KINETICS OF BASIC ENDURANCE AND BASIC SPEED ENDURANCE CHARACTERISTICS THROUGHOUT ONE OLYMPIC SEASON IN WHITE WATER SLALOM KAYAK

Anton Ušaj

ČASOVNI POTEK VREDNOSTI KAZALCEV OSNOVNE VZDRŽLJIVOSTI IN OSNOVNE HITROSTNE VZDRŽLJIVOSTI SKOZI ENO OLIMPIJSKO TEKMOVALNO SEZONO V SLALOMU KAJAKA NA DIVJIH VODAH

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Abstract

The aim of the study was to ascertain whether the one and/or bi-cycle training periodisation was accompanied by similar one and/or bi-cycle adaptation. Two groups of paddlers of the Slovene national team in slalom wild water kayak: an »Olympic« group of three paddlers and »Non-Olympic« group of four paddlers, who did not qualify to the Olympic Games, participated in a one year follow-up throughout the Olympic competition season. The Olympic group had bi-cycle and the NonOlympic group one-cycle training periodisation. They performed the two tests several times throughout the Olympic season. In the incremental testing protocol (ITP) the velocity determined by Lactate Threshold (v_{LT}), Onset of Blood Lactate Accumulation (v_{OBLA}) and maximal velocity (v_{max}) characteristics were used. The second was test of »Eight«, where the time of completing the test (t_8), heart rate (HR_8), and lactate concentration (LA_8) were used. The results showed that velocities v_{LT}, v_{OBLA} and v_{max} did not differentiate the groups. In the Olympic group periodisation showed an unexpected monocyclic response with very small changes. In the Non-Olympic group, the paddlers' response periodisation was closer to monocyclic expectations. Time t_8 fluctuated in a bi-cycle manner in both groups. This was expected for the Olympic group but was not accompanied by monocyclic changes of training in the Non-Olympic group. Of the other characteristics, LA_8 and pH_8 showed expected fluctuations in both groups. The study showed an absence of a typically significant relationship between training periodisation and periodisation of the selected characteristics of basic paddlers' performance in the two groups of the highest level of international wild water kayakers. Therefore, the practical application of training-based periodisation seems not to be always accurate in top level sport.

Key words: wild water kayak, slalom, training periodisation, paddlers' response periodisation

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Izvleček

Cilj naloge je bil ugotoviti ali je vadbena ciklizacija, ocenjena s pomočjo kazalcev količine in intenzivnosti vadbe v skupini kajakašev na divjih vodah v slalomu, ki so nastopili na Olimpijskih igrah (Olympic) in tistih, ki se niso uvrstili na to tekmovanje (Non-Olympic) skladna z ciklizacijo učinkov vadbe: kazalcev osnovne vzdržljivosti in osnovne hitrostne vzdržljivosti. Vadba prve skupine (trije udeleženci Olimpijskih iger) je namreč imela značilnosti dvojne, vadba druge skupine (štirje člani nacionalne ekipe, ki je nastopala v svetovnem pokalu) pa enojne ciklizacije. Opravili so dva testa: prvi, večstopenjski obremenilni test (ITP) in test »Eight«, oba na mirni vodi. Za oceno osnovne vzdržljivosti so v ITP uporabljeni laktatni prag (LP), prag izraženega povečanja laktata (OBLA) in največja obremenitev (v_{max}). V testu »Eight« so za oceno osnovne hitrostne vzdržljivosti uporabljeni čas veslanja (t_8), frekvenca srca (HR_8), vsebnost laktata (LA_8) in pH krvi (pH_8). Rezultati naloge kažejo, da hitrosti veslanja v_{LP}, v_{OBLA} in v_{max} ne razlikujejo obeh skupin. V skupini Olympic ciklizacija učinkov vadbe kaže nepričakovano en cikel z zelo majhnimi spremembami. V skupini Non-Olympic so ravno tako značilnosti ciklizacije bliže enojnemu ciklu, ki je pričakovan. V testu »Eight«, čas t_8 fluktuira v obliki dvojne ciklizacije in sicer v obeh skupinah. To je pričakovano za skupino Olympic, toda v nasprotju s pričakovanim odzivom enojne ciklizacije skupine Non-Olympic. Druge značilnosti: LA_8 in pH_8 kažejo pričakovane fluktuacije obeh skupin, toda z zmanjšanim spreminjanjem pH_8. Raziskava kaže odsotnost tipične povezave med osnovnimi značilnostmi vadbene ciklizacije in izbranimi značilnostmi ciklizacije učinkov vadbe športnikov visokega mednarodnega nivoja. Torej je praktična uporaba vadbene ciklizacije, ki naj bi povzročila predvidljivo cikličnost sprememb osnovne vzdržljivosti in osnovne hitrostne vzdržljivosti v vrhunskem športu dejansko dokaj omejena.

