themselves from other top 15 finishers until halfway, with the eventual medal positions decided even closer to the finish. Athletes finishing further down had positive pacing profiles relative to the winner, possibly because of early fatigue caused by a relatively quick first lap. Athletes should note that a patient approach during the early stages can benefit not only the mass field but also those who aim to win a medal.

INTRODUCTION

An optimal pacing profile that makes the most of an individual's physiological resources is an important component of success in endurance events (Tucker, Lambert, & Noakes, 2006). In competition, the athlete must regulate their pace based on their fatigue (Abbiss & Laursen, 2008) while taking into account the amount of distance remaining (de Koning et al., 2011; St Clair Gibson et al., 2006; Swart et al., 2009). For example, an athlete might speed up or slow down at a particular point in a race dependent on whether their rating of perceived exertion (RPE) is lower or higher than anticipated (de Koning et al., 2011; Tucker, 2009). It should be noted that RPE can be dissociated from an individual's physiological status by psychological factors that divert attention from purely physical cues (Baden, Warwick-Evans, & Lakomy, 2004), some of which could result from competition (e.g. daydreaming about success). Self-pacing can be difficult in competition as the actions of opponents can influence race dynamics (Abbiss & Laursen, 2008; Renfree & St Clair Gibson, 2013) and athletes might purposefully endure physiologically uncomfortable paces (and high RPEs) in an attempt to tire out rivals.

In endurance events, positive pacing profiles tend to be adopted, where the athlete starts off quickly and progressively slows (Abbiss & Laursen, 2008; Renfree & St Clair Gibson, 2013) because of kinematic changes such as reduced step length (Hanley, Smith & Bissas, 2011) that affect running economy (Nummela, Keränen, & Mikkelsson, 2007). These pacing profiles tend to occur during elite-standard distance running competitions where slower athletes do not self-select their early pace, but instead follow the leaders until the inability to maintain contact means they slow to a more comfortable and stable speed (Thiel, Foster, Banzer, & de Koning, 2012). While there are sound competitive reasons for adopting positive pacing, the disadvantage of this tactic is that it results in greater accumulation of fatigue-related metabolites and increased RPE (Abbiss & Laursen, 2008). Nonetheless, the adoption of an early quick pace is a strategy often used by distance runners in attempts to separate themselves from the main field, with the final top three positions usually decided by an endspurt (Thiel et al., 2012).

The World Cross Country Championships have been held under the auspices of the International Association of Athletics Federations [IAAF] since 1973. Because of its nominal length (12 km) (IAAF, 2011), the senior men's race most closely resembles the track distance of 10,000 m. In fact, the top 15 finishers in the World Cross Country Championships are considered to have achieved the 'A' standard for the 10,000 m track race at the IAAF World Championships in Athletics (IAAF, 2013a). The past six Olympic 10,000 m races have been won by athletes who were also competitive in the World Cross Country Championships. For example, World Record holder and two-time Olympic Champion Kenenisa Bekele won the event on six occasions (IAAF, 2013b). Because of the high quality of endurance athletes competing, the World Cross Country Championships are an excellent source of information to study characteristics of world-class endurance performances (Gonzalez-Freire et al., 2009).

Because of variations in course length, gradient and terrain, there are no personal bests or qualifying times to be achieved by competing in the World Cross Country Championships. Instead, the top athletes are merely trying to win and their pacing tactics might reflect this, similar to high-standard competitions such as the Olympic Games (Thiel et al., 2012) or IAAF World Championships in Athletics (Renfree & St Clair Gibson, 2013). The addition of a team competition means that athletes who might not be good enough to win an individual medal are still motivated to finish as high as possible, as they might likewise be in more prestigious races such as an Olympic final. For example, the athlete in 14th position at the 2013 Championships was part of the gold medal-winning team, while during the same race 26th position was good enough for a team bronze medal (IAAF, 2013b). Even those athletes who do not count for their team's score (four to count) can assist their teammates by displacing rival team members. The team competition is therefore a key element of the World Cross Country Championships as every position is keenly contested, and dropping out is discouraged.

Previous research has not analysed pacing profiles of competitors at the IAAF World Cross Country Championships. The ability to perceive the correct pace to adopt might be even more important in events such as cross country where there are no precisely measured distances, with the result that lap times are not accurate guides for pacing (Young, 2007). Knowledge of the pacing profiles used by endurance athletes of different abilities can therefore aid both athletes and coaches in understanding successful pacing profiles and inform suitable training regimes. The aim of this study was to describe the pacing profiles used by senior men competing in the IAAF World Cross Country Championships.

