Higher- Versus Lower-Intensity Strength-Training Taper: Effects on Neuromuscular Performance

Pritchard, Hayden J; Barnes, Matthew J; Stewart, Robin J; Keogh, Justin W; McGuigan, Michael R

Published in:
International Journal of Sports Physiology and Performance

DOI:
10.1123/ijspp.2018-0489

Published: 01/04/2019

Document Version:
Peer reviewed version

Note. This article will be published in a forthcoming issue of the *International Journal of Sports Physiology and Performance*. The article appears here in its accepted, peer-reviewed form, as it was provided by the submitting author. It has not been copyedited, proofread, or formatted by the publisher.

Section: Original Investigation

Article Title: Higher vs. Lower Intensity Strength Training Taper: Effects on Neuromuscular Performance

Authors: Hayden J. Pritchard[1,2], Matthew J. Barnes[3], Robin J. Stewart[1], Justin W. Keogh[4,2,5], and Michael R. McGuigan[2,6]

Affiliations: [1]Faculty of Health Sciences, Universal College of Learning, Palmerston North, New Zealand; [2]Sports Performance Research Institute New Zealand, Auckland University of Technology, Auckland, New Zealand; [3]School of Sport and Exercise, Massey University, Palmerston North, New Zealand; [4]Faculty of Health Sciences and Medicine, Bond University, Queensland, Australia; [5]Faculty of Science, Health, Education and Engineering, University of the Sunshine Coast, Queensland, Australia; [6]School of Medical and Health Sciences, Edith Cowan University, Western Australia, Australia.

Journal: *International Journal of Sports Physiology and Performance*

Acceptance Date: September 3, 2018

DOI: https://doi.org/10.1123/ijspp.2018-0489

"Higher vs. Lower Intensity Strength Training Taper: Effects on Neuromuscular Performance" by Pritchard HJ et al.
International Journal of Sports Physiology and Performance

Higher vs. lower intensity strength training taper: Effects on neuromuscular performance

Original Investigation

Hayden J. Pritchard[1,2], Matthew J. Barnes[3], Robin J. Stewart[1], Justin W. Keogh[4,2,5], & Michael R. McGuigan[2,6]

[1]*Faculty of Health Sciences, Universal College of Learning, Palmerston North, New Zealand*;
[2]*Sports Performance Research Institute New Zealand, Auckland University of Technology, Auckland, New Zealand*;
[3]*School of Sport and Exercise, Massey University, Palmerston North, New Zealand;*
[4]*Faculty of Health Sciences and Medicine, Bond University, Queensland, Australia;*
[5]*Faculty of Science, Health, Education and Engineering, University of the Sunshine Coast, Queensland, Australia.*
[6]*School of Medical and Health Sciences, Edith Cowan University, Western Australia, Australia*

Corresponding Author:
Hayden Pritchard,
UCOL,
Exercise and Wellness,
Private Bag 11022,
Palmerston North 4442,
New Zealand.
Phone: +646 952 7001 ext. 70666
Email: h.pritchard@ucol.ac.nz

Preferred running head: Intensity changes during the strength taper

Abstract word count: 249

Text-only word count: 3,429

Number of tables: 4

Number of figures: 3

Abstract

Purpose: To investigate the effects of strength training tapers of different intensities, but equal volume reductions, on neuromuscular performance. ***Methods:*** Eleven strength-trained males (21.3±3.3 years, 92.3±17.6 kg, relative 1RM deadlift 1.9±0.2 times bodyweight) completed a crossover study. Specifically, two four-week strength training blocks were followed by a taper week with reduced volume (~70%) involving either an increased (5.9%) or decreased (-8.5%) intensity. Testing occurred pre-training (T1), post-training (T2), and post-taper (T3). Salivary testosterone and cortisol, plasma creatine kinase, a daily analysis of life demands in athletes questionnaire, countermovement jump (CMJ), isometric mid-thigh pull (IMTP) and bench press (IBP) were measured. ***Results:*** CMJ height improved significantly over time ($p<0.001$), with significant increases from T1 (38.0±5.5 cm) to both T2 (39.3±5.3 cm; $p=0.010$) and T3 (40.0±5.3 cm; $p=0.001$), and from T2 to T3 ($p=0.002$). CMJ flight-time: contraction-time increased significantly over time ($p=0.004$), with significant increases from T1 (0.747±0.162) to T2 (0.791±0.163; $p=0.012$). IMTP relative peak force improved significantly over time ($p=0.033$), with significant increases from T1 (34.7±5.0 N/kg) to T2 (35.9±4.8 N/kg; $p=0.013$). No significant changes were found between tapers. However, the higher intensity taper produced small ES increases at T3 vs. T1 for IMTP relative peak force, CMJ height and flight-time: contraction-time, while the lower intensity taper only produced small ES improvements at T3 vs. T1 for CMJ height. ***Conclusions:*** A strength training taper with volume reductions had a positive effect on power, with a tendency for the higher intensity taper to produce more favourable changes in strength and power.