Ključne besede: kajak na divjih vodah, slalom, vadbena ciklizacija, ciklizacija učinkov vadbe

INTRODUCTION

The competitive season in white water kayak slalom starts with a preparatory period, usually in November (sometimes also in the second half of October) and finishes with the final competitions in September (Vest, 1996). The preparatory period lasts all of November, December and January. Basic endurance and strength type training are characteristic for this period. Training is performed mainly on flat or slowly moving water and by using other non-specific possibilities of training: cross country skiing, running, fitness. It continues with a pre-competition period in February, March and April. The training characteristically changes, to be specific for white water slalom paddling in a dominant part. The specific speed endurance and power training increased, with a reduction of basic endurance and strength training (tapering cycle). The main part of training is performed on wild water and through gates. The competition period begins in May (April). Training is concentrated mainly on preparations for competitions. The schedule of World Cup competitions is the main factor, which determines training characteristics of preparations for a specific competition. Therefore the periodisation is mainly influenced by this series of competitions. Usually, the competitions are more or less uniformly distributed. Therefore, training periodisation mainly consists of one competition cycle (Bompa, 1999). When very important competitions are included in the competitive season, then the date of this competition may have very dramatic influence on training schedule and periodisation, which may change to two cycle periodisation (two competition cycles) (Bompa, 1999). The Olympic Games is such a competition where periodisation is usually changed, according to training characteristics (Bompa, 1999). This, the most important competition, is usually under special care of preparation of sportsmen of all. Therefore two-cycle training periodisation is characteristic for such a competition period (Bompa, 1999; Vest, 1996).

In spite of clear two-cycle periodisation of the Olympic competitive season, which may be assessed from the time course of training volume and intensity, it is more important that the adaptations of paddlers' performance and biological adaptation as well also follows the training cycles (the paddlers' response periodisation). It is expected that the second cycle of responses should be more dramatic and in time of the Olympic Games. However, because of a possibility of very different response times of specific adaptations, which may occur very early after a certain training cycle or may be delayed, it is not possible to predict accurately the response of specific characteristics. Similarly also training adaptation of complex characteristics such as psychomotor performances, which are strongly influenced by emotions, cannot be accurately predicted (Vest, 1996). Therefore, dependent on individual training adaptations, it may be possible that the specific response to similar training may be different in its magnitude and also timing especially for high performance athletes when very small changes of training response occur. Therefore, the specific adaptations may not be clearly and simply assessed as in controlled training studies, where untrained subjects were usually used. The question is whether the training adaptations that occurred in a controlled training experiment and monotonous training will be the same for top level sport training of kayakers, who performed complex training.

Our special interest was placed on two basic training assumptions. The first assumption relates to the belief that high training volume and low-to-medium intensity influences the increase of endurance performance but does not influence significantly the increase of speed endurance. The second assumption related to »tapering«: the reduction of training volume and significant increase of its intensity increases speed endurance. If one looks at the entire competitive season, the changes of training characteristics and changes of specific characteristics of adaptations and performances of sportsmen, show periodisation. Our interest and the aim of the study was to ascertain if basic cyclic changes of training characteristics (training periodisation) corresponded to cyclic changes of specific training response of subjects (periodisation of paddlers response) who prepared and competed at the Olympic Games. The hypothesis we verified was that training periodisation may not always influence periodisation of paddlers' response in the predicted manner for a group of high performance paddlers.

METHODS

Two groups of paddlers: group Olympic of three paddlers who qualified for the Olympic Games in the white water kayak slalom Slovene national team

