

EVALUATION METHODOLOGY FOR ASSESSING THE EFFECTIVENESS OF SPORTS TECHNIQUES

Janis Lanka¹, Andris Konrads¹ and Anatoly Shalmanov²

¹Latvian Academy of Sport Education, Riga, Latvia

²University of Physical Culture and Sports, Moscow, Russia

The purpose of this study was to introduce with the methodology and long-term research results of sports technique effectiveness. In the research, using sport throwings as an example of a difficult movement, we worked out the evaluation methodology of the movement technique quality and ideas of this methodology can be used not only for the evaluation of shot-put, but also for other movement technique.

KEY WORDS: sports technique, technique effectiveness, model-indices

INTRODUCTION: A lot of research has been devoted to sports throwings, including biomechanical study and analysis of shot-put (look, for example, analytical report, J. Lanka, 2000). However, less attention has been paid to the questions of control and acquisition of shot-put technique, even forgetting the fact that sport biomechanics has also significant pedagogical tasks: 1) perfection of sports technique and working out technique's rational variation; 2) techniques control with an aim to avert mistakes and increase technical proficiency; 3) formation of effective special exercises; 4) working out biomechanically substantiated training and movements' teaching means; 5) prevention of sports injury. In the practice the quality of movement execution (technique) and its acquiring degree are often evaluated by the achieved result - if the athlete throws the farthest, jumps the highest, so -he has the best technique. Such evaluation is not correct, as sports performance is determined not only by the technical proficiency, but also by a lot of other important factors. Sports technical proficiency is determined by many indices, the most important being the rationality of technique, the effectiveness as well as the degree of acquisition (Donskoy, Zatsiorsky, 1979, Shalmanov, 2002). Taking into account congress organizers' recommendations mainly to focus on practical research aspects, so that coaches can make use of them in their work, the present article describes our obtained shot-put technique's research results and methodology.

METHODS: Stereofotogrammetric, tenzodynamographic, electromyographic methods there were used for study kinematical and dynamics qualities of shot put technique for shot putters of different skill levels. Linear and nonlinear correlation, factor and regression analysis (method of regression remnants) were employed for data analyses.

RESULTS AND DISCUSSION: An athlete's technique effectiveness is characterized by how close it is to the most rational variant. Three groups of technique's effectiveness: absolute, comparative and realization are distinguished (Donsky, Zatsiorsky, 1979).

To state the indices of absolute effectiveness, we must compare separate movement elements with a standard or criteria, that is determine on the basis of mechanical or biomechanical analysis. The derivation extent (the difference between real and standard value) serves there as the measure of technique element execution by athlete. Unfortunately, such criteria have not been worked out and in practice to evaluate the quality of athlete's technique there are usually applied comparative effectiveness indices.

There are three means when evaluating the comparative effectiveness of shot put technique: 1) technique of a definite shot-putter is compared to the technique of a top athlete, 2) technique of a shot-putter is compared to his own technique model indices, 3) technique of an athlete is compared to the model indices of top athletes.

The first mean of technique effectiveness is widely used in practice. However, it has two important drawbacks. The first - differences of the compared athlete conditioning are not taken into account. The second - the new athletes can copy not only what is good in top athletes' technique, but also their mistakes. The instrumental investigation of top shot-putters'

technique in one training session (40 puts one by another) in different preparing periods showed that, although they had a high standartization' level of separate technique elements, especially kinematical ones, and technique in general, everyone of them has such technique peculiarities (a high technique individualization degree, but maybe a mistake?) that cannot be explained only by the indices differences of the athletes' morphological or physical conditioning. It makes the choice of the movement example (standard) more difficult as this standard has several values.

The individual model indices of shot put technique were made for shot-putters of different qualification, who executed 40 puts during one training session. The following methodology of making individual and group model indices was used. First of all we stated the informative indices of shot put technique. For this we used a set of measuring equipment for stating the numerical value of movement indices and linear and nonlinear correlation analysis to evaluate the coherence of these indices with sports results. By the help of multi-factor regression analysis we stated the contribution of these indices in sports result. Then, using the empirical equations of regression analysis, the values of informative indices were forecasted in order to achieve the planned result. In the end the permissible variation borders of the forecasted indices were calculated.

