

## PACE VARIABILITY OF A FEMALE RACE WALKER IN A 20 KM RACING EVENT

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### Abstract

The paper deals with the issue of pace variation in race walking during a 20 km racing event. The research has shown that the female race walker slows down considerably from the fifteenth kilometre of the racing event. The deceleration lasts approximately up to the eighteenth kilometre. The female race walker is able to accelerate again in the final two kilometres of the racing event. We have discovered that the female race walker achieves the best results in the qualifiers. All her personal records were achieved in the qualifiers. The female race walker improved only once in the first top-level event and achieved the worst results in the second top-level event. By means of the ANOVA statistical method, we were able to determine statistically significant pace variations between the individual racing events ( $p < 0,01$ ) and pace variations in the split times- kilometres ( $p < 0,01$ ). We noticed an interaction ( $p < 0,01$ ) between the pace in individual kilometres and the course of the racing events, or more precisely with the sports performance. The significant variations in the individual split times point to the high pace variability in the 20km distance. This variability corresponds with the current level of special endurance in the given racing event. Based on our discovery, we advise the race walker to focus more on pace endurance and special pace during the training process.

**Key words:** race walking, pace, speed.

### Introduction

Race walking is an endurance sport and therefore 98% of the exercise takes place in the aerobic zone. The improvement of the pace endurance and general endurance is very lengthy, which makes the training process time-consuming (Čillík, et al., 2009, Broďáni, &Tóth, 2005). A long-term exercise in the high level of aerobic metabolism is one of the limiting factors of the race-walking performance. Strength requirements with the emphasis on mastering the racewalking technique, as well as speed requirements (with respect to the stride rate) are some of the other factors. The relaxedness of the locomotor system and the range of motion are also important (Čillík, &Rošková, 2005; Broďáni, 2005). Maintaining a steady pace throughout the whole racing event or accelerating in the final stage seems important when considering the sports performance in race walking. We have assumed for a long time that "hesitation" (deceleration at only two or three kilometres) is the determinant of success or failure for some female race walkers in 20 km racing events. That is why we decided to take a look at the issue of pace variation of a Slovak female representative for the 20 km race walking as part of our VEGA 1/0414/15 grant assignment (Optimization of the Training Load and Competition Load in Individual Sports). Nowadays, women are able to approach men's performance levels in some events, especially in the endurance. The main reason for this is that women have better endurance predispositions. However, there are big differences when it comes to the training process. Women's body structure, hormonal system, circulatory system and respiratory system have to be taken into consideration. The body structure differs mainly in the shape of the figure.

Women tend to have a more pear-shaped figure, wider pelvis, shorter femur and more body fat. As for the circulatory system, women have less blood, less haemoglobin, erythrocytes and they have a very varying level of iron, which is mostly influenced by menstruation. Women also have lower  $VO_2$  max values than men (Broďáni, 2002).

The muscular strength in women is also smaller than in men, which makes them more injury-prone (Korčok, &Pupiš, 2006).As for the mental preparedness for racing events, we may say that women can endure more. That is why the number of athletic events for men and women is almost equal nowadays. The 20 km racewalking distance is the longest track for women within the Olympic programme. We can observe how the body responds to a full racing load during the event. In order to optimize the pace, the race walker can monitor his/her body responses during the event with a sport-tester that follows his/her heart rate and other parameters. The racing event itself helps to determine the current training condition of a race walker. The race walker tries to deliver the best possible performance and achieve the best place. However, racing events are influenced by various factors. The factors can be external, such as track profile, number and importance of racing events and weather. The athlete's current physical and mental condition is another factor. It is also one of the reasons why pace variations during a racing event take place. Pace variations are often influenced by the wrong distribution of strength or starting a race too fast. Exhaustion of the body, overtraining or exhaustion of all energy can also lead to pace variations.