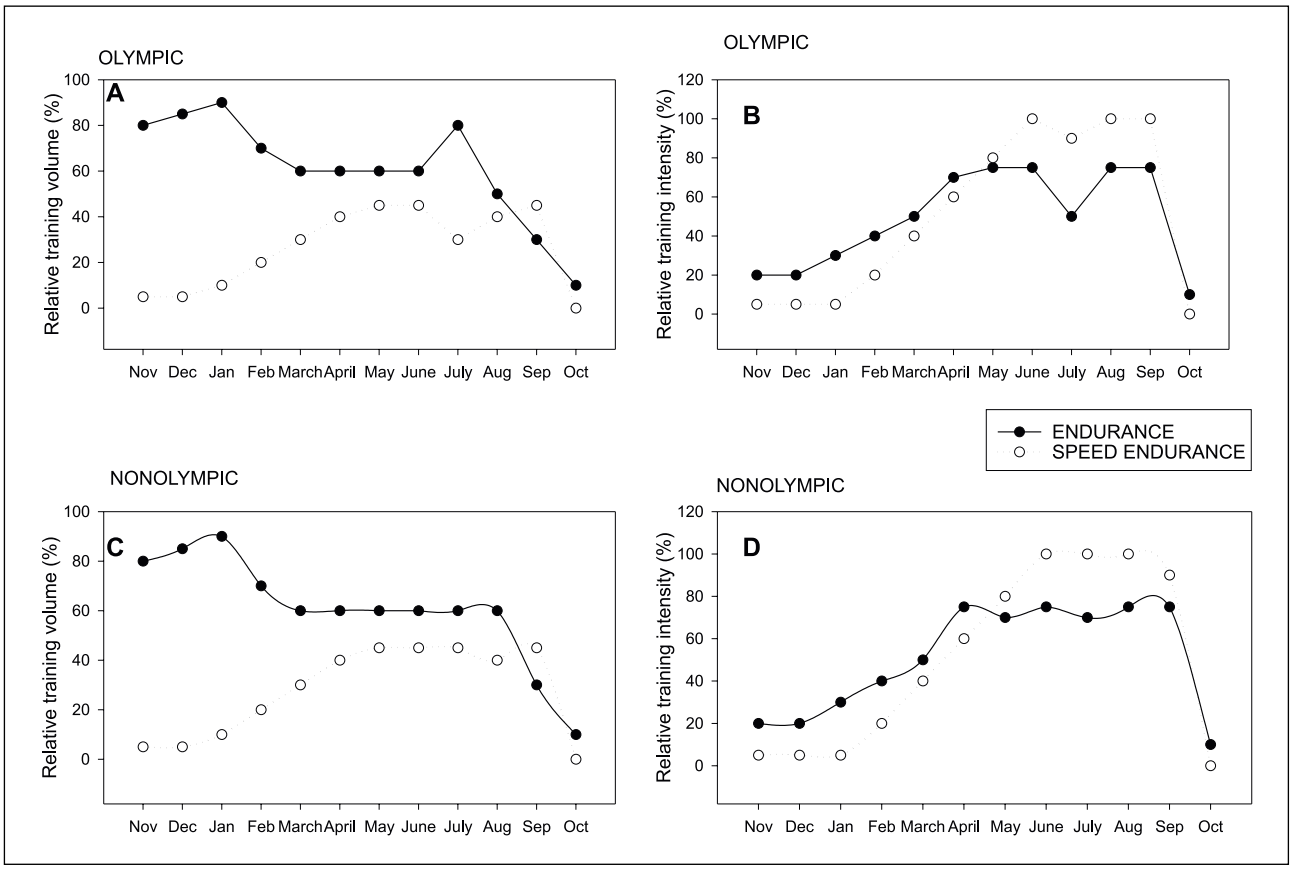

Fig. 1
Relative training volume, represented as a % of the sum of relative values of basic endurance and basic speed endurance training, showed typical bi–cyclic periodisation in the Olympic and monocyclic periodisation in the Non-Olympic group. Relative training intensity, which was based on calculated paddling velocities at each training session and compared with the best result during the whole competitive season, showed bi–cyclic periodisation in the Olympic and monocyclic periodisation in the Non-Olympic group.

(age 23±4 years; height 183±6 cm; weight 81±4 kg) and group Non-Olympic of four members of the national slalom team who failed to qualify for the Olympic Games, however competed successfully at the international level (age 21±3 years; height 184±5 cm; weight 79±6 kg), participated in the study.

Both groups trained equally until the end of qualification competitions in June. Training consisted of a preparatory period (November, December and January), pre-competition period (February, March and April) and competition period (May to October) (Fig. 1). The dominant characteristic of the preparatory period was large volume of endurance and strength training. Endurance training consisted of lower intensity, somewhere between the limits of heart rate (HR) determined by criterions Lactate Threshold (LT) and Onset of Blood Lactate Accumulation (OBLA), dependent on their duration and intensity of training: paddling on flat or slow moving water, cross-country skiing and running. Strength training was focused to influence more its endurance component by using classical circuit training, whole body variations. The aim of the training was to increase basic endurance performance. The following, pre-competition period consisted of more intense and lower volume training. The volume of endurance training decreased with no change in its intensity. The volume of speed endurance training increased. Its intensity quickly increased close to maximal. In general, the total training volume decreased in exchange to an increase of training intensity (tapering). Training used specific kayak–slalom characteristics on wild-water. The aim of the training was improvement of speed-endurance (power and speed) and to keep endurance on a steady level. The competition period starts in May with international competitions. Some of them are also qualifications for selection to the Olympic team. Training was specific and consisted characteristically of preparations for the competitions. The Olympic group changed their training characteristics when the qualification period was over. Training changes to a second shorter cycles of

intense basic training and pre–competition training with the goal to increase, for the second time, the basic endurance and speed endurance to the highest possible level and transform the attained level for use in competition situations with special training and also some competitions. Training characteristics showed a bi-cycle competition season (Fig. 1A and 1B). These groups concentrate to train further for the Olympics in September. The Non-Olympic group continued to compete at the international level (Fig. 1C and 1D). Their training showed a one–cycle competition season. Both groups trained under the program of the national coach.

