THEORY OF TRAINING, THEORETICAL CONSIDERATIONS - WOMEN'S RACE WALKING

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General characteristics of race walking

Sport performance is multiply determined, but we can't definitely settle the crucial factor, particularly when the obtained performances are at the highest limits of human capacities.

In the modern training process, either we refer to the 50 or 20-km walk race, preparation requires - daily, monthly and yearly - a huge work volume that fully exerts the body resistance.

In race walking, the most important *objectives* are the following:

- to consolidate and improve technique;
- to develop resistance, mainly the aerobic one;
- to develop strength and mobility;
- to develop a high metal concentration capacity, as well as perseverance when approaching the training process, which is strongly marked by monotony.

Objectives and tasks of the research

- to make a hierarchy of the training means;
- to determine the training means influence and efficiency on the performance level and consistency.

This research tries to approach and solve problems related to the use of some integrated informational systems and of their facilities for the race walking and training modeling, in order to increase their efficiency.

Hypotheses of the research

Having in view the above-mentioned aspects, we settled the following work hypotheses:

1. *The training means dynamics*, its volume and intensity are efficiency-generators in women's preparing for the high performance race walking.
2. *The optimum work volumes* and *the training means specifying* provide better premises for the goal achievement.
3. *The relationship between the total volume of race walk kilometers and the volume of long-duration race walk* is determining to obtain the best performances.
4. *The Taguchi method applying* emphasizes the most important factors that influence training and contribute to its optimization.

5. The technique, performed according to the *biomechanical model*, ensure *efficiency and the correct learning increased ratio*.

Methods and techniques of the research

- **Applications of the cybernetic method**

The systemic method contributed to the integration of some knowledge from different fields:

- ❖ the approach and research of sports training, in general, and of the race walking events, in particular, as hyper-complex dynamic systems;
- ❖ the informational system improvement, by adapting the Taguchi method to the race walking training characteristics, this one being assigned to design the experiment, to process data and to stress the most important factors influencing preparation, as well as the correlations among them.

The modeling method - in order to model the walking stride technique, under the efficiency aspect, we used an informational system made up of a movement simulator, integrated to some specific means and technologies (PC, videos etc.), and a specialized software, to analyze online the walking stride accuracy.

The experimental method had a major contribution to the research concrete application and to the confirmation of the initially formulated hypotheses. The experiment aimed at testing the efficiency of the training program drew up and proposed by us to the components of the women's race walking national team, under the instruction activity normal conditions. The Taguchi training model applying and testing was concretized in the followings:

- ✓ the athletes' evolution monitoring in training and competition, between 2000 and 2008;
- ✓ the administration of some training stimuli, according to the Taguchi method.

The experiment *independent variables* consisted of:

- ▪ data and information collected from the Romanian Athletics Federation and from the athletes' coaches, they representing the basis needed to determine the training individual models;
- ▪ the content and structure of the applied training model.

The experiment *dependent variables* consisted of the data obtained by the female race walkers in the testing events and of their results in competitions.

The mathematical-statistical method was used to process, analyze and present the obtained data and results.

Subjects

The experiment was conducted on the four female race walkers, components of the senior national team and of the Olympic team, in whose training program we included the Taguchi method.

Table 1. The experiment group

Crt. nb.	*Surname and name*	*Year of birth*	*Height*	*Weight*	*Personal record*	*Results in the great competitions*
1.	Carlan Daniela	1980	163 cm	45 kg	1h30:19	European junior vice-champion, 1998 Participant in the Athens OG, 2004 Participant in the World Championships, 2003 3rd place, team event, at the World Cup, 2003 2nd place, team event, at the European Cup, 2002
2.	Stef Claudia	1976	170 cm	53 kg	1h27:41	European junior champion, 1997 5th place at the World Championships, 2003 8th place at the World Championships, 2005 5th place at the European Championships, 2006 6th place at the World Championships, 2007
3.	Campean Norica	1972	164 cm	58 kg	1h27:46	6th place at the Sydney OG, 2000 6th place at the World Championships, 2001 7th place at the European Championships, 2003 Participant in three editions of the OG: Barcelona, Sydney, Athens
4.	Groza Ana-Maria	1978	167 cm	53 kg	1h29:31	Participant in three editions of the OG: Sydney - 13th place, Athens, Beijing 11th place at the European Championships, 2006

Table 2. Analysis of the training means in 2000-2001, for the athlete C.D.

