

Relationship between velocity changes and subjective effort in top-level high-school 400m hurdlers

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Purpose

To clarify the relationship among performance, race pattern, and subjective effort in the 400m-Hurdle race (400m-H).

Methods

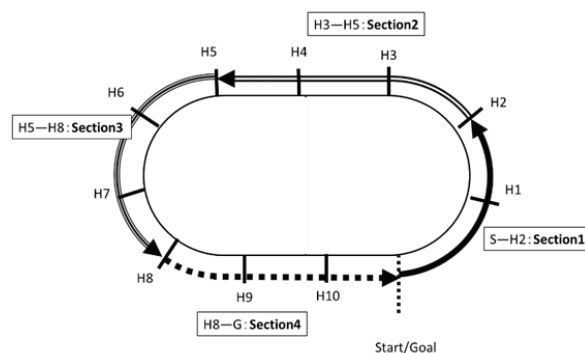
The races in high-school championship in Japan were recorded with video. Using the recordings, the time from the flash of the starter's gun to the touchdown time immediately after each hurdle was obtained for each hurdler. Furthermore, a survey of the runner's subjective effort during the race was conducted by using a mail-survey. The race was divided into four sections as follows: Section 1 (S1), which concerns the period from the start of the race to the second hurdle (H2); Section 2 (S2), from H2 to H5; Section 3 (S3), from H5 to H8; and Section 4 (S4), from H8 to the finish. The running velocity (V_{s1} , V_{s2} , V_{s3} , and V_{s4}), the rate of deceleration ($D_{s2/s1}$, $D_{s3/s2}$, $D_{s4/s3}$), the rate of section time in race time ($\%s1$, $\%s2$, $\%s3$, $\%s4$), and the subjective effort made in each section ($Es1$, $Es2$, $Es3$, $Es4$) were calculated, respectively. To classify the subjects by race pattern, the squared Euclidean distance in which the variables were standardized with respect to the section time ratio was calculated. Using the resulting patterns, we performed cluster analysis using Ward's method^{12,18}. To compare each parameter in the obtained race patterns, a non-paired t-test was carried out. To compare each parameter in each section of the race between the groups, a one-way analysis of variance (ANOVA) was performed and multiple comparisons conducted by Holm's method for significant F-values. Pearson's correlation coefficients were calculated to examine the relation among each parameter, race time, and section effort. The significance level was set to 0.05.

Results & Discussion

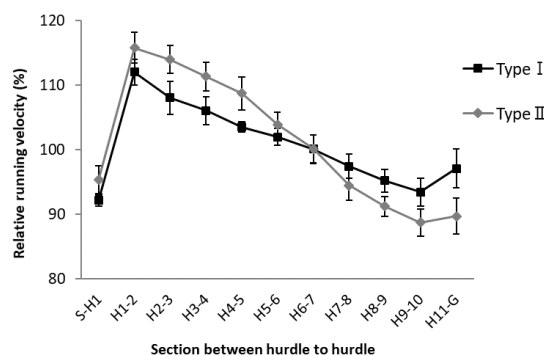
Subjective effort during the race was approximately 85% during S1, but individual differences varied widely. Effort declined somewhat in S2, before gradually increasing again from S3 to the finish line. At the high-school championship level, the higher the performance,

the higher the speed as a whole, with a lower speed decrease from S2 to S3, a slower relative pace at S1 and with a faster pace during S3. Athletes who exhibited "speed maintenance" more than "speed reduction" during S1 and had a low subjective effort, at the relative pace, showed no significant difference only in S3.

From these results, it is clear that top-level high-school 400m-H runners have a slow relative pace in S1 and that adopting a race pattern that involves setting a relatively high pace in S3 is important. Additionally, it is suggested that the subjective effort made in S1 is related to the race pattern, i.e., speed maintenance or speed reduction, but this is not related to the relative pace of S3, which correlates highly with the overall time. Thus, 400m-H runners should consider a strategy according to their individual ability, and build an ideal race pattern from an objective and subjective point of view.



Definition of each section



Changes of relative running velocity (%) on each section in Type I (speed maintenance type) and Type II (speed reduction type).