CORRELATION OF SOME VARIABLES OF EXPLOSIVE POWER AND COMPETITIVE SUCCESSFULNESS OF BOYS IN ALPINE SKIING

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Abstract:

The aim of this paper was to find the correlation between two variables of explosive power and their connection with the competitive successfulness of boys in alpine skiing. The sample comprised 24 young boys aged 12 and 13. The explosive power was analysed by the standing triple jump (3SM) and the standing long jump (SDM).

The correlation of the two independent variables of the explosive power space was statistically significant (r = 0.80). The two variables were also statistically significantly connected with the actual competitive successfulness of the tested category (3SM - r = 0.52, SDM - r = 0.47). The high value of the multiple coefficient of correlation between the two mentioned tests and the criterion variable was calculated by regression analysis (Mult R = 0.53), and proved to be statistically significant Sig F = 0.03). Taking into consideration the structure of movement in alpine skiing, the significance of using both tests for the measurement of explosive power of young alpine skiers simultaneously seems quite doubtful.

It was found that, regarding similar latent dimensions in the background of both independent variables, in the future it would be sounder to use only the standing triple jump test for analysing explosive power, which is also by its structure closer to the movement structure in alpine skiing.

Key words: alpine skiing, explosive power, competitive successfulness, boys, measuring, Slovenia

DIE KORRELATION ZWISCHEN EINIGEN VARIABLEN DER EXPLOSIVKRAFT UND DER WETTKAMPFLEISTUNG JUNGER ALPINER SCHIFAHRER

Zusammenfassung:

Das Ziel dieser Arbeit war, die Korrelation zwischen zwei Variablen der Explosivkraft sowie deren Beziehung zur Wettkampfleistung junger alpiner Schifahrer festzustellen. Die Stichprobe umfasste 24 Jungen, 12 oder 13 Jahre alt. Die Explosivkraft wurde mittels Dreisprung (3SM), bzw. Weitsprung (SDM) ohne Anlauf bewertet.

Die Korrelation zweier unabhängigen Variablen der Explosivkraft war statistisch bedeutend (r = 0,80). Diese zwei Variablen waren mit der eigentlichen Wettkampfleistung in den geprüften Kategorien auch statistisch bedeutend bezogen (3SM – r = 0,52; SDM – r = 0,47). Der hohe Wert des multiplen Korrelationskoeffizienten zwischen beiden Testen und der Kriteriumsvariable wurde mittels Regressionsanalyse gerechnet (Mult R = 0,53) und stellte sich als statistisch bedeutend dar (Sig F = 0,03). Zieht man die Bewegungsstruktur des alpinen Schifahrens in Betracht, scheint der Sinn simultaner Anwendung beider Teste zur Bewertung der Explosivkraft junger alpiner Schifahrer ziemlich bedenklich.

Bezüglich der ähnlichen latenten Dimensionen in der Grundlage beider unabhängigen Variablen wurde festgestellt, dass es in Zukunft besser wäre, nur den Dreisprung ohne Anlauf als den Test zur Bewertung der Explosivkraft anzuwenden, weil er auch der Struktur nach den Bewegungen im alpinen Schifahren näher liegt.

Schlüsselwörter: alpines Schifahren, Explosivkraft, Wettkampfleistung, Jungen, Bewertung, Slowenien

Introduction

In studying the significance of the motor abilities for success in alpine skiing the variables of explosive and repetitive power were significantly correlated to the criterion (Agrež, 1976). On the basis of regression analysis it was found that explosive power had a greater influence on the success in the explosive and repetitive power variables space.

The field of motor abilities was well - researched. Depending on the type - energetic or informational, we speak of two so-called secondary motor abilities. The field of power which is, according to its existing forms defined by various components (primary factors of power), is especially well studied. Besides the eight primary factors, Hošek and Momirović also defined the two secondary factors of power - the mechanism for the regulation of excitation intensity and the mechanism for the regulation of excitation duration. These two authors

selected the dynamo-metric force and the explosive power from the primary factors and ranked them with the mechanism for the regulation of excitation. On the basis of this research and numerous other studies (Kurelić et al., 1975; Gredelj et al., 1975), Čoh (1988) defined, on a sample of 124 categorised Slovenian athlets from different sport branches, the three latent dimensions of explosive power: the factor of relative power, the factor of short sprint and the factor of explosive power. On the basis of the taxonomic analysis of the same subject sample, the two taxonomic dimensions were found: the ability of performing counter movement jumps with antagonistic (contrary) movements and the ability of performing multiple one - leg horizontal jumps where the single-foot horizontal take-off represents the dominant element.

