Faster Marathon Times by Measuring Human Performance

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ABSTRACT
This article describes a study to performance monitoring and the variables that influence performance of runners during the marathon of Eindhoven. In 2009 core temperature and cooling was investigated. In this research we have not found a relation between core temperature and running pace. But we do have new insights on how the human body reacts on running a marathon. In 2010 the test group will be expanded to 100 athletes and the number of variables will be expanded.

Author Keywords
Marathon, heat, running pace, dehydration.

INTRODUCTION
The marathon of Eindhoven, situated in the south of the Netherlands, is not only one of the most fastest in the world but also one of the most innovative marathons. The region of Eindhoven is known for the concentration of knowledge institutes and companies focused on technology innovation. Combining this with one of the largest sports events of the region, one created a once a year field lab focused on measuring on marathon runners. These measurements leads to the understanding of the human body and eventually into products that support or improve physical performance.

The first project started in 2007 on the development of the RunAlyser, a device with which the foot pattern throughout the marathon could be monitored. This foot pattern gives information about the running technique which affects the performance, effectiveness and risk of injuries of the specific athlete. During the performance the athlete received real time feedback on his running technique which improved his performance.

For 2009 and 2010 projects in the Eindhoven Marathon are based on the themes heat and dehydration. These themes are the main cause of serious medical problems during the marathon. In cool weather, there are few problems, but in extreme situations in the Netherlands 1/3 of the athletes did not finish. In such cases, a significant proportion of the athletes need medical help. These projects focus on preventing such problems.

MATERIALS AND METHODS

Heat and Running Pace
In 2009 one started a project which investigated the effect of external cooling of the body during the running performance. The core temperature of an athlete can rise above 40 degrees during a marathon. Therefore, in this project athletes are cooled by running through a mist shower. The hypotheses in this research is:

By external cooling of the human body , core temperature decreases and physical performance (running pace) will increase [1].

During the marathon fourteen runners are equipped to measure the following variables: heart rate, respiration, and skin temperature. These variables are measured with a Hidalgo Equivital system. Core temperature is measured by means of a pill that is ingested three hours before the start of the marathon. Running pace is measured with a GPS tracker (MYlaps). Based on age, weight and maximal oxygen uptake (VO2 max), the runners are divided into two groups (n=7). The intervention group runs, during the marathon course, twice through a mist shower and drinks water with a temperature of 15°. The mist shower is a 10 meter tunnel which sprays water on the runners. The control group drinks water with a temperature of 35°. The data focus is on the data in the range of 2 KM before the mist shower compared to two KM after the mist shower in both groups.

RESULTS
Based on a t test (sign. $p< 0,05$) in case of significance the following differences are notified:

- Pulse Frequency (± 3 beats);
- core temperature (± 0.1 º C);
- Skin temperature (± 0.5 º C).

Also the trend line of running pace in the range of two KM before de mist shower was compared to running pace with the trend line of two KM after the mist shower.

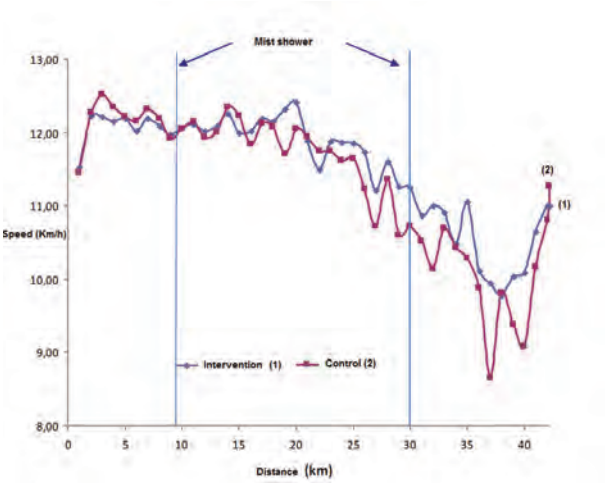

Figure 1. Average running pace of the intervention and control group during the marathon.

There are no significant result on average running pace between the intervention group and control group at the finish of the marathon (figure 1).

Both in the intervention group as in the control group the running pace decreases at the 20 KM point. Both groups are able to sprint to the finish. There was no significant difference in heart rate, or core temperature between the intervention and control group. The average core temperature of the runners increased after the start in the first 10 KM to 39 º C. In both groups the heart rate and core temperature decreases after 30 KM. There was a significant difference in skin temperature (see figure 2).

The intervention group has a significant higher skin temperature then the control group after the first 10 KM of the marathon. For both groups skin temperature decreases after the start and increases again after 30 KM. An important fact that may have influenced these results is that almost all runners were faced with rain during the final part of the marathon.

