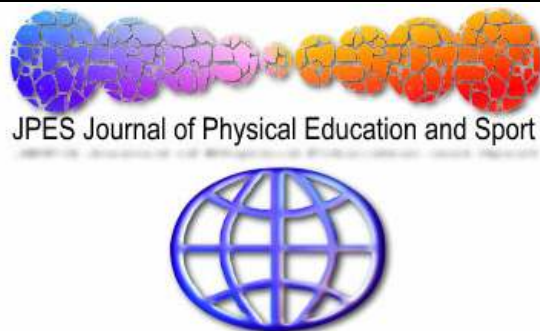




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ORIGINAL RESEARCH

TRAINING STRATEGY DEVELOPMENT OF EXPLOSIVE STRENGTH IN VOLLEYBALL

Marian Crețu, PhD¹ Larisa Vladu, PhD²^{1,2}The University of Pitești, Romania**Key words:** *muscular training, volley ball, izometrics, plyometric..***Abstract**

The muscular training is one of the most important factors and in some cases the most important admixture of sport training, with a view to reaching high performances, influencing the way the preparation is undergone. This training must be completed on a uniformly and balanced basis for each of the motric aptitudes required by the performance sport. The purpose of this paper is that of improving the muscular preparation by introducing alternate contracts schemes inside the training of the volley players (16-18 years).

Introduction

At the level of the high performance teams we notice an acceleration of the game rhythm, an increase of the number of attack stimulations, and a modification of the attack allotment over the net, with the purpose of increasing the incertitude degree and preventing the efficient organization of the opposite defense. One also notices the increase of the ball force which becomes more and more a team's weapon of attack.

The actual volley game is characterized by the increase of the execution speed and default of the reaction speed, which asks for the more intense training into effort of the solicited segments and of the whole body, as well as **the increase of the explosive force**. One other improvement is that of the complexity and variety of the technical and tactical actions, which led to the shortening of the pauses between the game phases, the increase of the effort intensity and to a limitation of the recovery time. The metabolic substratum of the effort is especially the anaerobe, alternative for short periods with the aerobe one. The locomotive apparatus is constantly solicited at the lower and higher level. The cardio-vascular apparatus solicitation is medium, with the exception of the submaximal intensity effort phases. The respiratory function is very much solicited all through the game; in the disputed game phases the organism can contract a pretty high oxygen need.

For the **performance** level (juniors), the strategic objective is centered on: improvement of the game actions which are integrated to the collective tactics and subordinated to the efficiency requests of competitions, doubled by the necessity of accomplishing a high level of **specific physical and psychical training**.

The volley instruction must be realized as a specialized process of developing and forming the player's personality, acting towards the goal of a maximal performance capacity, taken into consideration both as a whole and per its biological, technical and tactical, motrical, psychological and theoretical components.

The muscular development into a homogenous form, without disequilibrium encumbering the ulterior preparation and sport performance is needed in order to form players. Attention must be focused especially on developing the great

muscular groups, while the force training must be gradually introduced into the preparation, first making use of the exercises based on one's body weight, then facile exercises with medicinal balls, weight exercises, and ending with exercises specific to the practiced sport area, ensuring a high competitive level..

The physical preparation represents a determined structural side of the sport training inside the game of volley ball and an important content factor conditioning the technical-tactical level and the performance capacity. The more and more obvious specificity advanced through the biomechanical structures appropriated to the trial, game, influencing means, but also through the degree of the respective physical and psychical effort, is conclusively oriented towards developing the motric qualities specific to the volley game.

Measuring and evaluating the female sportive neuro-muscular qualities in the explosive effort, by the intermediary of simple, non-specific movements, the vertical jump, may orient the muscular training both in the force-speed relation as in the general control of the movement phases for the inferior level. The important parameters investigated are the following: the height of the weight center, as a consequence of the impulsion projection by a maximal singular effort or by using the elastic muscular component and the take-off, or the average of the heights obtained by repeatedly jumps under effort conditions, as a motric action which, due to its form, is a part of the contest exercises of basic volley techniques an essential game phases (Bompa T. 2002)

Hypothesis: taking into consideration the predetermined role of the muscular preparation in defining the physical training for female Volley players, we presuppose that by applying the alternate regimes with a view to developing the specific force, we create the premises of a more complex preparation if compared with the usual methods applied by trainers.

