Mechanical and Metabolic Responses to Traditional and Cluster Set Configurations in the Bench Press Exercise

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Abstract

García-Ramos, A, González-Hernández, JM, Baños-Pelegrín, E, Castaño-Zambudio, A, Capelo-Ramírez, F, Boullosa, D, Haff, GG, and Jiménez-Reyes, P. Mechanical and metabolic responses to traditional and cluster set configurations in the bench press exercise. *J Strength Cond Res* 34(3): 663–670, 2020—This study aimed to compare mechanical and metabolic responses between traditional (TR) and cluster (CL) set configurations in the bench press exercise. In a counterbalanced randomized order, 10 men were tested with the following protocols (sets × repetitions [inter-repetition rest]): TR1: 3 × 10 (0-second), TR2: 6 × 5 (0-second), CL5: 3 × 10 (5-second), CL10: 3 × 10 (10-second), and CL15: 3 × 10 (15-second). The number of repetitions (30), interset rest (5 minutes), and resistance applied (10 repetition maximum) were the same for all set configurations. Movement velocity and blood lactate concentration were used to assess the mechanical and metabolic responses, respectively. The comparison of the first and last set of the training session revealed a significant decrease in movement velocity for TR1 (Effect size [ES]: −0.92), CL10 (ES: −0.85), and CL15 (ES: −1.08) (but not for TR2 [ES: −0.38] and CL5 [ES: −0.37]); while blood lactate concentration was significantly increased for TR1 (ES: 1.11), TR2 (ES: 0.90), and CL5 (ES: 1.12) (but not for CL10 [ES: 0.03] and CL15 [ES: −0.43]). Based on velocity loss, set configurations were ranked as follows: TR1 (−39.3 ± 7.3%) > CL5 (−20.2 ± 14.7%) > CL10 (−12.9 ± 4.9%), TR2 (−10.3 ± 5.3%), and CL15 (−10.0 ± 2.3%). The set configurations were ranked as follows based on the lactate concentration: TR1 (7.9 ± 1.1 mmol·L^{-1}) > CL5 (5.8 ± 0.9 mmol·L^{-1}) > TR2 (4.2 ± 0.7 mmol·L^{-1}) > CL10 (3.5 ± 0.4 mmol·L^{-1}) and CL15 (3.4 ± 0.7 mmol·L^{-1}). These results support the use of TR2, CL10, and CL15 for the maintenance of high mechanical outputs, while CL10 and CL15 produce less metabolic stress than TR2.

Key Words inter-repetition rest, intra-set rest, velocity loss, lactate, fatigue

Introduction

Variation in training stimulus is one of the basic principles that should be considered to achieve continuous improvements in physical fitness and athletic performance (18,34). A number of variables (e.g., exercise type and order, number of sets and repetitions, loading magnitude, rest between sets, and movement velocity) are commonly manipulated during resistance training programs to vary the acute training stimulus and, consequently, induce specific physiological adaptations (31). One method that can be used to manipulate the set configuration providing a useful variation in training stimulus is known as cluster (CL) training (9,33). Briefly, CL training consists of the introduction of short rest periods between individual repetitions or groups of repetitions performed within a training set (33). These set configurations are effective methods for maintaining the mechanical strain, while lowering metabolic and perceptual responses when compared with traditional (TR) (i.e., continuous repetitions) set configurations (3,5,8,10,12,20,21).

