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2-day vs. 4-day Training Cessation Following a Step Taper in Competitive and Recreational Powerlifters

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by

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Keywords: recovery, detraining, maximal strength, back squat, bench press, deadlift

ABSTRACT

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The purpose of this study was to compare differences in maximal strength, perceived recovery and stress state, and body composition alterations in powerlifters undergoing a 2-day or 4-day period of training cessation following a step taper. Ten participants completed a 6-week powerlifting specific training protocol. Body composition, perceived recovery and stress state, and maximal strength in the back squat (BS), bench press (BP), and deadlift (DL) were assessed prior to the overreach week (week 5) and either 2-days or 4-days after the taper. Alpha criterion was set at $p \leq 0.05$. There were statistically significant increases in BP ($p<0.001$) and Wilks score ($p=0.03$) following the 2-day protocol. Following the 4-day protocol, there were statistically significant increases in DL ($p=0.03$) and statistically significant decreases in BP ($p=0.04$). The results of this study support the use of shorter periods of training cessation (i.e., two days) following a step taper to improve maximal strength performance.

DEDICATION

Although many deserve this dedication, one Man, Jesus Christ, stands above the rest. For Your work in my life, I dedicate my work to You.

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Chapter 1. Introduction

Tapering and training cessation have been implemented for decades to increase athlete preparation prior to important competitions. Tapering has been defined as a "reduction of the training load during a variable period of time, in an attempt to reduce the physiological and psychological stress of daily training and optimize sports performance" (Mujika & Padilla, 2003). Training cessation is a planned period of rest where all sporting activities discontinue while everyday activities persist (Pritchard et al., 2018). The topics of tapering and training cessation have been extensively examined in endurance sports (Bosquet et al., 2007, 2013; Houmard et al., 1994; Le Meur et al., 2012; Mujika & Padilla, 2003), but the efficacy of such practices in strength sports requires further investigation (Pritchard et al., 2015).

There have been several studies showing a positive effect of both tapering and training cessation on strength performance through various methodologies (Häkkinen et al., 1987; Kyriazis et al., 2009; Pritchard et al., 2018; Weiss et al., 2004; Williams, 2017; Zaras et al., 2014). Kyriazis et al. (2009) observed a 6.5% increase in back squat one-repetition maximum (1RM) following a 2-week step taper in national level throwers. Pritchard et al. (2018) demonstrated that both 3.5 and 5.5 days of training cessation preserves isometric bench press peak force similarly in strength trained males. However, the increase in dynamic bench press performance cannot be confirmed since 1RM bench press performance was not reported. A recent review has acknowledged the lack of literature regarding the effectiveness of either tapering or training cessation in strength athletes (Travis et al., 2020b). Similarly, Pritchard et al. (2015) noted the lack of studies examining the effects of tapering or training cessation on strength performance, and the underlying mechanisms that may lead to enhanced strength. There has been a specific lack in research in determining a duration of training cessation effective in preserving maximal strength. The aforementioned review suggests that 2-7 days is optimal (Travis et al., 2020b). Some literature suggests that periods of cessation on the lower end of this range (i.e., 2-4 days) may be optimal in improving total powerlifting performance (Cattanach, 1994; Travis al., 2021a; Weiss et al., 2004); however, very few studies have evaluated this hypothesis, therefore warranting further investigation.

In practice, tapers are typically followed by or include a period of training cessation (Pritchard et al., 2015; Travis et al., 2020b). A review by Travis et al. (2020b) recommends that a taper is followed by 2-7 days of training cessation to maximize performance outcomes. However, the optimal period of training cessation following a taper has never been experimentally analyzed. Therefore, the objective of this study was to compare the effectiveness of two common training cessation periods following a taper. To pursue this objective, this project compared the differences in maximal strength, perceived recovery and stress state, and body composition in strength athletes undergoing a 2-day (2D) or 4-day (4D) period of training cessation following a step taper.

Chapter 2. Review of the Literature

The purpose of this review was to provide an overview of the existing research on tapering and training cessation as they relate to pre-competition preparation in powerlifting.

