THE FOLLOW-UP OF THE DEVELOPMENT OF A COMPETITIVE AND POTENTIALLY SUCCESSFUL PERFORMANCE OF A TOP SPORTSMAN WITH THE AID OF THE "SPORT-EXPERT" SYSTEM

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Original scientific paper
UDC: 796.925:004.1:796.071.24
Received: January 21, 1998
Accepted: April 7, 1998

Abstract:

The aim of this study was to follow a five-year competitive and hypothetically potentially successful performance of a top ski-jumper with the help of the expert decisive "sport-expert" system.

In the primary phase of the formation of the expert system a hypothetical model of a competitive (CP) and the so-called reduced potentially (PP) successful performance was developed. The model of a potentially successful performance comprised 17 elementary and 14 derived motor variables, 4 elementary and 3 derived morphological variables and two variables containing special morphological-motor indices.

The evaluation of a successful performance based on the previously defined variables was founded on the method of expert decision-making (Chankong, Haimes, 1983). This method is based on decision rules with the help of which we determine the significance of an individual successful performance variable, as well as on the normalisers with which we determine the position of an individual of a defined successful performance variable in the individual quality-defined category.

The successful performance of the sportsman was then calculated with the "SPEX" computer program on all models of variables, starting from the most elementary and up to the finally derived hypothetically potential successful performance.The results showed an uninterrupted continuous quality development of a hypothetically potential successful performance (PP) of the young sportsman, who, even at the age of 13, showed a highly successful competitive performance, which in the following 5 years rose to the level where he won the first place in the total count of the ski-jumping World Cup for the 1996/97 season.

Key words: sport training, successful performance follow-up, the "Sport-expert" expert system

Zusammenfassung:

DIE BEWERTUNG DER ENTWICKLUNG POTENTIELLER UND WETTKAMPFLEISTUNG DER SPITZENSPORTLER MITTELS DES "SPORT-EXPERT" SYSTEMS

Das Ziel dieser Untersuchung war, die konkrete Wettkampfleistung, sowie die hypothetische potentielle Leistung eines Spitzenschispringers mittels des Expertentscheidungssystems "Sport-Expert" zu bewerten.

In der ersten Phase der Expertsystemgestaltung wurde ein hypothetisches Modell der Wettkampfleistung (CP), sowie der sogennanten reduzierten potentiellen Leistung (PP) entwickelt. Das Modell der potentiellen Leistung umfasste 17 Haupt- und 14 abgeleiteten motorischen Variablen, sowie 4 Haupt- und 3 abgeleiteten morphologischen Variablen und zwei Variablen mit speziellen morphologisch-motorischen Indexen.

Die Leistungsbewertung aufgrund definierter Variablen beruht auf der Methode der Expertentscheidung (Chankong und Haimes, 1983), d.h. auf den Entscheidungsregeln, mit denen die Signifikanz einzelner Leistungsvariablen festgestellt wird, sowie auf den Normalisierungsmitteln, die den Rang einzelner definierter Leistungsvariablen innerhalb der spezifischen Qualitätskategorie determinieren.

Danach wird, mittels des Computerprogrammes "SPEX", die Leistung des Sportlers nach allen Variablen gerechnet, von den Hauptvariablen aus bis zur abgeleiteten potentiellen Leistung.

Die Ergebnisse zeigen eine ununterbrochene konstante Entwicklung in der Qualität der hypothetischen potentiellen Leistung des jungen Sportlers, der schon im Alter von 13 Jahren eine große, in den folgenden 5 Jahren immer größere Wettkampfleistung zeigte, bis er im Saison 1996/97 die meisten Punkte und damit den ersten Platz im Schispringerweltcup gewonnen hat.

Schlüsselwörter: Sporttraining, Schispringer, Leistung, Expertsystem "Sport Expert"

Introduction

In the theory of sport training, the possibility of objective diagnostics and the follow-up of a competitive and potentially successful performance presents one of the fundamental expert and scientific problems (Milanović et al., 1996). The difference between a competitive and potentially successful performance is manifested only by the time dimension of observing a successful performance. A competitive success presents

an already realised success of a sportsman in individual competitions, while a potentially successful performance shows the potential competitive ability for success in competitions that are yet to be realised in the near or far future. In analysing successful performance it is significant to derive from all those major factors of a successful performance (Martin et al., 1993) which we feel play an important role in determining the success of sportsmen.