METHODS

Participants

The Faculty Ethics Committee approved the study. Overall race times and lap times were obtained from the open-access IAAF website (IAAF, 2013b) for competitors in the senior men's races at 10 IAAF World Cross Country Championships events held between 2002 and 2013 (Table 1). Some data were not available online and were obtained directly from IAAF or Local Organising Committee personnel. Data were not included for the 2003 event as it was held over five laps rather than the more usual six, and there was no race in 2012 as the championships were changed from an annual to a biennial event after 2011. A total of 1273 finishers were analysed across all 10 competitions (including athletes competing more than once). The performances of the 109 athletes who dropped out were analysed separately from those who completed the race. The total complement of lap times was not available for 11 athletes and none of these competitors' data have been included. Finally, there is no qualifying standard for these championships and the performances of eight athletes considered very slow (i.e. with a finishing time more than 30% slower than the winner's time) have been omitted.

Table 1. Details of each analysed competition.

Venue	Year	Finishers (N)	Gold medallist	Winning time (min:s)
Dublin (IRL)	2002	133	Bekele (ETH)	34:52
Brussels (BEL)	2004	130	Bekele (ETH)	35:52
St Etienne (FRA)	2005	129	Bekele (ETH)	35:06
Fukuoka (JPN)	2006	132	Bekele (ETH)	35:40
Mombasa (KEN)	2007	134	Tadese (ERI)	35:50
Edinburgh (GBR)	2008	165	Bekele (ETH)	34:38
Amman (JOR)	2009	137	Gebremariam (ETH)	35:02
Bydgoszcz (POL)	2010	126	Ebuya (KEN)	33:00
Punta Umbria (ESP)	2011	110	Marga (ETH)	33:50
Bydgoszcz (POL)	2013	96	Korir (KEN)	32:45

Data Analysis

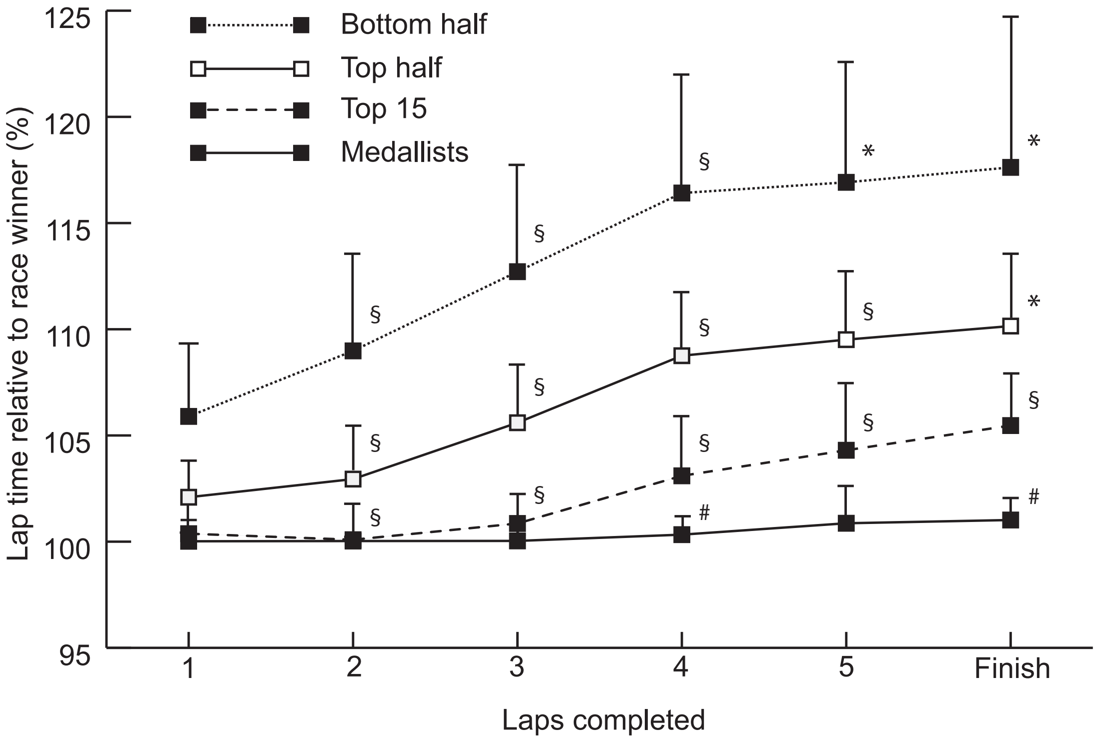
The study was designed as observational research in describing pacing profiles. Competitors in each race were divided into four groups, similar to previous research (Hanley, 2013; Thiel et al., 2012) and each athlete was placed in only one group. These groups were medallists (a total of 30 athletes); non-medallists who finished in the top 15 (120 athletes); the remaining athletes who finished in the top half of the race (492 athletes); and those athletes who finished in the bottom half (631 athletes). Cross country races are not held on standardised courses and therefore finishing times are meaningful only in the context of a specific race (even those races held at the same venue on separate occasions can take place over different courses, e.g. Bydgoszcz in 2010 and 2013 (IAAF, 2013c)). Furthermore, cross country courses generally deteriorate as the race progresses because of the large numbers of participants completing repeated laps. For these reasons, lap times were calculated as a percentage of the eventual winner's time for that lap (which was always expressed as 100%). This approach allowed for the effect of discrepancies in lap lengths both between and within races to be negated; the first and last laps are often different to allow for wide starting areas and finishing funnels respectively (e.g. Bydgoszcz in 2013) (IAAF, 2013c), and small extra loops are permitted on early laps to achieve the total distance (IAAF, 2011).