The Effects of Tapering on Performance

Tapering has been implemented for decades to increase athlete preparation prior to important competitions (Bosquet et al., 2007; Shepley et al., 1992). Tapering has been defined as a "reduction of the training load during a variable period of time, in an attempt to reduce the physiological and psychological stress of daily training and optimize sports performance" (Mujika & Padilla, 2003). This reduction in training load can be achieved by altering various components including training volume, training intensity, training frequency, etc. (Bosquet et al., 2007). The taper takes place during the final period of training before a major competition and is therefore of tremendous importance for athletic performance (Mujika & Padilla, 2003). If applied appropriately, tapering has been shown on average to produce 0.5-6.0% improvement in competitive performance (Le Meur et al., 2012; Mujika & Padilla, 2003). For decades, researchers and coaches alike have attempted to identify optimal tapering strategies for various sports and/or events (Bosquet et al., 2007; Mujika & Padilla, 2003).

There are several different types of tapering as identified by Mujika & Padilla (2003): linear, exponential (slow and fast decay), and step. Exponential and step tapers are most commonly used in the literature (Mujika & Padilla, 2003; Travis et al., 2020b). An exponential taper is a progressive, non-linear taper while the step taper is a nonprogressive taper (i.e., reduced training). Figure 2.1 visually describes the different types of tapers.

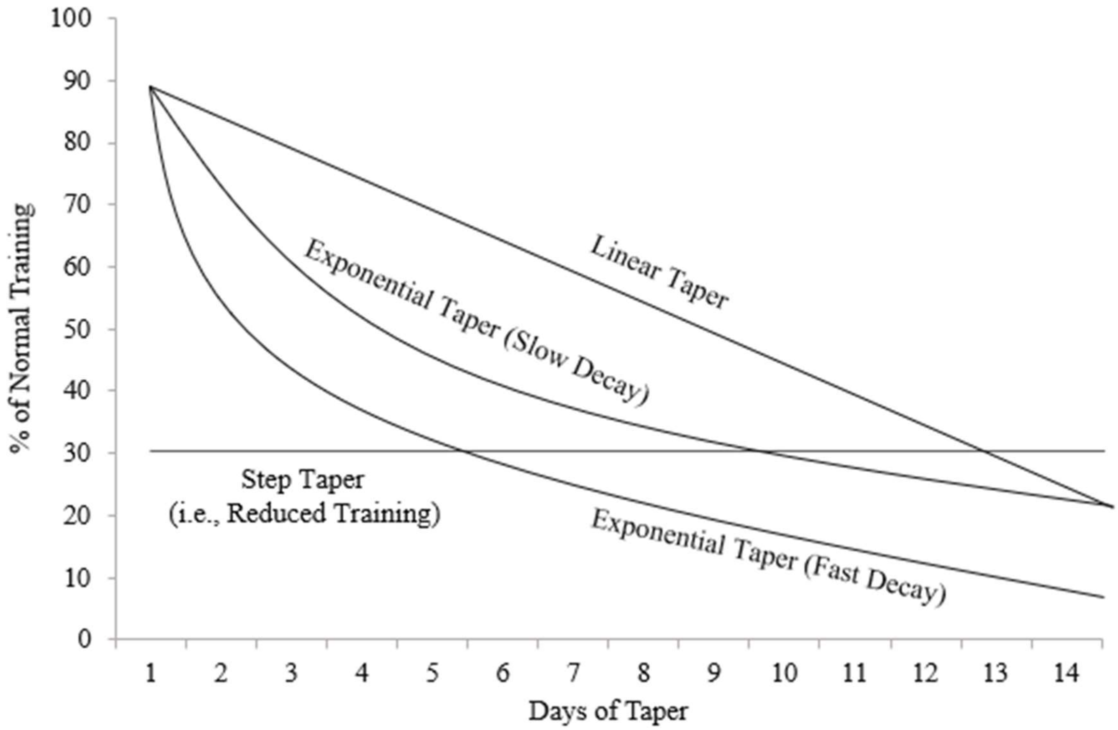

Figure 2.1.

