Control Parameters Provided by MGM Test – Tool for Assessing Physical Training

CLAUDIU MEREUTA[1], ELENA MEREUTA[2]
[1]Theory and Individual Sports Department, [2]Applied Mechanics Department
"Dunarea de Jos" University of Galati
47 Domneasca Street, 800008
ROMANIA
cmereuta@ugal.ro, emereuta@ugal.ro

Abstract: - The paper presents the control parameters provided by MGM test, and the influence of anthropometric data on their evolution. The control parameters are analyzed in terms of controlling the detachment phase from the ground when performing two-legged and one-legged vertical jumps and in terms of preparing the body for ground contact. The control parameters are relevant for the specificity for each individual, characterizing the neuromuscular ability of each athlete to adapt to certain situations. For a trainer is significant that he is able to assess the extent to which athletes respond to stimulus and how quickly they adjusts to unexpected situations that are common during competitions. The paper presents also the influence of some anthropometric parameters, like body mass, height and foot length on control parameters.

Key-Words: control parameters, vertical jump, neuromuscular system, anthropometric data

1 Introduction

Sports performance has evolved much and continues to evolve. Different sports fields have established their working methodology. Therefore, the content of training has been systematically adapted to precise rules, determined by tests conducted to assess the physical and neuromuscular control system.

They were differentiated and applied by precise rules, as their specificity and addressability, being then important parts of athletic training content. Physical exercises have found different areas of interest, such as technique, tactics, psychology, theory, artistic, biological and capacity of effort.

Thus, in contemporary training, we talk about: physical training, technical training, tactical training, theoretical and methodical training, psychological preparation, art preparation and biological preparation for the competition, which are the basic training factors.

Physical training is the main component of training process and plays an important role in the improvement of other training aspects.

2 Test description

In order to get a generally method for assessing the physical preparation level of athletes performing different sports, we have chosen the MGM test [9], [7], [8], which provides also the control parameters.

The effort used in the sample is a maximum effort of strength and speed. The maximal effort is useful in assessing characteristics related to control. Meanwhile, it eliminates the step of assessing subjective exercise [1], [2].

The effort required in this test addresses of large muscle groups. The best way to determine the physical skill assumes that we take into account the specific movements of various sports [3], [5], [6]. This requires a variety of conditions, techniques and devices that make such determination to be impossible or extremely difficult.

Therefore it was chosen an effort that is made by the largest body muscle mass. Lower limbs were chosen considering that the effort they carried out affects the results [10]. As the chosen effort is not found exactly in this form in exercise patterns in different branches of sport, the distorsion of the results by previous habits of athletes is eliminated, and the effort might be regarded as unspecific. A specific effort would give an advantage to athletes with technical skills [3], [4], [6].

The results of the test are mainly dependent on the basic skills of athletes. The assessment is general and can be useful in guiding subsequent training process.

The apparatus consists of a contact platform with usable area of about 1 m x 1.2 m, connected by a serial interface (RS-232) to a computer. Through this, the data acquisition is done: the flying time (T_a)

and time on ground (T_s) with an accuracy of 0.001 seconds. The computer calculates energetic parameters and control ones.

The program used for acquisition and processing, automatically performs both primary measurement data and calculations for each series of vertical jumps and for entire test.

The complete test consists of three sets of 15 jumps like "the ball", two-legged and one-legged vertical jumps.

The breaks between the vertical jumps are conditioned by the computer velocity of data processing (30 sec. to 1 min.).

The results must be assessed with a ratings system for each athlete. The tested athlete must not receive arid information, but a correct assessment of parameters, as qualitative information is better received by trainers and by athletes.

The testing method proposed by Georgescu [9] is using a portable device and provides information on the control parameters of tested athletes.

The computer removes five vertical jumps from each series, and based on the rest, it provides the control parameters: energetic variation coefficient (EVC) and structural variation coefficient (SVC).

The testing group was formed by fifteen male athletes (178.2 ±6.69 cm height, 75.64 ±12.74 kg body mass, 42.8 ±1.47 foot length), which gave their consent and volunteered to participate in this test. We have prior approval for conducted this test from the Ethics Committee of “Dunarea de Jos” University of Galati.

3 Results

The output data revealed the control parameters for each participant in the test, meaning that we were able to get the energetic variation coefficient (EVC) and structural variation coefficient (SVC).

The values of these parameters for the participants are shown in table 1.

