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Original Article

Study Regarding the Bio-Motor Capacity of Division A Female Handball Players

RAȚĂ GLORIA[1], HILLERIN PIERRE DE[2], RAȚĂ BOGDAN CONSTANTIN[1], RAȚĂ MARINELA[1], ANDREI, CARMEN[2], BOTEZATU CRISTINA[2]
[1]*VASILE ALECSANDRI University of Bacău, ROMANIA*
[2]*National Institute of Sport Researce, ROMANIA*

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Abstract
This paper presents a study trying to assess the level of bio-motor capacity recorded by the Stiinta Bacau Sports Club female handball players, at the beginning of their training period. For this assessment, we chose as an evaluation test, the "15 jumps" drill, performed using both legs, only the right leg, and only the left leg. As an assessment device, we used a DELSYS Myomonitor IV 16 channels electromyograph.
The results recorded in August 2011 have emphasized the fact that the average unit power had individual average values between 3.13 and 5.26 W/kg body, and a general average value of 3.92 W/kg body, for the take-off height, the individual average values were between 22 cm and 46 cm, with an average group value of 29 cm, the repetition speed had individual values between 0.27 and 0.17 s, with a group average of 0.21 s. The energetic variability coefficient values for this group of female players were between 0.81 and 4.49%, with an average of 2.10%, which shows an excessive automatism, deduced from the two-leg take-off value, and thus a low effectiveness during competition situations, while the structural variability coefficient values were between 4.33 and 22.04%, with an average of 8.40%, which draws attention to the fact that one of the female athletes is subjected to the risk of injury. The hypothesis stating that the players composing the handball team have high values regarding the power indicators, and an energetic variability coefficient, and a structural variability coefficient that allow an effective activity, was not confirmed. Creating an individualized training program, according to each player's training level, constitutes a primal condition for any training process.
Keywords: assessment, bio-motor, capacity, female handball players

Introduction

The assessment conducted at the beginning of the training period in handball is a mandatory endeavor that provides information regarding the bio-motor level of the team's players, information that constitute also a starting point for the orientation of the training process. The athletic result, represented by the score recorded during a competition, is determined by the quickness of the performances, by the power expressed in all segments. The actions of all the six players in the court depend mainly on their experience and value, and secondly, on the opponents' actions. The multitude, the diversity, and the precision of the individual and collective actions, but especially the quickness of the performances, depend on the complexity of the thinking process and creativity of the team's players, on the developed power that can be analyzed through the values of the assessment indicators.

The "15 jumps" drill consisted in "a succession of jumps in place, linked between them, in which the elastic component is very important" (Nicu Alexe, 1993), during which "the muscle is similar to a two-cycle engine... and the energy is divided to the whole *motor cycle* that comprises the contractile and relaxation stage" (Vasilescu and Margineanu, 1979, page 80), and it represented an assessment possibility that allowed us to perceive certain information, important for designing the training process.

"The take-off height body weight ratio" (Epuran, 2005, page 362) presents us with information regarding the power that can be developed in the lower limbs. This developed power greatly determines the athletic outcome. It can be assessed, in the lower limbs, through the vertical take-off drill, and it is given by the athletes' ability to synchronize the contact of their soles to the floor, and the action of pushing the floor away. The vertical take-off is influenced by the value of the flexion angle. When this is under 90º, it "increases the quantity of elastic energy" consumed for performing of the take-off (Cordun 2009, page 171). "The vertical jump height, respectively the top point of the general weight center of the body depends on the height of the body mass center of the body during the take-off and on the flight height, the vertical movement, on the duration of the air ascension", but also on the developed power, on the ground contact time, and, not in the least, on the reaction force of the support, whereas the latter "depends on the forces applied on the core by the head and arms, and on the forces of the hip, knees and ankles" (Rață, 2001, page 75). These aspects, gathered from the specialized literature draw attention towards the way in which the control drill can be performed. The take-off power is