Schematic Representation of the Different Types of Tapering. Adapted from Mujika & Padilla (2003).

Endurance Performance

Although not unanimous, evidence for the effect of tapering on endurance performance indicates that tapering can produce advantageous performance outcomes (Berger et al., 1999; Bosquet et al., 2007; Costill et al., 1985; Luden et al., 2010; Mujika & Padilla, 2003). Berger et al. (1999) demonstrated a 2-week taper following three weeks of overtraining to result in a 2.3% increase in average power output, as well as a decreased pursuit time in elite cyclists. Costill et al. (1985) found time trial performance in various swimming events ranging from 50-1650 yards to significantly improve by an average of 3.1% following a 2-week taper in male collegiate swimmers. Additionally, Luden et al. (2010) found a 3-week taper to increase 8-km cross-country race performance to increase by 3 ± 1% collegiate runners. Indeed, there is a large body of research supporting the use of tapering to improve endurance performance (Bosquet et al., 2007; Le Meur et al., 2012; Mujika & Padilla, 2003).

In fact, endurance performance has dominated tapering research. There are numerous reviews and meta-analyses that examine the effects of tapering on endurance performance, combining the information from hundreds of peer-reviewed articles (Bosquet et al., 2007; Grivas, 2018; Houmard & Johns, 1994; Le Meur et al., 2012; Mujika, 2011; Mujika & Padilla, 2003; Vachon et al., 2020). Although there is some resistance to the hypothesis that tapering improves endurance performance in individual studies (Child et al., 2000), many reviews and meta-analyses conclude that tapering improves endurance performance, strongly supporting the concept of tapering (Bosquet et al., 2007; Grivas, 2018; Houmard & Johns, 1994; Le Meur et al., 2012; Mujika, 2011; Mujika & Padilla, 2003; Vachon et al., 2020).

Several reviewers have sought to provide practical tapering recommendations for use by coaches, sport scientists, and athletes (Bosquet et al., 2007; Le Meur et al., 2012; Mujika & Padilla, 2003). Through a meta-analysis comprising the data from 27 tapering studies, Bosquet et al. (2007) concluded that a 2-week exponential taper with a volume decrease of 41-60% and a maintenance of training intensity and frequency is optimal. Mujika and Padilla (2003) had similar findings, asserting that maintenance of training intensity and utilization of a progressive, non-linear taper model (i.e., exponential taper) will optimize performance. However, Mujika and Padilla (2003) suggested that training volume may be reduced up to 90%, also contending that tapers ranging from 4-28 days may be effective. Vachon et al. (2020) noted how few studies experimentally compare various tapering strategies to one another, thus rendering such recommendations speculative in nature. Future research should seek to rectify this gap in the literature by experimentally comparing different tapering strategies.

Strength and Power Performance

There is, however, another deficiency in the current literature. In relation to the amount of research examining tapering in endurance athletics, there has been far less research conducted examining the effects of tapering on strength and power performance (Pritchard et al., 2015; Travis et al., 2020b). A recent review has acknowledged the lack of literature regarding the effectiveness of tapering in strength and power athletes (Travis et al., 2020b). Similarly, Pritchard et al. (2015) noted the lack of investigation dealing with the effects of tapering on strength performance, or the underlying mechanisms that may lead to enhanced strength. Therefore, further research is needed to confirm the efficacy of utilizing tapering practices to improve strength and power performance.

Several studies have shown a positive effect of tapering on strength and power performance (Bazyler et al., 2017; Kyriazis et al., 2009; Pritchard et al., 2019; Travis et al., 2021d; Williams, 2017; Zaras et al., 2014). Kyriazis et al. (2009) observed a 6.5% increase in back squat one-repetition maximum (1RM) following a 2-week step taper in national level throwers. Bazyler et al. (2017) showed unweighted countermovement jump (CMJ) peak force and peak power and throwing performance to significantly improve in Division I collegiate throwers after a 1-week overreach and a 3-week taper. Additionally, Williams (2017) found statistically significant increases in 1RM bench press performance following a 1-week step taper when compared to baseline and post-overreach values.