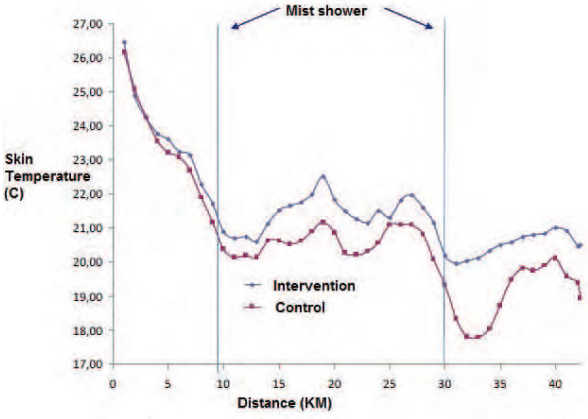

Figure 2. Average skin temperature of the intervention and control group during the marathon.

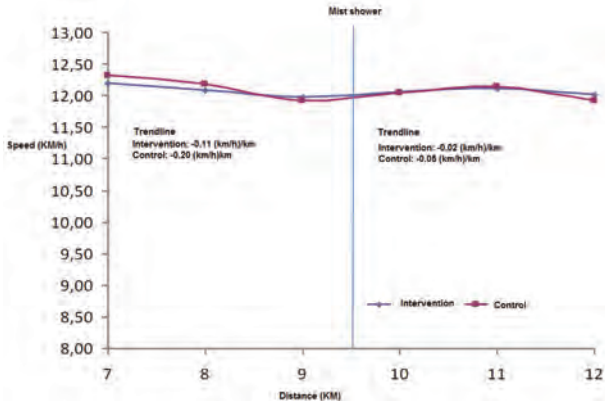

Figure 3. Average speed in a interval 2 KM before first cooling intervention and after.

When we focus on the interval 2 KM before the mist shower, there was no significant difference between the intervention group and the control group (see figure 3 and 4). The results of this research are summarized in table 1.

↑: increase ↔: no change ↓: decrease	Intervention Group		Control Group	
	Intervention 1	Intervention 2	Intervention 1	Intervention 2
Speed	↔	↔	↔	↔
Hart rate	↔	↔	↔	↓
Core temperature	↔	↔	↔	↔
Skin Temperature	↓	↓	↓	↓

Table 1. Results of the research on heat and cooling.

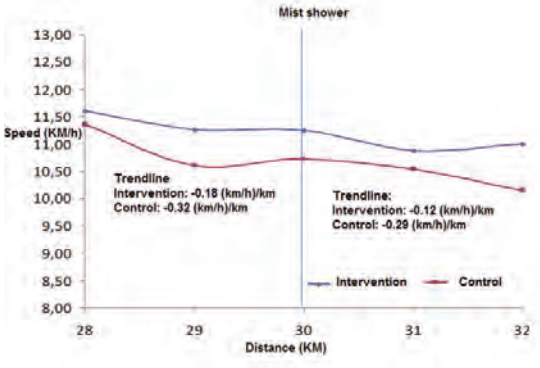

Figure 4. Average speed in a interval 2 KM before second cooling intervention and after.

Proceedings of Measuring Behavior 2010 (Eindhoven, The Netherlands, August 24-27, 2010)
Eds. A.J. Spink, F. Grieco, O.E. Krips, L.W.S. Loijens, L.P.J.J. Noldus, and P.H. Zimmerman

CONCLUSION AND DISCUSSION

In this research we rejected the hypothesis that cooling decreases core temperature and increases running pace. Level et al. [2] gives three possible explanations for a missing effect. First, core temperature is not the only variable that influences running pace. Also hydration level, motivation and temperature are important variables [3]. Second, also during the marathon outside temperature was only 12.8 º C to 16.7 º C and during the end both groups are cooled by rain which also minimizes the difference between the groups. And third, all test runners did not have a good pacing strategy due to inexperience.

However, we only presented the objective results of the research. In a questionnaire among the intervention group responded very positive on the question how they experienced running through the tunnel.

If this research is repeated we recommend the following:

- A higher frequency of cooling interventions;
- Trained athletes with a stable running pace;
- A larger research group.

Further Research Marathon Performance Dehydration

In 2010 the focus of the research is repeated with additional variables, especially hydration level. The human body loses a lot of water during the marathon this could lead to dehydration; the blood thickens. The athlete's heart must work harder to send blood with the necessary oxygen and energy to his muscles. This creates an increased heart rate, which in most cases the athlete is forced to reduce the intensity and slows down.

For this year there are 100 test runners (n=50). The intervention consists of a 3 months training program. The hypothesis is:

Specific advice ensures optimal hydration level among runners. With this intervention runners are better able to regulate heartbeat so the runner can keep pace. It is expected that the group with a hydration advice have the best individual performance.

Besides the variables that are measured in 2009 we also measure hydration level before and after the marathon, and the amount of fluid the runner drinks during the marathon.

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