Key words: performance, periodisation, strength and conditioning, strength training, tapering

Introduction

The primary objective of a taper is to minimize fatigue from training, allowing for expression of improved fitness, in order to maximise performance at a specific time point[1,2]. Reductions in training load typically define the taper, achieved primarily through alterations in training volume but also variations in training intensity. Training volume can be reduced through reduced volume of individual training sessions, or a reduced training frequency. Much of the literature regarding tapering has focused on performance in aerobic based or team sports[3-6], with less research on strength performance[7,8]. However, it appears that for both aerobic or strength performance to be enhanced following a taper, training volume should be reduced while training intensity should be maintained or slightly increased[1,9].

Reductions in training volume have been effectively utilized as a tapering strategy[7,10-12]. Hakkinen et al.[7] demonstrated that a one week volume reduced (by 50%) taper, following two weeks of strength training, was able to improve maximal force and electromyographic activity in the five strongest participants with no changes observed in the remaining five. Gibala et al.[11] reduced volume to 38% of initial training volume, while maintaining intensity, and saw improvements in isometric peak torque in comparison to baseline data. Marrier et al.[12] followed a four week rugby sevens training camp with a three week taper, whereby the strength training volume was reduced by ~50%. Small improvements (effect size (ES) = 0.43) in isometric mid-thigh pull (IMTP) and improvements in 30m sprint time (ES = -1.61) occurred from pre-training to peak values during the three-week taper. Together, these findings indicate that reducing training volume, while maintaining intensity, can be an effective tapering strategy in athletes with strength training backgrounds.

Intensity alterations during the taper, compared to prior training, have also been investigated. Coutts et al.[6] had rugby league players taper for one week, volume was reduced by ~55% and intensity slightly reduced, after six weeks of training. Following the taper low velocity isokinetic peak torque improved for both the knee extensors and flexors, and creatine kinase (CK) decreased. Following 16 weeks of training, Izquierdo et al.[13] had Basque-ball players undertake a four week strength tapering period. Volume was progressively reduced, while intensity increased from 90% one repetition maximum (1RM) to 90-95% 1RM. Bench press and half squat 1RM increased significantly following the taper. Tapering with reduced volume was again shown to result in performance improvements in trained populations, regardless of increases or decreases in training intensity. However, none of these studies directly compared differences in intensity during a volume reduced taper.

Zaras et al.[8] have performed the only study to date that directly compared different training intensities during a strength training taper. Throwers performed a crossover study utilizing either a light (30% 1RM) or heavy (85%) two-week taper, after 12-15 weeks of training. During the taper period, volume was reduced more with the light taper than the heavy taper. The heavy taper had significantly greater percentage increases in leg press 1RM and isometric peak force than the light taper. These findings are similar to qualitative findings showing elite powerlifters usually maintain a high intensity of training when peaking for important events while significantly reducing volume (>50%)[10,14]. However, Zaras et al.[8] did not control training volume in each taper, and therefore their reported enhancement of strength performance may be due to a combination of changes in training volume and intensity, not solely intensity.

While these studies demonstrate that tapering can be an effective strategy to enhance maximal strength, it remains unclear whether higher or lower training intensities are more beneficial if reductions in training volume are equal. Therefore, using a strength-trained population, the aim of this study was to investigate the performance effects of different training intensities during a strength training taper with equal training volume reductions. Potential mechanisms behind such changes were also explored. It was hypothesised that the higher intensity taper would produce greater improvements in neuromuscular performance.

Methods

Subjects

The inclusion criteria for the study were: (i) a current deadlift 1RM of at least 1.5 times bodyweight (BW), and, (ii) two or more years of involvement in resistance training. Eleven participants completed the study (age = 21.3 ± 3.3 years, BW = 92.3 ± 17.6 kg, height = 1.82 ± 0.08 m, relative 1RM deadlift 1.9 ± 0.2 times BW).

The study was approved by the Auckland University of Technology Human Ethics Committee prior to the commencement of the study. All participants were informed of the risks and benefits, and allowed to ask any questions about the research, prior to the provision of written informed consent.

Design

This study employed a randomized crossover design to investigate the performance effects, and underlying mechanisms, of two volume controlled one-week tapers, of differing intensities, on neuromuscular performance in strength-trained males. Specifically, following four weeks of standardized strength training, participants were assigned, at random, to a taper that either increased the intensity of training by ~5% (Taper A) or decreased it by ~10% (Taper B). In both cases, total training volume decreased by ~70%. Participants then had one week of self-directed training, prior to performing another four weeks of standardized strength training, followed by the remaining taper. Each four-week block of training ensured that participants were under a similar training load, both individually and collectively, prior to each taper (Figure 1).

