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FACTORS DIFFERENTIATING AND DETERMINING THE LEVEL OF RESULTS IN THE RACE WALKING OF WOMEN OF HIGH QUALIFICATION

Key words: race walking, training loads

Introduction

Contemporary training is an extremely complex process, having a variety of aspects, just to mention the biological, psychical, social or methodical one (Sozański 1986, 1999). Its effectiveness is determined by various factors, the knowledge of which is the backbone of the whole training activity. Today, the management of the training process is impossible without earlier in-depth exploration of the specificity of a given sports discipline or event. Although the basic rules and principles stem from biological determinants of a body, yet the prerequisite of an effective action is the determination of the motor and functional requirements of a given sports discipline.

In the era of pursuit for success, in the area of competitive sport a necessity is appearing for the acquisition and extension of knowledge on the theory and practice of training. By setting a goal, a competitor strives to achieve it in an optimal way – the best way possible under specified conditions (Ryguła 2000, 2005). Therefore, the development of knowledge on the training process necessitates the collection and elaboration of any data on loads, that form grounds for the rational management of that process and enable the application of solutions based on scientific premises.

The analysis of training loads is an indispensable element in the improvement of the training work of a coach, enabling the control over the training, according to the adopted plan (Naglak 1979). A comparative analysis of the loads realized along with the sports condition of a performer enables the evaluation of the effectiveness of training and verification of training plans.

Methods

The objective of the reported study was a trial of selecting factors that differentiate and, simultaneously, determine a sports level in women' race walking.

The study covered 35 one-year training macrocycles. The material collected was divided into three blocks. The criterion of classification was a sports level (the best score in a given season) displayed by the sportswomen analyzed. In the evaluation of the sports level, consideration was given to the score tables by the International Association of Athletics Federation (IAAF) – www.iaaf.org of the 10th of March 2007. The best sports results of a given season were converted into IAAF scores.

The first block was a compilation of material describing 15 one-year training cycles, the second block – that of 9 one-year training cycles, and the third (the highest level of performance) – that of 11 one-year training macrocycles.

The analysis was conducted for the material referring to the training work performed by the women competitors examined. The material was collated in the so-called training diaries elaborated for race walk or generally for endurance athletic events.

In the study, use was made of a method elaborated by Ważny (1981), which enables the analysis of loads from the perspective of two influence directions:

- classification of training loads in terms of the type of preparation (the so-called information area),
- classification of training work determined by criteria stipulated by Wołkow as well as Wołkow and Koriagin (1977), taking into account effects of the loads on the energetic mechanisms of the body (the so-called energetic area), with modifications by Sozański (1986) which consisted in the determination of the zones of training intensity.

This method may be claimed a complex one, as it allows to consider three directions of training effects (**versatile**, **directed** and **special**) and five basic areas of training intensity (sustaining efforts – T_1 , aerobic – T_2 , combined – T_3 , anaerobic lactate – T_4 and anaerobic non-lactate – T_5). For methodological reasons, the sixth area (T_6) was determined additionally that covered exercises intensifying the anabolic processes (exercises developing the muscle strength). This method enables load evaluation by summing up the “crude” time of work in particular areas: information and energetic ones (Ryguła 2005).

The basis of the training load analysis, describing their size and structure in the subsequent phases of the cycle, is the record of the training means

groups in race walking elaborated by Krzysztof Perkowski (Sozański, Śledziwski 1995), modified by the authors of this study.

In gathering and processing the training data of the sportswomen examined, use was made of computer techniques. Analyses were conducted by means of TreOb-4 software worked out within the Central Programme of the Basic Research at the Department of the Theory of Sports, Academy of Physical Education in Warsaw (Kosmol, Sozański 1991; Sozański, Śledziwski 1995).

Differences in training loads between three groups of sportswomen were evaluated with the use of a one-way analysis of variance (a parametric test ANOVA), and the Kruskal-Wallis test (a non-parametric test). Once the result was significant ($p < 0.05$), the differences between groups were evaluated with the Tukey (RIR) test (for parametric tests) or with the multiple comparison test (for the Kruskal-Wallis test). Next a discrimination analysis was conducted with the aim to verify whether the groups of sportswomen examined differed in terms variable means and to indicate which of them contributed to group discrimination to the greatest extent.