Mechanical and metabolic stimuli have been suggested to be important contributors to the development of the physiological adaptations that underpin maximal strength, power, and hypertrophy (27). However, it has been

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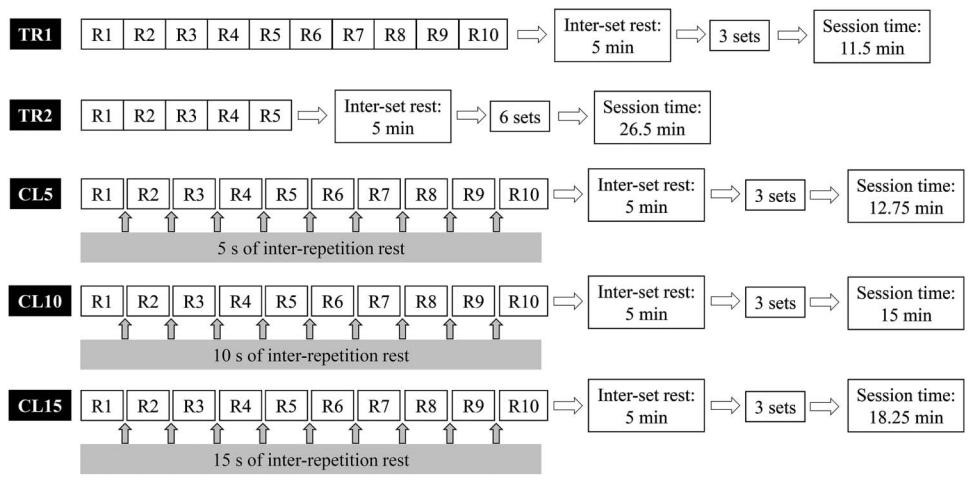

Figure 1. Traditional (TR; no rest between repetitions) and cluster set configurations (CL; a rest period was introduced between individual repetitions) analyzed in this study. Session time was calculated considering an average repetition duration of 3 seconds. R, repetition.

repeatedly observed that CL sets allow for the maintenance of high mechanical outputs (i.e., force, velocity, and power) when a larger number of repetitions are performed when compared with TR set configurations in which no rest is allowed between repetitions (3,4,10,11,13,19). These results have led researchers to recommend using CL sets during resistance training to enhance movement velocity and maximal power production (33). In addition, since CL sets allow for a higher training volume, they may also be a beneficial training tool when attempting to increase maximal strength and muscle hypertrophy (3,15,21,33). However, CL sets have also been associated with a lower metabolic stress (5,16,21), which may reduce hypertrophic responses to the training intervention (27). Thus, some researchers have suggested that CL set configurations may compromise muscle hypertrophy (3,11). In this regard, an alternative to not excessively reduce the metabolic contribution of CL set configurations could be the use of shorter interrepetition rest periods (<20 seconds) than the commonly applied (20–40 seconds) (33).

The bench press is a basic upper-body exercise commonly included in the resistance training programs of athletes of different disciplines (e.g., bodybuilders, sport athletes needing a good throwing ability, etc.) (2,30). This is because bench press training is able to induce specific gains on maximal strength, hypertrophy, power, and muscular endurance (2). Thus, it is important to study the effect that manipulating the set configuration in the bench press exercise may have on mechanical and metabolic variables that influence the physiological adaptations. The 10 repetition maximum (RM) load (i.e., load with which a maximum of 10 continuous repetitions can be performed) has been frequently prescribed during hypertrophic-oriented resistance training sessions (1,29). However, to date, the effect that different set configurations conducted against the 10RM load presents on the

Table 1. Two-way repeated-measures analyses of variance examining the effect of the number of sets and repetitions on movement velocity during each set configuration.*†

	Set		Repetition		Interaction	
Protocol	*F*	*p*	*F*	*p*	*F*	*p*
TR1	7.36	0.005	174.0	<0.001	1.63	0.059
TR2	1.73	0.148	81.7	<0.001	0.32	0.998
CL5	1.42	0.268	29.5	<0.001	0.48	0.965
CL10	9.63	0.001	18.1	<0.001	0.17	1.000
CL15	11.7	0.001	89.7	<0.001	0.73	0.781

*F = Snedecor's F; p = p-value.
†Sets × repetitions (interrepetition rest): TR1 = 3 × 10 (0 seconds); TR2 = 6 × 5 (0 seconds); CL5 = 3 × 10 (5 seconds); CL10 = 3 × 10 (10 seconds); CL15 = 3 × 10 (15 seconds).