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REPETITION SPEED INFLUENCE ON MAXIMUM HEART RATE IN WEIGHT TRAINING

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ABSTRACT. Changing speed of execution for repetitions is appreciated differently by weight training's practitioners (Diniz, Martins-Costa, Machado, Lima, & Chagas, 2014), aspect discussed by us with many practitioners encountered during our researches in fitness gyms. As a result of the observations made in fitness gyms, we came to conclusion that modification of execution speed determines changes of other factors involved in training programs. Our research took place between February 9 and April 19, 2015, in the gym of Faculty of Physical Education and Sports of the Babeș-Bolyai University of Cluj-Napoca. Our research objectives aimed to determine the maximum heart rate (HR max.) recorded at different speeds of execution and we were interested about the pattern described by these values on 3 different values for speed of execution. We concluded that HR max. doesn't have the same distribution pattern for all subjects included in our study.

Key words: *weight training, heart rate, speed of execution, maximum heart rate, pattern.*

REZUMAT. ***Influența vitezei de execuție a repetărilor asupra frecvenței cardiace maxime în antrenamentul cu greutăți.*** Modificarea vitezei de execuție a repetărilor este apreciată diferit de practicanții antrenamentului cu greutăți (Diniz, Martins-Costa, Machado, Lima, & Chagas, 2014), aspect discutat și de noi cu mulți practicanți cu care ne-am întâlnit în sălile de fitness. Ca urmare a observațiilor întreprinse am ajuns la concluzia că modificarea vitezei de execuție a repetărilor determină modificări ale altor factori implicați în programele de antrenament. Cercetarea s-a desfășurat în perioada 9 februarie - 19 aprilie 2015, în sala de fitness a Facultății de Educație Fizică și Sport din cadrul Universității Babeș-Bolyai Cluj-Napoca. Obiectivul cercetării a constat în înregistrarea valorilor maxime ale FC la diferite viteze de execuție a repetărilor și analiza modelului de distribuție a acestora pe 3 tempouri diferite de execuție.

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Rezultatele obținute sugerează că vârfurile înregistrate pentru FC nu se înscriu 100% într-un anumit model de distribuţie.

Cuvinte cheie: *antrenament cu greutăți, frecvenţă cardiacă, viteză de execuţie, frecvenţă cardiacă maximă, model.*

Objectives

Our research objectives aimed to determine the maximum heart rate (HR max.) recorded at different speeds of execution and we were interested about the pattern described by these values on 3 different values for speed of execution.

Material and methods

The research took place between February 9 and April 19, 2015, in the gym of Faculty of Physical Education and Sports of the Babeş-Bolyai University of Cluj-Napoca.

The research was applied to 11 subjects, students of Physical Education and Sports Faculty of the Babeş-Bolyai University. All subjects enrolled in the study were male, with a minimum of 6 months experience in weight training. Age of participants was between 19 and 25 years (for details see Table 1).

Table 1. Details of the subjects included in research

№	Age (years)	Bodyweight (kg)	Height (m)	Body mass index BMI
1	22	78	1.80	24.07
2	21	80	1.85	23.37
3	21	74	1.75	24.16
4	22	80	1.76	25.83
5	21	67	1.77	21.39
6	22	69	1.72	23.46
7	20	82.6	1.75	26.97
8	19	83.5	1.79	26.06
9	21	67.8	1.72	22.92
10	25	83.2	1.80	25.68
11	19	64.9	1.69	22.72

Muscle groups included in our research were:

- Latissimus Dorsi with the exercise "Back Lat Pull-Downs";
- Pectoralis Major with the exercise "Horizontal Bench Press".

Tempo of execution used in the research was:

- 1010 (1 second for eccentric, 0 seconds for isometric after eccentric, 1 second for concentric, 0 seconds for isometric after concentric);
- 3030 (3 seconds for eccentric, 0 seconds for isometric after eccentric, 3 seconds for concentric, 0 seconds for isometric after concentric);
- 6060 (6 seconds for eccentric, 0 seconds for isometric after eccentric, 6 seconds for concentric, 0 seconds for isometric after concentric).

The workload used in our experiment was 60% of one repetition maximum (1RM). Heart rate (HR) was recorded using our own protocol (Văidăhăzan, Hanțiu, Pop, & Pătrașcu, 2015). Heart rate values were analyzed and extracted from each record with SportTracks 3 (Zone Five Software LLC, 2013).

