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The Effects of Resistance Training Frequency on Strength Gains

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ABSTRACT

Serra R, Saavedra F, De Salles BF, Dias MR, Costa P, Alves H, Simão R. Effects of Resistance Training Frequency on Strength Gains. **JEPonline** 2015;18(1):37-45. The purpose of the present study was to compare the effects of different training frequencies on strength gains in untrained males after 8 months of resistance training. Forty-five middle-age men were randomly assigned to one of 3 training groups: 2 (G2; n = 18), 3 (G3; n = 17), and 4 sessions·week^{-1} (G4; n = 10). Each group performed the same resistance training program with the exception of the training frequency. The 10RM tests were conducted in 2 nonconsecutive sessions for the bench press, leg press, and lat pulldown exercises at baseline, and after 4 and 8 months following resistance training. All three groups showed significant increases in 10RM loads for all exercises (P<0.05). The findings of this study indicate that 2 to 4 weekly training sessions produce significant strength gains. Thus, lower frequencies may be all that is necessary for individuals with short time to increase adherence and strength gains in untrained males.

Key Words: Performance, Strength Training, Training Variables

INTRODUCTION

Resistance training is an efficient method to increase strength, power, and local muscular endurance. However, the prescription patterns should be related to the goals and individual needs of the participant (1). In this context, several prescription variables such as weekly frequency, exercise order, number of sets and repetitions, rest interval between sets, intensity, and volume must be carefully controlled and manipulated (2). The training frequency in resistance training refers to the number of sessions performed during a specific time period, but it can also be characterized as the number of sessions per week in which a single muscle group is trained (19).

The training frequency prescription depends on the volume, intensity, selected exercises, level of fitness and ability to recover from the individual, nutritional intake, and training goals (19). Excessively frequent stimuli in the same muscles could interfere with the proper recovery and impair performance by overtraining; whereas, infrequent stimuli could allow an excessive recovery time and, ultimately lead to detraining. For untrained subjects, it is recommended that 2 or 3 sessions·wk^{-1} of resistance training should involve all major muscle groups (2). A meta-analysis conducted by Rhea et al. (25) supports the recommendation. They concluded that untrained individuals demonstrated maximum strength gains when they performed 3 sessions·wk^{-1} for each muscle group.

Previous studies have investigated the influence of resistance training frequency on strength development (4,6-9,11-18,20-22,29,30), body composition (7,17,18,20,21,29), and functional performance (13,14,22,29) using several different experimental designs and populations. Despite the previous research on this topic, some doubts persist because of the difficulty of comparing the data from different studies with different experimental characteristics. For example, some researchers (7,18,20) equalized the weekly training volume between the analyzed groups. This experimental design increases the internal validity of the research to specifically examine the influence of resistance training frequency on the analyzed responses.

Other studies (4,6,9,11-16,21,22,29,30), however, did not equalized the weekly volume between the groups. Thus, the groups that have engaged in more frequent resistance training consequently had a higher training volume at the end of the study. The latter design has the advantage of providing data of the influence of the weekly frequency of the total training volume. Thus allowing analysis of the amount of stimulus needed for optimum development of the desired characteristics, answering if the performance of a higher weekly training volume has superior results compared to training with lower volume and frequency. This knowledge is important because the total training volume is directly related to how much time should be spent to perform it, which may be an important factor in the adherence to a training program.

Gillam (15) examined the bench press strength gains for untrained men after performing 18 sets of one repetition maximum in the same exercise. The subjects trained 1, 2, 3, 4, or 5 times·wk^{-1} for 9e wks, and the results indicated the group that trained 5 times·wk^{-1} had greater strength gains than the other groups. This suggests a higher weekly volume, obtained through a higher training frequency was more effective in promoting adaptations, in contrast to the traditional recommendation to not train the same muscle group on consecutive days.