Due to the nature of skiing motor system, the efficiency in mastering techniques, as well as the overcoming of great loads, depends on the ability of developing all the above mentioned forms of power which represent the foundations of the presented sport branch. Thus the single legged and parallel push-off may present the basis from the aspect of explosive power in alpine skiing. The new technique of top competitive alpine skiing is directed toward skiing on both skis. Mastering the load on turns with an ever increasing speed demands the loading of both the outer as well as the inner ski. This loading must allow the competitor the turn with minimal sliding (Raschner et al., 1996). Therefore, skiing on both skis mostly demands independent leg work. But according to some experts (Žvan et al., 1996) such a skiing technique only appears to be a parallel simultaneous pushing off, while in reality, due to the terrain decline (one ski represents the lower decline, the other the upper), there is a constant efficient transfer (at best this means pushing off) of weight, i.e. of load from one ski onto the other (alternate one - legged muscle activation). This is especially significant for younger categories since here such speeds are reached on turns which still (mostly) allow the loading of the lower ski.

Parallel and one-legged push-off are included in the group of motor tests for the category of younger alpine skiers (Žvan et al., 1996). In view of certain doubts concerning the significance of following only one or both push-off techniques, it would be essential to determine the inter-connection of the various types of push-off as well as their relation to the competitive successfulness of young boys in alpine skiing. In the case of a statistically significant correlation, only the test with a closer connection to competitive successfulness could be used in further research.

Methods

The sample comprised 24 young boys (age - AS=12.7 years, SD=+-0.21 years; body mass - AS=47.0 kg, SD=+-7.1 kg; height - AS=155 cm, SD=+-7.0 cm), members of ski clubs who competed in the season of 1995/1996 in races of the Radenska Cup, raced and scored, in the final count, more than 100 points.

The sample of independent variables included two variables of explosive power. The first variable was measured by the test *standing triple jump* (3SM), which represented the one-legged push-off. In the test the subject executed a parallel (simultaneously on both legs) push-off, landing on one leg, pushing off, landing on the other leg, pushing off and landing on both legs simultaneously. Every subject could perform two repetitions, taking care to execute the motor task correctly (Šturm, 1977). The second variable was measured by the test *standing long jump* (SDM), which represented the both-legged push-off. In the test the subject executed a parallel (simultaneously on both legs) push-off and landed on both legs simultaneously. Every subject could perform three repetitions. The results of both tests are presented in cm.

The final score from of the Radenska Cup races represented the criterion variable for each individual subject. In the season of 1995/1996 there were 10 races - 5 giant slalom, 3 slalom and 2 super giant slalom races.

By winning a certain place in the race the individual scored a certain number of points. On the basis of the sum of these points, according to the agreed criterion of Slovenian Ski Association (SZS), the 1st place scored 150 points, the 2nd place 135 points, the 3rd place 120 points, the 4th place 108 points, the 5th place 96 points, etc. (distribution according to Bulletin II. SZS, 1996). For greater objectivity of the criterion variable the

success of an individual in the races considered the classification according to points scored in the three ski events: the sum of the points scored in the two best skied runs in slalom, the sum of the points of the three best results in giant slalom and the sum of the points from best results in the super giant slalom. All the subjects had classified in the races taken into account.

Table 1: Arithmetic mean (AM), standard deviation (SD), maximal result (max.), minimal result (min.), and the test of Kolmogorov-Smirnov normalcy of distribution (K-SP)

	AM	SD	max.	min.	K-SP
3SM	580.88	36.72	631	477	0.74
SDM	201.42	11.57	220	177	0.84
POINTS	338.25	218.30	816	78	-

Measurements of the selected variables were performed in the frame of the annual post-season testing for categories of young and older boys and girls. The testing of 20 motor dimensions were carried out with the help of 28 measurers, students of the Faculty of Sport, University of Ljubljana, specialising in alpine skiing. All the tests were ranked according to their energetic demands, in such a manner as to enable the optimal execution (a more energetically demanding test was followed by a short pause and then by a less energetically demanding one).

The fundamental statistical parameters: arithmetic mean (AM), standard deviation (SD), maximal result (max.), minimal result (min.), and the test of Kolmogorov-Smirnov for testing normaley of the distribution (K-SP), were primarily calculated for all the used variables.

Using the method of calculating Pearson's correlation coefficients (r), the correlation between the chosen variables of explosive power and their connection with competitive successfulness in alpine skiing were determined. The statistical significance of the connections was tested bilaterally, considering a 5 % alpha error.

The connection of the space of explosive power and the criterion variable was calculated by the method of direct (classic) regression analysis. The following parameters were calculated by the above method: the multiple coefficient of correlation; the coefficient of determination; the statistical significance of the multiple correlation coefficient; the beta coefficient; and the statistical significance of beta coefficients. A 5 % alpha error was considered.

Results

Comparing the results of the test *standing long jump*, with the general population of boys of the same age (Strel, 1990), the results of the research sample show better average values. The value of standard deviation is also smaller, which points to the fact that the research sample is more homogeneous in the *standing long jump* test. The comparison of the results of basic statistical parameters in this research with the research on skiers of the same age category (Žvan and co-authors, 1995), shows a somewhat lower average value of the two used independent variables. The same holds for values of standard deviation.

