

**Original empirical article**

## **INFLUENCE OF DIFFERENT BENCH THROW TEMPOS ON THE STRENGTH OF THE UPPER EXTREMITIES**

*UDC 796.012.6:621018.7*

**Ratko Stanković, Saša Bubanj, Katarina Herodek,  
Radoslav Bubanj, Saša Marković, Dragan Nejić**

Faculty of Sports and Physical Education, University of Niš, Serbia

**Abstract.** *Upward pressure from the bench, i.e. the bench press, is the test of pure strength of the upper extremities. It includes lifting and lowering, as large a weight as it is possible and it evolved at the beginning of the 1960's, in the USA. There are certain discordances, in the previous research, concerning the strength training method, which refer to the methods of exercise performance, i.e. to single vs. multiple sets, optimal repetition range for increasing muscular strength and endurance, speed of movement during exercise and optimal training frequency. The focus of this research was on the speed of movement during practice. The first sub-sample exercised by using cadence with a 2/4 tempo, and the second sub-sample exercised by using cadence with a 4/4 tempo. As the differences of relative and absolute gains in the lifted amounts, at the initial and final measurements, between two sub-samples existed, but were not significant, it seems more reasonable to suggest a slower bench throw tempo. A slower bench throw tempo, i.e. slower movement speed, implies a smaller consumption of energy.*

**Key words:** *Bench press, cadence, speed of movement, strength*

### INTRODUCTION

Upward pressure from the bench, i.e. the bench press, is a test of pure strength of the upper extremities. It includes lifting up and lowering, as large a weight as possible and it evolved at the beginning of the 1960's, in the USA (Fourny et al., 2007). In addition to building strength and mass in the chest area, where the targeted muscles are the pectoralis major and minor, the barbell bench press strengthens shoulders (deltoids) and triceps. This exercise is also good for developing overall upper body strength. The Smith ma-

---

Received August 10, 2009 / Accepted November 18, 2009

**Corresponding author:** Ratko Stanković

Faculty of Sports and Physical Education, University of Niš, Serbia

Tel: +381 18 516 110 • E-mail: racaslavujac@gmail.com

chines have a barbell confined to a vertical track so the bar can travel only straight up or down, and also have adjustable safety stops, that prevent the weight from being lowered below a certain point (Maran, 2005).

There are certain discordances, in the previous research, concerning strength training methods, which refer to ways of exercise performance (single vs. multiple sets), optimal training frequency, optimal repetition ranges for increasing muscular strength and endurance and the speed of movement during exercise.

Jones (1993) showed an example of the efficacy of slow weight training. In 1973, an Olympic weightlifting team was formed, and exercised with only slow (mostly eccentric-only) weight training. The team was undefeated and untied for seven consecutive years. Madsen & McLaughlin (1984) described in detail the kinematics of the bar in single lifts for world class power-lifters and then compared the data with the kinematics observed for the group of recreational lifters. They found that the best performers moved the bar more slowly throughout the exercise and kept the bar more directly over the shoulder during the lift phase. Sakamoto & Sinclair (2006) investigated the effect of movement speed on the relationship between loading intensity and the number of repetitions during a bench press. The significant interaction between intensity and speed meant that speed had a much greater effect on repetitions at lower intensities. These results suggest that the benefits of using a stretch-shortening cycle during faster movements outweigh the related disadvantages from the force-speed relationship. Mikesky et al. (1989) examined the effects of a wrist flexion exercise on the forelimb strength and size of 62 cats. The cats were operantly conditioned to perform the exercise using a food reward, and weights were increased as the cats progressed. The cats which used slower lifting speeds showed significantly greater increases in muscle mass than those using faster lifting speeds. Mikesky et al. concluded that slow lifting speeds lead to greater strength increase and hypertrophy than faster lifting speeds. Kim et al. (2002) evaluated the influence of cadence on the bench press test for predicting 1 repetition maximum (1RM) bench press test performance. There was no significant difference among the number of repetitions performed at each cadence (30 and 60 repetitions per minute) for the men, whereas the women performed significantly more repetitions at the slower cadence. LaChance and Hortobagyi (1994) compared the effects of repetition cadence on a number of push-ups and pull-ups which the subjects were able to complete. They found that subjects completed more repetitions when performing fast, self-paced repetitions than when performing two-second concentric and two-second eccentric muscle actions, and that subjects could complete still fewer repetitions when performing two-second concentric and four-second eccentric contractions. Therefore, the difficulty of the exercise decreased as repetition cadence decreased. This points out that faster repetitions involve less muscle tension than slower repetitions. Hay et al. (1983) measured joint torque in three males, who were performing biceps curls. They found that with short duration lifts (< 2 s), little joint torque was required to move the weight through most of the ranges of motion (ROM). After the beginning of the movement the weight moved under its own momentum. This points out that fast movements do not provide as much muscle tension as slow movements through most of the ROM, which suggests that faster repetitions may not produce optimal strength increase through a muscle's full ROM.

