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INFLUENCE OF SELECTED FITNESS AND MENTAL FACTORS ON THE SPORT PERFORMANCE OF A COMPETITOR IN WHITE WATER SLALOM

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SUMMARY

Paper is focused on the observation of selected fitness and mental indicators of competitor's performance in white water slalom in the Czech Republic, and their influence on the final performance in race.

The observed sample consisted of 6 C1 competitors aged 18 to 31, members of the Czech national team. Selected performance indicators were: a) results in the test battery according to Bílý in runs for a different distance (Süss, Bílý and Bunc, 2008), b) results in the Wingate test on the arm ergometer and c) results from the CSAI-2 questionnaire measuring pre-start anxiety. The comparing criterion was the nomination rank for the Olympic race in Beijing 2008, which was determined by the results from 4 races.

Nonparametric correlation research with Spearman correlation coefficient was used to find statistic dependence between the sport performance and selected factors. Results show a close significant relationship between the terrain test and the somatic component of performance anxiety in comparison with the final competitor's performance in observed races. The dependence of the functional indicators values from the 30-s Wingate test and the cognitive component of competition anxiety on the final competitor's performance were not fully proved. However, high values of correlation coefficient ($r_s = 0.638$) between the values of cognitive anxiety, 30-s Wingate test and competitor's results in a race indicate that there may exist a dependence.

Key words: White water slalom, terrain tests, Wingate test, competition anxiety, sport performance

INTRODUCTION

Sport performance in white water slalom is influenced by many factors, which more or less influence the final result. The performance is determined by specific requirements for the energy supply of muscle work, specific requirements for the individual adjustment of

general paddling technique on the basis of biomechanical principles (requirements for individual technique) and finally specific requirements for the competitor's psychic state (psychic requirements). How to influence these requirements and prepare the competitor for the performance is sought during the training. It is necessary to pay attention to all factors which influence the final competitor's performance. According to Dovalil (2002) the sport performance is influenced by five groups of factors. Somatic, tactic and technical factors of competitor's performance were not the subject of this study; therefore we will not mention them any more, even though these are also important factors like the discussed fitness and mental factors.

Fitness factors

From the fitness and physiological point of view white water canoeing is a physical activity in which competitors have to excel in strength, speed, endurance and skills. Strength presumptions are necessary for realizing motor skills, their development is necessary for growth and keeping top performance. According to experts (Bílý, 2002) strength abilities create in the performance structure of a white water competitor approximately 20%. Due to different strength requirements for a stroke, these values are different for each category. According to strain gage treatment of strength on the paddle the highest values are at C2 canoeist (Bílý, 2002).

Performance in white water slalom is possible to characterize by a high development of cardio-respiration system (Havlíčková, 1999), high ability to transfer and use oxygen. The dominant zone of energy supply of muscle work in white water performance is anaerobic metabolism (Bílý, Heller, Vodička and Süß, 2006). Differences between the elite competitors are minimal; therefore it is necessary to devote attention to all factors which influence the final competitor's performance.

Mental factors

Very important mental factors in white water canoeing are sensomotor abilities, fast motor reactions, prompt situation solving, specific courage with the high willingness to risk, high tolerance to emotional stress and ability to concentrate maximally for a short time sequence with a distinct feeling for the distance judgement (Bílý, 2002).

Character of white water slalom requires a continuous improvement while using outer and inner imagination. During the sport training it uses a typical auto-didactic strategy (Macintyre, 1999). Valoušek (1974) found out that competitors reached in all examinations higher level of abilities in fast decision-making, direction of motor activity and adaptation to new stimuli. They were better in judging short time intervals. The positive relationship between maturity and kinaesthetic sensitiveness was proved – higher physical age has in slalom positive relationship to sport mastery.

It is shown that for performing the top performance in white water slalom the significant type of personality is phlegmatic with low scores in neurotism and restricting anxiety (Bílý, Süß, 2007).