Table 2: Statistically significant values of Pearson's coefficients of correlation are marked. The statistically significant values between the variables at a 5% risk are marked with (*), at 1% risk with (**).*

	3SM	SDM	POINTS
3SM	1		
SDM	0.80**	1	
POINTS	0.52**	0.47*	1

Pearson's coefficient of correlation between the independent variables shows a high statistical significance of both techniques of push-off (r= 0.80 **). The test *one-legged push-off* (3SM - r = 0.52 **), shows a closer connection value with successfulness, which is a statistically significant connection even with a 1 % alpha error. A somewhat lower value of Pearson's coefficient of correlation is found between the SDM test and the actual successfulness (r = 0.47 *). The value of the

Table 3: Multiple coefficient of correlation (Mult R), coefficient of determination (Rsq), standard error (St.err.), statistical significance of multiple correlation coefficient (Sig. F), beta coefficient (beta), and statistical significance of beta coefficients (Sig. T.)

	Mult R	Rsq	St. err	Sig. F	beta	Sig. T
TAKE-OFF POWER	0.53	0.28	194.14	0.03		
3SM					0.38	0.23
SDM					0.17	0.58

multiple coefficient of correlation of variables of explosive power shows the connection of this space with the competitive successfulness of the young competitors in alpine skiing (Mult R = 0.53). The part that the used variables explained was statistically significant at a 5 % risk (Sig F = 0.03). With both tests, 28 % of the variance of the criterion variables were explained (Rsq = 0.28). The beta coefficient of both variables of explosive power was positive. The variable *standing triple jump* had a higher beta value. None of the independent variables of explosive power had statistically significant projection on the criterion variable, but the variable *standing triple jump* (3SM beta = 0.38) contributed more.

Discussion

The most significant finding of this research was the high value of correlation between both methods of push-off. This therefore confirms the doubt about the use of both variables of explosive power for the category of young boys in alpine skiing. With the use of selected statistical methods it was indicated that the test *standing triple jump* might be more appropriate for determining the explosive power of the chosen sample.

In view of the conclusions of Čoh (1988), a high statistical significance of the correlation between both chosen variables of explosive power was anticipated even in this part. The authors of the previously mentioned research (Žvan and co-authors, 1995) also reached similar conclusions since the coefficient of correlation between the discussed variables was even higher. It may be deduced that both variables share similar latent dimensions which is the main reason for the level of correlation between both tests of explosive power being very high. Their individual connection with the criterion is quite similar (r = 0.52 **, r = 0.47 *), which means that only the test with the higher value of connection with the criterion might suffice to explain the efficiency of explosive power of young boys.

The obtained results in this part show that the variable *standing triple jump* has a higher correlation to the criterion. This can be explained by the fact that (Žvan et al., 1996) overcoming loads on turns in alpine skiing is mostly a matter of activating the muscles of one leg. The modern technique of competitive alpine skiing is based upon the execution of optimal turns with regard to the ideal line. The skier can, as a rule, come close to this by skiing on both skis, but it must be pointed out that in doing so the activity of the outer and the inner leg differs. Skiing on both skis does not mean parallel (simultaneous) skiing. The variations of techniques in the execution of turns range from a total loading of the outer ski to a partial distribution of weight also on the inner ski. This can cause, especially in skiers of younger categories, wrong loading of the inner ski and consequently the loss of the right line of skiing between the gates (Lešnik, 1999). The technique of the locomotor system movement in alpine skiing, mostly in technical events (slalom, giant slalom), is based on (chiefly) single - leg eccentricycles concentric of muscle contractions. It is therefore a matter of the alternate loading of one and the other ski. Among the used variables, the test *standing triple jump* (alternate movement of one leg and the other) is, by its structure, closer to the above type of loading.

The connection of the space of both variables of explosive power was statistically significant. Together the two variables explained 28 % of the criterion variable. Regarding the higher coefficient of the beta variable 3 SM, this variable shows a greater contribution to the formation of the regression function.

Regarding the obtained conclusions, the test *standing triple jump* alone could be used from the battery of tests for explosive power for the category of younger skiers. But it should be

taken into account that the subject sample had already been included in the regular process of transformation but is, regarding age, still relatively »non-treated« to allow a differentiation of the motor system (Žvan et al., 1996). In interpretation we should therefore bear in mind the specificities of the sample, as well as the time shift of the measurement of independent variables with regard to the criterion variable. Races for the Radenska Cup were organised over a longer (competitive) time span while the measurements were performed in two days, two months after the last race. The results of the measurements can only be a reflection of the momentary state (condition) of the subjects. This is, from the aspect of the psychophysical condition, not at the same level as during the competitive period and could increase the possibility of the influence of random factors that could cause a limitation in the generalisation of the conclusions of this research.

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