Endurance is a set of predispositions that can help us exercise with a certain intensity for the longest possible period of time, with the highest possible intensity. This definition indicates that the optimal state occurs if a race walker can undergo the whole distance with a maximum intensity and maximum heart rate. Since we know that different intensity generates different body responses, it is important to estimate the optimal pace → optimal load → optimal heart rate (Pupiš, & Čillík, 2005). A racing event can be described as a subject of the training science, which includes formation, management and diagnosis of a racing event. We can further say that a racing event is actually a comparison of performances according to a fixed set of rules of the given sport between individual athletes or teams in order to establish a winner and position. If we are to define a racing event from a training-scientific point of view, we must respect the different structures of individual groups of sports. As for endurance and strength sports, the point is to form the racing event optimally by a tactical use of the best current performance predisposition (Hohmann, Lanes, & Letzelter, 2010; Pupišová, 2013). From the point of view of sports performance in 20 km race walking, it is crucial to determine the right pace at the beginning of the race and then maintain it. Management of the race consists of the preparation for the race, management during the race and evaluation of the race. All three steps focus on the coach's and athlete's behaviour during the racing event. Competitive behaviour should be prepared, formed and evaluated depending on the goal of the racing event. Preparation for the race consists of two steps. The first step is to create a strategy based on the diagnosis and to implement it in the training process. Creating a competitive strategy as well as coaching lead to success. This strategy mainly shows the coach's quality. Developing a strategic plan is a key component when preparing for the race. Its quality can considerably affect the expected results as well as decision-making during the race. Particularly on the top level, the strategy is strongly reflected in the solution of the competitive situations and thus influence tactics during the racing event. When developing a plan one must take into consideration:

- a) The objective of the race. Finishing first or achieving the best result does not necessarily have to be the objective. It may also be saving energy (during the qualifiers), checking current performance or testing new tactics.
- b) The opponent's performance. If the opponent is expected to have a better performance, the runner adopts an active strategy.
- c) The opponent's strategy. We try to obtain information about the opponent's strategy or their usual strategy. For example, we may learn that our opponent starts with a fast pace, builds on strength or height.
- d) Personal performance. It is always important to evaluate one's strengths, weaknesses, current state of health and state of mind based on an honest assessment.

e) Information on the environment and conditions. It is important to obtain information about the sports venue, track profile, number of spectators, their behaviour, etc.

The coach then determines a strategy that should include all these points (Dovalil, 2009).

#### *Developing a strategy based on a diagnosis*

Preparation for a racing event places different requirements on the coach depending on the given sport. The precise timing of a top-level shape is a decisive factor in endurance and strength sports. Cognitive or psychological preparation is the key element in technical-acrobatic, combat and game sports. We try to develop planned competitive behaviour in the pre-race period in endurance and speed cycling events. This effort is based on the current value table with split times oriented on the track profile and track length. Later in the preparation process, we try to systematically optimize the condition of fitness, technical, tactical and psychological performance of the athlete by means of training interventions that focus on acquiring competitive strategy. The preparation process also includes a constant comparison of the existing and desired condition of the athlete (Martin, Carl, & Lehnertz, 1991; Pupišová, 2014). Mediation of the selected strategy - this is where athletes acquire the planned competitive strategy in the form of physical or cognitive-mental shape, or more precisely psychological preparation

- Sports-motor training. A maximum, sometimes even submaximal competitive speed based on the pace control for a shorter distance is carried out in this training method (Rudolph, 2001).
- Video training. This method is used to develop a tactical preparation, especially in team sports. Video training is also used to analyse personal technique, eliminate mistakes, etc.
- Mental training. Mental training used to control stress proved to be very effective during the preparation process. During the mental training, the athlete consciously, tactically and repeatedly envisions the course of the race and his/her behaviour.

Possible solutions of the competitive situation. The situation is influenced by the choice of a suitable competitive strategy. Application of the solutions depends to the extent to which the athlete practiced and acquired them. That is why we distinguish three types of solutions of the competitive situations: algorithmic, pattern and improvisation (Dovalil, 2009). Management during the race.

The objective of coaching is for the athlete to give an optimal competitive performance based on the acquired performance and preparedness of the competitive strategy. The coach can adjust the athlete's pace by an agreed set of hand gestures in some sports. Coaching is becoming increasingly important as the number of races in every sport grows over the year.