Corresponding Author:: Rață, Gloria *Email:* gloria_rata50@yahoo.com

measured with equipment testing the strength-speed qualities in the lower limbs, emphasizing the energy and control parameters; this equipment was in this case a DELSYS Myomonitor IV 16 channels electromyograph. With this drill we can get information regarding the basic elements of the neuro-motor, energetic, and control skills at the level of triple extension, during a maximal force-speed effort. The test is performed barefooted, and it is comprised of three series of 15 jumps in place each, performed using both legs, only the right leg, and only the left leg, and recorded using the electromyograph. Out of the 16 channels, we used 14 for the electrodes that would collect the values of the electrical activity in the muscles, and 2 channels for the pressure sensors to emphasize the contact with the floor. The data gathered through the 16 channels was recorded simultaneously. The EMG electrodes were positioned 7 for each leg, on the main muscle groups of the thigh and calf (quadriceps femoris, vastus medialis and lateralis, biceps femoris, tibialis anterior, gastrocnemius, being interested especially in the relation between the biceps femoris and the quadriceps femoris), and the pressure sensors were put each on one leg, on the tip of the big toe.

In this study we tried to assess the level of bio-motor capacity recorded by the female handball players, at the beginning of their training period. We objectified, through specific parameters, the energetic aspects resulted from the strength-speed quality levels: the average unit power (**Pu** - W/kg); – the average flight height (**H flight** - cm); the repetition speed as a speed parameter (**V rep.** - ms), which represents actually the average time of contact with the floor that is necessary for propulsion; the energetic variability coefficient (CVE), and the structural variability coefficient (CVS).

Hypothesis

Performing, at the beginning of a competition season, a verification of the skill level constitutes, in professional sports, a mandatory condition before creating the planning and prognosis of the training process, and achieving the envisaged competition results. The value of the indicators resulted from the 15 vertical take-offs using both legs, only the right leg, and only the left leg, can be objective indicators for assessing the high performance capabilities of a team.

In this study, we started from the hypothesis stating that the players composing the handball team have high values regarding the power indicators, and an energetic variability coefficient, and a structural variability coefficient that allow an effective activity.

Research methods and techniques

The subjects of this study were12 female handball players from the National Division A. They were between 18 and 26 years old, they had a good competition experience, going through a training process of 10-16 years.

The research methods we used were: the study of the specialized literature, the testing method and the case study method, the statistical-mathematical method, the analysis method; for the analysis of the results we used: the arithmetical mean, the maximum accomplished value, the maximum possible value.

In this study we conducted ***assessment tests*** that tried to show the anthropometric development (weight, height), and the bio-motor capacity level, through the 15 successive take-offs test (15 successive jumps performed using both legs, only the right leg, and only the left leg).

For the analysis of the bio-motor capacity, we used as indicators: the average unit power (PU), the average flight height (H_flight), the maximum flight height (HMax), the maximum accomplished power (PMr), the maximum possible unit power (PMp), the repetition speed/the average ground contact time (Vrep), the energetic variability coefficient (C.v.en.), and the structural variability coefficient (C.v.st.). The data in this study was recorded in August 2011.

Results of the research – analysis, interpretation

The results recorded during the assessment were inserted in three tables: Table 1- Individual results for each of the measured energetic parameter, and the descriptive statistical parameters calculated for this group of female athletes, Table 2 - Individual results for the unit power (average, maximum possible, and maximum accomplished) for both legs, and Table 3 - Individual results regarding the energetic variability coefficient and the structural variability coefficient.

Regarding the results of the **anthropometric indicators** we can see that the height has individual values between 1.75 m and 1.64 m, with an average of 1.75, and the weight was between 82 kg and 53 kg, with an average of 66.77 kg (Table 1). We can emphasize the fact that there are differences between the 12 female players that can influence the athletic outcome, differences both in height and weight.

Regarding the results for the **bio-motor capacity**, represented by the analysis indicators calculated from the values recorded during the "15 jumps" drill, we observed a series of aspects that shows a lack of homogeneity in the players, regarding the level of skills and motor habits.

