Changes in the step width, step length, and step frequency of the world's top sprinters during the 100 metres

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ABSTRACT

Coaches usually instruct athletes to take narrow steps and strive for high step frequency at the start of sprint races. However, the experimental data regarding the step width in 100m races is not well documented. The stride patterns of 18 male sprinters taking part in the first round heats of the 100m at the 2005 IAAF World Championships in Athletics were analysed. It was found that the main difference between sprinters at the 10.12-10.32 level and sprinters at the 10.40-10.90 level was in step length. It was also found that both groups decreased their step width from 0.39 ± 0.07m in the first step after the start to 0.17 ± 0.04m in full stride running. The authors suggest that a wide step width may be best suited for developing driving force during the long foot contacts in the acceleration phase while a narrow step width may be best for the short foot contacts of full stride sprinting.

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Introduction

Coaches usually instruct athletes that a narrow step width and a high step frequency are necessary for a good start in the sprints. However, the experimental data regarding the step width during 100m races has not been well documented. The purpose of this study was to clarify the changes in the step width, step length, and step frequency of the world's top sprinters during the acceleration phase and the phase when the full stride length had been achieved.

Methods

The subjects were 18 male sprinters who participated in the heats of the 10th IAAF World Championships in Athletics held in Helsinki, Finland in 2005. They were divided into two groups based on their times in the races: the high performance group (HG; 10.12–10.32s, 9 sprinters) and the lower performance group (LG; 10.40–10.90s, 9 sprinters).

Two video cameras were set up in the spectator tribune of the stadium. One camera was placed so that it recorded the foot contacts with the track surface covering the initial acceleration phase of 0 to 30m. The second camera was set to cover the middle phase of the race so that it gave the measures of the longest step length achieved in the race. It was assumed that its location at the 60m point of the race would give the camera the optical range from 40 to 80m necessary to provide this information. The Two-dimensional Direct Linear Transformation method was applied to the x-y coordinates of the runners' toe during each visible foot contact period. Consequently, the analysis provided accurate measures of the step length, step frequency and step width (Figure 1). These values were then used to compare the two groups of the sprinters.

Results and Discussion

As expected, the step length increased gradually during the early part of the acceleration phase (Figure 2). The patterns of the increase were similar in both groups. However, the better group (HG) had a longer step length during this acceleration phase. The same was true for the full stride length, which was, on the average, 0.12 ± 0.03m, longer ($p<0.003$) in the HG compared to the LG.

The step frequency was maintained at almost the same level (4.56 ± 0.16 steps/s; Figure 3) in the acceleration and full stride phases and no difference was observed between the groups. While the running velocity increased during the acceleration phase,