The successful model represents numerous factors of a successful performance that are simply ranked into the equation of successful performance specifications. Using this equation (Mallach, 1994), the result of a sportsman presents the hypothetical linear sum of ponderable factors of successfulness at a given moment. Among these factors we include morphological, motor, physiologic, health, technical, tactical, cognitive, conative, motivational, value, social, micro-social, personality-psycho-social, material, financial, leading, and various other successful performance factors. The basic hypothetical assumption of successful performance is the achievement, at a certain moment, of the highest possible quality level of these factors, as well as such a super-compensational value of their structural connection which will ensure the highest level of sport condition at a given instant in the competition. Following this very extensive complex of successful performance factors still presents a major contextual and methodological problem, since the successful performance model, as a reflection of an extremely complex dynamic system, demands, according to Kljajić (1994), a sound knowledge of the variables of the model, the momentary state of these variables, the desired space of the state of variables, and the functions of state transitions. Recently, the knowledge base in the field of the successful performance theory modelling has been growing rapidly, perfecting the computer program tools in the frame of a uniform expert system - the "Sport-expert". This will, in the near future, enable a basic qualitative perfection of the follow-up of a sportsman's successful performances.

The intent and goal of the present study has been to show the course of a development of the selected morphological and motor parameters of the most successful Slovenian ski jumper, the winner of the World Cup in ski jumping for the 1996/97 season.

The potential performance (PP) and the competition performance (CP) of the competitor was monitored from his 13th up to

Table 1: The competition performance mark for the individual competition season

COMPETITIONS	RANKING MARKS				
	EXCELLENT (5)	VERY GOOD (4)	GOOD (3)	SATISFACTORY (2)	UNSATISFACTORY (1)
SENIOR					
OG, WCe, WCH	1 - 3	4 - 6	7 - 25	26 - 50	51 and over
WCi	1	2 - 3	4 - 15	16 -35	36 and over
ICe		1 - 3	4 - 10	11 - 25	26 and over
ICi		1	2 - 6	7 - 25	26 and over
NCH, SCe			1 - 3	4 - 6	7 and over
Sci			1	2 - 6	7 and over
JUNIOR					
JWCH	1 - 3	4 - 6	7 - 25	26 - 50	51 and over
APe		1 - 3	4 - 10	11 - 25	26 and over
APi		1	2 - 6	7 - 25	26 and over
JNCH, JSCe			1 - 3	4 - 6	7 and over
JCCi			1	2 - 6	7 and over
CHILDREN					
GA-PA	1 - 3	4 - 6	7 - 25	26 - 50	51 and over
OPA		1	2 - 6	7 - 25	26 and over
CHNCH,CHSCe			1 - 3	4 - 6	7 and over
CHSCi			1	2 - 6	7 and over

(OG - Olympic Games, WCe - World Cup end general position, WCH - World Championships WCi - World Cup individual competition, ICe - Intercontinental Cup end position, ICi - Intercontinental Cup individual competition, JWCH - Junior Word Championships, NCH - National Championships, APe - Junior Alpine cup end position, APi - Junior Alpine Cup individual competition, SCe - Slovenian Cup end position, SCi - Slovenian Cup individual competition, OPA - Children OPA game, GA-PA - Children Grand Prix CUP).

his 18th year of age, i.e. from the 1991/92 up to the 1996/97 competition season.

The potential performance of the competitor was evaluated by means of a reduced performance model for ski jumpers, which has been developed within the scope of the theory of successful performance and the system of preparation of athletes according to the principle of correlation and subordination.

The competition performance was evaluated on the basis of the achievements of the competitor in the individual season and on the basis of the specially developed criteria (Table 1) for quality evaluation of the competition results.

Method

The basic method adopted for the evaluation and monitoring of the athlete's development was the expert system "Sport-Expert", developed for the requirements of monitoring the state of preparedness of athletes (Jošt, 1992). The computer application of the SPEX program was elaborated by B. Leskošek in 1994.

The basic structure of the SPEX expert system for the assessment of performance of athletes (Jošt, B., Leskošek, B., Ulaga, M., 1995) can be seen in linear representations No. 1 and No.2. Within the scope of this method:

1) We defined the elementary and the derived variables (the so-called elementary and aggregated decision criteria) and thus constructed the so-called decision tree of the reduced performance model. Within the scope of this decision tree we defined (see linear representation No.1):

- 17 elementary and 14 derived motor variables;
- 4 elementary and 3 derived morphological variables;
- 2 elementary special morphological motor index variables and 1 derived variable of the special morphological and motor status.