Table 1 MGM test control parameters

	Two-legged **VJ**		One-legged (right) VJ		One-legged (left) VJ	
	EVC	SVC	EVC	SVC	EVC	SVC
P1	5.7	12.15	9.23	8.46	8.31	10.21
P2	5.27	8.77	3.51	8.34	6.29	5.44
P3	3.26	10.27	3.22	8.52	6.69	4.67
P4	2.52	5.66	7.15	10.68	7.99	4.96
P5	5.53	9.31	6.39	6.46	12.12	21.75
P6	6.19	8.44	5.68	9.72	11.94	8.55
P7	6.48	15.79	7.93	7.29	7.2	5.76
P8	6.02	16.83	5.13	7.57	11.72	12.68
P9	5.79	11.55	6.95	20.27	11.46	8.76
P10	8.99	9.75	6.32	8.49	5.48	6.14
P11	3.56	9.38	5.12	8.76	3.61	5.43
P12	8.33	13.65	8.83	12.34	6.75	12.32
P13	4.48	7.23	4.34	6.02	6.36	7.57
P14	4.41	8.1	15.98	15.57	7.76	3.23
P15	6.42	9.78	8.23	7.42	4.29	5.12

The energetic variation coefficient (EVC) refers to the ability to control energy in unspecific motion and brings data on the quality of detachment on vault. The control parameter also highlights the automation of motion that is desired to be maximized for sports that require precise identical motions (canoeing, gymnastics, skating) and which is not intended to be maximal, but optimum, for sports involving an opponent (fencing, games, boxing).

The energetic variation coefficient (EVC) is calculated using the formula:

$$EVC = \frac{StDev(Ta_i)}{\sum_{i=1}^{10}(Ta_i)} \quad (1)$$

where: T_{ai} is the flying time for the jump “i”

A higher numerical value of EVC highlights a weak control of the athlete at the completion phases.

The structural variation coefficient (SVC) refers to the ability to control the ground contact preparation phase, to resume the ground contact when jumping, to defense, to prepare and catch the object while launching. The average on two-legged vertical jump is 3 - 3.5, meaning that at higher values the athlete does not anticipate, does not prepare , is not ready to catch, is too rigid, and drops objects. A weak SVC highlights the fact that the athlete is not aware of its body structure and he does not know how to prepare for a contact (with the opponent, with a ball or with the ground).

The structural variation coefficient (SVC) is calculated using the formula:

$$SVC = \frac{StDev(Ts_i)}{\frac{\sum_{i=1}^{10}(Ts_i)}{10}} \cdot 100 \quad (2)$$

where: T_{si} is the time on ground for the jump “i”

4 Discussions

Based on the control parameters provided by MGM test, we are able now to estimate the neuromuscular activity of each athlete, and discuss their control over the energetic resources and their ability to control the motion phases, by comparing their control parameters to the mean of the group (fig.1) or to the recommended values from literature [6], [9].

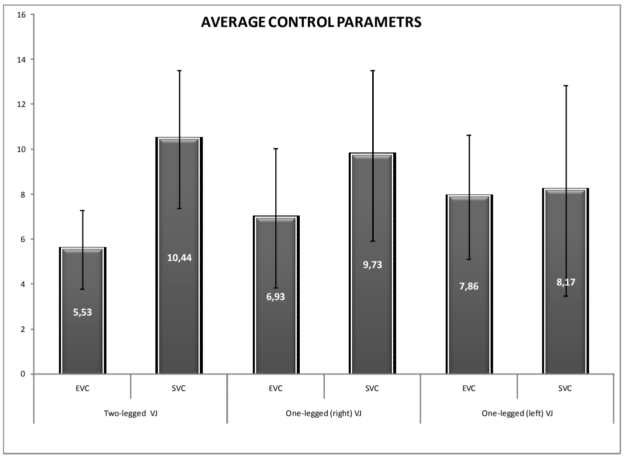

Fig.1 – Average control parameters

We can see that as for the first control parameter, EVC, discussed on two-legged vertical jump, participants 3,4 and 11 exhibit the best control for the finishing phases at high velocity motions, while participants 10 and 12 exhibit the worst control (fig.2).

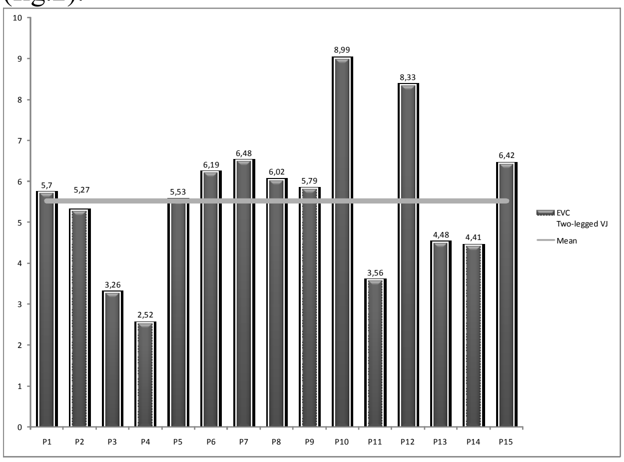

Fig.2 – EVC on two-legged vertical jump

As for the one-legged vertical jump, participants 3 and 2 exhibit the best control of energy consumption while jumping on the right leg, and participants 11 and 15 controls the best the finishing phases of motion while jumping on the left leg (fig.3).