In contrast, according to the research carried out by Newton et al. (1996) in terms of power development, lighter loads are thought important, based on optimizing the mechanical power output of muscle during ballistic movements (e.g. bench press throws).

Keeler et al. (2001) found greater increases in strength in some exercises with speed of movement above the 'super-slow' speed, with an average relative strength gain of 39 %, and only 15 % in the super-slow group after 10 weeks of training. However, as the subjects were novices, their strength gains from super-slow seem very low. This may be because all of the subjects in this study performed 8-12 repetitions/set. Therefore, in this study the different time under load in the two conditions was a major confounding variable. As super-slow repetitions are more difficult than traditional repetitions, requiring lighter resistance, 8-12 repetitions may require the use of a resistance that is too light to stress the muscle sufficiently. Indeed, this is why super-slow advocates often recommend a range of 4-6 repetitions. According to research conducted by Elliot et al. (1989), during 1RM bench presses, the bar decelerates for the final 24% of the range of motion. At 81% of 1RM, the bar decelerates for the final 52% of the range of motion. Research has indicated that for best results, it is important to load the bar with the amount of weight that allows for positive acceleration to be maintained through the full range of motion for the lift.

Research conducted by Hoff & Almasbakk (1995), pointed out that heavy load training was equally effective as light load training, in enhancing various measures of muscular power.

There are also numerous studies where no significant difference between slow and fast-paced repetitions in increasing strength development was found. For instance, Berger and Harris (1966) compared the effects of fast (1.8 s), intermediate (2.8 s) and slow (6.3 s) repetitions on bench press performance, with one set of the exercise being performed three times per week for 8 weeks by each group. All groups significantly increased in strength, with no significant differences between the groups. Liow and Hopkins (2003) examined the effect of slow and explosive weight training on sprint performance in the kayak discipline. The two regimes differed only by the time it took to undertake the concentric action of the movement, ie. slow (1.7 seconds) and explosive (< 0.85 seconds). An increase in performance was evident for both regimes of training, ie. mean sprint time at a distance of 15 meters increased by 3.4 % (slow training) and 2.3 % (explosive training), yet there were no significant inter-group differences.

There are also studies which investigated the relations between isometric tests and dynamic performance in bench press action. According to a study carried out by Ignjatović et al. (2009), results failed to demonstrate a high correlation between isometric testing and dynamic performance.

## METHOD

### Approach to the Problem

This research was carried out with the main aim of comparing the gain in the strength of subjects who exercised by using different movement speed.

### Subjects

The sample consisted of 21 male subjects, mean age  $20 \pm 6$  months. The sample was divided into two sub-samples, where the first consisted of 11 subjects, mean weight  $79.29 \pm 9.23$  kg and the second consisted of 10 subjects, mean weight  $79.84 \pm 11.99$  kg. All subjects agreed to the terms and aims of the research.