White water slalom belongs between risk sport disciplines. Risk is the demanding water terrain for the competitor. The issue of fast decision-making is often the essential

moment of sport performance. The fast and right decision-making does not have to be of course associated with risk, which is brought by the water terrain. The competitor is all the time forced to choose out of many possible gate combinations on the course, which are optimal regarding to his/her abilities and skills.

Competition anxiety

Anxiety in sport is a serious psychological problem because it is an unclear anticipation of danger, which we are not able to describe and determine and it is accompanied by functional changes in organism. Negative changes invoked by competition anxiety belong among the most serious manifestations. Those are changes of thinking (cognitive), psychomotor uneasiness, shaking, feelings of helplessness, stereotype in acting, narrower consciousness, disorders in evaluating an actual situation, schism in motives and somatic changes, overall muscle inertia, decrease of performance due to higher production of lactate or interference when using oxygen and sugar in muscle metabolism, gastrointestinal changes and others (Slepička, Hošek and Hátlová, 2006).

Cognitive anxiety closely relates to changes of self-confidence, which means expecting success or failure. There is a linear dependence between self-confidence and performance (Tomešová, 2006).

Modern sport, at least its performance and elite form, is characterized by intensive pressure on participants and expects high performance. This pressure significantly influences individual components of competition anxiety, mainly then the cognitive anxiety and self-confidence. Jones (1995) talks about “sport experiment”, subjects are elite athletes; their skill level is strictly controlled, so there are only slight differences in fitness preconditions. Therefore, the factor which distinguishes the winner from the loser is naturally psychologically specific. It is the ability to deal with the competition stress. Many seem to deal with these circumstances very well, some even flourish. However, for some people it can be rather traumatic experience characterized by anxiety and performance decrease. The competition anxiety is now understood as a multi-dimensional state and feature (Jones, 1995) containing cognitive and somatic components.

Results by Jones (1995) were used in our research. All tested persons were under the stress of the same competition, nomination races for getting into national teams, when we have supposed that mental stress of competitors reaches border values.

Research aim

The aim of the study was to find out how the selected fitness and mental factors influence the final competitor’s performance in white water slalom. We have estimated fitness indicators of competitors in white water slalom out of the test battery in runs for a different distance (Suss, Bílý and Bunc, 2008) and laboratory 30-s Wingate test on the arm ergometer. From the mental indicators we have observed the values of competition anxiety according to the CSAI–2 questionnaire. Values of selected indicators were compared to competitor’s results in nomination races into Czech national teams.

Working hypotheses

- H1 The competitor reaching the highest values of selected fitness indicators in the 30-s Wingate test on the arm ergometer will reach the highest rank in selected competitions,
- H2 The competitor reaching the best times in the terrain test will reach the best placement in the observed competitions.
- H3 The competitor with the lower values of the cognitive and somatic component of performance anxiety and higher values of self-confidence changes will reach the best placement in the observed competitions.

METHODOLOGY

It is a case study of an explorative character, in which the research has an association character. We have observed the relationship between variables. The dependent variable were the competition results in nomination races, the independent variables were the selected functional indicators reached in the 30-s Wingate test in the laboratory of the Faculty of Physical Education and Sport, results reached in the terrain test battery and results from the CSAI-2 questionnaire for observing performance anxiety.

Research sample

The research sample consisted of 6 canoeists in the age range 18 to 31 years, members of Czech national teams. It was a very elite sample of canoeists, medal owners from The World Championship, Europe Championship, Junior World Championship and Olympic Games participants. The age difference of individual competitors indicates the competitor's development in certain age periods. The sample characteristics are shown in table 1.

Table 1. Characteristics of the observed sample

Competitor	age	Characteristics
1.	31	Member of Czech national team, 3 rd place World Championship 2006
2.	31	Member of Czech national team, 5 th place Olympic Games 2000
3.	23	Member of Czech national team up to 23
4.	21	Member of Czech national team up to 23, 2 nd place European Championship up to 23, 2007
5.	20	Member of Czech national team up to 23
6.	18	Member of Czech junior national team

Data collection methods

To state the maximal amount of ATP created by anaerobic processes we have used the Wingate test on the arm ergometer with the load 4 W per a kilogram of body weight in men and 3.3 W in women. We have used the arm ergometer developed in the biomedicine

laboratory of the Faculty of Physical Education and Sport, the type Rump-Rokos 4.00/. C01 during braking resistance 3 (W/kg) in women and 4.0 (W/kg) in men, which corresponds the Wingate type developed by Ayalon, Inbar and Bar – Or from the Physical education institute Wingate in Israel in 1974 (Heller, 1999).