Training year	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sep.*	***Total***
Running [km]	250	305	210	236	225	273	156	191	278	106	201	44	2475
Race walk volume [km]		143	251	371	335	348	210	235	333	150	240	60	2276
Race walk duration: 5:20-5:05 min/km [km]		140	250	258	200	200	108	113	224	88	185	29	1795
Race walk tempo I: 5:00-4:40 min/km [km]				88	80	91	65	81	87	30	22	20	564
Race walk tempo II: 4:35-4:20 min/km [km]					22	32	14	19	19	24	12	7	284
Race walk tempo III: 4:15-4:05 min/km [km]							4	3					7
Race walk repetitions flat [km]				15	18	10	9	14		4			70
Launched + accelerated race walk [km]		3	1	10	15	15	10	5	2	5	21`	4	91
Mobility and strength exercises (hrs)	6	16	18	18	16	21	12	15	19	8	16	3	168
Total [km]	250	448	461	607	560	585	366	426	611	256	441	104	***5115***

Table 3. Analysis of the training means in 2005-2006, for the athlete S.C.

Training year	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sep.*	***Total***
Running [km]	80	180	240	300	300	270	240	150	270	270	180	25	2585
Race walk duration: 5:25-5:00 [min/km]		50	240	240	130	110	70	30	140	130	80	20	1270
Race walk tempo I: 5.00-4.45 [min/km]				40	80	110	100	40	50	120	60		600
Race walk tempo II: 4.45-4.30 [min/km]				15	60	50	30			28			188
Race walk tempo III: under 4:30 [min/km]			16	32	16	40	45	12	20	48	16		235
Repetitions [km]				10	20	20	20	10		20	10		110
Total [km]	80	230	496	637	606	625	525	282	480	636	366	55	***4888***

Table 4. Analysis of the training means in 2003-2004, for the athlete C.N.

Training year	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sep.*	***Total***
Running [km]		208	217	170	205	155	155	152	101	221	129		1713
Race walk duration: 5:20-5:00 min/km [km]		32	219	242	228	247	291	176	113	226	168	2	1834
Race walk tempo I: 5:00-4:40 min/km [km]				4	19	12	14	29		30	24		132
Race walk tempo II: 4:40-4:30 min/km [km]				1	18	34	10	28		6			97
Race walk tempo III: under 4:30 min/km [km]				5	15	30	10	20	10	5			95
Repetitions [km]				5	2		20	2	6	1			36
Race walk uphill [km]				4									4
TOTAL [km]		240	436	426	475	438	410	407	265	484	341	22	***4039***

Table 5. Analysis of the training means in 2001-2002, for the athlete G.A.

Training year	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	***Total***
Running [km]		80	117	114	185	124	148	57	105	199	175	29	1333
Race walk duration: 5:20-5:00 min/km [km]		20	150	129	180	133	135	92	136	202	181	65	1423
Race walk tempo I: 4:40-5:00 min/km [km]				64	72	5	57		20	70	50		338
Race walk tempo II: 4:30-4:40 min/km [km]					32	20			20		16	20	108
Race walk tempo III: under 4:30 min/km [km]				24	24		32	2		37	12		131
Race walk uphill [km]				1.5							3	3	7.5
Repetitions [km]						16		27	18		13	9	77
TOTAL [km]		100	267	332.5	521	298	372	178	299	508	451	126	***3477***

Description of the experiment, conducted according to the Taguchi method

The experiment was organized as stated by an M8-type experiment matrix, each figure up to 8 representing a month of training, with the aim of obtaining a minimalizable optimization criterion, namely the time at the testing events.

We settled the main training means to be used and we gave them minimum or maximum values (covered kilometers or training minutes). These values were reached by the female race walkers within the *8 months of training, during which the experiment was applied (E1, E2, E3, E4, E5, E6, E7, E8).*

By also taking into account other principles the athletes' training relies on, such as keeping to the volume and intensity curves all the training year long, the experiment was ordered from E1 to E8.

Each experiment supposed the athletes' training for about 25 days, the factors or the training means being kept at the same values. Then, in the final 5 days, training was performed in a similar way, but *the time obtained at the testing event* was daily recorded. This resulted in *5 timings, noted as follows: i1, i2, i3, i4, i5.*

The testing event was decided to take place on a 5-km race walking distance, because the measured values were conditioned by the timekeeping over 5 consecutive days. This distance was thought to be the most suitable for being covered in 5 successive days, it providing the athletes the opportunity to reach maximum performances, with a great probability of recovering the consumed energetic stores.