Each subject participated at 6 sessions interspersed with days of rest. Sessions included in the research were:

- Session 1, 1RM test for Latissimus Dorsi (LD);
- Session 2, 1RM test for Pectoralis Major (PM);
- Session 3, training session with 3 particular tempo (60% of 1RM);
- Session 4, research session with tempo 1010 (60% of 1RM);
- Session 5, research session with tempo 3030 (60% of 1RM);
- Session 6, research session with tempo 6060 (60% of 1RM).

The sequence of research sessions was conducted according to the following design:

- 1RM testing session for Latissimus Dorsi;
- 1RM testing session for Pectoralis Major;
- Rest day;
- One session with execution of 3 tempo;
- Rest day;
- Research session for 1010 tempo;
- Rest day;
- Research session for 3030 tempo;
- Rest day;
- Research session for 6060 tempo.

1RM testing protocol is different between researchers. There are many proposed programs that comply with some main rules regarding the length of the pause between test sets but there is no standardized model. Thus, our protocol was built based on several papers (Kraemer, Fleck, & Deschenes, 2012; Ratamess, 2012; Schwellnus, 2008).

The 1RM session, used by us, was as follows:

- Warm-up;
- Rest for 1 minute;
- Set No. 1 with 50% of predicted 1RM (10 repetitions);
- Rest for 3 minutes;
- Set No. 2 with 70% of predicted 1RM (5 repetitions);
- Rest for 5 minutes;
- Set No. 3 with 100% of predicted 1RM (1 repetition);
- Rest for 5 minutes;
- Set No. 4 with 100% of predicted 1RM (1 repetition);
- Rest for 5 minutes;
- Set No. 5 (if necessary) with 100% of predicted 1RM (1 repetition);
- Rest for 1 minute;
- Cool-down.

All research sessions were led by a scientist helped by an assistant. The exercises included in our research were recorded on camera to analyse the form of repetitions. In order to achieve the desired tempo we used an audio system connected to a digital metronome (Paul Girsas, n.d.). Centralization of data was performed with Microsoft Excel.

Sessions were coded as follows:

- The research session in tempo1010, codes LD_T1 (for Latissimus Dorsi) and PM_T1 (for Pectoralis Major);
- The research session in tempo 3030, LD_T2 (for Latissimus Dorsi) and PM_T2 (for Pectoralis Major);
- The research session in tempo 6060, LD_T3 (for Latissimus Dorsi) and PM_T3 (for Pectoralis Major).

Results

The maximum HR was recorded in each session with the required tempo. Values for Latissimus Dorsi are centralized in Table 2 and for the Pectoralis Major are centralized in Table 3.

Table 2. Maximum HR for Latissimus Dorsi

№	HR max (beats/min.) LD_T1	HR max (beats/min.) LD_T2	HR max (beats/min.) LD_T3	Graphic representation of the distribution pattern
1	170	168	170	
2	142	135	138	
3	169	142	166	
4	133	133	108	
5	164	156	153	
6	144	142	127	
7	162	154	150	
8	145	141	130	
9	109	98	113	
10	161	148	128	
11	152	128	120	
Mean of HR max.	150,09	140,45	136,64	

Table 3. Maximum HR for Pectoralis Major

№	HR max (beats/min.) PM_T1	HR max (beats/min.) PM_T1	HR max (beats/min.) PM_T1	Graphic representation of the distribution pattern
1	162	167	179	
2	141	137	155	
3	173	143	149	
4	120	100	115	
5	140	146	152	
6	125	120	105	
7	146	148	137	
8	150	136	168	
9	100	98	111	
10	158	139	128	
11	138	125	117	
Mean of HR max.	141,18	132,64	137,82	

Chart 1 shows the comparison of the HR max. between the two muscle included in the research.

