

# **RUNNING VELOCITY DYNAMICS IN 100 M SPRINT: COMPARATIVE ANALYSIS OF THE WORLD TOP AND ESTONIAN TOP MALE SPRINTERS**

**M. Misjuk<sup>1</sup>, M. Viru<sup>2</sup>**

<sup>1</sup>Institute of Health Science and Sports,  
University of Tallinn, Tallinn, Estonia

<sup>2</sup>Institute of Sports Pedagogy and Coaching, University of Tartu, Tartu,  
Estonia

## **ABSTRACT**

Estonian sprint runners have not achieved great success in international title competitions. This study was conducted to analyze their performance in 100m race. The aim of this study was to perform a comparative analysis of 100m sprint horizontal velocity dynamics in Estonian top level and world top-level male sprinters. We analyzed: 1) athletes' relative running velocity during different phases of the distance; 2) the loss of Estonian sprinters to the world best sprinters during different phases of the distance.

The study compared Estonian Athletics Championships (2006) men's 100m sprint final results with Berlin World Athletics Championships (2009) men's 100m final results. In both competitions, interval times were measured for the following sections of the race: 0–30m, 30–60m, 60–80m and 80–100m. We found out that Estonian sprinters' acceleration ability is relatively better than the other physical abilities necessary for achieving good results in 100m. Estonian sprinters loose most to the world best sprinters during the last part of the distance, 80–100m. However, the difference in running velocity of Estonian sprinters compared to the world best runners is approximately the same in all three last sections of the distance (30–60m, 60–80 and 80–100m).

**Key words:** sprint running, 100m, running velocity, Estonian sprinters

## INTRODUCTION

The 100m can rightly be considered the most remarkable event of athletics at major championships. The sheer speed of the 100m allows the winner to claim that he is the fastest runner in the country or in the world. The world best sprinters run 100m faster than 10 seconds, which makes the average velocity over the distance more than 10m per seconds. The world-class athletes make in average 45 steps in a world championship finals [4, 14]. However, during this short time and small number of steps the sprinter experiences four different phases of speed. First, the reaction speed phase in the start; second, the acceleration phase; third, the maximal speed phase; fourth, the speed maintenance phase [8, 13, 14, 15]. Reaction time is a contributor to the overall sprint time, however since it has not been found to be related to sprint performance [9], it was not focused upon in this study.

Different speed abilities have different importance in different sprint distances (100–400m). In 100m sprint running at maximal velocity is often taken as the most important part of the race [1, 2, 5]. According to Ralph Mann the most obvious general performance descriptor in the sprint is horizontal velocity. Ignoring the importance of the start, the athlete that can produce the greatest amount of horizontal velocity will be the most successful [9].

The aim of this study was to perform a comparative analysis of 100m sprint horizontal velocity dynamics in Estonian top level and world top level male sprinters. We analyzed: 1) athletes' relative running velocity during different phases of the distance; 2) the loss of Estonian sprinters to the world best sprinters during different phases of the distance.

## MATERIALS AND METHODS

The subjects of the study were 7 Estonian top male sprinters who took part in the final race of 100m in Estonian national championships in Tallinn (21.07.2006). The measurements of running velocity during different phases of 100m distance were done in the following sections: 0–30m, 30–60m, 60–80m and 80–100m. The timing system “Ivar” (accuracy 1/1000 s) designed and built by Ivar Krause was used to measure these split times. The final time of the race was taken from the official competition protocol of results. The timing system of the championships was produced by “Omega” (Switzerland).

### Statistical analysis

The relative running velocities (%) of Estonian and world best sprinters in different sections of 100m race (0–30m, 30–60m, 60–80m and 80–100m) were calculated taking the average velocity of the whole distance as 100%. Another calculation was made to find the ratio of Estonian runners' average velocities to world top sprinters average velocities in different sections of the 100m distance. 100% corresponded to the average velocities of different sections of the race in 2009 Berlin World Championship final.

The comparative data about the performance of the world best sprinters was taken from the analysis of 2009 Berlin World Athletics Championships 100m final race [6].