Prior to (≥ 48-hours) any testing, participants were familiarized with testing procedures. For all testing sessions participants arrived fasted, water was consumed ad-libitum prior to sessions, at the same time in the morning (± 30 min). Testing occurred prior to each four-week training period (T1), 36-60 hours after the final training session of the four week period (T2), and 36-60 hours after their final taper training session (T3). The time between final training sessions and testing times was kept consistent for each participant. For example, if a participant was tested 36 hours following training in Condition A (i.e. trained late afternoon on Thursday, had one full day's rest Friday, tested on Saturday morning) this was kept consistent for Condition B.

Gym-based Testing

In order to establish training loads, participants performed 1RM testing, according to National Strength & Conditioning Association (NSCA) guidelines[15] for the three powerlifts (squat, bench press and deadlift) within one week of the first testing session. Additionally, participants were also tested for a 2-8RM on all other programmed lifts. 1RM was estimated from these results using the following formula:

$$1\text{RM} = \text{Load} / (1.0278 - 0.0278 * \text{Repetitions Performed})$$ [16]

1RM testing was repeated during the week between conditions. All strength testing was performed at the same time of day (± one hour).

Resting Measures

Saliva was collected and CK measured using previously described techniques[17]. Saliva samples were analysed in duplicate according to manufacturer's instructions using an enzyme-linked immunosorbent assay (ELISA; DRG International, USA). The coefficient of variation (CV) of duplicate ELISA samples was 3.9% for testosterone and 8.5% for cortisol. The typical CV of CK measurements using the Reflotron® systems spectrophotometer (Roche Diagnostics, Switzerland) is 3.5%.

The Daily Analysis of Life Demands in Athletes (DALDA) questionnaire was then completed by participants (as well as prior to each training session, as part of the training records kept by participants). The frequency of 'worse than normal' results was recorded at each testing session and was analysed to determine any changes across testing sessions. This questionnaire has been used previously to monitor athletes[18,19].

Performance Measures

Participants then undertook performance tests consisting of the countermovement jump (CMJ), IMTP, and isometric bench press (IBP) on a force plate (400 Series, Fitness Technology, Australia). Performance test procedures occurred as previously described[17]. Analysis occurred using the Ballistic Measurement Systems software (BMS, Innervations, Australia). Three maximal efforts were undertaken for each performance test, with the effort that had the highest jump (CMJ) or greatest peak force (IMTP and IBP) utilised for analysis. For the CMJ, the CV was 3.0% for jump height and 7.0% for flight-time: contraction-time. For the IMTP, CV was 3.3% for IMTP peak force. For IBP, CV was 3.9% for IBP peak force.

Training protocol

After the first testing session, participants commenced their training program, focused on improvement in the powerlifts. The objective of this four-week program (see Table 1) was to bring all participants to a similar level of training and fatigue prior to the taper week. This four week program has been used previously to successfully enhance 1RM performance of the powerlifts[20]. Participants were instructed to separate each of the three training days with at least one full rest day between, i.e. if a strength training day occurred on Tuesday, the next strength training day would be Thursday. Participants could perform their habitual aerobic or conditioning focused training, but no further resistance training was allowed – although a limitation, this permitted greater recruitment from a limited local participant pool.

The tapering training protocol (Table 2) was designed to alter training volume and intensities compared to week four of the training period. Training volume was determined as the load used multiplied by the sets and repetitions performed, total training volume was the sum for all exercises performed. Average training intensity was determined as the average percentage of 1RM used per repetition performed, across all exercises. Taper A had a volume decrease of 71.9 ± 1.2% and an increase in intensity of 5.9%, while Taper B had a volume decrease of 70.0 ± 1.0% and a decrease in intensity of 8.5%. To balance volume reductions, intensity changes were slightly different from the targeted +5% and -10% targets. Intensity changes have no standard deviation (SD) as they were all identical between participants, while weights for differing exercises changed from subject to subject, producing small variations seen in volume. During the taper, accessory lifts were removed and only competition lifts, or variations, remained. This was to ensure specificity to a powerlifting style taper[10]. Overall, training compliance was 98.6% for the entire training and tapering periods, with no missed sessions during week four of training or taper week.

Statistical analysis

Performance (CMJ height, CMJ flight-time: contraction-time, IMTP and IBP peak force), psychological (DALDA ‘worse than’), hormonal (T and C) and biochemical (CK) measures were analysed for statistical differences with a two-way repeated measures ANOVA. This method of statistical analysis allowed for differences to be tested for over time, between taper conditions and time by taper interaction. Where a significant difference was found, a Student-Newman-Keuls post-hoc paired comparison was used. Significance was defined as $P \leq 0.05$. The above analysis occurred using computer software (Sigma Plot 11.0, Systat Software, Inc., Chicago, Illinois, USA).