Methods and Instruments

In order to evaluate the junior female sport performances, the **tests method** was used, by making use of the **Bosco Protocol**, applied on the force measuring platform Quattro Jump tip Kistler 9290AD.

Other investigation methods we appealed to were: the analysis and special field of literature data generalization, the pedagogical experiment, the statistic mathematical method.

Table 1 The Bosco Protocol evaluates 6 different jump types and calculates a variety of [parameters](#):

	Designation	Jump Type	Description
I	SJ	Squat Jump	Single jump starting from knees bent at 90 degrees
	SJbw	Squat Jump + Body Weight	Squat jump with an additional load of up to one body weight
II	CMJ	Countermovement Jump	Single jump starting with straight legs with a natural flexion before takeoff
	CJbref	Continuous Jump Bent Legs Reference	Series of 5 jumps with bent knees, used as reference to compare with CJb (15..60s)
III	CJs	Cont. Jump straight leg	Series of 5 jumps with straight knees
IV	CJb	Cont. Jump Bent Legs	Series of 15..60s jumping with knees bent

In order to test the force of the inferior limbs, we used in our paper *the platform of force measurement „Quattro Jump”*, accompanied by five of the six tests of the protocol:

Protocolul Bosco can evaluate the following by its components:

- Explosivity tests, detachment force, non –pliommetrical SJ and pliommetrical CMJ
- Hip force tests, CJbref, CJb
- Reactivity tests, CJs
- Additional tests SJBody weight SJbw, by use of the body weight

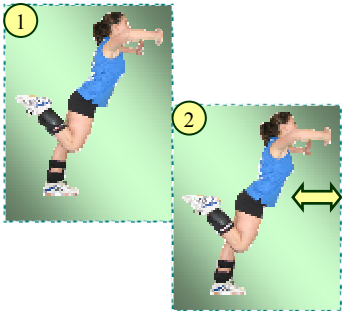
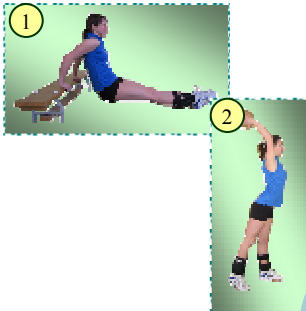
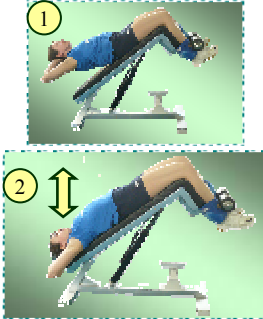
Sample: The experiment took place in the sport gymnasium of the National Highschool Alexandru Dima and at the localization of the Physical Education and Sport Faculty of Pitești, the selected group being the volley ball team of juniour females I, LPS Pitești, participant in the National Volley ball Championship. The lot is formed of 12 female players and is part of the LPS Pitești Sporting Club.

Procedure

The experimental investigation unfolded during the 15th of February 2008 – 15th of June 2008 period. It began with having the female players take 5 trials, then a training schedule was elaborated and used during their preparation.

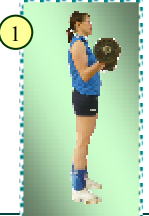
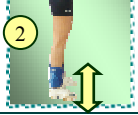
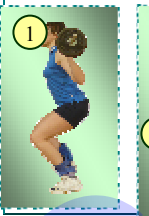
PROGRAMME 1

Table 6

A TYPICAL SESSION OF GENERAL MUSCULAR PROGRESS– by alternating the contraction regymes (isometric-plyometric)					
The warm-up	The superiour limbs muscles		The inferiour limbs muscles		The Abdominal muscles
					