The literature regarding the effect of tapering on strength and power performance is not unanimous (Coutts et al., 2007). Coutts et al. (2007) found no changes in 3RM bench press performance following a 6-week overload protocol followed by a 1-week taper. Nevertheless, two recent reviews examining the effects of tapering on strength performance assert that tapering, if appropriately applied, can be effective in improving strength and/or power performance (Pritchard et al., 2015; Travis et al., 2020b).

A few investigators have experimentally compared different tapering practices (Pritchard et al., 2019; Seppänen & Häkkinen, 2020; Travis et al., 2021d; Zaras et al., 2014). Zaras et al. (2014) showed greater improvements in 1RM leg press following a 2-week heavy taper versus a 2-week light taper (+5.9% vs. -3.4%) in track and field throwers. Pritchard et al. (2019) found CMJ height to significantly increase following a taper with either an increase or decrease in intensity (+5.9% vs. -8.5%), noting the higher-intensity taper as having greater effect sizes for CMJ height and isometric mid-thigh pull peak force scaled to body mass compared to the lower-intensity taper. However, there have only been two investigations that were experimental comparisons of different tapering models (e.g., exponential taper vs. step taper) (Seppänen & Häkkinen, 2020; Travis et al., 2021d). Travis et al. (2021d) found both a 1-week step taper and a 3-week exponential taper improved 1RM performance in the back squat and bench press, while 1RM deadlift was only improved in the exponential taper group. However, the step taper produced a more favorable myocellular environment for the enhancement of skeletal muscle adaptations (Travis et al., 2021d). Seppänen and Häkkinen (2020) found a 2-week step taper to produce significantly greater improvements in 1RM back squat when compared to a 2-week exponential taper (3.36% vs 1.72%, respectively), as well as greater improvements in 1RM bench press (2.02% vs. 1.42%, respectively), albeit not reaching statistical significance. Volume and intensity were equated between groups in both studies (Seppänen & Häkkinen, 2020; Travis et al., 2021d).

The aforementioned reviews by Travis et al. (2020b) and Pritchard et al. (2015) provide recommendations for tapering to improve maximal strength performance. Pritchard et al. (2015)

suggest a step or progressive (i.e., exponential) mode of tapering lasting 1-4 weeks with a volume decrease of 30-70%, a maintained or slightly increased training intensity, and a maintained training frequency. The recommendations of Travis et al. (2020b) agree with volume and taper modality recommendations presented by Pritchard et al. (2015). However, Travis et al. (2020b) assert that tapering to improve maximum strength lasting more than 2 weeks can lead to detraining and that training intensity may be maintained or decreased. Additionally, Travis et al. (2020b) proposed the implementation of 2-7 days of training cessation following tapering to further reduce fatigue and optimize performance. Both reviews agree that further research is needed to elucidate proper tapering practices for strength and power development (Pritchard et al., 2015; Travis et al., 2020b). Travis et al. (2020b) specifically identified a need for experimental studies comparing differing tapering protocols.

Powerlifting Performance

Powerlifters compete in the back squat, bench press, and deadlift. Athletes are given three trials to demonstrate maximal efforts for each lift. The sum of the heaviest successful trial for each lift (i.e., total) is considered. Wilks score, a formula used to adjust powerlifting scores for sex and body mass, is used to compare powerlifters across weight-classes and sex categories (Vanderburgh & Batterham, 1999). Despite the misleading name, success in powerlifting relies almost entirely on maximal force production (Travis et al., 2020b). There have been few examinations of the effects of tapering in powerlifters (Godawa et al., 2012; Travis et al., 2021d; Williams, 2017). Godawa et al. (2012), although not directly examining a taper, found a two-week exponential taper to aid in significantly improving total powerlifting performance (1.0% increase). Williams (2017) found a significant increase in 1RM bench press performance following a 1-week step taper when compared to both baseline and post-overreach values. Travis et al. (2021d) found a 1-week step taper to produce a more favorable myocellular environment for the enhancement of skeletal muscle adaptations when compared to a 3-week exponential taper, while the exponential taper demonstrated larger improves to deadlift 1RM. Both protocols improved back squat and bench press 1RM similarly (Travis et al., 2021d). When assessed as a whole, the results from the existing literature suggest various methods of tapering may be effective in improving powerlifting performance.