Races have become the main element of individual performance development in some sports (Hohmann, Lanes, & Letzelter, 2010). The evaluation of the race is about the evaluation and analysis of the achieved sports performance. Frohner (1994) established the following set of criteria for the optimal evaluation of races:

- Provision of the results must take place chronologically in order to ensure fast feedback.
- Processing of the analysis results must be individualized.
- Obtained information must have a direct effect on the training and competitive practice.
- Technical-tactical and game conceptual learning as well as teaching processes must work systematically and affect the whole team.

The diagnosis of the race is generally used to inform the participants (athletes, coaches, media, spectators) about the course of the race and the results (Hohmann, Lanes, & Letzelter, 2010). Performance quality in women race walking for 20 km has been growing considerably, therefore it is no longer possible (as in the recent past) to rely on the opponents' hesitation. The pace must be steady with a possibility of acceleration in the final stage. The aim of our research is to compare pace variations of a female race walker for a 20 km distance. The racing event helps us to determine the current training condition of the athlete. However, the pace variation during the race can be influenced by different elements.

## Methods

The observed race walker M. Cz. is a representative of the Slovak Republic in race walking for 20 kilometres. Her preparation process is 11 years long. She was a member of AC Stavbár Nitra from 2003 to 2008 and has been a member of MSC Dukla since 2009.

### *Characteristics of the female athlete M. Cz.*

Date of birth: 02. 10. 1988

Body height: 166 cm

Body weight: 56 kg

Personal record for 20 km: 1:32:23

The female athlete has participated in various racing events over a period of four years. She fulfilled the qualifying limits for the World Championship, European Championship, World Cup, European Cup and Olympic Games at these racing events.

We used the basic methods of comparison, mathematical statistics, and logical procedures and conclusions to evaluate the data. We presented all the obtained values in tables and charts. We also used the ANOVA statistical method with two repetition factors in our research.

The ANOVA method with two repetition factors is used to obtain information about the significance or insignificance of the research. We assessed the statistical significance on the  $p < 0.01$ , or more precisely  $p < 0.05$  level of statistical significance.

We obtained the final results and recommendations for the training practice by means of logical procedures and conclusions.

## Results

The female race walker participated in 12 significant racing events between 2011 and 2014. These racing events included both qualifiers and international races. We compared pace variations, average speed during the race and differences between the slowest and fastest kilometres during these racing events. Table 1 shows the time achieved by the female race walker in the individual kilometres as well as the total average in the racing event. We also indicated the total average in the individual kilometres of all the racing events together. The last table column shows that the average of the racing event kept changing. A considerable deceleration starts from the fifteenth kilometre and lasts up to the eighteenth kilometre, which indicates that the race walker really is able to accelerate in the last two kilometres. The race walker's slowest racing events were in Saransk and Shenzhen with the average pace of 5:10 per kilometre. The fastest racing event took place in Taicang with the average pace of 4:42 per kilometre. As we can further observe from Table 1, the race walker achieved her best times in the first racing event of the season where she reached her personal records in most cases.

The race walker managed to improve her personal record only once during the second race of the season, more specifically in 2014 in Taicang. The race walker did not manage to reach a personal record during the third race of the season. On the contrary, she was far behind her personal record. By means of the ANOVA statistical method, we were able to determine statistically significant pace variations between the individual racing events ( $p < 0.01$ ) and pace variations in the split times - kilometres ( $p < 0.01$ ). We noticed an interaction ( $p < 0.01$ ) between the pace in individual kilometres and the course of the racing events, or more precisely with the sports performance.