Description: Moderate running.	Description: 1. From one leg standing and having the other one bent, athwart to the wall, arms bending and maintained isometrics (same exercise with the hold of the other leg against the wall). 2. From standing on one leg and having the other one bent, push-up fall (with wall hold) with the body at 45° and come-back to the starting position by pushing.		Description: 1. From tip-standing position, legs apart, maintained isometrics. 2. Jumping on the gymnastics box with two legs.		Description: 1. Lifting the body at 45° and maintained isometrics from a down and backwards position on an oblique surface, head down also. 2. Fast body lifting and come back from a down and backwards position on an oblique surface, head down also.
Dosage: 5 X 50-60 m	Dosage: 10'' isometrics, 14 of arms stretching and bending + 10'' isometrics, 14 of arms stretching and bending X 3-5 SERIES		Dosage: 10'' isometrics, 7 jumps (40 cm) + 10'' isometrics, 7 jumps (40 cm) X 3 SERIES		Dosage: 10'' isometrics, 14 lifts + 10'' isometrics, 14 lifts X 3 SERIES
Pause: 4 seconds	Pause: 2 minutes after each session		Pause: 1 minute and 30 sec		Pause: 1 minute and 30 sec
Methodical indications: The warm-up must be complete and thus put together on a muscular and articular basis as to raise up to the intensity of the session to come.	Methodical indications: The height of the fall must be chosen in function of the muscular force of the superiour part of the player, but also of his or hers dorso-abdominal girdle.		Methodical indications: We look for the maximal lift of the weight centre, overcoming obstacles without excessive flexing of the inferiour limbs.		Methodical indications: Straight back. The lift is done rapidly, without pauses.

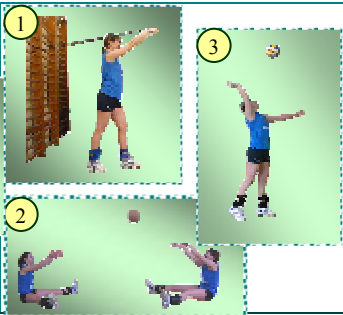
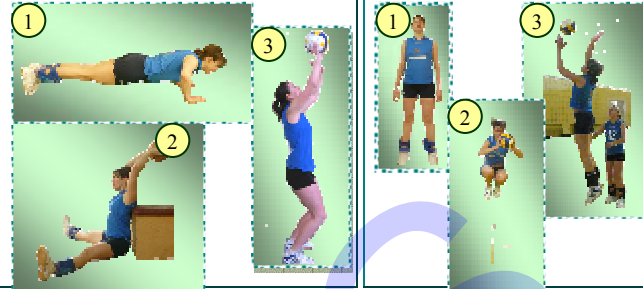
PROGRAMME 2

Table 7

A TYPICAL SESSION OF MAXIMAL FORCE PROGRESS— by alternating the contraction regymes (isometric-plyometric)					
The warm-up	The superiour limbs muscles		The inferiour limbs muscles		Relaxation
	 	 	 	 	
Description: 1. Moderate running; 2. Progressive rhythm running; 3. Speed running; 4. High speed running.	Description: 1. From backwaerd lying down on the gymnastics box, holding weights, elbow bending and maintained isometrics. 2. Weightsd push-ups from lying down.		Description: 1. Lifting the weight and maintained isometrics from standing. 2. Weight lifting at chest level and descending it from standing.		Description: Slight running
Dosage: 1. 6-7 minutEs; 2. 2 or 3 X 100 m; 3. 2 X 60 m; 4. 2 X 40 m.	Dosage: 10'' isometrics, 7 chest push-ups with a 60-90%weight + 10'' isometrics, , 7 chest push-ups with a 60-90%weight X 3-5 SERIES		Dosage: 10'' maintained isometrics, 7 knees flexing + 10'' maintained isometrics, 7 knees flexing X 3-5 SERIES, with a 60-90%weight		Dosage: 5-6 minutes
Pause: 3 minutes	Pause: 1'30'; 2' after each series; 5' after the last series		Pause: 1'30'; 2' after each series; 5' after the last series		Pause: -
Methodical indications: The warm-up must be complete and thus conceived as to intensively solicit the muscular mass to be used during the session.	Methodical indications: The weight held at the shoulder's level. Each series is clocked.		Methodical indications: Too heavy weights are to be avoided here. The energetic use being very important, the maximal recovery between series will be used.		Methodical indications: Ample breathing movements.