Results

Results obtained in the area of total load values (TR) as well as in the information and energetic areas in a one-year cycle (CR) were presented in Tab. 1-9.

The analysis of the information area (Tab.1) showed that statistically significant differences ($p < 0.001$) in a one-year cycle were reported for the directed loads (D). The significance of differences referred only to the sportswomen displaying the lowest (I) and the most advanced (III) sports level (Tab. 2).

Data presented in Tab. 1 indicate also the likelihood than in the energetic area, in a one-year cycle, significantly different were the loads realized in the fourth (T_4) area of intensity, yet significant differences were noted between groups I and III (Tab. 3).

Tab. 1. Analysis of differences in training loads in a one-year training cycle of advanced women race walkers (one-way analysis of variance ANOVA).

Training load	SS Effect	MS Effect	SS Error	MS Error	F	p
V	7.140071E+10	3.570036E+10	7.556712E+11	2.361473E+10	1.512	0.236
D	3.374423E+10	1.687211E+10	1.335898E+11	4.174682E+09	4.041	0.027*
S	5.373216E+10	2.686608E+09	1.481116E+12	4.628486E+10	0.580	0.565
T ₁	1.217920E+10	6.089601E+09	1.850580E+11	5.783061E+09	1.053	0.361
T ₂	1.280454E+10	6.402269E+09	1.814947E+12	5.671708E+10	0.113	0.894
T ₃	2.143520E+10	1.071760E+10	1.275566E+11	3.986144E+09	2.689	0.083
T ₄	3.888939E+08	1.944470E+08	1.154867E+09	3.608959E+07	5.388	0.001**
V ₁	1.175640E+10	5.878198E+09	2.567978E+11	8.024930E+09	0.732	0.488
V ₃	7.598888E+07	3.799444E+07	1.277423E+10	3.991947E+08	0.095	0.909
S ₂	5.178889E+10	2.589444E+10	1.190134E+12	3.719170E+10	0.696	0.506
S ₄	7.031441E+07	3.515721E+07	1.012506E+09	3.164083E+07	1.111	0.342
Score at a distance of 10 km (IAAF scores)	1.323442E+05	6.617212E+4	2.284543E+04	8.159084E+02	81.102	0.001***

* – differences significant at $p < 0.05$; ** – differences significant at $p < 0.01$; *** – differences significant at $p < 0.001$

Tab. 2. Differences in directed (D) training loads between three groups of sportswomen in a one-year training cycle (CR) – Post Hoc (RIR) Tukey test.

Sports level (acc. to Tab. 4)	I $\bar{x} : 109457,3$	II $\bar{x} : 109833,9$	III $\bar{x} : 42713,8$
I	 	0,999	0,036*
II	0,999	 	0,069
III	0,036*	0,069	

* – differences significant at $p < 0.05$; ** – differences significant at $p < 0.01$; *** – differences significant at $p < 0.001$

Tab. 3. Differences in training loads realized in the fourth area of intensity (T₄) between three groups of sportswomen in a one-year training cycle (CR) –Post Hoc (RIR) Tukey test.

Sports level (acc. to Tab. 4)	I $\bar{x} : 12609$	II $\bar{x} : 7277.6$	III $\bar{x} : 5100.3$
I	 	0.105	0.01**
II	0.105	 	0.702
III	0.01**	0.702	

* – differences significant at $p < 0.05$; ** – differences significant at $p < 0.01$; *** – differences significant at $p < 0.001$

Tab. 4. Differences in results of race walk at a distance of 10 km between three groups of sportswomen in a one-year training cycle (CR) –Post Hoc (RIR) Tukey test.