There is another avenue of research that may provide insight into proper tapering practices in powerlifting. Recently, a few surveys have been published that summarize the tapering practices of powerlifters from different regions (Grgic & Mikulic, 2017; Pritchard et al., 2016; Travis et al., 2021b). Pritchard et al. (2016) surveyed New Zealand's Raw Powerlifters (n=11, 431.9 ± 43.9 Wilks score) to determine their tapering practices. On average, tapering began 2.4 ± 0.9 weeks before competition, volume was decreased by 58.9 ± 8.4%, and the final training session was completed 3.7 ± 1.6 days before competition; the preferred method of tapering, however, was not considered (Pritchard et al., 2016). Grgic & Mikulic (2017) adapted the protocol from Pritchard et al. (2016), adding an assessment of preferred type of tapering. Grgic & Mikulic (2017) found that Croatian powerlifters (n=10, 322.8 ± 55.3 Wilks score) prefer a 2.6 ± 1.1-week exponential taper with a volume reduction of 50.5 ± 11.7% and a final training session 3 ± 1 day before competition. The most recent survey found a 7-10 day step taper with a volume reduction 41-50% and a final training session 2.8 ± 1.1 days before competition to be the preferred method of tapering in North American Powerlifters (n=364, 418.0 ± 65.2 Wilks score) (Travis et al., 2021b). The study conducted by Travis et al. (2021b) featured a substantially greater applicability compared to Pritchard et al. (2016) and Grgic and Mikulic (2017) due to the sample size and inclusion of all levels of powerlifters, regional to international. This study recommends that, based on the practices of North American Powerlifters, a 7-10 day step taper with a volume reduction of ~50% that ends with ~3 days of training cessation may be beneficial for powerlifters (Travis et al., 2021b).

The Effects of Training Cessation on Performance

Training cessation has drawn significant interest from researchers (Bosquet et al., 2013; Pritchard et al., 2015). Training cessation is a planned period of rest where all sporting activities discontinue while everyday activities persist (Pritchard et al., 2018). The length of training cessation dramatically changes the expected physiological adaptations and subsequent performance outcomes (Bosquet et al., 2013; Travis et al., 2020b). Long-term training cessation is associated with detraining, reversal of training adaptations, and decreased performance (Bosquet et al., 2013; Travis et al., 2020b). Short term training cessation, however, has been shown to be efficacious in preserving and/or exposing training adaptations by promoting recovery (Figure 2.2) (Pritchard et al., 2015).