The research showed that the number of informative technique indices depends on the athlete's qualification - the higher the proficiency, the greater the number of the indices which closely correlates with the sports results. That proves the high uniformity of technical element execution and integration degree in the top athlete's technique and vice versa in the beginner's technique. It was clarified that there are mainly coherences of non-linear forms between informative technique indices and sports result, and the planned chosen result should not exceed the best result by the athlete shown in the experiment - more than 1-2 metres. The technique individual model indices should be used for stating the technique effectiveness of only that athlete whose technique was investigated.

In order to arrive to high qualification shot-putters' group model indices we used biomechanical indices of 27 athletes (best performance 17 m to 20.50 m) and calculated the numerical values of model indices for movement perspective model of 21, 22 and 23 meters long puts.

Sports performance depends not only on the level of technical proficiency but also from the physical possibilities of the athlete. To what extent the athlete can realize (change into sports result) his/her preparedness potential, using one or other variant of movement execution, shows the realization effectiveness of a technical means. This means is based on the coherences that exists among: sports performance, development level of physical qualities and technical effectiveness, assuming that the athlete is motivated to realize his/her physical abilities in the definite motor activity as well as possible.

To get as much information as possible not only about the shot put technique but also the indices of shot-putters condition and body composition that determine achievements in shot put, as well as the possible causes that call the same deviations in technique, we made a questionnaire and the testing of explosive force qualities. The athletes' weight, height (it is known that a man's movement possibilities depend also on the total sizes of the body), the indices of the main muscle group static and dynamic strength (absolute and relative) were fixed. The investigation of correlative coherences between these indices and sports result allowed evaluating their importance.

We evaluated the special physical conditioning with the results in such exercises as pushing of a barbell from a lying position, squats with a barbell on the shoulders, shot putting from static position, shot throwing forward and backward that shot-putters use traditionally to develop speed and explosive-force qualities or as control tests for the evaluation of the quality level. The values of correlation coefficients between the results of these tests and the performance in shot putting were in the borders of 0.73-0.97, but between the test results from 0.58-0.85 (32 shot-putters, shot-putting result from 12.00 m up to 20.50 m). First of all, it proves the close coherence between the test results and the result in shot putting that allows to use them for stating the technique realization effectiveness. Secondly, these tests reflect the same qualities essential for shot-putters.

The regression remnants method was used to estimate the efficiency of technique's realization and to work out technique's model-indices, as well as movements' statistic models. The method allows evaluating the efficiency of sportsmen technique - to compare them, though it fails to provide answer to the question itself and particularly what determines these differences. The usage of the regression remnant method becomes more useful in case it is applied alongside with the biomechanical analyses. Regression analysis and the comparing of regression remnants allowed evaluating the degree of the realization of these qualities (Figure 1).

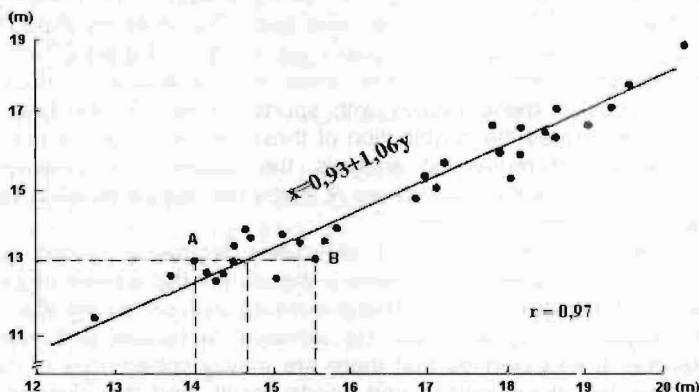


Figure 1 Correlation coherence between performances in shot putting with a glide (X) and from a standing position (Y). Athlete's A technique is worse, athlete's B is better than average technique.

The regression line depicted in the picture shows the relation as between the results of shot put from standing position and shot put with glide, from point of coordination - in a simpler and more difficult movement. Athlete, who put shot from a standing position, e.g., 13 m, do achieve in average 14.72 m when putting shot with a glide. In the event, one of two athletes who have reached such result from a standing position pushes with a glide 14.00 m (the point A is on the left from the regression line), then his technique is worse than the group average and that of the other one, who attains 15.60 m (point B is on the right from the regression line) and whose technique is better. This means that the second athlete makes use in a better way the running speed acquired during the glide in the final part of shot putting.