The both finals were run in similar good weather conditions with a tail wind: +0.6 m/s in Estonian Championships and +0.9 m/s in World Championships. Though the difference of 0.3 m/s of wind speed can slightly influence the results in 100m sprint according to J. Mureika calculations [11] we did not considered this small difference relevant enough to make any corrections in our calculations.

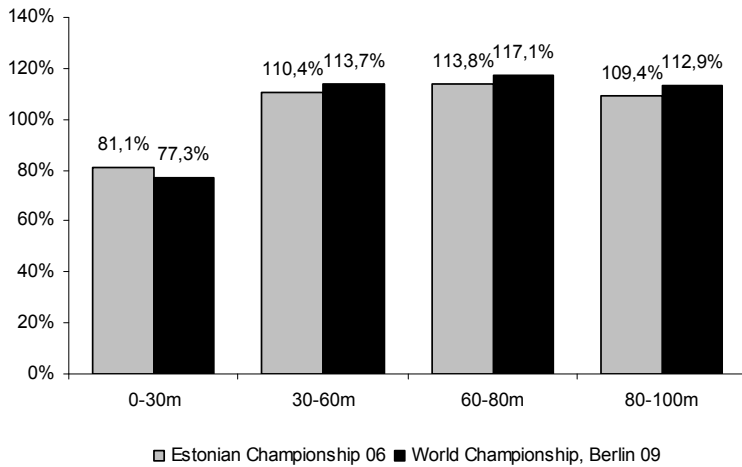
## RESULTS

The Estonian sprinters showed results in 100m final race from 10.51s up to 11.21s. These results can be considered quite average during this decade. Table 1 presents the split times and the final results of 2006 Estonian Athletics Championships men's 100m final.

**Table 1.** The split times of men's 100m final in 2006 Estonian Athletics Championships

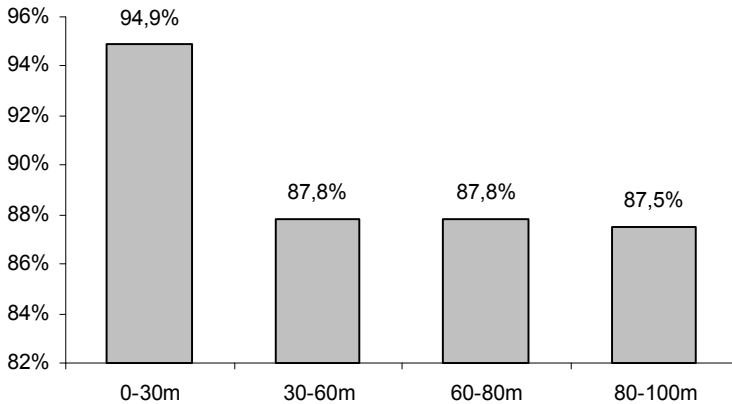
Athlete	Time			
	30m	60m	80m	100m
1.	4.02	6.77	8.61	10.51
2.	4.05	7.00	8.89	10.84
3.	4.03	6.91	8.85	10.93
4.	4.06	7.07	9.00	11.00
5.	4.08	7.17	9.10	11.12
6.	4.06	7.12	9.11	11.15
7.	4.09	7.20	9.17	11.21
Mean ± SD	4.06±0.02	7.03±0.14	8.96±0.18	10.97±0.22

Figure 1 presents the Estonian and the world best male 100m sprinters relative velocities in different sections of the distance. The base for the comparison was the average running velocity over the whole 100m distance. The value of the distance average velocity was taken to be equal to 100%. The values over 100% showed higher velocity and values lower than 100% lower velocity than average in different phases of the distance.



**Figure 1.** The relative running velocities of Estonian and world best male sprinters in different sections of 100m race: 0–30m, 30–60m, 60–80m and 80–100m. 100% corresponds to the average velocity of the whole distance.

Figure 2 shows how much Estonian sprinters are slower than to the world best sprinters in different phases of 100m sprint. Again, similar to previous analysis the followed distance sections were 0–30m, 30–60m, 60–80m and 80–100m.