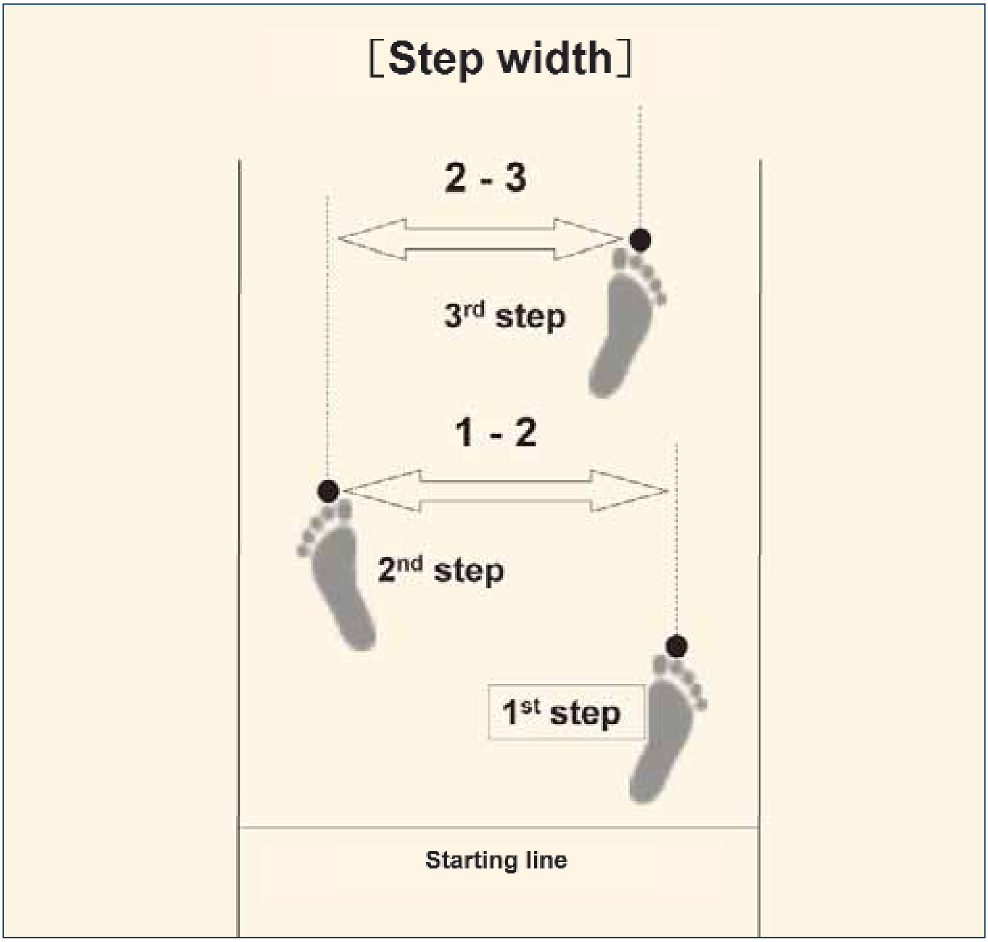

Figure 1: Measurement method of step width

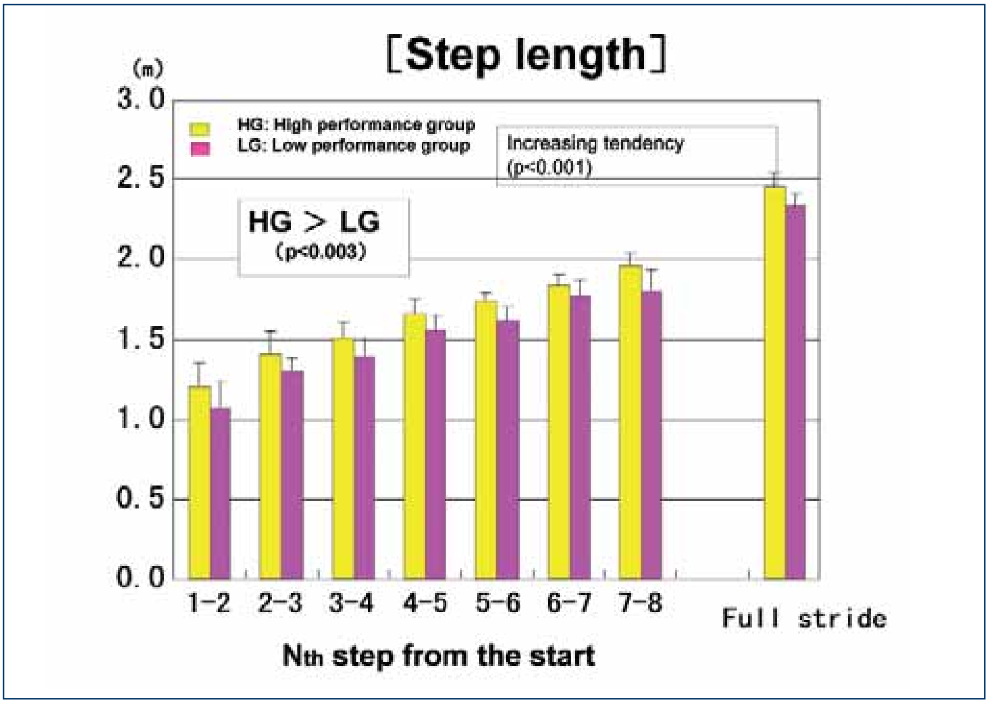

Figure 2: Step length measured in the initial acceleration steps and the full stride length phase of the 100m