The worst control over the completion phase have shown participants 14, 1 and 5 during the series of jumps on right leg, while for the series of vertical jumps on the left leg jump, the worst control have been shown by participants 5, 6, 9 and 10 (fig.3).

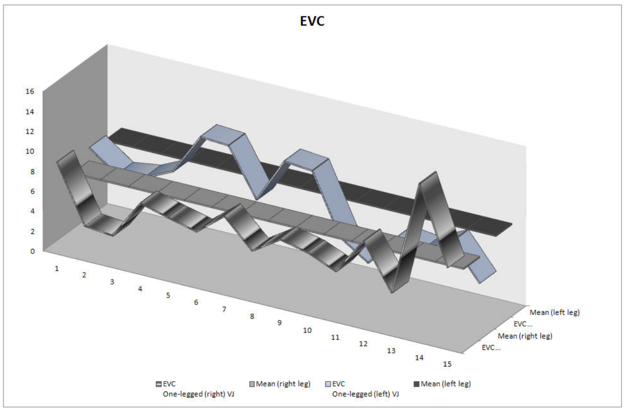

Fig.3 – EVC on one-legged vertical jump

As for structural variation coefficient (SVC) we have found that only participant 14 exhibit optimum values of SVC, while jumping on left leg, which proves that he is able to coordinate and to anticipate the contact phases, especially on the left side of the body, including the left upper limb (fig.4).

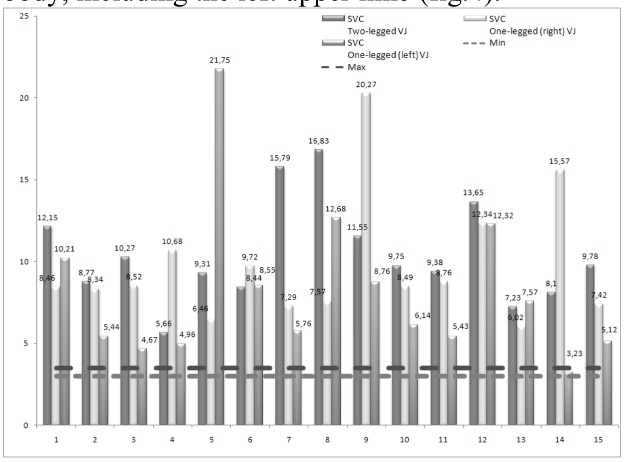

Fig.4 SVC control parameters

All the other participants in the test have proved that their capacity of control is weak and sometimes very weak (P5 while jumping on left leg, P9 while jumping on right leg and P8 while jumping on both legs) (fig.4).

We can conclude that for values of SVC < 3 (stated in literature [9]) the athlete is not able to prepare the contact, whatever its nature is, with the opponent, with the ball, with ground.

Also, for values of SVC > 3.5, we conclude that the athlete is rigid, he is not able to anticipate next phase and often he reacts with delay.

5 Regression analysis

In order to determine the influence of anthropometric parameters on the control parameters EVC and SVC, a regression analysis was performed.

The regression method provides the estimation of a linear model using the least squares method and the calculus of the statistics associated to this model.

Considering as dependent variable the EVC control parameter, we find that only 14.42% of the variance of EVC on two-legged vertical jump is influenced by the variance of the height, mass and foot length.

The estimated values for the coefficient of the model are tested for significance (table 2). The results show that the intercept (constant term of the model) is -6.75302, while the estimated coefficients are 0.014, -0.04621 and 0.306.

Table 2 – Estimated values of coefficients for EVC

	Coeffi-cients	Standard Error	t Stat	P-value
Intercept	-6.75	14.55	-0.46	0.65
Height	0.01	0.13	0.12	0.91
Body mass	-0.05	0.04	-1.12	0.29
Foot	0.31	0.55	0.56	0.59

The proposed model for EVC control parameter is:

$$EVC_{TLVJ} = -6.75302 + 0.014 \cdot H - 0.04621 \cdot M + 0.306 \cdot L_f \quad (3)$$

We can compare the EVC diagram to the predicted one, using the regression method for each independent variable (fig.5).