Sports level (acc. to Tab. 4)	I – \bar{x} : 1030.2 (IAAF scores)	II – \bar{x} : 1100.1 (IAAF scores)	III – \bar{x} : 1185.1 (IAAF scores)
I	0.001***	0.001***	0.001***
II	0.001***	0.001***	0.001***
III	0.001***	0.001***	0.001***

* – differences significant at $p < 0.05$; ** – differences significant at $p < 0.01$;

*** – differences significant at $p < 0.001$

Significant differences were also recorded for the types and intensities of combined training loads (Tab. 5). They covered versatile loads performed in the fourth area of intensity (V_4) – the differences referred to the sportswomen displaying the most advanced (III) and the lowest (I) sports level (Tab. 6). In the area of special training, the particular groups of women athletes were differentiated by the size of the work performed in the third (S_3) and the fifth (S_5) area of intensity (Tab. 5, 7, 8). In the case of the S_3 loads, it was observed that a higher value of that parameter had a positive effect on training. Differences were noted between groups I and III as well as groups II and III – the work of the most advanced sportswomen is characterized by a high utilization of S_3 loads. In analysing the special loads realized in the fifth area of intensity (S_5), significant differences were recorded between groups I and II as well as groups II and III. In that case, the women athletes from group II are recommended to increase the volume of those loads.

No statistically significant differences were found, in turn, in the total load value (TR) between the groups examined.

Tab. 5. Analysis of differences in training loads in a one-year cycle of advanced women race walkers – non-parametric KRUSKAL-WALLIS test (H).

Training load	Sum of ranks (division into groups acc. to Tab. 4)			H	p
	I	II	III		
TR	281.00	154.00	195.00	0.152	0.927
T₅	294.00	118.00	218.00	2.762	0.251
T₆	265.00	188.00	177.00	1.114	0.573
V₂	325.00	149.50	155.50	3.650	0.161
V₄	337.00	161.00	132.00	9.250	0.010**
V₅	291.00	144.50	194.50	0.620	0.733
V₆	257.50	208.00	164.50	3.316	0.191
D₂	273.50	177.00	179.50	0.571	0.751
D₃	311.00	188.00	131.00	5.669	0.059
D₄	293.00	144.00	193.00	2.294	0.318
S₃	228.00	130.00	272.00	6.945	0.031*
S₅	311.00	83.00	236.00	8.992	0.011*
Results at a distance of 5 km (IAAF scores)	124.00	110.00	201.00	18.648	0.001***

* – differences significant at $p < 0.05$; ** – differences significant at $p < 0.01$;

*** – differences significant at $p < 0.001$

Tab. 6. Differences in versatile training loads realized in the fourth area of intensity (V_4) between three groups of sportswomen in a one-year training cycle (CR) – Kruskal-Wallis test (H).

Sports level (acc. to Tab. 4)	I R: 22.467	II R: 17.889	III R: 12.000
I	 	0.868	0.030*
II	0.868	 	0.603
III	0.030*	0.603	

* – differences significant at $p < 0.05$; ** – differences significant at $p < 0.01$;

*** – differences significant at $p < 0.001$

Tab. 7. Differences in special training loads realized in the third area of intensity (S_3) between three groups of sportswomen in a one-year training cycle (CR) – Kruskal-Wallis test (H).

Sports level (acc. to Tab. 4)	I R: 15.200	II R: 14.444	III R: 25.727
I	 	1.000	0.044*
II	1.000	 	0.049*
III	0.044*	0.049*	

* – differences significant at $p < 0.05$; ** – differences significant at $p < 0.01$;

*** – differences significant at $p < 0.001$

Tab. 8. Differences in special training loads realized in the fifth area of intensity (S_5) between three groups of sportswomen in a one-year training cycle (CR) – Kruskal-Wallis test (H).

Sports level (acc. to Tab. 4)	I R: 20.733	II R: 9.222	III R: 21.455
I	 	0.023*	1.000
II	0.023*	 	0.024*
III	1.000	0.024*	

* – differences significant at $p < 0.05$; ** – differences significant at $p < 0.01$;
 *** – differences significant at $p < 0.001$

Tab. 9. Differences in results of a race walk at a distance of 5 km between three groups of sportswomen in a one-year training cycle (CR) – Kruskal-Wallis test (H).

Sports level (acc. to Tab. 4)	I R: 8.857	II R: 15.714	III R: 25.125
I	 	0.246	0.00004***
II	0.246	 	0.098
III	0.00004***	0.098	

* – differences significant at $p < 0.05$; ** – differences significant at $p < 0.01$;
 *** – differences significant at $p < 0.001$

Statistically significant differences were also observed in sports results achieved at a distance of 5 km (Tab. 5) and 10 km (Tab. 1). In the first case, they referred to the sportswomen of the highest and the lowest classification (Tab. 9), whereas in the second – they referred to all analyzed groups (Tab. 4). The results obtained confirm the soundness of the selection of the criterion of sportswomen classification.