Both groups performed two tests on flat water: incremental testing protocol (ITP) for assessing the adaptation in biological background of basic endurance performance and test of eight (EIGHT), which was a typical exercise for assessment of basic speed endurance performance. The ITP consisted of 5 repetitions of a 600 m distance with controlled intensity, which is made possible by using fixed, pre determined HR of 110, 130, 150, 165 and maximal possible intensity. The rest between each 600 m repetition was about 1 min (blood sampling). The test EIGHT consisted of all-out paddling over a 200 m distance in a manner of the number 8 through two gates, separated by 50m.

During ITP the heart rate (HR) was continuously measured by using Polar Sport Tester (Polar, Finland). Additionally, capillary blood samples (10 µl) were taken from hyperaemic ear lobe immediately after each 600 m distance and measured for lactate concentration (LA) by using MINI 8 Photometer (dr. Lange, Germany).

During the test EIGHT, the time for completing the test was measured by using a stopwatch, HR was continuously measured at 5 s intervals and LA was measured before and after the test.

LT, OBLA and maximal characteristics in ITP were used for final analysis. Paddling velocity (v_{LT} and v_{OBLA}), HR (HR_{LT} and HR_{OBLA}) and LA (LA_{LT}) were calculated by using criterions Lactate Threshold (Beaver, Wasserman, & Whipp, 1985; Ušaj, 1990; Ušaj, 1998a; Ušaj, 1998b) and Onset of Blood Lactate Accumulation (Karlsson, & Jacobs, 1982; Ušaj, 1998a; Ušaj, 1998b). Additionally, maximal values of velocity (v_{max}), LA (LA_{max}) and HR (HR_{max}) were also used for further analysis (Ušaj, 1998a; Ušaj, 1998b).

The time for completing the test EIGHT (t_8), end HR (HR_8) and end LA (LA_8) were used for further analysis (Ušaj, 1998a; Ušaj, 1998b).

The differences between the Olympic and the Non-Olympic groups were calculated by using repeated T-test with a level of significance of $P<0.05$. The time course curves of the used characteristics throughout the Olympic season were fitted by using 4^{th} grade polynomial. This was also the characteristic of specific periodisation in the Olympic group. Differently, the Non-Olympic group periodisation was expected to be monocyclic, but we were not sure. Therefore, the same model was used because it may be applied to bi-cycle and monocycle response, dependent on the calculated beta coefficients' values of curves which would be very low, when monocycle curve would be calculated. Using logical relationships based on the theoretical assumptions made, a comparison between estimation of training periodisation and calculated curves of training response was made.

RESULTS

The frequency of testing by ITP followed the practical point of view and applied it as an additional tool of training planning. Therefore, the test was repeated more frequently during the preparatory period and less during the competitive one (Table 1, Fig. 2, Fig. 3 and Fig. 4). The Olympic and the Non-Olympic groups did not differ in the observed characteristics throughout the Olympic competition season (Table 1).

This practical point of view was followed also in the test EIGHT; this test was repeated more frequently during pre–competition than in the competition periods (Table 2, Fig. 5). Again, the Olympic and Non-Olympic groups were not different in the observed characteristics throughout the Olympic competition season (Table 2). In spite of non-significant differences, HR_8 showed a tendency to be lower in the Olympic group (Table 2, Fig. 5). Additionally, LA_8 showed a tendency to be higher in the Olympic group in July and September (Table 2, Fig. 5). Blood pH_8 did not show the expected mirrored picture (Fig. 5).

When time course changes of v_{lt}, v_{OBLA} and v_{max} (Fig. 2) were compared to changes of general training characteristics during the basic endurance period (November, December and January) (Fig. 1), then unexpectedly no changes of parameters can