ES for performance data were calculated between time points (with data from both tapers pooled together), and between time points for each taper condition. ES were interpreted as: trivial 0-0.2, small 0.2-0.6, moderate 0.6-1.2, large 1.2-2.0 and very large >2.0 [21].

Results

Table 3 shows the results for all performance measures. CMJ height showed significant improvements over time ($P < 0.001$), with significant increases from T1 to T2 (p =0.010; pooled ES = 0.23), T1 to T3 (p =0.001; pooled ES = 0.37), as well as from T2 to T3 (p =0.002; pooled ES = 0.14). CMJ flight-time: contraction-time showed significant improvements over time (p =0.004), with significant increases from T1 to T2 (p =0.012; pooled ES = 0.27), and improvements approached significance from T1 to T3 (p =0.073; pooled ES = 0.26). No significant differences were found between taper conditions, or time by taper condition, for any CMJ measure.

IMTP relative peak force showed significant improvements over time (p =0.033), with significant increases found from T1 to T2 (p =0.013; pooled ES = 0.25). No significant differences were found between taper conditions, or time by taper condition, for any IMTP or IBP strength measure.

The higher intensity taper produced small ES improvements following the taper for CMJ height (ES = 0.43), CMJ flight-time: contraction-time (ES = 0.42) and IMTP relative peak force (ES = 0.37). In contrast, the lower intensity taper only produced a small ES improvement for CMJ height (ES = 0.30). Individual responses in CMJ height to the tapers are presented in Figures 2 and 3.

There were no significant changes for any other results, including the testosterone to cortisol ratio. Hormonal, biochemical and DALDA results are displayed in Table 4.

Discussion

The major findings from this study were that, (1) a one-week strength taper with 70% reduction in volume allowed maintenance or enhancement of strength and power qualities, and, (2) the higher intensity taper seemed to produce more favourable changes in neuromuscular function. Specifically, significant improvements were observed in CMJ height, flight-time: contraction-time, and IMTP relative peak force from pre- to post-training. CMJ height also significantly improved from pre-training to post-taper, and from post-training to post-taper. There was no significant difference in any isometric strength measure from post-training to post-taper. However, the higher intensity taper resulted in small ES improvements at post taper vs baseline for IMTP relative peak force, CMJ height and flight-time: contraction-time, while a decreased intensity taper only showed this improvement in CMJ height.

Improved CMJ performance demonstrates the effectiveness of both tapers in enhancing maximal power performance. Maximal power is vital to performance in many sports[22], hence a volume focused strength taper with small intensity changes could be implemented as an effective tapering strategy to optimise power. Improved CMJ height may provide an indication of more efficient neuromuscular function or a reduced degree of training induced neuromuscular fatigue[23]. A performance improvement following peaking utilizing training cessation was been previously observed[17], an indication that both training cessation and tapering can be effective strategies in reducing fatigue.

There was a tendency for the higher intensity taper to improve performance more than the lower intensity taper. Both tapers resulted in small ES improvements in CMJ height (T3 vs T1), but only the higher intensity taper resulted in small ES improvements in IMTP relative peak force (T3 vs T1). A small ES improvement in performance at T3 indicates the fatigue accumulated from training may have been dissipated following the taper. Specifically, immediately following training, at T2, training fatigue is likely still present[24],preventing improved performance from being expressed. Thus, the performance improving following the taper period indicates the tapers effectiveness at reducing training related fatigue, allowing the improved fitness to be expressed. Although these are only small ES improvements, it is important to note that small changes are often important in strength based sports, with performance changes as little as 1.2% considered worthwhile for elite Olympic weightlifters[25]. While not controlling training volume, Zaras et al.[8] also showed a tendency for greater improvements in maximal strength (leg press 1RM and isometric peak force) following a heavy load taper (85% 1RM) compared to a light load (30% 1RM) taper. Taken together, these results suggest that a higher training intensity may be more beneficial during a taper.