### Procedures

Two measurements, an initial and final one, were performed. Both measuring comprised a maximum possible weight lift (1RM). During the research, which lasted 10 weeks, the subjects exercised with 70% of their maximally lifted weight, two times per week, by using the Smith machine. They made three sets per exercise (8-12 repetitions within one set). The focus of this research was on the speed of the movement during exercise. The first sub-sample exercised by using cadence with a 2/4 tempo, and the second sub-sample exercised by using cadence with a 4/4 tempo. The reason why all of the subjects exercised with 70% of 1RM can be found in the fact that immediately after the initial measuring, the subjects of the 2<sup>nd</sup> sub-sample were not able to follow the cadence, if the load was greater than 70% of 1RM.

### Statistical analyses

The statistical approach to the analyses of the data sets was based on the use of parametric and non-parametric tests, i.e. the t-test for the independent and the t-test for the dependent samples and the Mann-Whitney U test (for independent samples).

## RESULTS AND DISCUSSION

Table 1 shows descriptive statistics of 1<sup>st</sup> and 2<sup>nd</sup> sub-sample.

Table 1. Descriptive statistics of 1<sup>st</sup> and 2<sup>nd</sup> sub-sample.

variable	sub-sample	N	Minimum	Maximum	Mean	Std. Deviation	Variance
IM (initial measuring)	1	11	60	125	85.91	17.438	304.091
	2	10	75	110	91.00	9.944	98.889
FM (final measuring)	1	11	65	140	94.09	20.472	419.091
	2	10	80	110	96.00	9.944	98.889
RG (relative gain in %)	1	11	5.00	22.22	9.3459	5.02681	25.269
	2	10	.00	11.11	5.5980	3.56201	12.688
AG (absolute gain in kg)	1	11	5.00	20.00	8.1818	5.13455	26.364
	2	10	.00	10.00	5.0000	3.33333	11.111

The Kolmogorov Smirnov test (table 2) was used to test if the observed variables had normal distribution or not, in order to justify the use of parametric and non-parametric tests. The statistical significances for variables at the initial measuring, and the final measuring and relative gain (0.284, 0.604 and 0.387, respectively) were greater than 0.05, so the null hypothesis, which assumed that the variables had normal distribution was accepted. Therefore, in testing for the existence of a significant difference, the t-test was applied.

Table 2. Results of Kolmogorov Smirnov test.

1 <sup>st</sup> & 2 <sup>nd</sup> sub-sample		IM	FM	RG (%)	AG (kg)
N		21	21	21	21
Normal Parameters(a,b)	Mean	88.33	95.00	7.5612	6.6667
	Std. Deviation	14.259	15.969	4.69285	4.56435
Most Extreme Differences	Absolute	.215	.167	.197	.357
	Positive	.215	.167	.195	.357
	Negative	-.169	-.139	-.197	-.262
Kolmogorov-Smirnov Z		.987	.764	.904	1.635
Asymp. Sig. (2-tailed)		.284	.604	.387	.010

a Test distribution is Normal. b Calculated from data.

The statistical significance for the variable absolute gain (0.010) was less than 0.05, so it was accepted that, it did not have a normal distribution. Therefore, in testing for the existence of a significant difference, the non-parametric Mann-Whitney U test was used.

The t-test for independent samples (table 3) was used to test for the existence of statistically significant difference in the values of the lifted amounts between the 1<sup>st</sup> and 2<sup>nd</sup> sub-sample, at the initial and final measuring and existence of a statistically significant difference in the values of relative gain of the lifted amounts between the 1<sup>st</sup> and 2<sup>nd</sup> sub-sample. Based on the derived significance, 0.428 at the initial and 0.792 at the final measuring, the null hypothesis, which assumed that there was no statistically significant difference between these sub-samples, either at the initial, or at the final measuring, was accepted. Concerning the relative gain of the lifted amounts, based on the derived significance of 0.066, the null hypothesis, which assumed the non-existence of a statistically significant difference of the relative gain from the lifted amounts between the 1<sup>st</sup> and 2<sup>nd</sup> sub-sample was accepted with reservation, because the statistical significance of the test (0.066) is close to critical value (0.05).