PROGRAMME 3

Table 8

A TIPYCAL SESSION OF THE SPECIFIC FORCE PROGRESS (main thrower)– by alternating the contraction regymes (isometric-plyometric)					
The warm-up	The superiour limbs muscles		The inferiour limbs muscles		Relaxation
					
Technical description: 1. Running. 2. Stretching exercises	Technical description: 1. From a position of legs apart, the left leg forwards, the right arm lifted, holding the end of an elastic band. Taking the arm forward and stretching the band, with maintained isometrics. 2. Two players facing other two, from a seated position: throw of the medicinal ball. 3. Front, high serve.		Technical description: 1. Maintained isometrics from a tip position with legs apart. 2. Lateral jumps on two legs over the fences and holding the volley ball . 3. Ball-throw attack.		Technical description: 1. Maintained semiflexed position, legs bent 90°. 2. Two mattresses on the ground, 7 canes placed on them, at a 50 cm distance one from another. Jumps over them. 3. Attack throw.
Dosage: 1. 3-5 minutes 2. 10-20 seconds of maintaining it	Dosage: 10'' isometrics, 14 throws (3 kg) , 14 serves + 10'' isometrics, 14 throws (3 kg) , 14 serves X 3-5 SERIES		Dosage: 10'' isometrics, 7 jumps, 5 attack throws + 10'' isometrics, 7 jumps, 5 attack throws X 3 SERIES		Dosage: 10'' isometrics, 7 jumps, 5 attack throws + 10'' isometrics, 14 jumps, 5 attack throws X 5 SERIES
Pause: 1. 2 minutes 2. 10 seconds between exercises	Pause: 1'30'; 2' after each series; 5' after the last series		Pause: 1'30'; 2' after each series; 5' after the last series		Pause: -
Methodical indications: The warm-up must solicit the muscular masses to be worked during the session.	Methodical indications: Arms forward, the body slightly pushed forward also.		Methodical indications: The body is maintained in a vertical position and the knees are bent forwards.		Methodical indications: Ample breathing movements.

Results and discussions:

Table 9 The results of the initial-final testing and the dynamics of the jump height indicator for the 4 tests

No.	First and last name	h SJ		h CMJ		h CJbref		h CJS	
		TI	TF	TI	TF	TI	TF	TI	TF
1.	C.M	36.3	38.9	37.7	40.6	37.8	38.2	38.5	39.5
2.	Pr.A	38.1	40.7	38.2	40.6	34.8	38.6	41.8	43.5
3.	Pa.A	36.5	44.4	38.5	41.4	32.8	35.7	34.2	37.4
4.	M.A.	38.2	42.6	37.1	39.8	38.5	41.7	36.6	40.5
5.	I.M.	36.4	39.5	38.6	42.6	33.8	36.5	31.7	36.3
6.	M.A.	34.7	38.8	35	39.5	32.4	37.5	36.7	40.0
7.	G.D.	42.4	45.1	42.7	46.8	42.9	46.6	39.1	43.8
8.	T.R.	33.3	38.3	35.9	37	32.0	36.3	35.9	42.5
9.	T.A.	42.1	45.7	41.4	45.1	36.4	39.2	3	38.1
10.	P.D.	33.1	37.7	32.8	36.3	31.7	34.5	36.2	39.3
11.	C.A.	38.8	42.5	40.5	44.3	36.1	39.6	44.3	46.3
12.	U.D.	35.8	37.8	34.8	40.4	33.7	38.6	32.9	39.6
	X	37.14	41	37.73	41.2	35.24	38.58	34.24	40.56
	S	2.97	2.94	2.88	3.10	3.29	3.18	10.45	2.92
	Cv	8.01	7.17	7.63	7.53	9.35	8.24	30.53	7.20
	t		8.504		10.385		9.403		2.373
	p		< 0.001		< 0.001		< 0.001		< 0.05

The height indicator (h)

The jump height indicator registered significant increases for la SJ, CMJ and CJb at $t = 8,504$ la SJ, 10,385 la CMJ and 9,403 at CJb for $p < 0.001$. In the final CJs the evolution is significant, $t = 2,373$ $p < 0.05$.