The present results show the importance of volume reductions as a successful tapering strategy. It has previously been shown that elite powerlifters usually reduce training volume by 58.9 ± 8.4%, with intensity peaking 1.9 ± 0.8 weeks before a meet, during a 2.4 ± 0.9 week taper[10]. Grgic and Mikulic[14] showed that Croatian national powerlifting champions reduced training volume by 50.5 ± 11.7%, with intensity peaking 1.1 ± 0.4 weeks before the meet, during a 2.6 ± 1.1 week taper. A clear emphasis in both studies was found on dramatically reducing the training volume, while intensity alterations are less clear with more variation amongst athletes (based on SD of final training sessions). In its most extreme form, a reduction of training volume results in training cessation. Complete training cessation has been shown to be beneficial for maximal strength performance when undertaken for short periods of time (up to a week) in several studies[17,26,27]. Both qualitative studies[10,14] noted that powerlifters take training cessations of 3.7 ± 1.6 days and 3 ± 1 days, respectively, to finish the taper. These results again emphasise that short term training cessation (or complete volume reduction) is an important part of the strength taper.

In previous taper studies, improvements in power performance have often also occurred in conjunction with improved performance in dynamic strength tasks. Coutts et al.[6] showed increases in vertical jump performance following a tapering period as well as improvements in 3RM squat and bench press, and measures of quadriceps and hamstring isokinetic strength in team sport (rugby league) athletes. Zaras at el.[8] found larger improvements in both squat jump power and percentage change in leg press 1RM for a heavy taper in comparison to the light taper in throwers. Marrier et al.[12] showed large improvements in sprint times along with smaller improvements in IMTP strength. However, this is not always the case. Izquierdo at al.[13] showed increases in 1RM half squat and bench press following a taper, while half squat and bench press power (at 60% 1RM) was only maintained in active men. It could be hypothesised, that given the maintenance of isometric strength alongside improved dynamic power, the present taper may be able to improve dynamic strength. However, as dynamic strength was not measured, future research needs to investigate this possibility. Conducting multiple performance testing sessions during a taper may also provide useful insights into the kinetics of any performance changes observed, this may also provide insights into dissipation of fatigue of different performance tests.

No significant changes were found in hormonal or biochemical measures. Chronic changes in hormones such as testosterone and cortisol following training are not frequently observed[28]. Given that the training volume within the present study was not excessive, it was unlikely changes associated with overreaching would occur[6,29]. However, further investigations could attempt to induce overreaching prior to a strength taper, and observe subsequent performance effects and changes to hormonal and biochemical measures. It is also recommended that, given large variation between individuals in these measures, a larger sample size could be warranted to increase the likelihood of detecting changes.

Practical Applications

When reducing training load during a strength training taper, the focus should be primarily on reductions in training volume. Athletes and coaches are encouraged to considerably reduce the strength training volume (>50%) during a strength taper, while making smaller adjustments (if any) to the intensity of strength training. Slight increases in intensity may be useful, and thus, coaches and athletes could trial such a strategy. Removing accessory exercises and focussing on the most important major compound movements may be a useful method to assist in reducing training volume.

Conclusions

The present study is consistent with previous literature[6,7,11-13], that a strength taper with volume reductions can have positive effects on maximal strength and power performance. There was also a tendency for increased intensity to produce more favourable performance improvements, although no significant differences were found between conditions. Enhanced vertical jump performance may also indicate a reduction in neuromuscular fatigue for both tapers.

Acknowledgements

We would like to thank the volunteers who gave up their time to participate in this study.

References

1. Pritchard H, Keogh J, Barnes M, McGuigan M. Effects and mechanisms of tapering in maximizing muscular strength. *Strength & Conditioning Journal.* 2015;37(2):72-83.

2. Le Meur Y, Hausswirth C, Mujika I. Tapering for competition: A review. *Science & Sports.* 2012;27(2):77-87.

3. Mujika I, Padilla S. Scientific bases for precompetition tapering strategies. *Medicine and Science in Sports and Exercise.* 2003;35(7):1182-1187.

4. Hooper SL, Mackinnon LT, Ginn EM. Effects of three tapering techniques on the performance, forces and psychometric measures of competitive swimmers. *European Journal of Applied Physiology and Occupational Physiology.* 1998;78(3):258-263.

5. de Lacey J, Brughelli M, McGuigan M, Hansen K, Samozino P, Morin J-B. The effects of tapering on power-force-velocity profiling and jump performance in professional rugby league players. *Journal of Strength & Conditioning Research.* 2014;28(12):3567-3570.

6. Coutts A, Reaburn P, Piva TJ, Murphy A. Changes in selected biochemical, muscular strength, power, and endurance measures during deliberate overreaching and tapering in rugby league players. *International Journal of Sports Medicine.* 2007;28(2):116-124.

7. Häkkinen K, Kallinen M, Komi PV, Kauhanen H. Neuromuscular adaptations during short-term "normal" and reduced training periods in strength athletes. *Electromyography and Clinical Neurophysiology.* 1991;31(1):35-42.

8. Zaras N, Stasinaki A, Krase A, et al. Effects of tapering with light vs. heavy loads on track and field throwing performance. *Journal of Strength & Conditioning Research.* 2014;28(12):3484-3495.