The analysis of variance was not conducted for the directed loads realized in the first (D_1), fifth (D_5) and sixth (D_6) area of intensity as well as for effects of the special loads realized in the first (S_1) and sixth (S_6) area of intensity. It results from the fact that the sportswomen were not performing any work in those areas.

The results obtained were next subjected to a discrimination analysis. Tab. 10 presents the model of variables for the prediction of affiliation to groups, involving three statistically significant variables (T_4 , S_3 and S_5), determined in the analysis of variance. Data collated in the table indicate that the greatest contribution to discrimination had the variable T_4 – loads realized in the fourth area of intensity. This is indicated, among other things, by the value of the test of partial Wilk's Lambda (the closer the value to null, the greater the contribution of variable to discrimination). In total, the variables presented in Tab. 10 showed a high level of significance ($p < 0.001$).

Tab. 10. Analysis of a discrimination function – training loads of advanced women race walkers in a one-year cycle – model of variables for the prediction of affiliation to a group.

Training loads	Wilk's Lambda	Partial Wilk's Lambda	F of removal (2.30)	P	Tolerance value	1-Toler. (R-quadr.)
T ₄	0.722	0.615	9.352	0.001***	0.779	0.220
S ₃	0.603	0.737	5.345	0.010**	0.723	0.276
S ₅	0.554	0.801	3.703	0.035*	0.855	0.144

Wilk's Lambda – 0.444, F – 4.992, Significance level – $p < 0.001$

* – differences significant at $p < 0.01$, ** – differences significant at $p < 0.05$,

*** – differences significant at $p < 0.001$

Another step in searching for factors determining to the greatest extent the sports level involved conducting a canonical analysis (Tab. 11). Taking into account the model of variables for predicting affiliation to groups, two discriminatory functions were formulated (two roots), which turned out to be statistically significant. The first discriminatory function was significant at a level of $p < 0.001$. After the removal of the first root, values of the second function (the second root) were not correlated with the values of the first function and exhibited statistical significance at a level of $p < 0.05$.

Tab. 11. Chi-square test for successive roots (discriminatory functions) – for training loads of advanced women walk racers in a one-year cycle (CR).

Discriminatory function	Removed root	Own value	Canonical R	Wilk's Lambda	Chi-square	p
1	0	0.799	0.666	0.444	25.105	0.001***
2	1	0.248	0.446	0.800	6.885	0.031*

* – differences significant at $p < 0.05$; ** – differences significant at $p < 0.01$;

*** – differences significant at $p < 0.001$

Next, calculations were made for the values of discriminatory function coefficients and for the accumulated percentage of common separated by each of the functions (Tab. 12). The first function constituted 76.3% of the explained variable (76.3% of the total discriminatory strength) and, thus, was recognized as the most important one. The second function constituted only 23.7% of the discriminatory strength. In the first root (function), the most significant strength of discrimination was shown by loads realized in the fourth area of intensity (T₄), whereas a slightly lower strength was observed for the special training loads realized in the third (S₃) and fifth area of intensity (S₅). These loads were found to affect, to the greatest extent, the achievement of high scores in race walk of women.

A factor determining success (a high sports level) in the race walk that was the most strongly correlated with the discriminatory function turned out to be loads performed in the fourth area of intensity (T_4). This is indicated by a high value of a structural coefficient (Tab. 13.). The structural coefficient of the first function may be referred to as a discriminatory function being under the influence of T_4 .

Tab. 12. Coefficients of discriminatory functions – for training loads of advanced women race walkers in a one-year training cycle.

Discriminatory variable	Function 1		Function 2	
	Crude	Standardized	Crude	Standardized
T4	0.000175	1.051	0.00001	0.089
S3	0.000054	0.888	0.00002	0.247
S5	0.000100	0.401	0.00022	0.895
Own value	0.799		0.248	
Per cent of variation	76.3%		23.7%	

Tab.13. Structural coefficients for training loads of advanced women race walkers in a one-year training cycle ($p < 0.05$).