Conversely, a considerable amount of evidence (6,9,11,13,14,16,21,22,29,30) demonstrated similar strength gains between groups that trained with different training frequencies and volumes. The data from the studies suggest that a higher training volume does not always result in higher strength gains. However, most of the aforementioned studies analyzed frequencies of up to 3 sessions·wk^{-1} in relatively short periods of intervention. We hypothesized more frequent training could lead to higher strength gains in long-term resistance training. Therefore, the purpose of the present study was to compare the effects of different training frequencies on strength gains in untrained subjects after eight months of resistance training.

METHODS

Subjects

The sample was composed of 75 untrained middle-age men. To participate in the study, the subjects could not have: (a) performed resistance training for at least one year; (b) performed any type of regular exercise in addition to the prescribed resistance training during the participation in the study; (c) presented any limitation to the performance of the tests and/or the training program; and (d) used any nutritional supplement or ergogenic aid. Also, it was necessary that the subjects answered negatively to all the questions on the Physical Activity Readiness Questionnaire (PAR-Q) (27).

The subjects were randomly assigned to 1 of 3 groups, but only 45 of the original 75 completed the study: (a) 2 sessions·wk^{-1} (G2; n = 18); (b) 3 sessions·wk^{-1} (G3; n = 17); and (c) and 4 sessions·wk^{-1} (G4; n = 10). There was no significant differences (P>.05) among the groups in pre-training anthropometric measurements (Table 1). The experimental training period lasted eight months and all subjects analyzed completed at least 95% of all training sessions. The subjects who missed more than a training session in the same week were also excluded from the analysis. Before the data collection, all subjects signed an informed consent form, as per the National Health Council Resolution (196/96). The experimental procedures were approved by the Institution's Ethics Committee.

Table 1. Subjects Characteristics (mean ± standard deviation).

Groups	Age (yrs)	Height (cm)	Body Mass (kg)
G2[a] (n=18)	39.4 ± 9.6	175.8 ± 4.8	82.8 ± 12.4
G3[b] (n=17)	44.4 ± 8.4	174.8 ± 6.1	79.5 ± 7.8
G4[c] (n=10)	40.3 ± 11.7	174.8 ± 6.1	85.4 ± 10.6

a = 2 sessions·wk^{-1}; b = 3 sessions·wk^{-1}; c = 4 sessions·wk^{-1}.

Procedures

Ten Repetitions Maximum Testing (10RM)

The 10RM tests were conducted in two nonconsecutive sessions. On the first visit, after the anthropometric measurements, the subjects performed the first 10RM tests. After 48 hrs, the procedures were repeated to verify the load reproducibility. The highest load achieved in the two trials was considered as the 10RM. Each subject was asked to not perform any exercise along the recovery period between test sessions, in order to not interfere with the results obtained. The exercise order of the 10RM tests was: lat pulldown, leg press; and bench press machine (Technogym®, Italia). The exercises were selected due to their dissemination in resistance training centers and ease of implementation. In addition, exercises were chosen that involved different muscle groups, which allowed for the assessment of the influence of training frequency on such muscle groups. During the 10RM tests, each subject performed a maximum of three 10RM attempts for each exercise with 5 min of rest between attempts. After the 10RM load for a specific exercise was determined, a 10-min rest was instituted before the first 10RM attempt of the next exercise.

This 10RM testing protocol was used previously (3,28). Standard exercise techniques were followed for each exercise. Specific strategies were adopted to minimize the errors. Standard instructions concerning the testing procedures were given to the subjects before the test. The subjects received standardized instructions on exercise technique. Body position was held constant (e.g., hand width during bench press and foot position during the leg press test). Verbal encouragement was provided during the testing procedure. The mass of all weights and bars used were determined using a precision scale. After four and eight months, the 10RM procedures were repeated to examine the improvements in strength.

Training Protocol

All groups performed familiarization over the course of a week with exercises, loads, and rest intervals adopted (three sessions). The training protocol consisted of 2 (Tuesday and Thursday), three (Monday, Wednesday, and Friday), and 4 (Monday, Tuesday, Thursday, and Friday) sessions·wk^{-1} in a total of eight months of resistance training for all groups. An experienced physical education professional with the knowledge of resistance training supervised the exercise. The training protocol included eight exercises performed in the following exercise order: lat pulldown, leg press, bench press machine, leg extension, seated row machine, leg curl, shoulder press, and abdominal crunch.