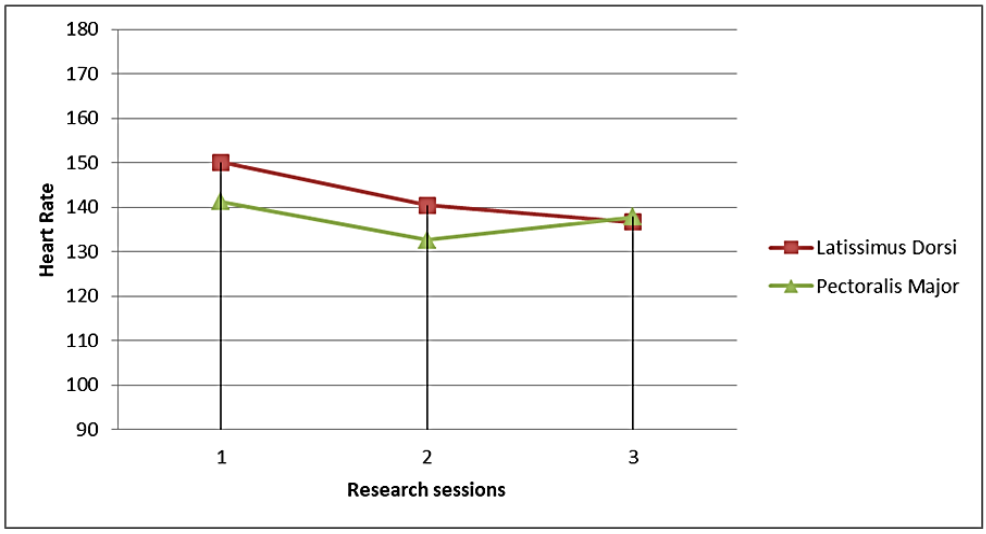

Chart 1. Maximum Heart Rate Model, comparison between Latissimus Dorsi and Pectoralis Major

Discussions

HR max. doesn't have the same distribution pattern for all subjects included in our study. Buitrago and his collaborators (Buitrago, Wirtz, Yue, Kleinoder, & Mester, 2011) showed a pattern of decreasing distribution as a result of the study in which they recorded HR' peaks on 4 execution tempo. Their model has been built based on HR means. Unfortunately, the study doesn't show the records for each subject. However, for the HR means, researchers have noted that the highest peak was recorded when the weight was shifted at maximum speed. The HR peaks showed a declining pattern while the execution speed was lower (see Table 4, built after the results reported by Buitrago, Wirtz, Yue, Kleinoder, & Mester, 2011, p. 2743).

Table 4. Maximum HR reported by Buitrago et al.

	Execution Tempo			
	Maximum speed	1111	2121	4141
Maximum HR (beats/min.)	128,3	128,1	126,2	122,2

In our case, when we analysed the mean for both muscles, we observed for Latissimus Dorsi a decreasing pattern, and for Pectoralis Major a "V" model (descending and then ascending).

Conclusions

The HR' peaks recorded on the three execution tempo do not show the same dynamic pattern for all subjects. Therefore, we can't assert that the maximum HR during weight exercises is influenced by the specific of the execution tempo. Analysis of the distribution pattern of means indicates a difference between the two muscles included in our research.

REFERENCES

American College of Sports Medicine. (2005). *ACSM's Guidelines for Exercise Testing and Prescription - Seventh Edition.* Statele Unite ale Americii: Lippincott Williams & Wilkins.

Buitrago, S., Wirtz, N., Yue, Z., Kleinoder, H., & Mester, J. (2011). Effects of load and training modes on physiological and metabolic responses in resistance exercise. *Eur J Appl Physiol, 112*(7), 2739-2748. doi:10.1007/s00421-011-2249-9

Diniz, R.C., Martins-Costa, H.C., Machado, S.C., Lima, F.V., & Chagas, M.H. (2014). Repetition duration influences ratings of perceived exertion. *Perceptual and Motor Skills, 118*(1), 261-273.

Kraemer, W.J., Fleck, S.J., & Deschenes, M.R. (2012). *Exercise physiology.* Statele Unite ale Americii: Wolters Kluwer Health/Lippincott Williams & Wilkins.

Paul Girsas. (fără an). *Easy Metronome*. Preluat pe ianuarie 5, 2015, de pe play.google.com: *https://play.google.com/store/apps/details?id=girsas.metronome*

Ratamess Jr., N. (2012). *ACSM's Foundations of Strength Training and Conditioning.* Statele Unite ale Americii: Lippincott Williams & Wilkins.

Schwellnus, M. (2008). *The Olympic textbook of medicine in sport.* Marea Britanie: Wiley-Blackwell.

Văidăhăzan, R.-C., Hanţiu, I., Pop, N.H., & Pătraşcu, A. (2015). Heart rate recording system for participants to weight training in Cluj-Napoca's fitness gyms (compatibilities between Android and Windows 7). *Studia Universitatis Babeş-Bolyai, Educatio Artis Gymnasticae, 1*, 29-40.

Zone Five Software LLC. (2013, February 12). *SportTracks*. Retreived from zonefivesoftware.com: *http://www.zonefivesoftware.com/sporttracks/*