Statistical analysis

The lap time percentages were arcsine transformed for the purposes of statistical analysis (Vescovi, 2012). One-way repeated measures ANOVAs were conducted on the lap time data with repeated contrast tests conducted to identify changes between successive laps (Field, 2009). Greenhouse-Geisser corrections were used if Mauchly's test for sphericity was violated. In addition, one-way ANOVAs with Tukey's post-hoc tests were conducted to compare mean lap times between groups (Field, 2009). Statistical significance was accepted as $P < .05$ as in similar previous studies (Renfree & St Clair Gibson, 2013; Tucker et al., 2006). Effect sizes (ES) for differences between successive laps, and between groups on each lap, were calculated using Cohen's *d* (Cohen, 1988) and considered to be either trivial (ES: < 0.20), small (0.21 – 0.60), moderate (0.61 – 1.20), large (1.21 – 2.00), very large (2.01 – 4.00), or nearly perfect (> 4.00) (Hopkins, Marshall, Batterham, & Hanin, 2009).

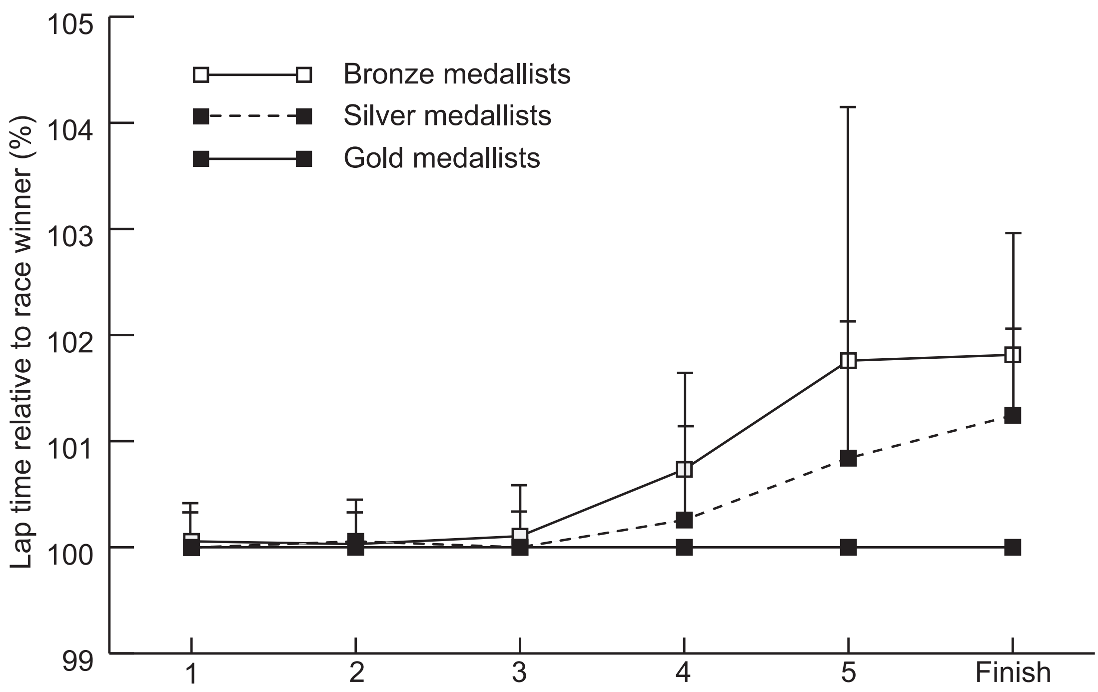
RESULTS

Figure 1 shows the mean lap time percentages for each group of athletes at the end of every lap. As a guide, 1% of the winner's lap time was equivalent to an absolute time of between 3 and 4 s. All groups slowed relative to the winner's pace between successive laps (medallists: F = 11.0, *P* < .001; top 15 group: F = 204.6, *P* < .001; top half group: F = 1094, *P* < .001; bottom half group: F = 1620, *P* < .001). Most of the effect sizes for differences between successive lap times were trivial or small. There were moderate effect sizes for the top 15 group for the differences between laps 3 and 4 (ES = 0.71); for the top half group between laps 2 and 3 (ES = 0.73) and laps 3 and 4 (ES = 0.74); and for the bottom half group between laps 1 and 2 (ES = 0.77) and laps 3 and 4 (ES = 0.72).



In addition, there was a large effect size for the bottom half group between laps 2 and 3 (ES = 0.82). The medallists were faster than both the top half and the bottom half groups by the end of lap 1, and after every subsequent lap (P < .001); effect sizes ranged between 1.00 and 1.77. By the end of lap 3, the medallists had become faster than the top 15 group (ES = 0.57) and continued to be faster after every subsequent lap (P < .001) (lap 4: ES = 1.07; lap 5: ES = 1.26; lap 6: ES = 2.88).

Figure 2 shows the mean lap time percentages for the 10 gold, 10 silver and 10 bronze medallists. The gold medallists' lap times are always shown as 100%. The gold medallists were faster than the silver and bronze medallists only at the end of the race (lap 6) (P < .001), where the respective effect sizes were very large (silver medallists: ES = 3.85) and nearly perfect (bronze medallists: ES = 4.38). The final time difference between gold and bronze positions was less than 10 s in six of the 10 races. Apart from the 2007 race, where the eventual winner was 8 s behind the leader at the end of lap 2, no gold medallist was ever more than 2 s off the lead pace.