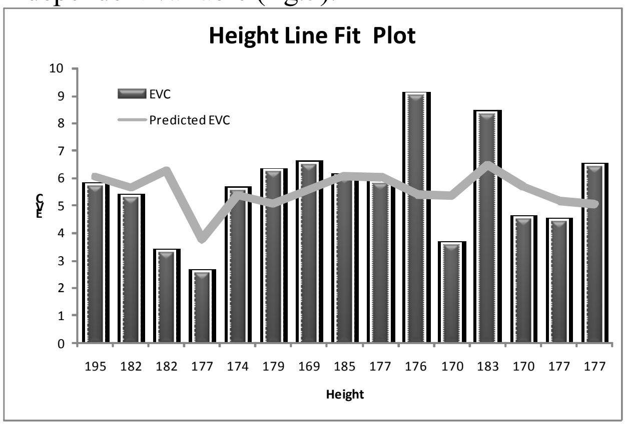

Fig.5 – Predicted EVC and determined EVC

Performing the same analysis for one-legged vertical jump we find the linear models for EVC parameter on right leg (4) and on left leg (5) as follows:

$$EVC_{RLVJ} = -8.046 - 0.244 \cdot H + 0.108 \cdot M + 1.176 \cdot L_f \quad (4)$$

$$EVC_{LLVJ} = -13.284 + 0.002 \cdot H + 0.026 \cdot M + 0.436 \cdot L_f \quad (5)$$

The regression analysis reveals the fact that the most significant influence of anthropometric data on EVC control parameters occurs for the one-legged vertical jump (right leg), meaning that 28.11% of the total variance is produced by the independent variables.

Considering now as dependent variable the SVC control parameter, we find that 42% of the variance of SVC on two-legged vertical jump is influenced by the variance of the height, mass and foot length.

The estimated values for the coefficient of the model are tested for significance (table 3). The results show that the intercept (constant term of the model) is -30.47, while the estimated coefficients are 0.04, -0.13 and 1.03.

Table 3 – Estimated values of coefficients for SVC

	Coeffi-cients	Standard Error	t Stat	P-value
Intercept	-30.47	21.10	-1.44	0.18
Height	0.04	0.18	0.20	0.85
Body mass	-0.13	0.06	-2.15	0.05
Foot	1.03	0.80	1.29	0.22

The proposed model for SVC control parameter is:

$$SVC_{TLVJ} = -30.47 + 0.04 \cdot H - 0.13 \cdot M + 1.03 \cdot L_f \quad (6)$$

We can compare the SVC diagram to the predicted one, using the regression method for each independent variable (fig.6).

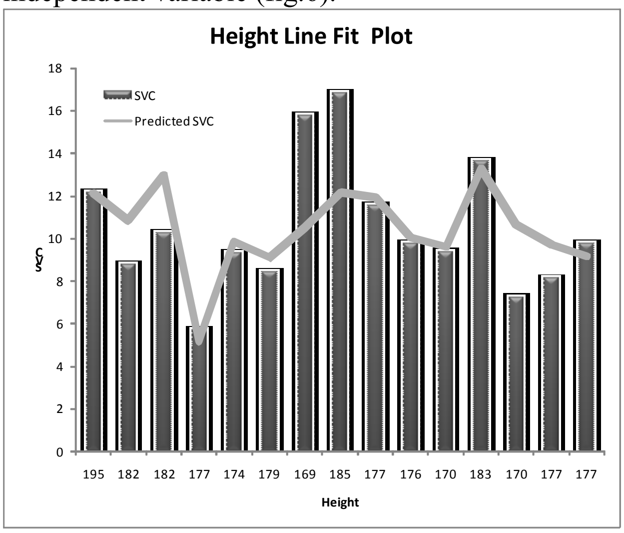

Fig.6 – Predicted SVC and determined SVC

Performing the same analysis for one-legged vertical jump we find the linear models for SVC parameter on right leg (7) and on left leg (8) as follows:

$$SVC_{RLVJ} = -9.044 - 0.176 \cdot H + 0.027 \cdot M + 1.125 \cdot L_f \quad (7)$$

$$SVC_{LLVJ} = -12.057 + 0.288 \cdot H - 0.11 \cdot M + 0.521 \cdot L_f \quad (8)$$

The regression analysis reveals the fact that the most significant influence of anthropometric data on SVC control parameters occurs for the two-legged vertical jump, meaning that 42% of the total variance is produced by the independent variables.

As for SVC determined during one-legged vertical jumps, only 0.08% of the total variance is determined by anthropometric data, for the right leg and only 11.93% for the left leg.

6 Conclusions

The control parameters provided by MGM test are important for the estimation of neuromuscular control of athletes. For a trainer is significant that he is able to assess the extent to which athletes respond to stimulus and how quickly they adjusts to unexpected situations that are common during competitions.

An important observation is related to the fact that we can expand the findings on control parameters of MGM test (one-legged vertical jump) to study the behavior of upper limb, considering that neuromuscular control ability is of the same type.

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