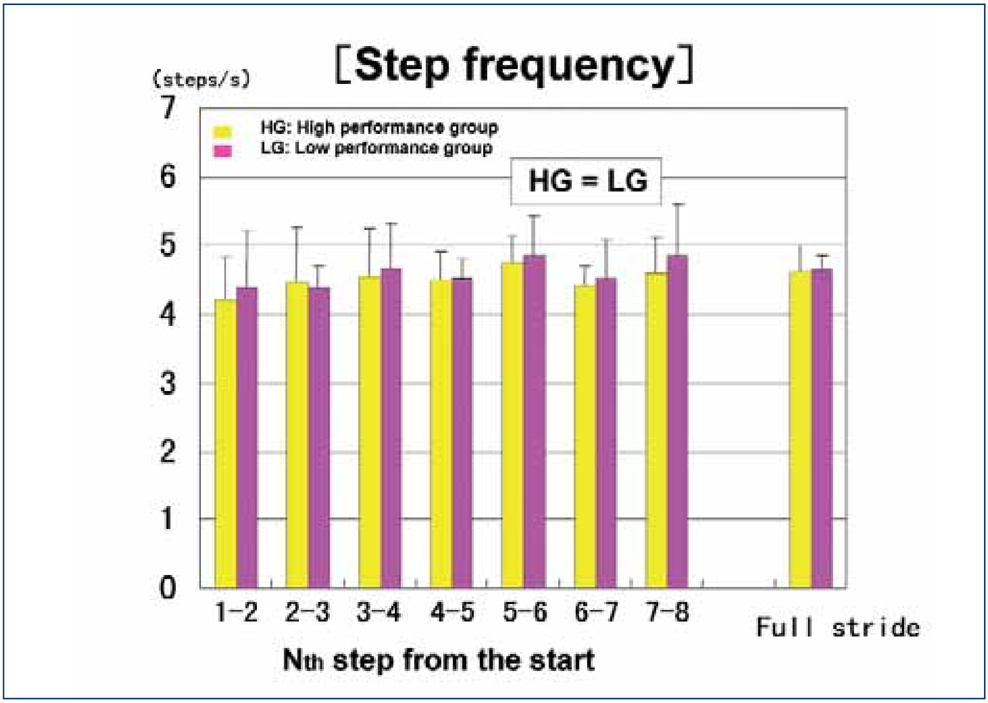

Figure 3: Step frequency measured in the initial acceleration steps and the full stride length phase of the 100m.