Except for the first three exercises of the sequence, the exercise order was alternated for the other exercises after each month, but always keeping within the training methodology used (alternating upper and lower body). Three sets of 10-12RM were performed for all exercises, with the exception of the abdominal crunch that was performed with 15-20RM. In addition, the weekly total repetition volumes were different depending on the number of sessions for each group (Table 2). The training loads were adjusted whenever the repetitions training zone upper limit was exceeded. The rest interval between sets and exercises was 60 to 120 sec (10). Before each training session, the subjects performed two sets of 15 repetitions with 50% of load used in the first and second exercises of the sequence.

Statistical Analyses

Levene's test was performed to verify the homogeneity of the data. Repeated-measures analysis of variance (ANOVA) procedures were used to examine between groups changes for the dependent variables (baseline, after 4 and 8 months). Post hoc tests with Tukey adjustment were used when a significant main effect was observed. As there was found the sphericity assumption, we used the F value of the Greenhouse-Geiser epsilon. The significance level for statistical testing in this study was $P<0.05$. The software used for analysis was SPSS 20.0.

RESULTS

There was no statistically significant difference among the groups in pre-training for age, height, or body mass ($P>0.05$) (Table 1). All groups showed significant increases in 10RM loads for all exercises after 4 and 8 months of training ($P<0.001$). In addition, there were no significant differences among groups ($P=0.497$). However, the G4 showed higher percent increases when compared to G2 and G3 in each period (4 and 8 months). Table 3 presents the absolute 10RM loads and delta percentage.

Table 2. Training Session's Distribution at the Week and Total Repetitions Volume.

Groups	Monday	Tuesday	Wednesday	Thursday	Friday	TRV[d]
G2[a] (n = 18)		TS 1		TS 2		467 repetitions
G3[b] (n = 17)	TS 1		TS 2		TS 3	693 repetitions
G4[c] (n = 10)	TS 1	TS 2		TS 3	TS 4	924 repetitions

(TS = Training Session); a = 2 sessions·wk^{-1}; b = 3 sessions·wk^{-1}; c = 4 sessions·wk^{-1}; d = total repetitions volume (seven exercises x number of sessions x three sets x 10-12RM + abdominal crunch x number of sessions x three sets x 15-20RM)

Table 3. 10RM Loads and Percentage of Change at Baseline, Four (Mid-Point) and Eight Months (Post-Training) of Training.

		Baseline	Mid-Point		Post-Training	
	Groups	**10RM[d] (kg)**	**10RM (kg)**	**Delta (%)**	**10RM (kg)**	**Delta (%)**
BP	G2[a] (n = 18)	41.7 ± 16.4	50.3 ± 14.0*	18.4 ± 9.7	57.4 ± 15.4*†	36.3 ± 15.6
	G3[b] (n = 17)	38.8 ± 16.3	48.9 ± 18.1*	23.9 ± 6.3	59.5 ± 16.5*†	46.5 ± 16.4
	G4[c] (n = 10)	39.0 ± 16.1	54.4 ± 16.9*	32.7 ± 6.1	62.8 ± 18.1*†	65.1 ± 19.7
LP	G2 (n = 18)	83.3 ± 21.4	101.4 ± 23.6*	22.8 ± 11.0	113.3 ± 26.6*†	30.4 ± 10.6
	G3 (n = 17)	88.2 ± 21.9	102.9 ± 23.9*	17.5 ± 12.4	112.5 ± 18.5*†	32.4 ± 13.7
	G4 (n = 10)	80.0 ± 25.4	97.8 ± 27.8*	23.9 ± 13.1	117.8 ± 30.5*†	45.4 ± 13.9
LP	G2 (n = 18)	50.1 ± 12.0	59.2 ± 11.9*	17.7 ± 11.4	67.4 ± 12.0*†	29.4 ± 12.7
	G3 (n = 17)	52.2 ± 12.8	62.2 ± 15.2*	17.3 ± 8.6	69.7 ± 17.0*†	32.0 ± 11.9
	G4 (n = 10)	54.5 ± 16.2	68.6 ± 16.7*	28.8 ± 14.2	77.5 ± 18.1*†	46.0 ± 16.9

BP = Bench Press, LP = Leg Press, LP = Lat Pulldown; a = 2 sessions·wk^{-1}; b = 3 sessions·wk^{-1}; c = 4 sessions·wk^{-1}; d = repetition maximum; *Significant difference from baseline; † significant difference from four months.