Thus, the average for SJ increases from 37,17 in the initial testing at 41 in the final testing with a 3,8 difference at a very high performance homogeneity: $Cv = 8,01$ and decreases at 7,17 % in the final testing.

For CMJ the average raises from 37,73 in the initial testing to 41,2 in the final testing with a 3,47 difference and a great performance homogeneity of $CV = 7,63$ % at the initial test and 7,53 % in the final one.

In the CJb trial, the average goes up from 35,24 at the initial testing to 38,58 in the final one, with a difference of 3,34 at a great performance homogeneity of $Cv = 9,35$ % and goes down at 8,24 % in the final testing..

In CJs the average raises from 34,24 in the initial test at 40,56 in the final test, with a difference of 6,32 and a lack of homogeneity of performances, as $CV = 30,56$ % in the initial test and decreases at 7,20 % in the final testing, thus proving a large increase in homogeneity.

Table 10 The results of the initial-final testing and the dynamics of the power indicator at the level of the inferior limbs muscles for the 4 tests

No.	First and last name	P SJ		P CMJ		P CJB		P CJS	
		TI	TF	TI	TF	TI	TF	TI	TF
1.	C.M	13.1	17.3	23.8	30.2	26.6	28.4	45.1	46
2.	Pr.A	14.4	16.6	23.2	47.1	19.7	35.3	51.5	47.1
3.	Pa.A	12.3	14.7	21.3	22.4	18.0	32.8	35.3	34.2
4.	M.A.	12.1	14.7	19.7	27.5	17.7	27.9	28.1	35
5.	I.M.	15.6	19.7	20.1	24.1	19.5	21.3	27.6	32.6
6.	M.A.	11.7	15.1	20.2	22.0	18.3	23.8	38.0	34.1
7.	G.D.	18.3	20.1	21.3	24.2	22.5	20.5	41.4	40.2
8.	T.R.	10.2	14.2	20.3	22.8	20.2	19.2	38.5	32.9
9.	T.A.	11.7	14.9	23.2	31.0	21	26.5	37.1	38.6
10.	P.D.	8.2	12.4	19.7	20.5	17.7	19.1	28.1	34.7
11.	C.A.	15.8	17.5	24.7	24.2	26.3	30.5	53.6	50.9
12.	U.D.	14.4	16.9	23.7	24	22.2	31.4	35.7	34.9
	X	13.15	16.17	21.76	26.66	20.80	26.39	38.33	38.43
	S	2.728	2.273	1.83	7.18	3.09	5.56	8.54	6.25
	Cv	20.75	14.05	8.61	26.95	14.87	21.09	22.30	16.27
	t	2.876		2.564		3.341		0.081	
	p	< 0.05		< 0.05		< 0.01		> 0.05	

The power indicator (P)

The average of the power indicator for SJ raises significantly $t = 2,876$, $p < 0.05$ from 13,15 in the initial testing to 16,17 in the final one, with a difference of 3,02 at an average homogeneity of performances $Cv = 20,75$ and decreases at 14,05 % in the final testing.

For CMJ the average of the power indicator increases significantly $t = 2,564$, $p < 0.05$ from 21,76 in the initial testing to 26,66 in the final testing, with a difference of 4,9 at a very good homogeneity of performances in the initial test $Cv = 8,61$ and increases, becoming a lack of homogeneity for the final testing: $Cv = 26,95$ %.

In the CJb trial, the power average raises significantly $t = 3,341$, $p < 0.01$ from 20,80 in the initial test to 26,39 in the final test, with a difference of 5,59 at a mediocre homogeneity of performances $Cv = 14,87$ % in the initial testing and raises becoming weaker at 21,09 % in the last training.

For CJs the performances average increases in a non-significant matter, $t = 0,081$, $p > 0.05$ from 38,33 in the first test 38,43 at the final test, with a difference of 0,1 and a lack of homogeneity of performances $CV = 22,30$ % in the initial testing and decreases up to 16,27 % in the final test,

Becoming a medium homogeneity.