Table 1: *Individual results for each of the measured energetic parameter, and the descriptive statistical parameters calculated for this group of female athletes*

No.	Name	I. B.		P. U. (W/Kg)			Dif. P 2pic-(Pstg+Pdr)		Assymetry		(H.z) (cm)			V. Rep. (s.)		
		Height [m]	Weight[kg]	2 legs	right	left	W/kg	%	W/kg	%	2 legs	R.	L.	2 Pic.	R.	L.
1	A.P. D.	1,7	60	3,82	2,12	2,66	-0,96	-25,15	-0,54	-25,27	0,25	0,13	0,18	0,2	0,3	0,29
2	C._A.	1,77	59	4,12	2,82	2,98	-1,68	-40,88	-0,16	-5,68	0,3	0,19	0,21	!!0.22	0,29	0,28
3	C._A.	1,74	70	4,58	2,41	2,76	-0,58	-12,74	-0,35	-14,7	0,31	0,16	0,18	*0.17	0,31	0,28
4	C._L.	1,7	63	~5.26	3,2	2,99	-0,93	-17,79	0,2	6,35	0,39	0,22	0,2	0,18	0,27	0,25
5	C._A.	1,78	60	4,07	2,36	2	#-2.28	-56,08	-1,64	-69,32	0,29	0,16	0,18	!!0.23	0,31	0,23
6	C._A. M.	1,78	69	4	2,29	2	##-0.3	-7,44	0,29	12,56	0,27	0,15	0,13	0,2	0,31	0,31
7	I._I.	1,8	73	3,68	1,83	1,92	##-0.07	-1,98	-0,09	-4,87	0,25	0,12	0,13	!!0.23	0,34	0,33
8	M._D.	1,82	82	**3.17	1,61	1,77	##-0.21	-6,69	-0,16	-9,82	0,22	0,11	0,12	!!0.26	0,38	0,34
9	P._L.	1,76	74	**3.13	2,21	1,89	#-2.97	-94,83	-1,68	-75,7	0,22	0,14	0,14	!!0.27	0,29	0,46
10	R._M.	1,74	61	3,92	2,72	2,39	-1,19	-30,32	0,33	12,17	0,26	0,17	0,16	0,2	0,26	0,29
11	S._C.	1,76	66	3,88	1,76	2,98	-0,86	-22,2	-1,22	-69,17	0,25	0,1	0,2	0,19	0,3	0,26
12	V._M.	1,76	78	3,81	2,29	2,3	-0,78	-20,53	-0,01	-0,58	0,24	0,13	0,13	0,18	0,25	0,25
	average	1,75	66,77	3,92	2,47	2,37	-1,30	-34,82	-0,29	-16,50	0,29	0,16	0,16	0,21	0,29	0,29
	st. dev.	0,05	8,11	0,54	0,71	0,66	1,13	33,45	0,80	32,82	0,07	0,05	0,07	0,13	0,05	0,06
	av+st.dev.	1,80	74,88	4,46	3,18	3,42	-0,17	-1,36	0,52	16,32	0,35	0,21	0,27	0,34	0,34	0,35
	av-st.dev.	1,70	58,66	3,38	1,76	2,09	-2,43	-68,27	-1,09	-49,32	0,22	0,11	0,12	0,08	0,24	0,24
	maximum	1,82	82,00	5,26	3,20	2,99	-0,07	-1,98	1,32	29,50	0,39	0,22	0,21	0,27	0,38	0,46
	minimum	1,64	53,00	3,13	1,61	1,77	-4,09	-115,97	-1,68	-75,70	0,22	0,10	0,12	0,17	0,25	0,23
	CV [%]	2,61	12,14	13,66	28,88	24,13	0,00	0,00	0,00	0,00	23,31	29,79	37,63	51,99	17,81	19,51

*Legend: NP= First name, last name; IB = biological indicators; PU= average unit power: Dif.2 pic. - (Pstg+Pdr) = difference between the average two-leg take-off power and the sum of the averages of the right leg and left leg power; H.zbor = the average take-off height; V. Rep. = average repetition speed; !! - speed deficit, # - strength excess, ~ Good unit power, **-Low unit power , ## - strength deficit,* - good speed*

The recording of the **15 two-leg jumps** (Table 1) has proven that:

- the ***average unit power (PU)*** has dispersed individual values situated between 5.26 and 3.13 W/kg body, with an average value of 3.92 W/kg. body. This distribution shows that the 12 female players are not homogeneous, or at least close, as level of skills and training. Only one player recorded a very good value of 5.26 W/kg body, while two players, with values of 3.13 W/kg body, are very low on the training and skill scale, and are situated well below average. Six players have individual average values below the group average, one has the same values as the group average, four recorded values a little above the average, and one has a very good value. The big difference between the individual values are also emphasized by the large values of the variability coefficient and of the standard deviation, which show the group's dispersion and lack of homogeneity;
- the spring, or the ***take-off height (H.z)*** values are between 22 cm and 39 cm, with a group average of 29 cm, which shows large differences regarding the skill level. Seven players have individual average values below the group average, one has the same values as the group average, and four recorded values above the group average. These values also, together with the standard deviation (0.07), and the variability coefficient value (23.31), prove that there are large differences between players, regarding their training.
- the ***repetition speed (V.rep.)*** has individual values between 0.27 and 0.17s, with an average group value of 0.25 s. In this case, five of the subjects had individual average values larger than the average group value, and seven of them had smaller values than the average group value. This aspect emphasizes a low level of performance speed, determined by a deficit in strength and speed. Five of the players have a deficit in speed (marked in Table 1 with "!!"), which influences directly the athletic outcome, because handball is a sport in which speed is of great importance;

In the **15 jumps using only the right leg** drill (Table 1), the recorded values show that:

- the ***average unit power (PU)*** has dispersed individual values situated between 3.20 and 1.61 W/kg. body, with an average value of 2.47 W/kg. body. The 12 players' values are distributed on a large scale, which shows that their training levels are different. Only one player recorded a very good value of 3.20 W/kg body, while three players had values between 1.61 - 1.83 W/kg body, which are very low on the training and skill scale, and are situated well below average. Nine players have individual average values below the average group value, and three present values that are slightly higher than the group average.

- the spring / ***take-off height (H.z)*** values are between 22 cm and 10 cm, with a group average of 16 cm, which shows large differences regarding the skill level. Seven players have individual average values below the group average, one has the same values as the group average (16 cm), and four recorded values above the group average;

- ***the repetition speed (V.rep.)*** has individual values between 0.38 and 0.25 s, with an average group value of 0.29 s. In this case, seven players have individual average values larger than the average group value, three of them have smaller values, and two of them have values that are equal to the group average. This aspect emphasizes a low level of the performance speed, determined by a deficit in strength, but also a low ability in transmitting the nervous impulses;

In the **15 jumps using only the left leg** drill (Table 1), the recorded values show that:

- the ***average unit power*** has dispersed individual values situated between 2.99 and 1.92 W/kg. body, with an average value of 2.47 W/kg. body. The 12 players' values are distributed on a large scale, which shows that their training levels are different. Three players recorded very good values, between 2.99 - 2.98 W/kg body, while three players had values between 1.77 - 1.92 W/kg body, which are very low on the training and skill scale, and are situated well below average. Six players have individual average values below the average group value, and three present values that are slightly higher than the group average.

- the spring / ***take-off height (H.z)*** has values between 21 cm and 12 cm, with a group average of 16 cm, which shows large differences regarding the skill level. Five players have individual average values below the group average, one has the same values as the group average (16 cm), and six players recorded values above the group average;

- ***the repetition speed*** has individual values between 0.46 and 0.23 s, with an average group value of 0.29 s. In this case, four players have individual average values larger than the average group value, six of them have smaller values, and two of them have values that are equal to the group average. This aspect emphasizes a low level of the performance speed, determined by a deficit in strength, but also a low ability in transmitting the nervous impulses;

Regarding the **possibility of improvement for the strength-speed quality** in the lower limbs, resulted from the data recorded in Table 2, we can say that it exists.