Table 3. Results of the t-tests for independent samples for difference between the 1<sup>st</sup> and 2<sup>nd</sup> sub-sample in the values for the lifted amounts at the initial measuring, in the values of the lifted amounts at the final measuring and in relative gain.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
1 <sup>st</sup> and 2 <sup>nd</sup> sub-sample		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
IM	Equal variances assumed	1.104	.306	-.810	19	.428	-5.091	6.285	-18.245	8.063
FM	Equal variances assumed	1.405	.250	-.267	19	.792	-1.909	7.145	-16.864	13.046
RG (%)	Equal variances assumed	1.110	.305	1.952	19	.066	3.74787	1.91999	-.27070	7.76645

The t-test for paired samples (table 4) was used to test for the existence of a statistically significant difference in the values of the lifted masses, at the initial and final measuring, for the subjects of the 1<sup>st</sup> sub-sample, and the 2<sup>nd</sup> sub-sample. Based on the derived significance, 0.000 for the 1<sup>st</sup> sub-sample and 0.001 for the 2<sup>nd</sup> sub-sample, an alternate hypothesis was accepted. The alternate hypothesis assumed the existence of a statistically significant difference between the lifted amounts, at the initial and final measuring, for the 1<sup>st</sup> sub-sample and the second 2<sup>nd</sup> sub-sample.

Table 4. Results of the Paired Samples T-Test for the difference between the subjects of the 1<sup>st</sup> and 2<sup>nd</sup> sub-sample at the initial and final measuring.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
1 <sup>st</sup> sub-sample	IM-FM	-8.182	5.135	1.548	-11.631	-4.732	-5.285	10	.000
2 <sup>nd</sup> sub-sample	IM-FM	-5.000	3.333	1.054	-7.385	-2.615	-4.743	9	.001

With regard to the fact that the variable for absolute gain from the lifted amount did not have a normal distribution, in testing for the existence of a statistically significant difference between the 1<sup>st</sup> and 2<sup>nd</sup> sub-sample, the Mann Whitney U test was used (table 5). Although the descriptive statistics (table 1) indicated the existence of a difference in the absolute gain from the lifted amounts between the 1<sup>st</sup> and 2<sup>nd</sup> sub-sample, based on significance of this test (0.145) the conclusion is that the difference was not statistically significant.

Table 5. Results of Mann-Whitney U test (for independent samples) of the difference in absolute gain value from the lifted amounts, between the subjects of the 1<sup>st</sup> and 2<sup>nd</sup> sub-sample.

1 <sup>st</sup> and 2 <sup>nd</sup> sub-sample	IM	FM	RG (%)	AG (kg)
Mann-Whitney U	41.000	50.000	30.000	37.000
Wilcoxon W	107.000	116.000	85.000	92.000
Z	-1.006	-.356	-1.767	-1.457
Asymp. Sig. (2-tailed)	.315	.722	.077	.145
Exact Sig. [2*(1-tailed Sig.)]	.349(a)	.756(a)	.085(a)	.223(a)

a Not corrected for ties. b Grouping Variable: group

## CONCLUSION

There seems to be no agreement as to the effects of the training speed on gains in strength. For some authors, fast types of training generate gains in strength, while others found gains in strength by using slow types of training. There are also others, who

reached completely different conclusions based on the data derived from their research. Apropos this research, differences in the relative and absolute gain from the lifted amounts existed at the initial and final measuring between the two sub-samples, but they were not significant, so it seems more reasonable to suggest a slower bench throw tempo. Slower bench throws tempos, i.e. slower movement speed, implies lesser consumption of energy.