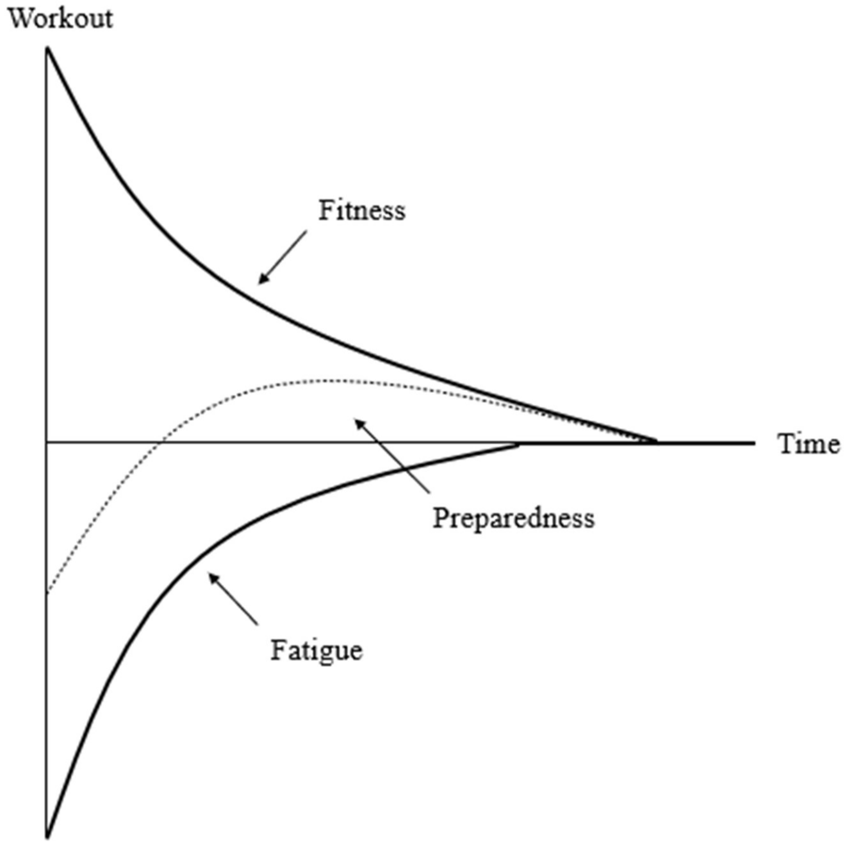

Figure 2.2.

Fitness-Fatigue Model. Adapted from Plisk & Stone (2003).

Long-Term Training Cessation

Detraining has been defined as the partial or complete loss of training-induced adaptations as a consequence of training cessation (Mujika & Padilla, 2000a). Training cessation lasting more than two weeks often inflicts decreases in aerobic and anaerobic performance (Bosquet et al., 2013; Mujika & Padilla, 2000a; Travis et al., 2020b). Izquierdo et al. (2007) showed four weeks of training cessation to result in statistically significant decreases in 1RM hack squat strength (-6%). Peak torque during knee extension has also been shown to decrease following twelve weeks of training cessation (Blocquiaux et al., 2020). These are but a few examples; based on reviews of literature, more than a hundred studies have shown the negative effect long-term training cessation has on performance (Bosquet et al., 2013; Mujika & Padilla, 2000a, 2000b). Therefore, it is well established that long-term training cessation is not a valid method of improving athletic performance. However, the effects of short-term training cessation (i.e., training cessation lasting less than two weeks) on training adaptations have not been extensively examined. The following section discusses the literature investigating short-term training cessation.

Short-Term Training Cessation

Training cessation lasting less than two weeks is referred to as short-term training cessation (Bosquet et al., 2013). Admittedly, the reversal of training adaptations has been shown to occur in less than two weeks (Bosquet et al., 2013; Häkkinen et al., 2000). However, recent evidence suggests that short-term cessation <7 days may maintain or improve performance (Cattanach, 1994; Pritchard et al., 2018; Travis et al., 2021a; Weiss et al., 2004). Pritchard et al. (2018) demonstrated that both 3.5 and 5.5 days of training cessation preserves isometric bench press peak force similarly in strength trained males; however, the increase in bench press performance cannot be confirmed since 1RM bench press performance was not reported. Similarly, Weiss et al. (2004) found two, three, four, and five days of training cessation to increase 1RM bench press performance in strength trained males.

However, there has been an emerging trend favoring shorter periods of training cessation. In the Weiss et al. (2004) study, the greatest 1RM bench press values were achieved after two and three days of training cessation. Cattanach (1994) found two and four days of training cessation to improve 1RM back squat performance to a greater extent than seven days of training cessation; 1RM bench press performance, however, was similar across all periods of training cessation. Most recently, Travis et al. (2021a) found isometric bench press performance to be preserved after three days of training cessation but decrease after five days of training cessation. Both periods of cessation preserved isometric squat performance similarly (Travis et al., 2021a). When taken together, then results seem to suggest that shorter periods of training cessation (i.e., 2-4 days) may be optimal in preserving maximal strength, especially as it relates to powerlifting. However, the evidence is limited by the number of studies that have examined the effect of training cessation on maximal strength performance (Pritchard et al., 2015; Travis et al., 2020b). Both reviews by Travis et al. (2020b) and Pritchard et al. (2015) call for further research to elucidate the proper application of training cessation as it relates to maximal strength performance.