The amount of regression remnants and direction in relation to regression line, that characterizes the average technique of the definite athlete group, gave a possibility to evaluate the technique effectiveness of each athlete is it better or worse than the average one and to what extent. This analysis gave one more possibility to compare the set up performance in shot put with the performance that the athlete, taking into account his level of physical conditioning (it is reflected by the control exercise result), would achieve if he improves his technique. The difference between the "real" and "possible" result serves here as the measure of the technique effectiveness. We calculated the "possible" result by the help of regression equation. Using this equation it was possible to state what competition result the athlete could hope for if he managed to improve the control test result, or vice versa, planning a definite result in shot putting, to forecast what level of strength or rapid-force indices he needed. Similary, we evaluated the realization degree of other control tests. Using regression equations we made the nomogramms (by means of which a coach can evaluate easily the effectiveness of athletes' technique, that is, how effectively his trainees use their movement possibilities and their physical potential (Table 1).

Table 1 Realization effectivity in shot put with a glide according to the results in squats with a barbell on shoulders.

Squats With barbell	Effectivity of realization				
	Low	Under average	Average	Good	Exelent
170 kg	13.37-13.95	13.95-14.53	14.53-15.11	15.11-15.69	15.69-16.27
190 kg	14.37-14.95	14.95-15.53	15.53-16.11	16.11-16.69	16.69-17.27
210 kg	15.37-15.95	15.95-16.53	16.53-17.11	17.11-17.69	17.69-18.27
230 kg	16.36-16.95	16.95-17.53	17.53-18.11	18.11-18.69	18.69-19.27
250 kg	17.37-17.95	17.95-18.53	18.53-19.11	19.11-19.69	19.69-20.27
270 kg	18.37-18.95	18.95-19.53	19.53-20.11	20.11-20.69	20.69-21.27
290 kg	19.37-19.95	19.95-20.53	20.53-21.11	21.11-21.61	21.61-22.27

And, vice versa, forecasting a definite result in shot putting, we can state what level of strength and special strength quality would be necessary.

Wide application of the regression method to solve sports problems are restricted by several conditions (Shalmanov, 2002). The first in case the research does not involve a great number of individuals, the precision of the regression equation is not high. Secondly variable marks that are included in regression equations, may in an intrinsic way mutually correlate and the signs of plus or minus that stand before the equation's members may not correspond to the real situation. Thirdly the regression equities with two and more variables are difficult to be applied in practice due to data obtaining, as well as selection of the necessary information becoming more and more difficult. Multifactor regression equities may be applied in practice only if the variable they contain mutually do not correlate, but correlate closely with the dependent variable sports performance. In this case the variables depict those various factors that the sports result depends on and they show the importance of the factors, their investment in sports result. In the event there is a mutual correlation between the variables that enter the regression equity, it means that they depict the influence of some common factor. In this case we speak about factors co-linearity the factors correlate mutually, as well as they correlate with the sports result, however, those factors may have no logical causes consequences' coherence with the result.

CONCLUSIONS: 1. There are three means when evaluating the comparative effectiveness of shot put technique: 1) the technique of a definite shot-putter is compared to the technique of a top athlete; 2) the technique of a shot-putter is compared to his own technique model indices; 3) the technique of an athlete is compared to the model indices of top athletes. The results of research allow to recommend the second and third as the most motivated and objective. 2. The usage of informative technique indices, individual and group model indices, accelerates and gives the possibility to realize the principle of individual approach in technique acquiring process. 3. Regression analysis and the comparing of regression remnants allow to evaluate to what extent the athlete can realize his/her technical or physical preparedness.

REFERENCES:

- Donskoy, D.D., Zatsiorsky, V.M. (1979) Biomechanics (Russian). Moscow: FIS. 235-252.
 Lanka, J. Shot putting (2000). In Zatsiorsky V.M. (ed) Biomechanics in Sport: Performance Enhancement and Injury Prevention. Blackwell Science, LTD, Oxford, 2000. 435-457.
 Shalmanov, A. (2002). Methodological Basis of Human Movements Investigation in Sport Biomechanics. PhD dissertation, University of Physical Culture and Sports, Moscow, 2002.