Table 1: BASIC STATISTICAL DATA FROM THE INCREMENTAL TESTING PROTOCOL

		NOV.	DEC.	JAN.	MARCH	MAY	JULY
LT	v_{LT} (m/s)	2.23 ± 0.06	2.19 ± 0.06	2.19 ± 0.05	2.21 ± 0.05	2.25 ± 0.02	2.26 ± 0.02
		2.17 ± 0.03	2.19 ± 0.04	2.17 ± 0.04	2.20 ± 0.05	2.24 ± 0.05	2.27 ± 0.04
	HR_{LT}	142 ± 3	135 ± 5	142 ± 12	135 ± 6	138 ± 4	139 ± 3
	(b/min)	146 ± 5	141 ± 2	140 ± 4	144 ± 8	142 ± 5	146 ± 6
OBLA	v_{OBLA}	2.30 ± 0.03	2.32 ± 0.04	2.28 ± 0.01	2.33 ± 0.05	2.34 ± 0.04	2.36 ± 0.04
	(m/s)	2.25 ± 0.09	2.31 ± 0.05	2.28 ± 0.05	2.32 ± 0.06	2.35 ± 0.07	2.36 ± 0.09
	HR_{OBLA}	152 ± 5	151 ± 4	154 ± 1	150 ± 5	153 ± 4	154 ± 4
	(b/min)	156 ± 5	155 ± 6	154 ± 6	159 ± 5	159 ± 5	160 ± 5
max	v_{max}	2.57 ± 0.01	2.57 ± 0.04	2.52 ± 0.01	2.59 ± 0.04	2.65 ± 0.01	2.65 ± 0.3
	(m/s)	2.54 ± 0.11	2.57 ± 0.05	2.50 ± 0.05	2.57 ± 0.07	2.58 ± 0.10	2.60 ± 0.15
	HR_{max}	183 ± 1	181 ± 3	183 ± 6	181 ± 5	184 ± 7	191 ± 6
	(b/min)	153 ± 5	182 ± 3	178 ± 9	187 ± 3	184 ± 2	185 ± 3
	LA_{max}	15 ±1	14.3 ± 1.7	15.7 ± 2.3	14.1 ± 0.9	14.5 ± 0.5	14.6 ± 1.2
	(mmol/l)	13.3 ±10	13.2 ± 1.7	14.7 ± 1.1	15.2 ± 2.3	14.4 ± 2.0	13.9 ± 1.5
	p-H_{min}	7.21 ± 0.02	7.19 ± 0.03	7.22 ± 0.01	7.21 ± 0.02	7.20 ± 0.02	7.19 ± 0.03
		7.22 ± 1.01	7.21 ± 0.01	7.19 ± 0.01	7.19 ± 0.04	7.19 ± 0.04	7.19 ± 0.02

LEGEND: For abbreviations see the text
Results in upper lines of each cell are the results of Olympic, in lower lines of the Non-Olympic group

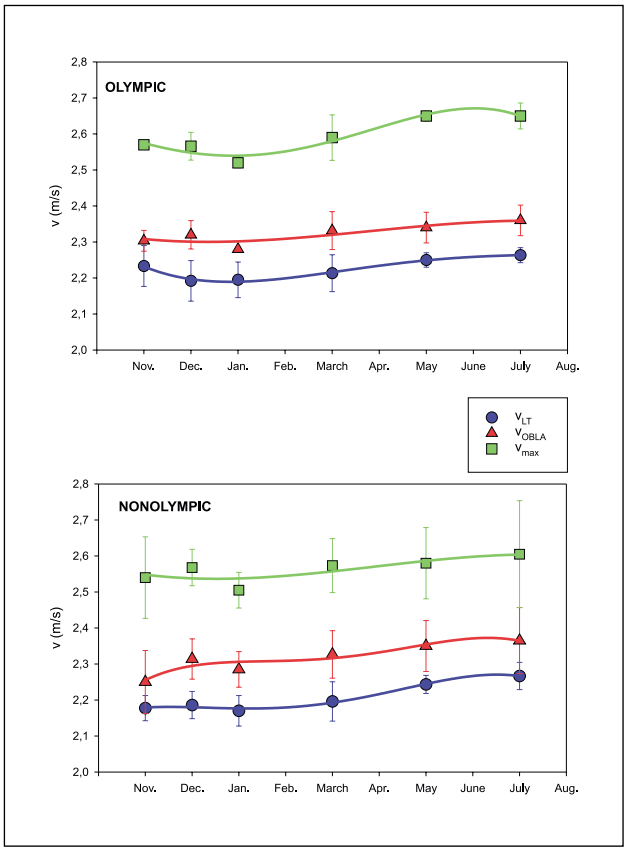

Fig. 2
The periodisation of velocities v_{LT}, v_{OBLA} and v_{max} showed very small fluctuations. When type of the time course of each velocity was estimated for a certain type of training response periodisations, then monocyclic periodisation showed for both the Olympic and the Non-Olympic group.