9. Mujika I. Intense training: The key to optimal performance before and during the taper. *Scandinavian Journal of Medicine & Science in Sports.* 2010;20(s2):24-31.

10. Pritchard HJ, Tod DA, Barnes MJ, Keogh JW, McGuigan MR. Tapering practices of New Zealand's elite raw powerlifters. *Journal of Strength & Conditioning Research.* 2016;30(7):1796-1804.

11. Gibala MJ, MacDougall JD, Sale DG. The effects of tapering on strength performance in trained athletes. *International Journal of Sports Medicine.* 1994;15(8):492-497.

12. Marrier B, Robineau J, Piscione J, et al. Supercompensation kinetics of physical qualities during a taper in team sport athletes. *International Journal of Sports Physiology and Performance.* 2017;0(0):1-24.

13. Izquierdo M, Ibanez J, Gonzalez-Badillo JJ, et al. Detraining and tapering effects on hormonal responses and strength performance. *Journal of Strength & Conditioning Research.* 2007;21(3):768-775.

14. Grgic J, Mikulic P. Tapering practices of Croatian open-class powerlifting champions. *Journal of Strength & Conditioning Research.* 2016;[Epub ahead of print].

15. Haff GG, Triplett NT. *Essentials of Strength Training and Conditioning (4th Edition).* Human Kinetics; 2015.

16. Brzycki M. Strength testing—predicting a one-rep max from reps-to-fatigue. *Journal of Physical Education, Recreation & Dance.* 1993;64(1):88-90.

17. Pritchard HJ, Barnes MJ, Stewart RJC, Keogh JWL, McGuigan MR. Short term training cessation as a method of tapering to improve maximal strength. *Journal of Strength & Conditioning Research.* 2018;32(2):458-465.

18. Rushall BS. A tool for measuring stress tolerance in elite athletes. *Journal of Applied Sport Psychology.* 1990;2(1):51-66.

19. Storey AG, Birch NP, Fan V, Smith HK. Stress responses to short-term intensified and reduced training in competitive weightlifters. *Scandinavian Journal of Medicine & Science in Sports.* 2015;26(1):29-40.

20. Pritchard HJ, Barnes MJ, Keogh JW, McGuigan MR. The effectiveness of Prilepins chart for strength improvements in recreationally strength trained males. *Journal of Strength & Conditioning Research* 2016;30(S2):S101.

21. Hopkins WG. A scale of magnitudes for effect statistics. *A New View of Statistics.* 2002.

22. Cormie P, McGuigan MR, Newton RU. Developing maximal neuromuscular power. *Sports Medicine.* 2011;41(1):17-38.

23. Twist C, Highton J. Monitoring fatigue and recovery in rugby league players. *International Journal of Sports Physiology and Performance.* 2013;8:467-474.

24. Argus CK, Gill N, Keogh J, Hopkins WG, Beaven CM. Effects of a short-term pre-season training programme on the body composition and anaerobic performance of professional rugby union players. *J Sports Sci.* 2010;28(6):679-686.

25. McGuigan MR, Kane MK. Reliability of performance of elite Olympic weightlifters. *The Journal of Strength & Conditioning Research.* 2004;18(3):650-653.

26. Weiss LW, Coney HD, Clark FC. Optimal post-training abstinence for maximal strength expression. *Research in Sports Medicine.* 2003;11(3):145-155.

27. Weiss LW, Wood LE, Fry AC, et al. Strength/power augmentation subsequent to short-term training abstinence. *Journal of Strength & Conditioning Research.* 2004;18(4):765-770.

28. Kraemer WJ, Ratamess NA. Hormonal responses and adaptations to resistance exercise and training. *Sports Medicine.* 2005;35(4):339-361.

29. Fry AC, Kraemer WJ. Resistance exercise overtraining and overreaching: Neuroendocrine responses. *Sports Medicine.* 1997;23(2):106-129.