Table 2 - *Individual results for the unit power (average, maximum possible, and maximum accomplished) for both legs*

Nr. Crt.	Name	Unit Power (W/Kg)			Growth potential	Possible growth potential
		P U	Max Acc. PU	Max. Poss. PU	%	%
1	A.P. D.	3,82	4,17	4,18	9,16	9,42
2	C.A.	4,12	4,39	4,42	6,55	7,28
3	C.A.	4,58	4,73	4,84	3,28	5,68
4	C.L.	5,26	5,51	5,59	4,75	6,27
5	C.A.	4,07	4,39	4,48	7,86	10,07
6	C.A. M.	4	4,13	4,2	3,25	5,00
7	I.I.	3,68	3,96	4,02	7,61	9,24
8	M.D.	3,17	3,37	3,42	6,31	7,89
9	P.L.	3,13	3,51	3,83	12,14	22,36
10	P.M.	3,52	4,32	4,57	22,73	29,83
11	R.M.	3,92	4,1	4,13	4,59	5,36
12	S.C.	3,88	3,98	4	2,58	3,09

In Table 2 we can see that all of the female athletes had maximum accomplished power values between 3.37 and 5.51 W/kg body, which were larger than the average unit power values, comprised between 3.13 and 5.26 W/kg body. We can also observe that for each player there is the possibility to improve her maximum unit power, between 0.01 and 0.32 W/kg body. The growth potential of the strength-speed quality in the lower limbs is different from one player to another, it being higher for two players (PL and PM) and smaller for the other players.

Regarding the ability to control the energy resources, measured through the energetic variability coefficient (CVE), and the ability to control the body movements, measured through the structural variability coefficient (CVS), the data is presented in Table 3.

Table 3: *Individual results regarding the energetic variability coefficient and the structural variability coefficient*

No.	Last name, first name	Energ. Variab. Coef. (%)			Struct. Variab. Coef. (%)		
		2 legs	right	left	2 legs	right	left
1	A.P. D.	2,71	6,1	5,44	6,89	6,27	8,38
2	C.A.	~ 1.54	3,63	2,18	8,82	2,61	7,05
3	C.A.	~ 2.31	2,61	3,17	4,72	7,76	4,38
4	C.L.	~ 1.58	3,7	4,22	8,04	5,39	6,26
5	C.A.	4,2	3,08	4,15	6,7	5,18	6,75
6	C.A.M.	~ 1.73	4,03	2,66	4,9	4,69	3,92
7	I.I.	~ 1.93	6,51	2,46	10,88	8,06	6,1
8	M.D.	~ 1.77	7,64	6,2	6,65	6,3	5,81
9	P.L.	4,49	3,74	3,87	* 22.06	3,61	*52.49
10	R.M.	~ 1.62	3,44	3,77	4,33	2,66	4,57
11	S.C.	~ 0.81	2,23	2,09	5,55	2,33	7,04
12	V.M.	~ 1.24	2,93	2,24	10,15	6,62	4,82
	average	2,10	3,92	3,45	8,80	5,09	9,22
	st. dev.	1,06	1,72	1,26	4,74	1,83	12,59
	maximum	4,49	7,64	6,20	22,06	8,06	52,49
	minimum	0,81	1,35	2,09	4,33	2,33	2,25

Legend:* - high risk of injury; ~ -excessive automatism.

The energetic variability coefficient (CVE) values recorded by the 12 female players during the "15 jumps" drill performed using both legs, show that regarding the ability to control their energy resources during an unspecific movement, two of the athletes (C.A and P.L) presented a probability of error in the control of movement endings, giving variability performances that exceed the normality interval of the group. These aspects can lead to imprecision at the end of a movement during passes, or any other technical performances dependent on the control of a movement's final stage. The other players have a high degree of automatism in their movements, which is unfavorable for handball, due to its specific demands. An excessive automatism can lead to the opponents easily guessing your tactics, your technical approach. This, in turn, leads to a very weak game, most of the times ending with unexpected misses. The values for the energetic variability coefficient, which are between 0.81 and 4.49%, with an average of 2.10% (Table 2), emphasize an excessive automatism, which can be clearly deduced from the value recorded in the two-leg take-off, thus resulting in a low effectiveness during competitions. Only in two of the 12 female athletes we did not observe any excessive automatisms, they were handball players who had a coefficient of over 4%;

The Structural Variability Coefficient (CVS) presents the ability to control your movements when preparing to make contact with the floor, with the ball, with the opponent, which is the quality of the body structure in anticipation of this contact. Regarding the values of this coefficient, the higher the score is, the higher the probability of injury. Two of the 12 players (P.L. and P.M.) present a very high risk of injury. The values for the structural variability coefficient, which are between 4.33 and 22.04%, with an average of 8.40% (Table 2), indicate that one of the female athletes is subjected to a risk of injury.