2) By means of the method of expert decision-making (Chankong, Haimes, 1983) we established the heuristic rules of conclusion-drawing and decision-making. In the first stage, the decision rules were applied to determine the weights by means of which the significance of each model variable was separately determined. In the second stage, the limits for the quality evaluation of the results obtained within the cluster elementary variables were determined by means of normalisers. Thus, all the raw results were classified into five quality categories (unsatisfactory /0.0 - 2.0/, satisfactory /2.1 - 2.9/, good /3.0 - 3.4/, very good /3.5 - 3.9/, and excellent /4.0 and more/).

3) By means of the computer program we calculated the results on the derived variables of the performance model (i.e. the aggregated criteria of the decision tree). The results on the aggregated variables were simply calculated in such a way that the so-called weighted sum was calculated within the node of the respective derived variable by adding up the factors of weights and the mark attained on the sub-derived criterion. On the basis of these model variables, the competitor's potential performance (PP) was then assessed.

The competition performance (CP) was assessed on the basis of the competitor's ranking in major competitions in the respective competition season and according to the criteria shown in Table 1.

Results

The results (graphic representation No. 1) of the absolute monitoring of the status of the selected morphological and motor dimensions, based on absolute category normalisers, have shown an extraordinary increase in potential performance (PP) of the young ski jumper up to the last competition season, when he became the winner of the World Cup. The mentioned positive trend still continues, a fact which allows us to conclude that the final competition performance of the young ski jumper - assuming the improvement in technical, tactical, psychological and theoretical quality - can still improve.

The evaluation of competition performance (CP) has shown that the best ski jumper in the world has been excellent since his childhood. In no competition season was the mark of his competition performance less than excellent (4). Basically, the ski jumper concerned here has an extraordinary talent for competition, so that by suitable development of his primary

Linear representation No. 1: Structure of the decision tree (DT) of the elementary and derived variables, weights (W), raw results of measurements (R), marks of the expert system on the individual variables (U) and descriptive mark (C).

(DT)	(W)	(R)	(U)	(C)
COMPET. PERF. (CP)	100.0	1.place	5.0	excell.
PUSPEH (PP)	100.0		3.2	good
+-OSMORMOTST	69.6		3.1	good
¦ +-MOTORIKA	47.7		2.7	satisf.
¦ ¦ +-ENKOGI	23.6		2.8	satisf.
¦ ¦ ¦ +-TRAEKS	5.0		4.0	excell.
¦ ¦ ¦ ¦ +-REP MOC	5.0		4.0	excell.
¦ ¦ ¦ ¦ +-MMRNPK3	3.4	119	4.7	excell.
¦ ¦ ¦ ¦ +-MMRTDT45	1.5	15	2.5	satisf.
¦ ¦ ¦ +-INTEKS	18.7		2.5	satisf.
¦ ¦ ¦ +-HIT MOC	9.9		2.7	satisf.
¦ ¦ ¦ ¦ +-MMENSDM	2.9	277	2.2	satisf.
¦ ¦ ¦ ¦ +-SMABAV0	7.0	53	3.0	satisf.
¦ ¦ ¦ +-EKS MOC	4.8		2.4	satisf.
¦ ¦ ¦ ¦ +-EKSPL0	1.0	85	3.0	satisf.
¦ ¦ ¦ ¦ +-EKSPLO1	3.8	7.26	2.3	satisf.
¦ ¦ ¦ +-ELAST MOC	4.0		2.1	satisf.
¦ ¦ ¦ +-MMEN3SM	4.0	8.84	2.1	satisf.
¦ ¦ +-INKOGI	24.0		2.6	satisf.
¦ ¦ +-REGSIN	9.1		2.3	satisf.
¦ ¦ ¦ +-RAVNOTEZ	4.0		1.2	unsatisf.
¦ ¦ ¦ ¦ +-MRSAGIT	2.7	14.2	1.5	unsatisf.
¦ ¦ ¦ ¦ +-MRFRONT	1.2	4.7	0.4	unsatisf.
¦ ¦ ¦ +-HITROST	1.2		2.9	satisf.
¦ ¦ ¦ ¦ +-MHFNTD	0.6	34	3.2	good
¦ ¦ ¦ ¦ +-MHFNTL	0.6	31	2.6	satisf.
¦ ¦ ¦ +-GIBLJIVOST	4.0		3.2	good
¦ ¦ ¦ +-MGGTPK	0.0	68	3.8	v. good
¦ ¦ ¦ +-MGGTPKR	3.1	277	3.6	v. good
¦ ¦ ¦ +-MGGOLS	0.8	48	1.7	unsatisf.
¦ ¦ +-KOORDIN	14.9		2.7	satisf.
¦ ¦ +-MFE10P	7.5	58	2.4	satisf.
¦ ¦ +-MKKROSP	2.9	16.3	1.4	unsatisf.
¦ ¦ +-MKPOLN	4.5	6.0	4.1	excell.
¦ +-MORFO	21.9		4.1	excell.
¦ +-BAZDIM	10.8		4.6	excell.
¦ ¦ +-AT	5.4	60.8	4.8	excell.
¦ ¦ +-AV	5.4	178.8	4.4	excell.
¦ +-MORF IND	11.2		3.6	v. good
¦ +-INDPLOV	7.1	1013	3.8	v. good
¦ +-INDODSK	4.1	191	3.1	good
+-SPMORMOTST	30.4		3.4	good
+-MMISSK	12.2	1374	3.6	v. good
+-SMISSKA	18.3	260	3.3	good