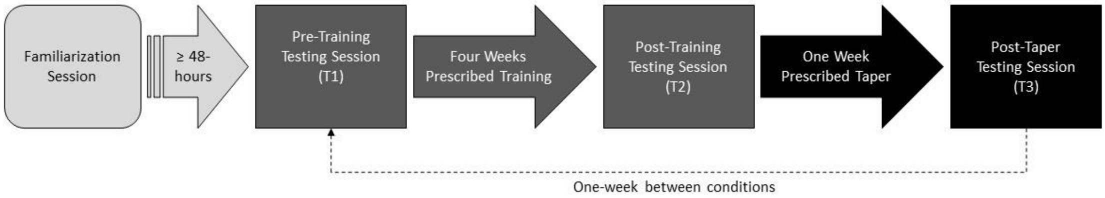

Figure 1. Experimental design

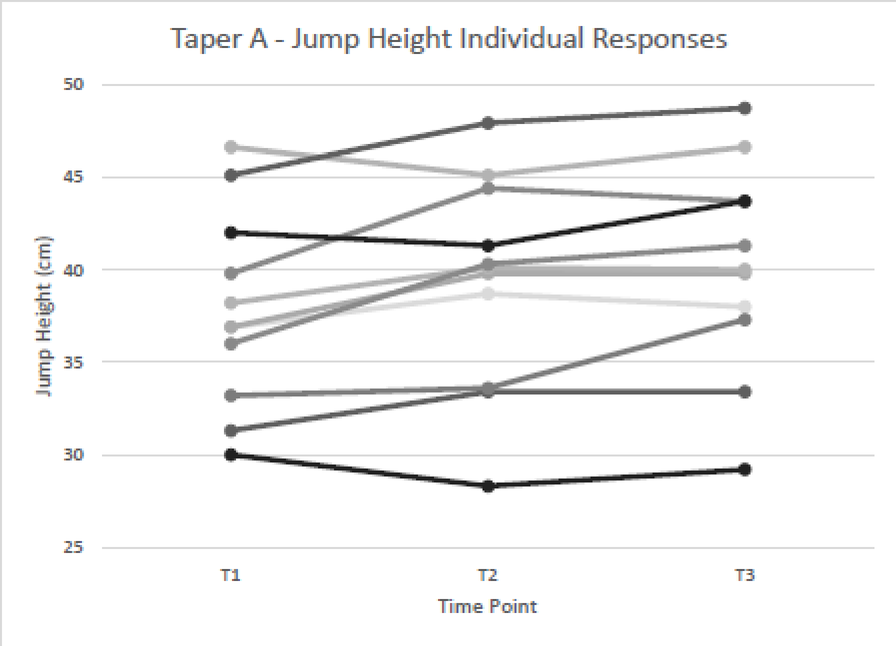

Figure 2. Taper A - Jump height individual responses

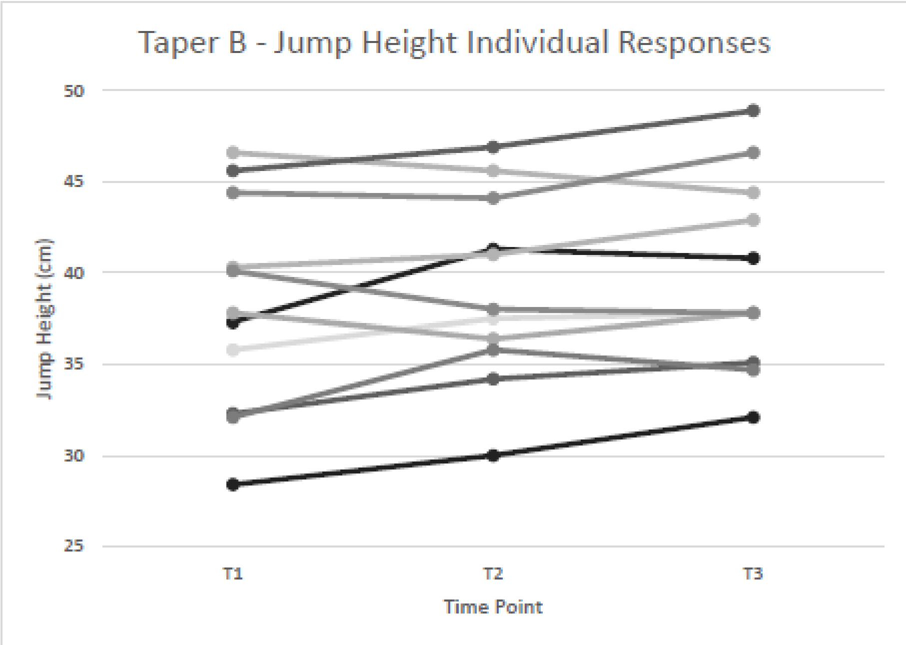

Figure 3. Taper B - Jump height individual responses

“Higher vs. Lower Intensity Strength Training Taper: Effects on Neuromuscular Performance” by Pritchard HJ et al.
International Journal of Sports Physiology and Performance

Table 1: Training program.