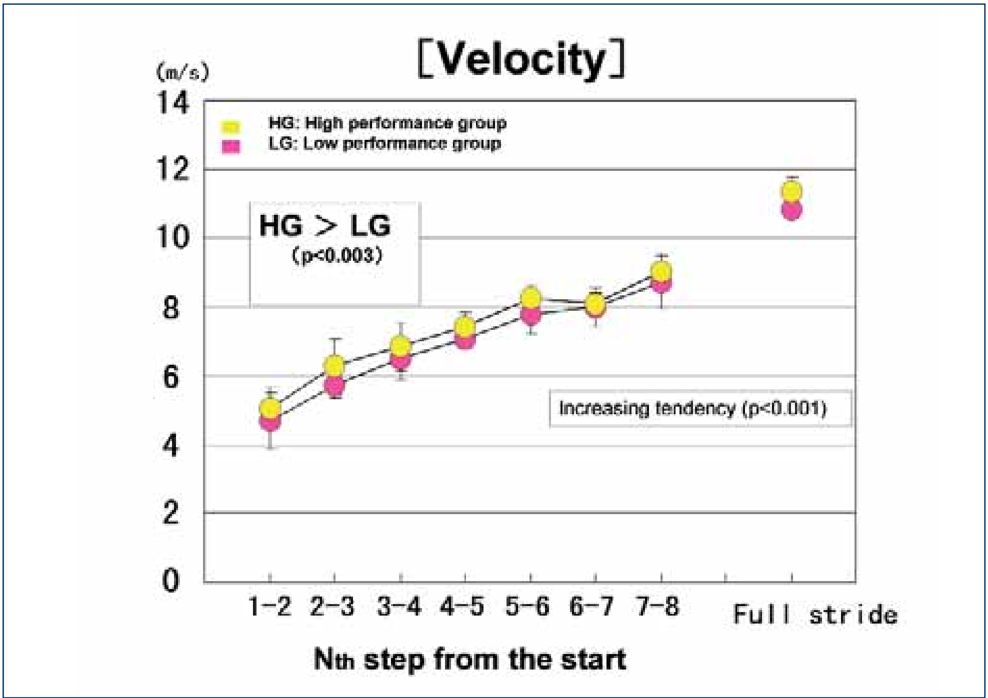

Figure 4: Running velocity measured in the initial acceleration steps and the full stride length phase of the 100m.

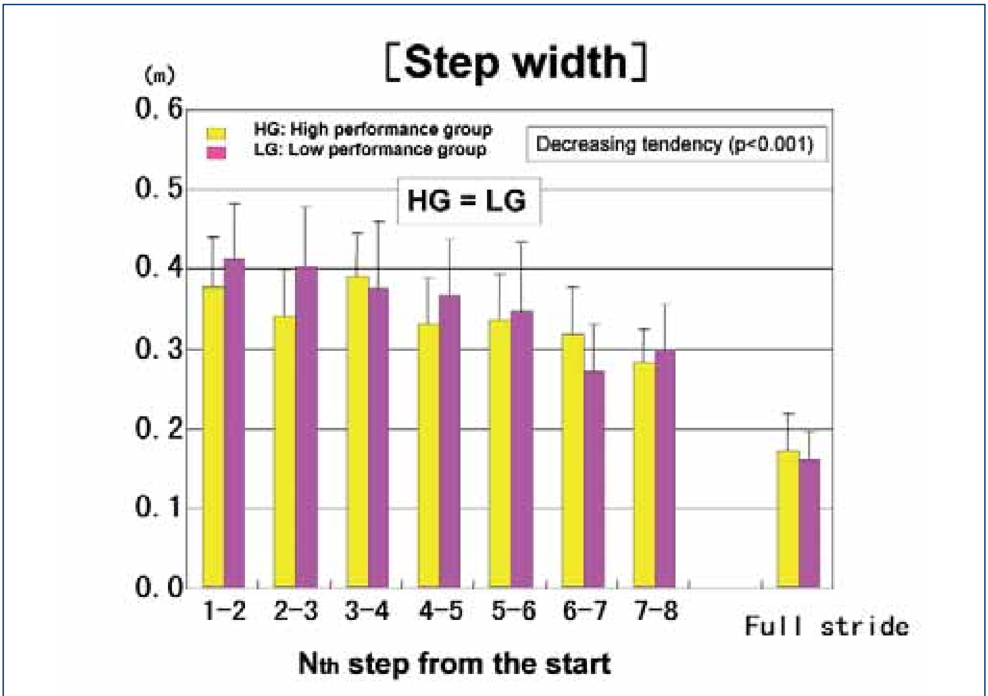

Figure 5: Step widths measured in the initial acceleration steps and the full stride length phase of the 100m.