Legend: CP - competition performance , PUSPEH (PP)- expected success in ski-jumps, OSMORMOTST - basic morphological-motor status, MOTORIKA - motor status, ENKOGI - energetic component of motion, TRAEKS - duration of excitation of the neuro-muscular system, REP_MOC - repetitive power, MMRNPK3 - jump over the Swedish bench, MMRTDT60 - abdominal crunches, INTEKS - regulation of excitation intensity, HIT MOC - speed power, MMENSDM - long jump from a standstill, SMABAVO - vertical jump = the abalac test, EKS MOC - explosive power, EKSPLO - high jump explosiveness, EKSPLO1 - elastic power, MMEN3SM - triple jump from a standstill, INKOGI - information component of motion (movement), REGSIG - regulation of synergists and antagonists, RAVNOTEZ - balance, MRFRONT - balance in sagittal plane, MRSAGIT - balance in frontal plane, HITROST - speed, MHFNTD - tapping with the right foot, MHFNTL - tapping with the left food, GIBLJIVOST - flexibility, MGGTPK - forward bend, MGGTPKR - forward bend - relative, MGGOLS - angle (shank-base) of the ankle, KOORDIN - structuring of motion coordination, MFE10P - hurdle - jumping, MKKROSP - "figure-of-eight" with bending, MKPOLN - polygon backwards, MORFO - morphological status, BAZ DIM - basic dimensions, AT - body weight, AV - body height, MORF IND - morphological index, INDPLOV - aerodynamic index, INDODSK - special take-off index, SPMORMOTST - special morphological - motor index , MMISSK - basic morphological index and SMISSKA - special morphological - motori index.

Linear representation No. 2: Results of the five-year monitoring of competition (CP) and potential performance (PP) with all submodel dimensions of the winner of the world cup in ski jumping for the 1996/97 season.