Conclusion and Further Deficiencies

Throughout this review, several themes have emerged. Irrespective of sport category, there is a lack of research experimentally comparing differing tapering protocols to one another (Travis et al., 2020b; Vachon et al., 2020). Additionally, although there is promising evidence supporting the use of tapering and training cessation to improve strength and power performance, there is a distinct lack of research in this area (Pritchard et al., 2015; Travis et al., 2020b). Furthermore, there is a scarcity of research examining the effects of tapering and/or training cessation in powerlifting despite the widespread use of such practices among powerlifters (Grgic & Mikulic, 2017; Pritchard et al., 2015, 2016; Travis et al., 2020b, 2021b).

However, there is another, possibly more blatant deficiency in the current literature that relates to the interplay between tapering and training cessation. In practice, tapers are typically followed by or include a period of training cessation (Pritchard et al., 2015; Travis et al., 2020b). A review by Travis et al. (2020b) even recommends that a taper is followed by 2-7 days of training cessation to maximize performance outcomes. Despite this connection, the optimal period of training cessation following a taper has never been experimentally examined as it relates to strength and power performance. The current study therefore aims to shed light on the current deficiencies in the literature.

2-day vs. 4-day Training Cessation Following a Step Taper in Competitive and Recreational Powerlifters

Original Investigation

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ABSTRACT

The purpose of this study was to compare the differences in maximal strength, perceived recovery and stress state, and body composition alterations in strength athletes undergoing a 2-day (2D) or 4-day (4D) period of training cessation following a step taper. Ten competitive and recreational powerlifters (22.2 ± 2.3 years; 94.4 ± 21.5 kg; 174.6 ± 8.3 cm) completed a 6-week training protocol designed to peak strength on the back squat (BS), bench press (BP), and deadlift (DL). The final two weeks of training consisted of a 1-week overreach and a 1-week step taper ending in either 2D or 4D of training cessation. Body composition, perceived recovery and stress state, and maximal strength in the BS, BP, and DL were assessed prior to the overreach week (T1) and after the training cessation (T2). Alpha criterion was set at $p \leq 0.05$. There were statistically significant increases in BP ($p < 0.001$, $g = 0.07$) and Wilks score ($p = 0.03$, $g = 0.12$) following the 2D protocol. Following the 4D protocol, there were statistically significant increases in DL ($p = 0.03$, $g = 0.14$) and statistically significant decreases in BP ($p = 0.04$, $g = -0.14$). There were no statistically significant changes in any other variable for either protocol. Additionally, there were no statistically significant differences between groups for any variable. The results of this study support the use of shorter periods of training cessation (i.e., 2D) following a step taper to improve maximal strength performance.

KEYWORDS: recovery, detraining, maximal strength, back squat, bench press, deadlift

INTRODUCTION

Tapering and short-term training cessation have been implemented for decades in an attempt to optimize athlete preparedness leading into competition (20,29). Tapering has been defined as a "reduction of the training load during a variable period of time, in an attempt to reduce the physiological and psychological stress of daily training and optimize sports performance" (20). Training cessation is a planned period of rest where all sporting activities discontinue while everyday activities persist (23). Tapering and training cessation have been extensively examined in relation to endurance sports (8,9,15,16,19,20), but the efficacy of such practices in strength sports requires further investigation (24,29).

The existing literature which examines tapering in relation to maximal strength performance consists primarily of observational and qualitative research (3,5,12,18,25,36). To date, few studies have experimentally compared different tapering protocols directed towards improving maximal strength performance (22,26,33). Pritchard et al. (22) found a higher intensity tapering protocol (+5.9%) to produce greater improvements in isometric mid-thigh pull peak force scaled to body mass compared to a lower intensity taper (-8.5%) in strength trained males. Travis et al. (33) found a 3-week exponential taper improved powerlifting performance to a greater extent compared to a 1-week step taper, yet the step taper produced a more favorable myocellular environment for the enhancement of skeletal muscle adaptations (33). Conversely, Seppänen & Häkkinen (26) found a 2-week step taper produced substantially greater improvements in one-repetition maximum (1RM) back squat and bench press when compared to a 2-week exponential taper (3.36% vs 1.72%, 2.02% vs. 1.42%, respectively), albeit not statistically significant. Volume and intensity were equated between groups in both studies (26,33).