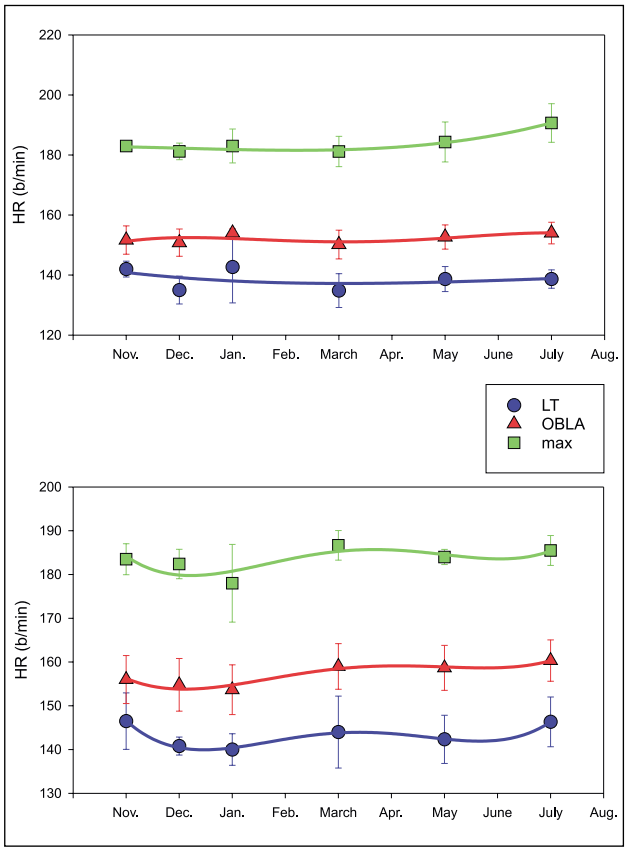

Fig. 3
When HR fluctuations were observed at the level of LT, OBLA and maximal intensity, then changes were practically negligible. No characteristic type of periodisation can be seen from the available data for the Olympic and the Non-Olympic group.

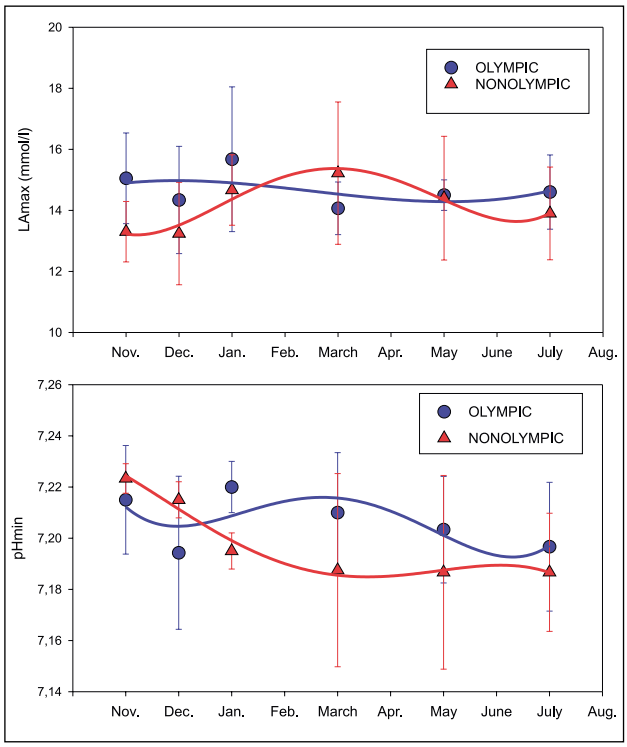

Fig. 4
Time course of LAmax fluctuations in the test ITP showed negligible fluctuations in the Olympic group, without supporting any type of training response periodisation. In the Non-Olympic group training response periodisation may show monocyclic response. The training response periodisation assessed by the time course analysis of pHmin data may show a bi-cyclic training response in the Olympic group. In the Non-Olympic group, the time course of pHmin showed monocyclic training response.