COMPETITION SEASON:	1991/92		1992/93		1993/94		1994/95		1995/96		1996/97	
DATE OF MEASUREMENTS:	30.10.91		10.11.92		25.10.93		28.10.94		21.10.95		21.10.96	
		(R) (U)	(R)	(U)	(R)	(U)	(R)	(U)	(R)	(U)	(R)	(U)
COMPETITION PERFORMANCE (CP)		4.0		4.0		4.0		4.0		5.0		5.0
PUSPEH (PP)		2.0		2.1		2.3		2.6		3.0		3.2
+-OSMORMOTST		1.7		1.7		2.1		2.5		2.9		3.1
¦ +-MOTORIKA		1.7		1.7		2.2		1.9		2.4		2.7
¦ ¦ +-ENKOGI		1.5		1.9		2.2		2.3		2.5		2.8
¦ ¦ ¦ +-TRAEKS		1.9		3.2		3.7		4.0		3.6		4.0
¦ ¦ ¦ ¦ +-REP_MOC		1.9		3.2		3.7		4.0		3.6		4.0
¦ ¦ ¦ ¦ +-MMRNPK3	86	1.9	102	3.2	108	3.8	114	4.3	116	4.4	119	4.7
¦ ¦ ¦ ¦ +-MMRTDT45	--	--	--	--	18	3.5	18	3.5	12	1.7	15	2.5
¦ ¦ ¦ +-INTEKS		1.4		1.6		1.7		1.9		2.2		2.5
¦ ¦ ¦ +-HIT_MOC		1.4		1.6		1.8		1.8		2.2		2.7
¦ ¦ ¦ ¦ +-MMENSDM	208	1.5	219	1.6	223	1.6	246	1.8	263	1.9	277	2.2
¦ ¦ ¦ ¦ +-SMABAV0	32	1.4	37	1.6	44	1.9	44	1.9	49	2.3	53	3.0
¦ ¦ ¦ +-EKS_MOC		--		--		--		2.1		2.4		2.4
¦ ¦ ¦ ¦ +-EKSPL0	--	--	--	--	--	--	82	2.7	83	2.8	85	3.0
¦ ¦ ¦ ¦ +-EKSPLO1	--	--	--	--	--	--	6.78	1.9	7.27	2.3	7.26	2.3
¦ ¦ ¦ +-ELAST_MOC		1.5		1.5		1.6		1.8		1.9		2.1
¦ ¦ ¦ +-MMEN3SM	6.58	1.5	6.80	1.5	7.22	1.6	7.72	1.8	8.48	1.9	8.84	2.1
¦ ¦ +-INKOGI		1.9		1.4		2.2		1.5		2.3		2.6
¦ ¦ +-REGSIN		3.0		1.9		2.3		2.2		2.3		2.3
¦ ¦ ¦ +-RAVNOTEZ		--		0.4		0.8		1.0		1.1		1.2
¦ ¦ ¦ ¦ +-MRSAGIT	--	--	3.7	0.4	5.8	0.6	5.3	0.6	13.0	1.4	14.2	1.5
¦ ¦ ¦ ¦ +-MRFRONT	--	--	4.0	0.3	13.1	1.1	22.4	1.9	5.6	0.5	4.7	0.4
¦ ¦ ¦ +-HITROST		--		--		2.2		2.2		2.4		2.9
¦ ¦ ¦ ¦ +-MHFNTD	--	--	--	--	30	2.3	30	2.3	31	2.6	34	3.2
¦ ¦ ¦ ¦ +-MHFNTL	--	--	--	--	28	2.0	29	2.1	30	2.3	31	2.6
¦ ¦ ¦ +-GIBLJIVOST		3.0		3.3		3.9		3.5		3.5		3.2
¦ ¦ ¦ +-MGGTPK	54	1.8	60	2.2	59	2.0	62	2.7	67	3.6	68	3.8
¦ ¦ ¦ +-MGGTPKR	--	--	--	--	--	--	--	--	276	3.6	277	3.6
¦ ¦ ¦ +-MGGOLS	40	3.0	38	3.3	34	3.9	37	3.5	39	3.2	48	1.7
¦ ¦ +-KOORDIN		1.2		1.2		2.2		1.0		2.3		2.7
¦ ¦ +-MFE10P	61	1.7	63	1.1	54	3.5	66	0.3	63	1.1	58	2.4
¦ ¦ +-MKKROSP	17.5	0.0	18.2	0.0	16.4	1.2	15.7	2.5	15.1	3.6	16.3	1.4
¦ ¦ +-MKPOLN	--	--	7.1	2.0	7.7	0.7	7.5	1.2	6.4	3.5	6.0	4.1
¦ +-MORFO		1.7		1.8		2.0		3.8		4.1		4.1
¦ +-BAZDIM		1.7		1.8		2.0		3.7		4.6		4.6
¦ ¦ +-AT	35.5	1.6	38.2	1.7	45.5	2.1	52.2	3.2	57.5	4.4	60.8	4.8
¦ ¦ +-AV	146.3	1.8	152.5	1.9	159.8	2.0	169.4	4.1	175.8	4.9	178.8	4.4
¦ +-MORF_IND		--		--		--		4.0		3.5		3.6
¦ +-INDPLOV	--	--	--	--	--	--	1035	4.1	1009	3.8	1013	3.8
¦ +-INDODSK	--	--	--	--	--	--	198	3.8	191	3.1	191	3.1
+-SPMORMOTST		2.7		2.8		2.7		2.8		3.1		3.4
+-MMISSK	1484	4.2	1508	4.3	1373	3.6	1379	3.6	1374	3.6	1374	3.6
+-SMISSKA	199	1.7	218	1.9	236	2.2	236	2.2	247	2.7	260	3.3

motor and morphological factors his competition performance could improve further.