We shall present, in the following lines, the important elements defining the athletes' training for the **20-km race walking event**, respectively the training factors or means, as well as an example related to their limit-values expressed in kilometers covered within a month of training or in minutes of strength and mobility exercises performed within a day, revealed by the indices 1 (minimal value) and 2 (maximal value):

A = TV - total volume of covered km (running + race walking), (A_1 = 300 km; A_2 = 600 km)
B = RWV - total volume of covered km (race walking), (B_1 = 200 km; B_2 = 400 km)
C = RWT1 - km of race walking in tempo 1 (5'30"/km-5'05"/km), (C_1 = 80 km; C_2 = 250 km)
D = RWT2 - km of race walking repetitions (under 5'/km), (D_1= 40 km; D_2= 100 km)
E = strength exercises [min], (E_1 = 10 hours; E_2 = 20 hours)
F = stretching and mobility exercises [min], (F_1 = 10 hours; F_2 = 20 hours).

If we consider that, in the athletes' training, it is particularly important to rely on the **interaction between the B factor - total volume of covered km (race walking) - and the C factor - volume of covered km (race walking), in a long-duration tempo, at a movement speed representing 80 to 90% of each athlete's maximum possibilities**, then training can be assimilated to a Taguchi-type optimization experiment.

In table 6, we present the important elements that could define the athletes' training for the **20-km race walking event**, respectively the training factors or means, as well as the limit-values expressed in kilometers covered within a month of training or in minutes of strength and mobility exercises performed within a day.

Experiment training and scored values

Experim. nb.	***Training means***						***Interaction***	***Measured values (performances obtained at the 5-km race walking test events)***				
	A	B	C	D	E	F	BC	i1	i2	i3	i4	i5
E1	1	1	1	1	1	1	1 1					
E3	1	1	1	2	2	2	1 1					
E8	1	2	2	1	2	2	2 2					
E7	1	2	2	2	1	1	2 2					
E2	2	1	2	1	1	2	1 2					
E5	2	1	2	2	2	1	1 2					
E4	2	2	1	1	2	1	2 1					
E6	2	2	1	2	1	2	2 1					

As previously mentioned, each experiment assumed the athletes' training for about 25 days, the training means being kept at the same values and, subsequently, in the next 5 days, they were timed on the 25-km race walking distance (which resulted in 5 timings, noted as follows: i1, i2, i3, i4, i5).

We shall present the scored results under the table form, as well as their graphical illustration.

The graph analysis shows the training means ranking, according to their importance, and the optimum combination among them.

Table 6. The training means influence on performance and consistency

Athlete ► / *Training means* ►	C.D.		C.N.		G.A.		S.C.	
	I.O.P.	*I.O.P.C.*	*I.O.P.*	*I.O.P.C.*	*I.O.P.*	*I.O.P.C.*	*I.O.P.*	*I.O.P.C.*
A	V. LITTLE	V. LITTLE	V. LITTLE	V. LITTLE	V. LITTLE	V. LITTLE	V. LITTLE	V. LITTLE
B	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM
C	LITTLE	LITTLE	GREAT	GREAT	GREAT	GREAT	GREAT	GREAT
D	V. LITTLE	V. LITTLE	V. LITTLE	V. LITTLE	LITTLE	LITTLE	GREAT	GREAT
E	LITTLE	LITTLE	LITTLE	LITTLE	MARE	MARE	LITTLE	LITTLE
F	LITTLE	LITTLE	LITTLE	LITTLE	LITTLE	V. LITTLE	V. LITTLE	V. LITTLE

I.O.P. - represents the training means influence on the performance

I.O.P.C. - represents the training means influence on the performance consistency

Conclusions

1. *Through the Taguchi method*, an improved variant of the factorial analysis, it is possible *to render the race walking training more efficient*, but, at the same time, it could represent an original tool in the preparation of other athletic events.
2. We can assert that the research general hypothesis was confirmed, because, by applying, in the race walking top performance training, a preparation model based on the Taguchi method, we managed to make a clear hierarchy of the *training means which mostly influence performance*, but particularly *the performance consistency*. The women race walkers' training process, after this method application, accurately settled the training means hierarchy, which obviously improved their preparation efficiency.
3. It was emphasized that *the training means appropriate administration*, as for the training volume and intensity, was an efficiency-generator in the athletes' preparation, because it avoided the unjustified training volumes. Hypotheses 1 and 2 were thus confirmed.
4. It was highlighted there were used only *the optimum training means and work volumes*, because they provided increased premises for the transfer to performance goal achievement, the hypothesis being thus confirmed.
5. It was also confirmed the hypothesis that, in the race walking training, there is an interaction among certain specific training means, the most obvious being *the relationship between the total volume of race walking kilometers and the long-duration race walking volume*. This interaction is determining to achieve the best performances.
6. It was stressed *the preparation strictly individual character* in the race walking top performance training, because the scored results, in relation to the training means ranking, according to their importance, as well as the limit-values of the work volumes were applicable only to each athlete's particular case.

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