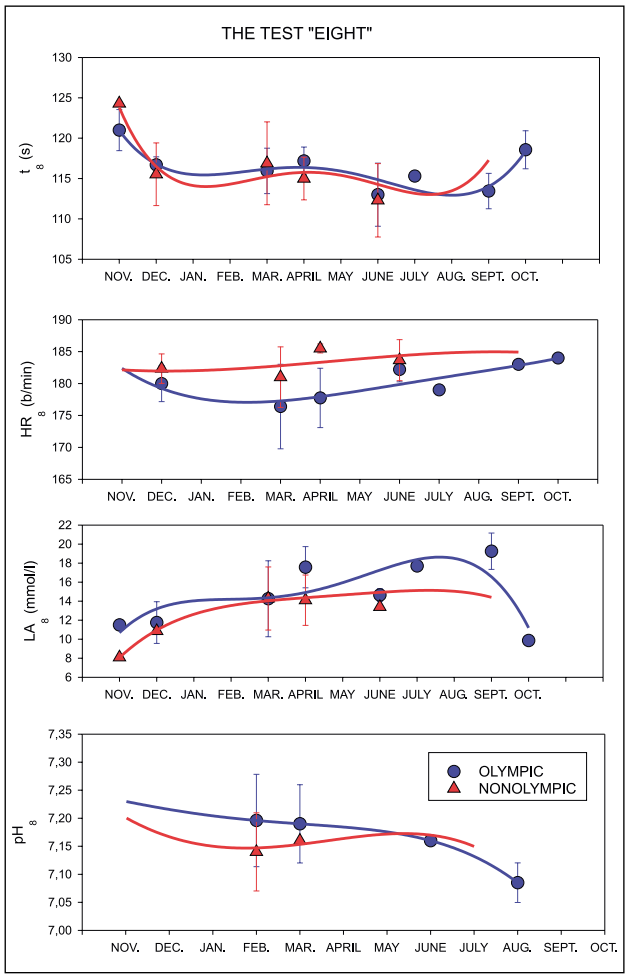

Fig. 5
Time course of t8 showed characteristically a bi-cyclic periodisation in the Olympic group, which was expected, and similarly in the Non-Olympic group, which was unexpected, because of monocyclic training periodisation. Heart rate (HR_8) did not show any type of characteristic periodisation. However, for the Olympic group, the initial decrease of HR_8 showed relatively large adaptation if increase of paddling speed is also taken into account. Thereafter, HR_8 increased linearly, which may also be some kind of monocyclic periodisation. The time course in the Non-Olympic group did not show any typical periodisation. However, this did not mean that adaptations did not occur: similar HR_8 at increased velocity of paddling means positive adaptation. LA_8 showed characteristically a bi-cyclic periodisation in the Olympic group and a non-typical but visible monocyclic periodisation in the Non-Olympic group. Both periodisation types were expected. pH_8 showed non-typical, but not expected (bi-cyclic training periodisation) monocyclic periodisation in the Olympic group, which was however positive. In the Non-Olympic group, the periodisation may be also assessed as monocyclic. This was the expected periodisation for this group.

be assessed in contrast to an increase in endurance training volume. HR_{LT}, HR_{OBLA} and HR_{max} generally followed the tendency of no changes (Fig. 3). Only LA_{max}, showed increased values in the Non-Olympic group but not in the Olympic group (Fig. 4). Blood pH_{min} accompanied LA_{max} changes in the Non-Olympic group and in the Olympic group (relatively values) (Fig. 4) in this period. Surprisingly, the most dramatic changes occurred in t_8 in spite of absence of such training. Both groups show very similar changes (Fig. 5). HR_8 showed a tendency for decreasing in spite of the increase of velocity in this test (Fig. 5). This is valid for the Olympic group. However, the results in the Non-Olympic group were stationary. LA_8 increased in both groups, which may be expected from the increased paddling velocity in this test. pH_8 logically accompanied LA_8 changes in this period, however with a smaller magnitude (Fig. 5).

Velocities v_{LT}, v_{OBLA} and v_{max} of both groups showed a continuous tendency for increasing during the pre-competition cycle (February, March and April), which continued in the competition cycle, until July (Fig. 2). This was in contrast to training characteristics, which showed a clear decrease of volume of endurance training but increased volume of speed endurance training, which was more intense. Nevertheless, the phenomenon was welcome. Changes of HR_{LT}, HR_{OBLA} and HR_{max} in both groups did not accompany changes of velocities in

Table 2: BASIC STATISTICAL DATA FROM THE TEST »EIGHT«

	NOV.	DEC.	MARCH	APRIL	JUNE	JULY	SEPT.	OCT.
t_8 (s)	121 ± 2.5	116.7 ± 1.0	115.9 ± 2.8	117.2 ± 1.7	113.0 ± 3.9	115.3 ± 1.0	113.4 ± 2.1	118.6 ± 2.0
	124.3 ± 1.0	115.5 ± 3.8	116.9 ± 5.1	115.0 ± 2.6	112.3 ± 4.5	115.0 ± 3.5	117.0 ± 1.0	
HR_8 (b/min)	180 ± 3	176 ± 7	177 ± 5	182 ± 2	179 ± 1	183 ± 5	184 ± 3	
	182 ± 2	181 ± 5	185 ± 3	183 ± 3	184 ± 2		165 ± 5	
LA_8 (mmol/l)	11.5 ± 0.4	11.7 ± 2.1	14.2 ± 4.0	17.6 ± 2.1	14.6 ± 0.7	17.7 ± 0.9	19.2 ± 1.9	9.9 ± 0.4
	8.1 ± 2.0	10.9 ± 0.6	14.3 ± 3.3	14.1 ± 2.6	15.4 ± 1.2		14.4 ± 1.3	
PH_8	7.20 ± 0.03	7.17 ± 1.2	7.20 ± 0.08	7.19 ± 0.06		7.16 ± 0.05		7.08 ± 0.03
			7.14 ± 0.07	7.16 ± 0.05		7.17 ± 0.12		

LEGEND: For abbreviations see the text
Results in upper lines of each cell are results of the Olympic, in lower lines of the Non-Olympic group

spite of their fluctuations (Fig. 3). LA_{max} fluctuated relatively stationary to July in the Olympic group in contrast to LA_{max} of the Non-Olympic group which reached its top values in March (Fig. 4). Then, it decreased to the lowest values in July. Blood pH_{min} decreased to July in the Non-Olympic group in contrast to more stable LA_{max} fluctuations in the Olympic group (Fig. 4). Differently, the decrease of pH_{min} in March accompanied LA_{max} increase in the Non-Olympic group (Fig. 4). When data from test EIGHT was analysed for the pre– competition and competition periods then the decrease of t_8 from November to January and after April were present in both groups (Fig. 5). This was expected for the Olympic but not for the Non-Olympic group. HR_8 did not accompany t_8 changes (Fig. 6). Differences observed between the groups became negligible towards the end of the competitive period. LA_8 accompanied t_8 changes in the Olympic group and showed bi–cyclic periodisation (Fig. 5). The time course in the Non-Olympic group showed non–characteristic, but visible monocyclic periodisation (Fig. 5). Both types of periodisation were expected. The pH_8 changes showed non–typical monocyclic response periodisation in the Olympic group (Fig. 5). This was expected for the observed period. The decrease of pH_8 in August can be explained easily by LA_8 data, which showed the highest values (Fig. 5). Therefore, LA_8 and pH_8 showed very similar periodisation in the Olympic group. The periodisation of pH_8 in the Non-Olympic group may be also assessed as monocyclic periodisation, which was also expected (Fig. 5).