With regard to those athletes who did not finish, five dropped out before completing even one lap, while 21 dropped out during the second lap, 30 during each of lap 3 and 4, 16 during lap 5, and seven at some point during the last lap. Twenty-one of the athletes who eventually dropped out were within 101% of the lead time at the end of the first lap. Three of these athletes dropped out after the first lap, while the other 18 dropped out once their pace had slowed to a mean of 109% (± 8) of the winner's lap time. A further 46 athletes who did not finish were within 105% of the winner's lap time after lap 1, with two runners experiencing very large decreases in pace before dropping out (lap times more than 200% of the winner's pace).

DISCUSSION

The aim of this study was to describe the pacing profiles used by senior men competing in the IAAF World Cross Country Championships. The fact that nearly all gold medallists were consistently within two seconds of the leader showed that the winners adopted a tactic of staying close to the front from the very beginning. Furthermore, the silver and bronze medallists were also close to the eventual winner until the latter stages of the race where, like in Olympic track races (Thiel et al., 2012), the eventual differentiation between the top three positions was decided close to the finish. It is therefore important for those who aim to win a medal at the World Cross Country Championships to position themselves near the front from an early stage, particularly as elements of course design (e.g. narrow sections, multiple turns) might make overtaking difficult.

Athletes who finished outside the medal positions appeared to follow the winner's pace at the beginning but gradually drop back. It has been suggested that this tactic of following rivals' behaviours in endurance events is taken because it appears the easiest decision to make where rewards are based on finishing position rather than time (Renfree & St Clair Gibson, 2013); because many athletes have unrealistic perceptions of their athletic ability (Abbiss & Laursen, 2008); and because of a possible wind shielding effect (Hanley et al., 2011). The difference in pacing profiles between groups was demonstrated by how early they slowed relative to the winner and by how much. While the relative 'positive pacing' pattern shown by non-medallists was probably due to some degree by the non-medallists slowing down, it is also possible that in some cases it was caused by the winner speeding up (or a combination of both). Starting too quickly relative to finishing time has been shown to lead to a progressive reduction in running speed because of fatigue (Abbiss & Laursen, 2008) and those athletes who did slow throughout the race might be better advised to try an even-paced profile, as adopted by faster marathon runners (Haney & Mercer, 2011). This is not particularly easy in competitions like the World Cross Country Championships where there are no distance markers or pre-arranged pacemakers (Tulloh, 1996); indeed, coaches could conceivably utilise some athletes as unofficial pacemakers whose role would be to strategically push or disrupt the lead pace. Athletes who can learn to hold back in the early stages with a pace that feels too slow (because the opposition starts faster and RPE might also be low) and maintain even pacing will have an advantage over athletes who start too quickly (as in other endurance events (Abbiss & Laursen, 2008)), and ultimately achieve a higher finishing position that could be important in the team competition.