Variable	Structural coefficient of the first function	Structural coefficient of the second function
T4	0.646	0.092
S3	0.346	0.541
S5	0.030	0.957

Summary and conclusions

The value of overall training loads (TR) is not the only determinant of accomplishing record-breaking results. An increase in the sports level of a women performer is not directly linked with the training volume itself, but is determined by effects of an integrated system of stimuli leading to a long-standing endurance adaptation, in conformity with motor and functional characteristics of an event (Baj-Korpak 2008).

In summary, it may be concluded that in differentiation of extreme sports levels (I vs. III) significant turned out to be the loads realized in the fourth area of energetic transformations (T_4), directed (D) loads and versatile loads performed in the fourth area of intensity (V_4). The study showed that training of the sportswomen of the highest classification, as compared to that of the sportswomen from group I, was characterized by low values of those loads. It indicates that the examined women athletes representing the

highest sports level were restricting the use of strength and running means. In their case, the higher S_3 values were also found to exert a positive effect on high scores achieved in race walk – they differentiated groups I and III as well as groups II and III. The sports women representing the lowest and the highest sports level, as compared to those from group II, performed a greater special training in the fifth area of intensity (S_5) – those loads turned out to be a factor differentiating levels I and II and levels II and III.

The conducted discrimination analysis proved that the parameters differentiating particular sports level were, simultaneously, determining them (Tab. 13). The predominating factor turned out to be the loads realized in the area of anaerobic-lactate transformations (T_4).

Abstract

The objective of the reported study was a trial of selecting factors that differentiate and, simultaneously, determine a sports level of women specializing in race walking.

The study covered 35 one-year training macrocycles. The material collected was divided into three blocks.

The study was conducted with the method of recording, gathering and analysis of training loads worked out at the Department of the Theory of Sports, Academy of Physical Education in Warsaw. Use was also made of the classification of training means groups for the event of race walking elaborated by Krzysztof Perkowski, with own modification.

Differences in training loads between three groups of sportswomen were evaluated with the use of a one-way analysis of variance (a parametric test ANOVA), and the Kruskal-Wallis test (a non-parametric test). Once the result was significant ($p < 0.05$), the differences between groups were evaluated with the Tukey (RIR) test (for parametric tests) or with the multiple comparison test (for the Kruskal-Wallis test).

Loads that significantly differentiated the training of sportswomen at various levels of advancement turned out to be efforts realized in the fourth area of energetic transformations (T_4), directed loads (D) as well as versatile loads realized in the fourth area of intensity (V_4). The achievement of high scores is facilitated by reduction of those loads and by increasing the special loads realized in the fourth area of energetic transformations (S_3), the effect of which appeared to be statistically significant. Another factor differentiating the levels of sports advancement turned out to be the special loads realized in the fifth area of intensity (S_5).

References

1. Baj-Korpak J., Wielkość i struktura obciążeń treningowych wysoko kwalifikowanych zawodniczek w chodzie sportowym. Praca doktorska. AWF, Warszawa 2008.
2. IAAF Scoring Tables: <http://www.iaaf.org/downloads/scoringTables/index.html> z dn. 30.03.2007.
3. Kosmol A., Sozański H., Programy komputerowe do analizy obciążeń treningowych. Sport Wyczynowy, 1991, nr 3-4, s. 39-53.
4. Naglak Z., Trening sportowy. Teoria i praktyka. PWN, Warszawa 1979.
5. Ryguła I. (red.), Elementy teorii, metodyki, diagnostyki i optymalizacji treningu sportowego. AWF, Katowice 2005.
6. Ryguła I., Narzędzia analizy systemowej treningu sportowego. AWF, Katowice 2000.
7. Sozański H. (red.), Podstawy teorii treningu sportowego. RCMSzKFiS, Warszawa 1999.
8. Sozański H., Śledziwski D. (red.), Obciążenia treningowe dokumentowanie i opracowywanie danych. RCMSzKFiS, Warszawa 1995.
9. Sozański H., Zróżnicowanie rozwoju sportowego młodocianych zawodników w zależności od rodzaju treningu. Warsztaty badawcze. AWF, Warszawa 1986.
10. Ważny Z., Współczesny system szkolenia w sporcie wyczynowym. Sport i Turystyka, Warszawa 1981.
11. Wołkow N.I., Koriagin W.M., Z badań nad kryterium klasyfikacji obciążeń treningowych. Sport Wyczynowy, 1977, nr 11-16.