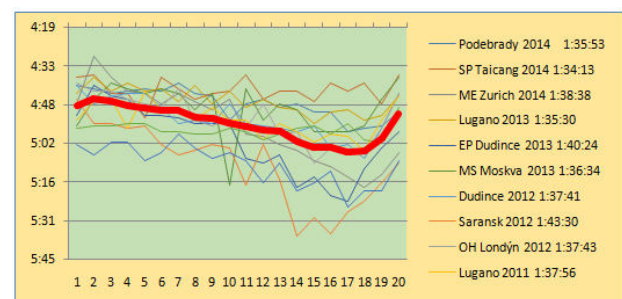


Fig. 1 Average tempo during competitions

The significant variations in the individual split times point to the high pace variability in the 20 km distance. This variability corresponds with the current level of special endurance in the given race. Figure 1 shows the pace variations that occurred during the race.

**Table 1** Variability of competitions tempo

	Podebrady 2014 1:35:53	WC Taicang 2014 1:34:13	ECH Zurich 2014 1:38:38	Lugano 2013 1:35:30	EC Dudince 2013 1:40:24	WCH Moskva 2013 1:36:34	Dudince 2012 1:37:41	Saransk 2012 1:43:30	Olympic Londýn 2012 1:37:43	Lugano 2011 1:37:56	Shenzhen 2011 1:43:25	WCH Daegu 2011 1:39:07	Average
1	4:41	4:38	4:48	4:44	4:52	4:56	4:41	4:46	4:40	4:54	5:03	4:57	4:48
2	4:42	4:37	4:30	4:38	4:41	4:46	4:48	4:55	4:43	4:47	5:07	4:56	4:45
3	4:44	4:44	4:38	4:43	4:45	4:40	4:45	4:55	4:43	4:46	5:02	4:56	4:46
4	4:43	4:44	4:43	4:40	4:46	4:42	4:44	4:57	4:46	4:57	5:02	4:55	4:48
5	4:42	4:53	4:44	4:43	4:52	4:44	4:44	4:56	4:48	4:43	5:09	4:55	4:49
6	4:43	4:38	4:48	4:42	4:52	4:42	4:49	5:03	4:49	4:50	5:06	4:58	4:50
7	4:40	4:42	4:44	4:47	4:53	4:44	4:55	5:07	4:42	4:49	4:59	4:58	4:50
8	4:44	4:46	4:47	4:41	4:55	4:50	4:54	5:05	4:54	4:54	5:04	4:59	4:52
9	4:45	4:44	4:50	4:48	4:55	4:44	4:55	5:03	4:56	4:49	5:08	4:59	4:53
10	4:54	4:43	4:46	4:43	4:55	5:18	4:48	5:04	4:53	4:54	5:06	4:57	4:55
11	4:48	4:37	4:59	4:49	5:08	4:42	4:55	5:18	4:57	4:54	5:09	4:58	4:56
12	4:46	4:46	5:00	4:46	5:10	4:54	4:56	5:03	4:48	5:01	5:17	5:01	4:57
13	4:49	4:43	5:03	4:49	5:07	4:48	4:57	5:16	4:59	4:55	5:10	4:59	4:57
14	4:48	4:43	5:05	4:50	5:19	4:50	4:58	5:37	4:58	4:58	5:20	4:57	5:01
15	4:51	4:47	5:09	4:55	5:15	4:58	4:56	5:30	5:10	5:02	5:17	4:56	5:03
16	4:51	4:40	5:11	4:51	5:22	4:58	5:04	5:36	5:04	4:59	5:13	4:59	5:04
17	4:58	4:43	5:15	4:50	5:24	4:58	5:03	5:28	5:06	5:00	5:26	4:55	5:05
18	4:57	4:40	5:19	4:54	5:12	4:56	5:08	5:24	5:06	5:05	5:20	5:01	5:05
19	4:56	4:48	5:14	4:52	5:04	4:46	4:57	5:17	4:57	4:54	5:20	5:02	5:00
20	4:51	4:37	5:06	4:45	4:58	4:38	4:44	5:10	4:44	4:45	5:09	4:49	4:51
Average	4:47	4:42	4:55	4:46	5:01	4:49	4:53	5:10	4:53	4:53	5:10	4:57	