In most instances, dropping off the lead group quickly resulted in these athletes slowing to sustainable paces that appeared to plateau between lap 4 and the finish.

However, most athletes who eventually dropped out completed the first lap within 105% of the leader's time and showed that starting too quickly could be a cause of drop out for some individuals. Most athletes who dropped out did so in the middle two laps of the race, and while fatigue probably increases towards the end of the race, fewer athletes dropped out in laps 5 and 6, possibly because of the psychological boost of approaching the finish, as in other endurance events (de Koning et al., 2011; Hanley, 2013). Pacing errors leading to drop out can be made by even the world's best athletes; for example, during the 2007 race, six-time champion Kenenisa Bekele went into the lead with one lap remaining, but reportedly misunderstood how many laps were left because of heat-induced confusion and was unable to complete the unexpected remaining distance (Yohannes, 2007). Bekele's case highlights the importance of correctly knowing how much distance is remaining with regard to RPE and the adoption of a successful pacing profile in elite-standard distance running (de Koning et al., 2011; St Clair Gibson et al., 2006; Swart et al., 2009).

The results of this study have some practical implications for distance runners and their coaches. For world-class distance runners, training sessions that replicate the physiological and psychological demands of getting close to the front early and staying there are recommended. Most runners followed the winner's pace at the beginning of the race, but this approach tended to result in a rapid drop off from the lead group and a more cautious approach in an attempt to run an even-paced profile might be more beneficial. Indeed, even the eventual winners were not faster than the top 15 finishers until the end of the third lap, and did not separate themselves from the bronze and silver medallists until the very end; coaches of elite-standard cross country runners should note that those aiming to win can be patient in the early stages and do not need to attempt to break away from the lead pack until the second half of the race. While a conservative starting speed could benefit many of the top cross country runners, it might benefit the slower athletes who follow the lead pace to a greater extent in achieving a more even-paced profile. All athletes, regardless of ability, are advised to adopt realistic pacing strategies based on prior training and racing to avoid the possibility of early fatigue. It is particularly important for athletes to be mindful of the distance remaining in cross country where lap lengths and the number to be completed can vary. A thorough examination of the course before the race is invaluable for correct pacing (e.g. with regard to timing of the endspurt).

The findings of this study could be used in the design of future research into cross country running; for example, the pacing profiles of elite-standard women and junior runners have not been described to date and could differ from those of senior men because of the shorter distances covered. It might also be informative to compare athletes' pacing profiles under different racing conditions (i.e. cross country, track and road) to see if different pacing strategies are adopted because of, for example, differences in underfoot conditions and access to pacing information. In addition, the efficacy of training methods (e.g. positive pace training, interval running) suggested for high-standard track competitors (Thiel et al., 2012) could be evaluated for cross country runners. It is worth noting the IAAF's requirement that cross country races incorporate natural obstacles to create a challenging course (IAAF, 2011). This means that while mean lap times might not differ greatly from each other, small but frequent changes in running speed are likely to occur with variations in gradient, underfoot conditions, and course direction (e.g. running with or against the prevailing wind). As this study was limited to analysing ‘macrovariations’ based on lap times that do not fully reflect the subtle changes in pace that occur in cross country running, higher resolution data (i.e. of shorter sections of each lap) would be particularly useful in measuring any microvariations (Thiel et al., 2012), and could provide more information about pacing differences between faster and slower competitors.

CONCLUSIONS

This study examined senior men’s pacing profiles at the World Cross Country Championships. The very best athletes were able to keep up with or dictate a lead pace that other athletes tried to follow but eventually dropped off, with the slowest finishers becoming detached by the end of the first lap but those in the top 15 not losing contact until halfway, while the eventual medal positions were decided at the very end. A large proportion of those who dropped out completed the first lap within 105% of the winner’s lap time and suggested that many had selected a poor pacing strategy in attempting to keep up with faster competitors. Successful cross country racing therefore depends not only on having trained and prepared appropriately in advance, but also on pacing oneself carefully throughout the race regardless of ability.

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