To test the psychical factors we have used the questionnaire data collection method – the structured questionnaire CSAI-2 (The Competitive State Anxiety Inventory – 2) for testing the performance anxiety (Martens, Vealey and Burton, 1990). Gained data from the CSAI-2 questionnaire for testing performance anxiety were evaluated according to norms. We have used “Norms for male elite athletes” written in “Competitive anxiety in sport” (Martens, Vealey and Burton, 1990). At individual components of performance anxiety we have observed the dependence on the final competitor’s performance.

For testing the fitness factors in terrain we have used the adjusted test battery according to Bílý (Süss, Bílý and Bunc, 2008). The competitors paddled through three distances – 40, 80 and 200 metres on flat water in maximal speed.

Data analysis methods

Basic analysis was realized through descriptive statistics (average and standard deviation – SD). To fulfil the study’s aim, which was finding the dependence between selected fitness and psychical parameters and the results in nomination races, we have used non-parametric correlation – Spearman correlation coefficient with regard to the small number of data.

Correlation research is characterized by the fact that independent variables are observed in timing advance. In time t_1 there are known inputs and unknown outputs (Blahuš, 1996).

RESULTS

Results of dependent variables – competitors’ results in nomination races are stated in table 2. The nomination order is determined on the basis of three best placements out of four passed races, which were organised in two following weekends.

Table 2. Competition results

Tested person	1 st competition	2 nd competition	3 rd competition	4 th competition	Rank in nomination
1.	2	2	1	1	1
2.	1	1	4	3	2
3.	4	3	2	7	3
4.	7	6	7	11	4
5.	6	15	9	6	5
6.	11	9	11	10	6

Results show a relatively well-balanced placing in first two tested persons, the other competitors reached different placing in the observed races.

Furthermore, all persons were tested on the mechanical arm ergometer (Wingate 30-s) with the load 4 W/kg and in the terrain test in runs for different distances. Table 3 shows the summarizing results of the complete test (Pmax – maximal performance, AnC – anaerobic capacity, UI – fatigue index, Pv – performance decrease, Po – number of turns, TF – heart rate). For comparing with the competition performance we have used maximal performance (Max) and anaerobic capacity (AnC).

Table 3. Wingate 30-s

Tested person	age	weight (kg)	Pmax (W/kg)	AnC (J/kg)	IU (%)	PO	Pv (W)	TF	Rank
1.	31	67	10.2	226	47.7	56	327.3	173	4
2.	31	78.8	10.5	255.1	39.9	63.2	330.6	147	3
3.	23	71.5	11.6	259.5	49.6	64.2	411	177	1
4.	21	74.4	10.1	229.4	46.7	56.9	351.5	156	5
5.	20	61.3	10.7	256.6	36.1	63.4	235.9	211	2
6.	18	82	9.1	224.8	38.5	55.8	286.9	177	6
average	24	75.5	10.4	241.9	43.1	59.9	323.7	173.5	
SD	13	20.7	2.5	34.7	13.5	8.4	175.1	64	

In the terrain test we have measured three different distances passed in the maximal speed on flat water – 40m, 80m a 200m (Süss, Bílý and Bunc, 2008). 40 metres was passed twice, the better time was counted. The results are stated in table 4.

Table 4. Results in the terrain test – runs for a different distance

Tested person	40 m		80 m		200 m	
	t (s)	rank	t (s)	rank	t (s)	rank
1.	12.99	4	26.83	1	69.37	2
2.	12.57	1	27.92	2	69.15	1
3.	12.85	3	28.13	4	69.99	3
4.	12.71	2	28.08	3	70.05	4
5.	13.25	5	28.24	5	71.34	5
6.	14.04	6	28.8	6	73.92	6

The further observed parameter was the competition anxiety. Table 5 shows the summarizing results.