Day	Exercise	Week One			Week Two			Week Three			Week Four		
		Reps	Sets	Intensity	Reps	Sets	Intensity	Reps	Sets	Intensity	Reps	Sets	Intensity
1	Bench Press	4	3	80%	4	3	82.5%	3	4	85%	3	4	87.5%
1	Back Squat	6	4	75%	6	4	77.5%	4	4	80%	4	4	82.5%
1	Military Press	6	4	75%	6	4	77.5%	4	4	80%	4	4	82.5%
1	Barbell Row	10	3	70%	10	3	72.5%	8	4	75%	8	4	77.5%
2	Deadlift	4	3	80%	4	3	82.5%	3	4	85%	3	4	87.5%
2	Close Grip Bench Press	6	4	75%	6	4	77.5%	4	4	80%	4	4	82.5%
2	Deficit Deadlift	6	4	75%	6	4	77.5%	4	4	80%	4	4	82.5%
2	Good Morning	10	3	70%	10	3	72.5%	8	4	75%	8	4	77.5%
3	Back Squat	4	3	80%	4	3	82.5%	3	4	85%	3	4	87.5%
3	Paused Bench Press	6	4	75%	6	4	77.5%	4	4	80%	4	4	82.5%
3	Front Squat	6	4	75%	6	4	77.5%	4	4	80%	4	4	82.5%
3	Barbell Row	10	3	70%	10	3	72.5%	8	4	75%	8	4	77.5%

N.B. Intensity is percentage of 1RM; Deficit Deadlift was with feet raised on a 2” plate; Paused Bench Press had a two second pause on the chest.

Table 2: Taper programs.

Day	Exercise	Taper Week A			Taper Week B		
		Reps	Sets	Intensity	Reps	Sets	Intensity
1	Bench Press	4	2	90%	3	3	80%
1	Back Squat	3	3	82.5%	3	4	70%
2	Deadlift	4	2	90%	3	3	80%
2	Close Grip Bench Press	3	3	82.5%	3	4	70%
3	Back Squat	4	2	90%	3	3	80%
3	Paused Bench Press	3	3	82.5%	3	4	70%

N.B. Intensity is percentage of 1RM; Paused Bench Press had a two second pause on the chest.

Table 3: Performance results.

Performance Measures				
	CMJ Height (cm)	CMJ FT: CT	IMTP Relative Peak Force (N/kg)	IBP Relative Peak Force (N/kg)
A1	37.8 ± 5.3	0.738 ± 0.171	34.0 ± 4.8	18.6 ± 2.2
A2	39.4 ± 5.7*	0.788 ± 0.163*	35.9 ± 5.0*	18.4 ± 3.0
A3	40.2 ± 5.7*	0.803 ± 0.138*	35.9 ± 5.5*	18.4 ± 2.6
B1	38.2 ± 5.9	0.755 ± 0.160	35.4 ± 5.4	18.8 ± 2.9
B2	39.2 ± 5.2	0.793 ± 0.172*	35.9 ± 4.8	18.6 ± 2.8
B3	39.9 ± 5.3*	0.771 ± 0.169	35.2 ± 5.0	19.1 ± 2.6
P1	38.0 ± 5.5	0.747 ± 0.162	34.7 ± 5.0	18.7 ± 2.5
P2	39.3 ± 5.3*	0.791 ± 0.163*	35.9 ± 4.8*	18.5 ± 2.8
P3	40.0 ± 5.3*	0.787 ± 0.151*	35.5 ± 5.1	18.7 ± 2.5

(A = +5% Intensity Taper; B = -10% Intensity Taper; P = Pooled Data; Numbers indicate testing time point, 1 = Pre-training; 2 = Post-training, 3 = Post-taper).

* represents a small ES improvement compared to that conditions baseline. CMJ = countermovement; FT: CT = flight-time: contraction-time; IMTP = isometric mid-thigh pull; IBP = isometric bench press.

Table 4: Non-Performance Test Results.

Non-Performance Test Results					
	Cortisol (ng/ml)	**Testosterone (pg/ml)**	**T/C Ratio (x 1,000)**	**Creatine Kinase (I/U)**	**DALDA "worse than's"**
A1	7.65 ± 2.90	150.77 ± 46.43	25.10 ± 14.59	296.4 ± 216.6	4.2 ± 2.6
A2	8.89 ± 4.74	155.70 ± 45.92	24.25 ± 15.41	220.8 ± 101.6	4.6 ± 2.9
A3	8.62 ± 3.79	151.47 ± 41.31	20.42 ± 7.13	246.7± 136.6	3.5 ± 3.2
B1	9.20 ± 6.72	156.72 ± 55.00	24.00 ± 15.60	282.5 ± 155.6	3.4 ± 2.2
B2	8.94 ± 4.29	146.87 ± 35.57	20.53 ± 10.62	319.5 ± 204.9	2.6 ± 2.0
B3	8.04 ± 5.19	138.16 ± 33.27	21.02 ± 9.15	223.4 ± 162.6	2.1 ± 1.8

(A = +5% Intensity Taper; B = -10% Intensity Taper; Numbers indicate testing time point, 1 = Pre-training; 2 = Post-training, 3 = Post-taper)