**Figure 2.** The ratio of Estonian top sprinters' average velocities to the world top sprinters' average velocities in different sections of 100m race. 100% corresponds to the average velocities of different sections of the 100m race in 2009 Berlin World Championships final.

## DISCUSSION

This study analyzed horizontal running velocity dynamics of Estonian and world best 100m male sprinters according to the data obtained from 2006 Estonian Championships (abbreviated as EC) and 2009 World Athletics Championships (abbreviated as WC).

### **Athletes' relative running velocity during different phases of the distance**

The relative running velocities of Estonian and the world best athletes is presented in Figure 1. The baseline for the comparison is the average velocity over the 100m distance. The figures show that only in the first section, during acceleration phase, the running velocity is lower than the average velocity of the whole distance. Estonians achieve 81.1% of their average velocity over the first 30m running distance, while the world best sprinters gain 77.3% of their average velocity in this phase of race. It does not mean that the Estonian runners are better accelerators as the mean time in this section was better in the world top sprinters (3.85s vs. 4.06s). But this probably

shows that sprinters of lower maximal running velocity level need less time to achieve their maximal velocity.

The next section of the distance, 30–60m, was run with a significantly higher velocity. The world best sprinters achieve their maximal running velocity usually during this part of the distance [7, 10, 12]. Estonian sprinters were able to raise their running velocity by 29.0% in this phase of the race, while the world top sprinters added 36.4% to their running velocity. The explanation of this different capability to add running velocity in this middle section of the distance is probably also related to differences in the levels of maximal running velocity. Estonian sprinters lower maximal velocity enables them to reach their maximal velocity earlier, but does not enable them to raise running velocity as much as the world top sprinters do in the middle section of the race.

Estonian and world top sprinters showed similar running velocity dynamics in the next section of the distance between 60–80m. The velocity in both groups remained rather constant with a small raise in average by 3.4%.

The running velocity decreased similarly in both groups of sprinters in the last section of the distance, between 80 and 100m. Estonian sprinters' running velocity decreased by 4.4% and the velocity of the world top sprinters by 4.1%.

Whilst Estonian sprinters maximal running velocity is considerably lower than world best ones, then to enhance their performance, the key part for Estonian sprinters should be the last parts of the distance. Estonian sprinters might pay more attention to the developing of speed endurance in their training, as there are more opportunities to develop speed endurance than maximal speed. Estonian sprinters should be able to maintain their lower maximal or close to maximal velocity for a longer time. For example in 1987 Rome World Athletics Championships all the male sprinters showed in the 100m final that they were able to achieve maximal running velocity over 11 m/s (Johnson and Lewis even 11.76 m/s). There were also sprinters in the first rounds of the competition who achieved the same maximal velocity (11 m/s), but did not run faster than 10.50 m/s. Good level maximal running velocity does not guarantee a good result in 100m race, but is a good precondition for it. Hence, attention should be paid to the development speed endurance [10].

### **The loss of Estonian sprinters to the world best runners in running velocity during the different phases of the race**

For this analysis the same data from EC 2006 and WC 2009 men's 100m final was used. The results show a clear tendency that Estonian sprinters loose to the world best sprinters less in the first section of the distance (0–30m), only 5.1%. The loss to the world top runners is higher and approximately at the same amount (between 12.2%–12.5%) for the other sections of the distance (30–60m, 60–80 and 80–100m), (Figure 2). Estonian sprinters have relatively better acceleration ability compared to the rest of the physical abilities necessary to run 100m at high level. Estonian sprinters loose to world best sprinters most in the last section of the race (80–100m) where the loss rises to 12.5%. Breizer and Zukov [3] compared world best sprinters with Russian top sprinters and found the same tendency. The Russian sprinters loose most in the last part of the distance between 80 and 100m where athlete should be able to maintain the running velocity close to the maximal.

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**Correspondence to:**

Mikola Misjuk  
University of Tallinn  
Tondi 55, 11316 Tallinn,  
Estonia.  
E-mail: [mikola.misjuk@gmail.com](mailto:mikola.misjuk@gmail.com)