Conclusions

The analysis of the results recorded in August 2011 emphasized a series of aspects.

- The average unit power recorded individual values between 3.13 and 5.26 W/kg. body, with an average value of 3.92 W/kg. body.
- For the take-off height, the individual average values were between 22 cm and 46 cm, with an average group value of 29 cm;
- The repetition speed has individual values between 0.27 and 0.17s, with a group average of 0.21s.
- These values emphasize a deficit of strength and speed, an excessive automatism, which can be clearly deduced from the value of the energetic variability coefficient in the two-leg take-off, thus resulting in a low effectiveness during competitions.
- The values for the energetic variability coefficient, which are between 0.81 and 4.49%, with an average of 2.10% (Table 2), emphasize an excessive automatism, which can be clearly deduced from the value recorded in the two-leg take-off, thus resulting in a low effectiveness during difficult game situations.
- The values for the structural variability coefficient, which are between 4.33 and 22.04%, with an average of 8.40% (Table 2), indicate that one of the female athletes is subjected to a risk of injury.

- The hypothesis stating that the players composing the handball team have high values regarding the power indicators, and an energetic variability coefficient, and a structural variability coefficient that allow an effective activity, was not confirmed.
- Creating an individualized training program, according to each player's training level, constitutes a primal condition for any training process.

References

Cordun, M., 2009 *Kinantropometrie,*Edit. CD PRESS, Bucureşti.
Epuran, M., *Metodologia cercetării activităţilor corporale, Exerciţii fizice, Sport, Fitnes,* Edit. FEST, Bucureşti
Hillerin, J.P. 1999, - *Propunere de interpretare a variabilitatii timpilor de contact cu solul si de zbor in proba "MGM-15", cu indicatori ai calitatii controlului neuromuscular al fazelor interactiunii de tip motric* - Conferinta nationala de psihologie, 27 -29 mai 1997, Bucureşti.
Hillerin, J.P., *1997, Despre proba Miron Georgescu modificată. Material de uz intern, republicat, CCPS,* Bucureşti. Â
Hillerin, J.P., Enescu, M., 1997, *Raportul automatizare-variabilitate in sportul cu adversitate directă,* Mutaţii în sportul de performanţă la sfarşit de secol XX", CCPS, p. 104, Bucureşti
Nicu, A. , 1993, *Simularea si simulatoarele in teoria si practica antrenamentului sportiv in* "Antrenamentul Sportiv Modern", Bucuresti, Edit. -Editis, p. 396, Bucureşti.
Niculescu, M., Vladu, L., 2009, *Performanţa Sportivă,* Edit. Universitaria, Piteşti.
Raţă G., Grapă F., Raţă B-C, Manole L., Ciocan D., 2010 *Study regarding the correlations between the flight height and the take-off power, using one leg, and using two legs, in a division female volleyball players*, SPORT SCIENCE, ISSN 2066-8732, Bucureşti, XIX Nr. 3/4 .
Raţă G., Rata B-C., Manole L., 2010, *Study regarding the dynamics of the explosive force manifestation in the lower limbs, in 8- 18 years old boys* , Citius Altius Fortius Journal of Physical Education and Sport (JPES) Issue Nr. 1 An 2010, ISSN 1582-8131, România, Piteşti
Raţă G., Raţă B., Raţă M., Raţă GH., 2010, *The explosive force for the two legs and for one leg in the stiinta bacau female handball players,* Educaţie Fizică şi Management în Sport Fascicula XV, , Galaţi. University Press, ISSN 1454-9832, România
Vasilescu, V., Marginean, G., 1997, - *Introducere în neurobiofizica*, Editura Ştiinţifică, Didactică şi Enciclopedică, p. 80, Bucureşti.