Table 11 The results of the initial-final testing and the dynamics of the leg equilibrium, (LE), Fast Twitch Fibres (FT), Effect of Prestretch (EP) characteristics for the legs muscles in the 4 tests

No.	First and last name	EP		FT		LE	
		TI	TF	TI	TF	TI	TF
1.	C.M	3.8	4.6	44.6	44.8	1.95	1.69
2.	Pr.A	0.1	0.4	39.9	43.1	2.08	2.63
3.	Pa.A	13.2	22.4	41.4	29.1	1.76	1.95
4.	M.A.	3.0	27.5	50.6	46.6	1.59	1.59
5.	I.M.	6.2	5.1	29.3	27	2.62	1.42
6.	M.A.	0.9	4.6	25.3	25.5	2.04	2.08
7.	G.D.	0.6	9.2	44.9	38.4	1.84	1.84
8.	T.R.	7.9	11.1	31.2	26.8	1.61	1.91
9.	T.A.	1.7	0.9	52.4	43.8	1.71	1.76
10.	P.D.	3.0	1.1	50.6	49.5	1.69	1.59
11.	C.A.	4.3	9.2	44.0	48.4	1.42	2.04
12.	U.D.	21.3	13.1	34.7	46.3	1.91	1.61
	X	5.5	9.1	40.74	39.10	1.85	1.84
	S	6.18	8.53	8.89	9.32	0.31	0.31
	Cv	112.45	93.65	21.84	23.83	16.75	17.33
	t		1.536		0.893		0.067
	p		> 0.05		> 0.05		> 0.05

The Pre-stretch Effect (Re-Use Elastic Energy) (EP) indicates the importance of the benefit produced by the pre-stretch (CMJ compared to SJ). The test results show insignificant evolutions at the level of the experimental group: $t = 1,536$, $p > 0.05$. One notices the effects of the training stimulations and the increase of the results average from 5,5 in the initial testing to 9,1 in the final one, showing the capacity to learn the reuse of the effective elastic muscular energy, thus reaching the optimal, recommended values. At an individual level, we find that a number of 4 female players reach excelency in what this indicator is concerned, 2 are at the optimum level, but the rest of the subjects reach inferior values, showing lack of ability to reuse the muscular elastic energy and a poor efficiency in strong vertical detachments in plyometrics execution conditions.

The percentage of Fast Twitch Fibres (estimation) indicates the percentage of fast muscle fibres responsible for the explosive force. The average of the two tests is kept around the data of 40,74 and 39,10 with insignificant evolutions at the level of the experimental group all throughout the experiment. The estimation of the percentage of fast muscle fibres shows a weak, bellow the average value, also determined by the lack of maturity of the young organism still growing and progressing, with an unstructured age, sex and training type connection.

The leg Equilibrium Index Equilibrium of the functional structure of the leg including three joints (hip, knee, ankle) and the upper and lower leg (thigh, calf)

The average values of 1,85 and 1,84 in the two testing do not go through significant changes $t = 0,067$, $p > 0.05$, but show that the neuromuscular function of the knee, ankle and lower limbs are weaker than the hip and thigh. This is the reason why we may conclude that the force training for the legs muscles must be oriented towards the muscle evolution which consolidates the knee and calf joints, not to mention the neuro-muscular control capacity at this level.

CONCLUSIONS:

- Specific physical preparation must be one of the objectives which have precedence over others, in order to obtain optimal sporting performances;
- The muscular training objectives at this age were established for each period, in order to properly lead to its accomplishment at superior standards, and to favor its manifestation in optimal conditions during the competition period;
- Applying programmes of muscular training inside the preparation of young female volley players I, has contributed to improving the level of the technical executions and of their tactical behavior, a fact confirmed by the fulfillment of the game tasks and performance objectives, and it has also helped to decrease the number of accidents, thus creating premises for prolonging the sporting career.