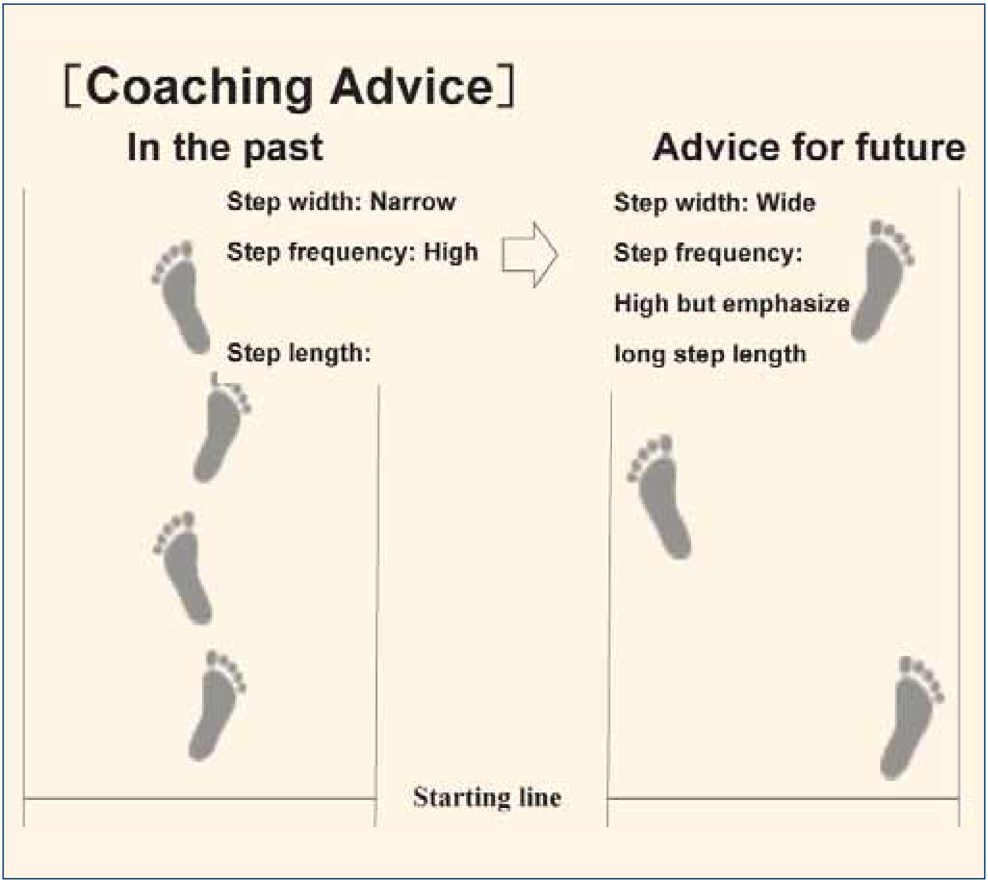

Figure 6: Coaching advice for foot placement in the acceleration phase

the distance (60m) when the full stride length had been achieved in both groups demonstrated that the HG group had already reached a higher velocity (see Figure 4).

With regard to step width, there was no difference between groups, but the width decreased in all runners from 0.39 ± 0.07m in the first step after the start to 0.17 ± 0.04m in the phase of the full stride length ($p < 0.001$; Figure 5).

These results indicate that a wide step width may be best suited for developing driving force during the long foot contact periods in the acceleration phase. On the other hand, a narrow step width may be best suited for developing driving force during the short foot contact periods characteristic of full stride sprinting. However, the full mechanisms of the optimal step width changes need further clarification.

Suggestions for coaching

The results obtained could suggest the following advice: 1) sprinters should concentrate on reaching a higher step frequency in the start; 2) at the same time they should strive for longer steps from the start; 3) it could be advisable that step width be maximised during the first steps and then gradually decreased from about 0.4m (in the first steps) to about 0.17m (in full stride running).

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