**Table 2** Difference of slowest and faster km

	Podebrady 2014 1:35:53	WC Taicang 2014 1:34:13	ECH Zurich 2014 1:38:38	Lugano 2013 1:35:30	EC Dudince 2013 1:40:24	WCH Moskva 2013 1:36:34	Dudince 2012 1:37:41	Saransk 2012 1:43:30	Olympic Londýn 2012 1:37:43	Lugano 2011 1:37:56	Shenzhen 2011 1:43:25	WCH Daegu 2011 1:39:07	Average
Max	4:58	4:53	5:19	4:55	5:24	5:18	5:08	5:37	5:10	5:05	5:26	5:02	5:11
Min	4:40	4:37	4:30	4:38	4:41	4:38	4:41	4:46	4:40	4:43	4:59	4:49	4:41
Max-Min	0:18	0:16	0:49	0:17	0:43	0:40	0:27	0:51	0:30	0:22	0:27	0:13	0:29

Table 3. Anova 2 factor with replication

Source of variation	SS	df	MS	F	P value	F- crit
Sample	260343 00	3	86781 00	70,53 645	0,000 0	2,651 64
Columns	602358 60	11	54759 87	44,50 937	0,000 0	1,838 792
Interaction	162592 20	33	49270 3,6	4,004 744	0,000 0	1,497 264
Withim	236217 60	19 2	12303 0			
Total	126151 140	23 9				

The race walker delivered the poorest performance in Saransk and the best in Taicang. The picture further shows the changes in average speed during the race. The race walker started with the average

pace of 4:48 min./km, decelerated to 5:05 min./km and then accelerated again to the average pace of 4:50 min./km.

### Conclusion

Our research focused on the comparison of pace variations during racing events and top-level events in which the representative participated between 2011 and 2014. The comparison helped us to discover that the race walker's pace is faster in the first half of the 20 km track in most cases. She starts decelerating in the second half and decelerates considerably from the sixteenth kilometre on. This deceleration lasts up to the eighteenth kilometre. In most cases, the race walker was able to accelerate again in the last two kilometres. When we compared the racing events,

we discovered that the female race walker achieves the best results in the qualifiers that take place at the beginning of each racing season. That is when she improves or approaches her personal records. The race walker was able to improve her personal record only once during the first top-level event.

She was far behind her record in other cases. The race walker was not able to reach her personal record during the second top-level event of the one-year training cycle. On the contrary, the comparison shows that her results are weakest during the second top-level event of the season.

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## VARIJABILNOST TEMPA HODAČICE U UTRCI NA 20 KILOMETARA

### Sažetak

Ovaj rad bavi se problemom varijacije tempa u utrci hodanja tijekom utrke na 20 kilometara. Istraživanje je pokazalo da hodačica u utrci znatno uspori od petnaestog kilometra utrke. Usporavanje traje prosječno do osamnaestog kilometra. Hodačica je u utrci u stanju ponovo ubrzati u posljednja dva kilometra utrke. Otkrili smo da hodačica u utrci ostvaruje bolje rezultate u kvalifikacijama. Svi njeni osobni rekordi su postignuti u kvalifikacijama. Hodačica u utrci se poboljšala samo jednom u prvom vršnom događaju i postigla je najgore rezultate u drugom vršnom događaju. Putem ANOVA statističke metode bili smo u mogućnosti odrediti statistički značajnu varijaciju tempa između pojedinačnih utrka ( $p < 0,01$ ) i varijacije tempa i prolazno vrijeme po kilometrima ( $p < 0,01$ ). Primijetili smo interakciju ( $p < 0,01$ ) između tempa u pojedinačnim kilometrima i smjera natjecanja, ili preciznije sa sportskim izvedbama. Značajne varijacije u pojedinačnim prolaznim vremenima ukazuju na visoku varijabilnost tempa na udaljenosti od 20 kilometara. Ova varijabilnost odgovara trenutnoj razini posebne izdržljivosti u danom natjecanju. Zasnovano na našem otkricu, savjetujemo natjecatelje da se fokusiraju više na izdržljivost koraka i poseban tempo tijekom procesa treninga.

**Ključne riječi:** utrka u hodanju, tempo, brzina

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