Bibliography:

1. **Bosco, C., Luhtanen, P. & Komi, P.** (1983). A simple method for measurement of mechanical power in jumping. *European Journal of Applied Physiology*. **50**: 273-282.
2. **Bosco Carmelo Ph.D.**, (1999)– Strength assessment with the bosco, tests, Italian Society of Sport Science Rome.
3. **Cayla J., L., Lacrampe, R.**, (2007) – Manuel pratique de l'entraînement, Editura Amphora, Paris.
4. **Cometti, G.**, (1988) – La pliométrie, IUFUR STAPS, Dijon.
5. **Dyon, N., Gaden, Y.**, (2005) – Musculation et renforcement musculaire du sportif, Editura Amphora, Paris
6. **Fox, E. & Mathews D.** (1981). The physiological basis of physical education and athletics, 3rd edn. Saunders, Philadelphia.
7. **Genson M., G. Di Giantomaso.**, (1988) – VOLLEYBALL, Editura Axone Sport.
8. **Georgescu, M. & Kunstghermanescu, I.** (1982). Aerobic and anaerobic maximal power of Handball players. *XXII World Congress on sports medicine*. Vienna.
9. **Harman, E., Rosenstein, N., Frykman, P., Rosenstein, R. & Kraemer, W.** (1991). Estimation of human power output from vertical jump. *Journal of Applied Sports Science Research*. **5**: 116-200.
10. **Hertogh, C., & Hue O.**, (2002). Jump evaluation of elite volleyball players using two methods: jump power equations and force platform. *Journal of Sports Medicine Physical Fitness*. **42**: 300-303.
11. **Kibele, A.**, (1998) - Possibilities and Limitations in the Diagnosis of Countermovement Jumps - A methodological study. in: *Journal of Applied Biomechanics* 14, 105-117,
12. **Kibele, A.**, (1999) Possible Errors in the Comparative Evaluation of Drop Jumps from Different Heights. in: *Ergonomics* 42, 1011-1014,
13. **Komi P.V.**, (1973) – Measurement of force-velocity relationship in human muscle under concentric and eccentric contraction, *Biomechanics III* ed S Cerquiglini Basel
14. **Lafay, O.**, (2004) – Methode de musculation, Editura Amphora, Paris.
15. **Lamache, S.**, (2003) – Volleyball methode d'entraînement, Editura Chiron, Paris.
16. **McDonagh M.J.N., Davies C.T.M.**, (1984) – Adaptive response of mammalian skeletal muscle to exercise with high loads, *European Journal of Applied Physiology*
17. **Mero A., Jaakkola L., Komi P.V.**, (1991) –Relationship between muscle fiber characteristics and physical performance capacity in trained athletic boys, *Journal of Sport Science* 9
18. **Niculescu, M., Mateescu, A., Crețu, M., Trăilă, H.**, (2006) – Bazele științifice și applicative ale pregătirii musculare, Editura Universitaria, Craiova.
19. **Niculescu, M., Vladu, L.**, (2005) – Volei de la A la Z, Editura Universității din Pitești.
20. **Pasquet, G., Potier, Ph., Robert, Ph., Hascoat, L., Roussey, Th.**, (2004) – Echauffement du sportif, Editura Amphora, Paris.
21. **Sayers, S., Harackiewicz, D., Harman, E., Frykman, P. & Rosenstein, W.** (1999). Cross-validation of three jump power equations. *Medicine and Science in Sports and Exercise*. **31**: 572-577.
22. **Selinger, A., Ackermann-Blount, J.**, (1992) – Power volleyball, Paris, Editura Vigot.
23. **Simion, Gh.**, (2006) – Arta pregătirii forței musculare, Editura Universității din Pitești
24. **Smidt G.I.**, (1973) – Biomechanical analysis of knee flexion and extension, *Journal of Biomechanics* Vol 6
25. **Tihany J., Apor P., Fekete G.**, (1982) – Force-velocity-power characteristics and fiber composition in human knee extensor muscle, *Eur. J. Appl. Physiol.* 48
26. **Vandewalle H., Pere G., Monod H.**, (1987) – Standard Anaerobic Test, *Sport Medicine* Vol 4, N 4
27. **Viitasalo J.**, (1985) –Measurement of force-velocity characteristics for sportsmen in field condition, *Biomechanics IX-A*, Champaign IL, Human Kinetics
28. **Viera, B., Ferguson, B.J.** (2001) – Volley-ball, Editura Vigot, Paris.
29. **Weineck, J.**, (2003) – Manuel d'entraînement, Edition Vigot, 4-eme edition, Paris.