When observing the trend of potential performance of the best Slovenian ski jumper in comparison with eight best Slovenian ski jumpers in the absolute category there emerges an interesting finding. His lagging behind the average of the eight ski jumpers was the largest in the 1991/92 season, and then began to decrease gradually until the last competition season of 1996/97. In the 1995/96 season the mark attained by the young Slovenian ski jumper was good, which means that he had already surpassed those minimal limits of satisfactory potential capacity which allowed him to achieve his first two wins in the World Cup. In the next competition season of 1996/97, the competitor further improved his potential performance which enabled him, at full utilisation of his competition talent, to achieve a further seven wins in competitions for the World Cup, the overall win in the New Year Tournament in ski jumps and the final win in the World Cup.

As we have to do with a young ski jumper whose morphological and motor development has not been completed yet, it is possible to expect - on the basis of the positive tendency of potential performance - further improvement in the quality of the said competitor. However, this improvement in quality should not only be limited to the potential performance , but should also extend to his competition performance .

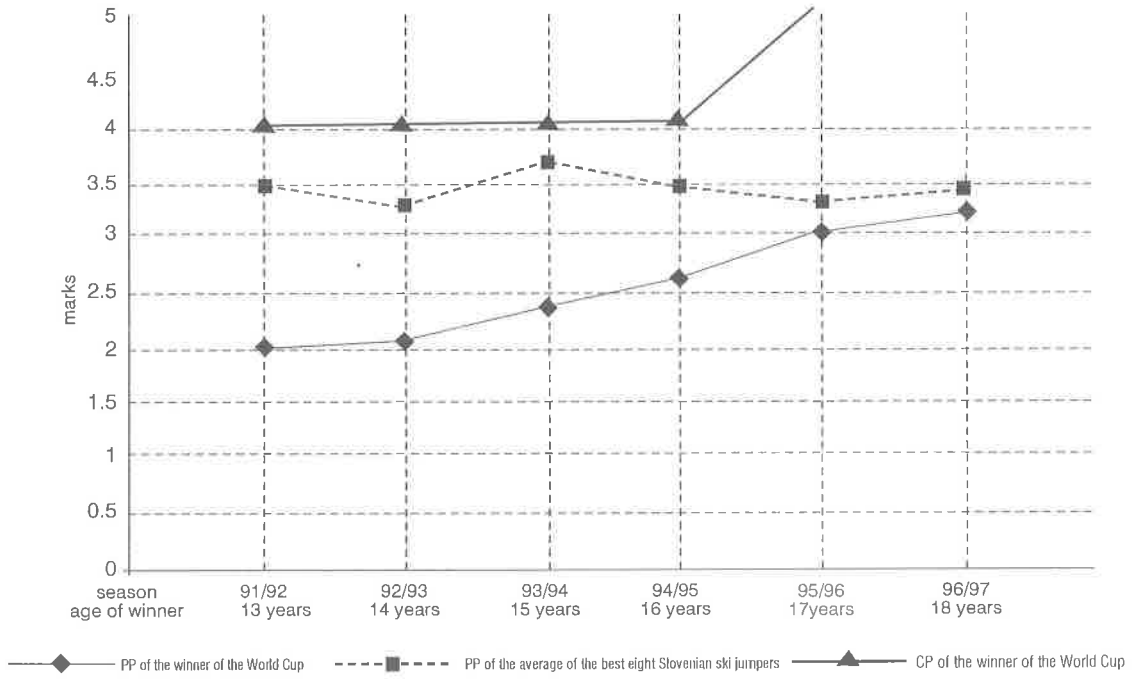
Conclusion

The present study has again confirmed that for high performance in ski jumping a high

degree of general motor preparedness and a favourable morphological profile are required.

The results of the research study thus confirm the importance of monitoring the preparedness of ski jumpers from the aspect of the selected morphological and motor dimensions (Jošt, Leskošek, Ulaga, 1995). Thus, the coaches can more reliably affect the development of suitable morphological properties and motor abilities and carry out the transformation of the structure of the said abilities.

Graphic representation No. 1: The trend of the development of potential performance (PP) of the winner of the World Cup in ski jumps for the 1996/97 season and comparison of the state of the potential performance (PP) with the best eight Slovenian ski jumpers



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