#### REFERENCES

- Berger, R. & Harris, M. (1966). Effects of various repetitive rates in weight training on improvements in strength and endurance. *J Assoc Phys Mental Rehabil.* 20: 205-207.
- Elliot, B., Wilson, G. & Kerr, G. (1989). A biomechanical analysis of the sticking region in the bench press. *Medicine and Science in Sports and Exercise.* 21 (4): 450-464.
- Fourny, D. et al. (2007). *The Complete Visual Reference - Sports.* QA International.
- Hay, J., Andrews, J. & Vaughan, C. (1983). Effects of lifting rate on elbow torques exerted during arm curl exercises. *Med Sci Sports Exerc.* 15 (1): 63-71.
- Hoff, J. & Almaasbakk, B. (1995). The effects of maximum strength training on throwing velocity and muscle strength in female team handball players. *J Strength Conditioning Res.* 9: 255-258.
- Ignjatović, A., Stanković, R., Herodek, K. & Radovanović, D. (2009). Investigation of the relationship between different muscle strength assessments in bench press action. *Facta Universitatis series Physical Education and Sport.* Vol 7 (1): 17-26.
- Jones, A. (1993). *The lumbar spine, the cervical spine and the knee: testing and rehabilitation.* Ocala, FL: MedX Corporation.
- Keeler, L., Finkelstein, L., Miller, W. & Fernhall, B. (2001). Early phase adaptations to traditional speed vs superslow resistance training on strength and aerobic capacity in sedentary individuals. *J Strength Conditioning Res.* 15 (3): 309-314.
- Kim, P., Mayhew, J. & Peterson, F. (2002). A Modified YMCA Bench Press Test as a Predictor of 1 Repetition Maximum Bench Press Strength. *J Strength Conditioning Res.* 16: 440-445.
- LaChance, P. & Hortobagyi, T. (1994). Influence of cadence on muscular performance during push up and pull up exercises. *J Strength Conditioning Res.* 8: 76-79.
- Liow, D. & Hopkins, W. (2003). Velocity Specificity of weight training for kayak sprint performance. *Med Sci Sports Exerc.* 35 (7): 1232-1237.
- Madsen, N. & McLaughlin, T. (1984). Kinematic factors influencing performance and injury risk in the bench press. *Med. Sci. Sport Exerc.* 16 (4): 376-381.
- Maran, R. (2005). *Maran Illustrated Weight Training.* Course Technology, Inc.
- Mikesky, A., Matthews, W., Giddings, C. & Gonyea, W. (1989). Muscle enlargement and exercise performance in the cat. *J App Sport Sci Res.* 3: 85-92.
- Newton, R., Kraemer, W., Hakkinen, K., Humphries, B. & Murphy, A. (1996). Kinematics, kinetics and muscle activation during explosive upper body movements: Implications for power development. *J Appl Biomech.* 12: 31-43.
- Sakamoto, A. & Sinclair, P. (2006). Effect of movement velocity on the relationship between training load and the number of repetitions of bench press. *J Strength Conditioning Res.* 20 (3): 523-527.

## UTICAJ RAZLIČITE BRZINE POTISKA SA KLUPE NA JAČINU GORNJIH EKSTREMITETA

**Ratko Stanković, Saša Bubanj, Katarina Herodek,  
Radoslav Bubanj, Saša Marković, Dragan Nejić**

*Potisak sa klupe, odnosno bench press je test čiste snage gornjih ekstremiteta. Sastoji se iz podizanja i spuštanja, što je moguće veće težine i nastao je početkom 60-tih godina prošlog veka u SAD. Postoje određena neslaganja, u prethodnim istraživanjima, u vezi metoda treninga snage,*

*koja se odnose na načine vežbanja tj., jednu u odnosu na više serija ponavljanja, optimalan opseg ponavljanja u cilju povećanja mišićne snage i izdržljivosti, brzinu pokreta tokom vežbanja i optimalnu učestalost treninga. Fokus ovog istraživanja bio je usmeren na brzinu pokreta tokom treninga. Prvi subuzorak ispitanika vežbao je pomoću taktnog signala u 2/4 ritmu, a drugi subuzorak vežbao je pomoću taktnog signala u 4/4 ritmu. Obzirom da su postojale razlike u apsolutnim i relativnim dobicima podignutih masa, na inicijalnom i na finalnom merenju, između dva subuzorka, ali koje nisu bile statistički značajne, čini se razumnijim, da se predloži sporiji ritam izbačaja i spuštanja tereta. Sporiji ritam prilikom bench press-a, tj. manja brzina pokreta, podrazumeva, manju potrošnju energije.*

*Ključne reči: potisak sa klupe, takt, brzina pokreta, snaga*