Table 5. Test results of mental parameters in CSAI-2

Tested person	CSAI-2			CSAI-2			CSAI-2		
	Rough scores			Standard scores			percentiles		
	Cog.	Som.	Self.	Cog.	Som.	Self.	Cog.	Som.	Self.
1.	9	11	23	285	386	433	0	10	25
2.	17	16	16	452	494	287	33	55	3
3.	12	16	24	348	494	454	5	55	33
4.	12	19	29	348	558	558	5	70	70
5.	14	18	20	390	537	371	12	67	8
6.	24	21	14	598	601	246	82	80	2
average	14.7	16.8	21	403.5	511.7	391.5	22.8	56.2	23.5
SD	5.28	3.4	5.5	110.06	73.74	104.77	31.24	22.4	23.73

Results in the correlation analysis are shown in table 6 and 7. Table 6 describes correlation matrices of fitness tests and nomination rank and table 7 brings results of the Spearman correlation coefficient of nomination rank and CASI-2 questionnaire results.

Table 6. Correlation matrices of fitness tests and nomination rank

	Rank in nomination	200	80	40	Wingate
Rank in nomination	1	0.943	0.943	0.6	0.314
200		1	0.886	0.771	0.371
80			1	0.657	0.086
40				1	0.257
Wingate					1

Table 7. Correlation coefficient of rank nomination and CASI-2 questionnaire results

	Anxiety components		
Rank in nomination	Cognitive	Somatic	Self-confidence
	0.638	0.928	0.314

DISCUSSION

30-s Wingate test

Our assumption that the competitor reaching the highest values in selected fitness indicators on the arm ergometer in 30-s Wingate test will reach the best placing in the observed races was not proved. This statement does not correspond with the study results dealing with a similar problem. Borkovcová (2006) states that the best flat-water kayakers

reached even the highest values in the 30-s Wingate test on the arm ergometer. Bílý, Heller, Vodička and Süß (2006) states that the best observed competitors – members of Czech national teams in white water slalom (categories K1 men and K1 women) reached the highest values in selected fitness indicators in Wingate test.

When comparing these results it is possible to assume that the test on the arm ergometer is a suitable predictor of competition performance in kayaking (both flat and white water). The same relationship was not proved for performance prediction in canoeing. The explanation can be the “biomechanical similarity” of movement on the arm ergometer with paddling on kayak – symmetrical loading in cyclic movement for both hands, in comparison to non-symmetric arm movement when paddling on a canoe.

Terrain test

Results in test battery showed a very close correlation dependence between the measured test values in 200 meters and 80 metres distances and performance in competitions ($r_s = 0.943$ and p -value 0.005). Linear dependence between performance and 40 meter test was not proved ($r_s = 0.600$, $p = 0.208$). Nevertheless, the high value of correlation coefficient indicates a certain relationship. It appeared that in our case these specific abilities are fully essential for the performance of a white water competitor of a high quality. This statement supports our former results in this test (Süß, Bílý and Bunc, 2008).

Competition anxiety

When comparing with the questionnaire CSAI-2 norms for common population to find out the competition anxiety (Martens et al., 1990), stated in the table 8, the average value of the observed competitors in the cognitive component is lower about 4.6 points and the average value of self-confidence is lower about 5.2 points. The average of the somatic anxiety value gets near the norm average.

Table 8. CSAI-2 questionnaire norms expressed in rough scores (Martens et al. 1990)

	Parameter	Average	SD
CSAI – 2	cognitive	19.29	4.80
	somatic	16.29	4.65
	self-confidence	26.21	4.81

In the study we have focussed on the relationship between individual components of competition anxiety and performance in the observed competition. As the testing was realized during the 3rd nomination competition, we have observed the relationship straight in the race and also in the final rank of nomination races. The values of Spearman correlation coefficient $r_s = 0.638$, p -value 0.173 (respectively $r_s = 0.314$, $p = 0.544$) did not proved in both cases high correlation dependence of values in the *cognitive* component of competition anxiety and the result in of the observed competitors in race. Nevertheless, a rather high value of correlation coefficient (0.638) indicates that certain dependence

could exist. Similarly, static dependence was not proved ($r_s = 0.314$, $p = 0.544$) between the component *self-confidence changes* and competition performance.