When cyclic characteristics were estimated from the interpolated time courses of the training response characteristics and compared with cyclic changes of training volume and intensity, then only pH_{min}, t_8 and LA_8 of the Olympic group fluctuated in a characteristic two–cycle manner according to expectations (Fig. 4 and Fig. 5) based on fluctuations of general training characteristics (Fig. 1). In contrast pH_8 response showed more cyclic fluctuations. In the Non-Olympic group the pH_{min}, LA_8 and pH_8 fluctuated in a monocyclic manner (Fig. 4 and Fig. 5) according to expectations also based on training characteristics (Fig. 1). In contrast, t_8 showed a characteristic bi–cyclic response (Fig. 5). The first training cycle was in period from November to April for both groups (Fig. 1). The second training cycle occurred from June to September in the Olympic group only (Fig. 1). In contrast, training response cycle of t_8 was similar in the Olympic and the Non-Olympic groups in spite of monocycle training characteristics in the Non-Olympic group. All other training response characteristics did not show characteristic cycles or cycles were not recognised.

DISCUSSION

The Slovene national kayak slalom wild-water team members were followed throughout the Olympic season in the current study. The aim was to ascertain whether the changes of training volume and intensity during the season (training periodisation) were somehow accompanied by changes in the selected characteristics of paddlers' basic endurance and basic speed endurance performance (training response periodisation). Additionally, we ascertained whether the selection to the Olympic team or not differentiates kayakers according to their basic endurance and basic speed endurance performance. Results showed that qualification in the Olym-

pic team has no base in differences of basic endurance and basic speed endurance performance of paddlers. Therefore, the selection principle, which uses competitive results as the criterion includes predominantly very specific paddlers' characteristics, mostly probably related to daily-variable characteristics and/or non-systematic factors (emotions), which usually caused mistakes (Vest, 1996).

The time course of general training characteristics: volume and intensity of basic endurance and basic speed endurance training showed a bi-cycle competition season for the group of paddlers, who qualified for the Olympic Games and a monocyclic competition season for those who did not. The first cycle in Olympic group included the preparatory period, pre-competitive period and competition period. The second included the second basic, second pre- competition and second competition periods. These were different from the Non-Olympic group, which consisted of only one preparatory, pre-competitive and one competitive period. It may be assumed that such training will influence selected characteristics similarly in both groups only in the first preparatory period. In contrast, training should influence differently on the two groups thereafter because of different periodisation. Results showed that training did not influence some of the most important characteristics (v_{LT}, v_{OBLA}, v_{max}, t_8, LA_8 and pH_8) logically. In spite of large volume of basic endurance training and strength training and practically no speed endurance training, the characteristics of basic endurance: v_{LT}, v_{OBLA} and v_{max} practically did not change at all. This was an unexpected phenomenon. In contrast, t_8 showed clear improvement of speed endurance performance in spite of the absence of speed endurance training. Our explanation is that possibly a positive influence of strength training may have such effect. Anyway, such adaptation still remains unexplained by the available data. The dramatic change in training during the pre-competition phase (tapering phase) did not change dramatically and simultaneously any of used characteristics in the March to May period. v_{LT}, v_{OBLA} and v_{max} in the Non-Olympic group and v_{max} in the Olympic group increased during this period in contrast to expectations. The only explanation is reduction of training volume of basic endurance training, and the increase of basic speed endurance training volume. The second cycle of decrease of t_8 and increase of LA_8 in the Olympic group may be explained by the second basic pre-competition and competition periods which included more frequent maximal effort in the period of preparations for the Olympic Games. However, it cannot be explained why the second cycle occurred in Non-Olympic group (t_8), where training did not change so dramatically.

In conclusion, the study showed an absence of a significant relationship between basic training characteristics and some of the selected characteristics of basic paddlers' performance. The discrepancy of expected relationship cannot be reasonably explained by the available data. However, it is assumed that training influence at such a high level of performance is relatively small because paddlers probably reached their highest limit of biological adaptation (Astrand, & Rodahl, 1986). They also trained practically the whole year with individually dependent large training volume and high intensity. Therefore, the interaction of many different training characteristics, which influenced performance simultaneously, has no simple influence on the paddlers' adaptation at the top level of the competition performance.

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