DISCUSSION

The main purpose of this study was to examine the strength gains of untrained men after four and eight months of resistance training performed in 2, 3, or 4 sessions·wk^{-1}. After 8 months of resistance training, all three exercises 10RM loads increased significantly compared to pre-training and after 4 months of training in all training groups. No significant differences in strength gains among groups at 4 and 8 months were observed, although the percentage change of the group that trained 4 times·wk^{-1} was higher than the groups engaging in 2 and 3 sessions·wk^{-1}.

Previous studies also analyzed the influence of weekly resistance training frequency on strength gains. Gillam (1981) examined the effects of 1, 2, 3, 4, or 5 sessions·wk^{-1} on bench press strength increases. During 9 wks, the subjects underwent the same training protocol, which consisted of 18 sets of 1RM for the bench press exercise. After the training period, the group that performed 5 sessions·wk^{-1} presented higher strength improvements than the other groups. Confirming this result, Hunter (1985) showed that the most frequent training was more effective in the development of bench press muscular strength and endurance. In this study, one of the groups trained 3 sessions·wk^{-1} on alternate days while the other group trained 4 sessions·wk^{-1} on consecutive days. However, the total sets performed per week were the same for both groups, which was different from the study conducted by Gillam (1981). Collectively, these data suggest higher training frequencies result in superior muscular fitness improvements. Another key point that should be noted is the recovery duration between training sessions. In the two studies, the best results were obtained by the groups that trained on consecutive days. This suggests it is not necessary to provide the minimum interval of 48 hrs between sessions involving a single muscle group as recently recommended by the American College of Sports Medicine position stand (1).

Other studies analyzing the weekly resistance training frequency variable did not present significantly higher strength gains in the groups that trained more sessions per week, even when there was no control of the weekly training volume (6,9,11,14,16,21,29). These data corroborate the findings of the curent study and demonstrate that a higher training volume does not always reflect significantly higher strength and fitness gains, as is usually suggested by anecdotal evidence. This is important information because one of the main arguments for not engaging in a resistance training program is the time availability. In fact, it is often believed that to achieve significant results it is necessary to spend several days a week and several hours a day to exercise. However, as can be observed in the present results, the group training twice a week had such impressive gains as the group who trained four times a week. Thus, individuals with little time can be encouraged to participate in less frequent routines and expect significant strength gains. This is also important information to public agencies or companies that offer wellness programs for large population masses. The knowledge that less frequent and less costly time programs can be effective may help in the development of intervention strategies that require less financial investment or that they can cover a larger number of participants.

The percentage changes showed that the G4 obtained higher strength gains over other groups at all times and in all exercises, although this difference was not significant. However, this may be useful information for practitioners, athletes, and fitness enthusiasts who might desire superior strength gains than the minimum necessary for health.

The comparison between the present results and the findings of previous studies that analyzed resistance training frequency is difficult due to the different methodological models used. For example, some authors have chosen to equalize the weekly training volume (frequency × sets × repetitions) between the experimental groups in order to isolate the variable training frequency (7,18,20). However, other authors preferred to not control the weekly volume (5,12,17). In the present study, the weekly training volume was not controlled such that the volume of training per session (sets × repetitions) could be kept constant between the groups, which seems to increase the external validity of the results. Nevertheless, this might be a limitation of the present study, because the groups who performed the greater training frequencies also performed the largest total training volumes in the same period, which may have reflected directly on the scores obtained.

CONCLUSIONS

The findings of this study indicate that two to four weekly training sessions are sufficient to produce significant strength gains. Thus, lower frequencies can be used for individuals with short time to increase adherence. On the other hand, the percentage strength increases suggest higher training frequencies may be useful to improve strength gains.

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