On the other hand, a strong static dependence in both relationships 0.928 , $p = 0.008$ and $r_s = 0.899$, $p = 0.015$ was proved in the somatic component. We have reached the same results as Marek (Marek, 2006), who proved a strong dependence of the men performance in flat-water canoeing – 1000 m on this component. The study of men and women kayakers in white water slalom (Bílý, Kubričan and Süß, 2009) does not prove this dependence.

It is very probable that it is caused by a different time, when the questionnaire was submitted competitors to fill in. In comparison to the mentioned study (Bílý, Kubričan and Süß, 2009), when the competitors filled in the questionnaire in the evening before the competition due to organisation circumstances, we have asked the competitors to fill in the questionnaire between the first and second run on one of the hardest slalom courses in Europe.

CONCLUSION

The aim of the study was to find out what influence selected psychical and fitness factors of sport performance have on the final competitor's performance in white water slalom – C1 men.

We have found out a close linear relationship between terrain tests and the final competitor's performance in observed races. On the basis of this statement we can recommend this test into practice as a suitable indicator of the specific fitness of a C1 competitor.

We have found a close linear relationship between the somatic component of performance anxiety and the final competitor's performance in the observed races.

The linear dependence between the values of functional indicators from the 30-s Wingate test and performance in the observed races was not proved.

At the same time the dependence between the values of cognitive component of performance anxiety on the final competitor's performance was not proved. However, high values of correlation coefficient ($r_s = 0.638$) between values of cognitive anxiety, respectively 30-s Wingate test correlation coefficient and competitor's results in a race indicate that there might exist a special dependence.

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VLIV VYBRANÝCH KONDIČNÍCH A PSYCHICKÝCH FAKTORŮ NA SPORTOVNÍ VÝKON ZÁVODNÍKA VE VODNÍM SLALOMU

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SOUHRN

Příspěvek je zaměřen na porovnání vybraných kondičních a psychických indikátorů výkonu závodníků ve vodním slalomu v ČR a zjistit jejich vliv na výsledný výkon v závodě. Sledovaný soubor tvořilo 6 závodníků kategorie kanoje jednotlivců ve věkovém rozpětí 18 až 31 let, členů reprezentačních družstev ČR. Vybrané indikátory výkonu tvořili a) výsledky v testové baterii dle Bílého v jízdě na různou vzdálenost (Süss, Bílý a Bunc, 2008), b) výsledky Wingate testu na ručním klikovém ergometru a c) výsledky vyšetření předstartovní úzkosti pomocí dotazníku CSAI-2. Srovnávací kritérium tvořilo pořadí nominace na olympijský závod v Pekingu pro rok 2008, které bylo určeno z výsledků 4 závodů.

Pro zjištění statistické závislosti mezi sportovním výkonem a vybranými faktory sportovního výkonu byl použit neparametrický korelační výzkum pomocí Spearmanova korelačního koeficientu. Výsledky ukazují na těsný signifikantní vztah mezi terénním testem a somatickou složkou závodní úzkosti v porovnání s výsledným výkonem závodníka ve sledovaných závodech. Vliv mezi hodnotami funkčních ukazatelů z 30-s Wingate testu a kognitivní složky závodní úzkosti na výsledný výkon závodníka se nepodařilo plně prokázat. Ovšem vysoké hodnoty korelačního koeficientu ($r_s = 0,638$) mezi hodnotami kognitivní úzkosti, resp. 30-s Wingate testu a výsledky závodníka v závodě naznačují, že zde pravděpodobně nějaká závislost může existovat.

Klíčová slova: Vodní slalom, terénní testy, Wingate test, závodní úzkost, sportovní výkon

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