Likewise, the body of research examining the effects of short-term training cessation on maximal strength performance is meager (23,29,30,35). Pritchard et al. (23) demonstrated both 3.5 and 5.5 days of training cessation maintain isometric bench press peak force similarly in strength trained males. Weiss et al. (35), however, found two, three, four, and five days of training cessation to produce small, nonstatistically significant improvements in 1RM bench press (effect size = 0.15, 0.08, 0.03, 0.07, respectively) and isokinetic bench press performance in strength trained males. Most recently, Travis et al. (30) found isometric bench press performance to be preserved after three days of training cessation, but decrease after five days of training cessation (-0.9% vs. -2.4%, respectively). Both periods of cessation preserved isometric squat performance similarly (30).

Fortunately, several qualitative studies provide insight into optimal tapering and training cessation strategies for maximal strength performance (12,24,25,29,31). Grgic & Mikulic (12) found that Croatian powerlifters (n=10, 322.8 ± 55.3 Wilks score) prefer a 2.6 ± 1.1 week exponential taper with a volume reduction of 50.5 ± 11.7% and a final training session 3 ± 1 day before competition. A recent survey found a 7-10 day step taper with a volume reduction 41-50% and a final training session 2.8 ± 1.1 days before competition to be the preferred method of tapering among North American Powerlifters (n=364, 418.0 ± 65.2 Wilks score) (31). The aforementioned study recommends, based on the practices of North American Powerlifters, a 7-10 day step taper with a volume reduction of ~50% that ends with ~3 days of training cessation may be beneficial for powerlifters (31).

There are currently two reviews that provide recommendations for tapering to improve maximal strength performance (24,29). Pritchard et al. (24) suggest a step or progressive (i.e., exponential) mode of tapering lasting 1-4 weeks with a volume decrease of 30-70%, a maintained or slightly increased training intensity, and a maintained training frequency. The recommendations of Travis et al. (29) agree with volume and taper modality recommendations presented by Pritchard et al (24). However, Travis et al. (29) assert that tapering lasting more than two weeks can lead to detraining and that training intensity may be maintained or decreased. Additionally, Travis et al. (29) proposed the implementation of 2-7 days of training cessation following tapering to further reduce fatigue and enhance performance. Both reviews agreed that further research is needed to elucidate proper tapering and training cessation practices for maximal strength performance (24,29). Travis et al. (29) specifically identified a need for experimental studies comparing differing tapering protocols.

There is, however, a deficiency in the current literature relating to the interplay between tapering and training cessation. In practice, tapers are typically followed by or include a period of training cessation (24,29). Indeed, the review by Travis et al. (29) recommends that a taper is followed by 2-7 days of training cessation to maximize performance outcomes. Despite this connection, the optimal period of training cessation following a taper has never been experimentally examined as it relates to strength and power performance. Therefore, the objective of this study was to compare the effectiveness of two common training cessation periods following a taper. To pursue this objective, this project compared the differences in maximal strength, perceived recovery and stress state, and body composition in strength athletes undergoing a 2-day (2D) or 4-day (4D) period of training cessation following a step taper.

METHODS

Experimental Approach to the Problem

The study utilized a randomized, matched-pairs design to compare 2D and 4D of training cessation following a step taper in powerlifters. All participants were familiarized with training and testing procedures over an 8-week period before the beginning of the study. Participants were required to abstain from any strenuous activity outside of the training and testing for the length of the study to limit confounding factors. The participants completed six weeks of supervised strength training comprising of three training sessions per week on non-consecutive days. The initial four weeks of training were followed by a 1-week planned overreach and a 1-week step taper. Testing sessions assessing body composition, stress and recovery state, and maximal strength on the back squat (BS), bench press (BP), and deadlift (DL) through a mock powerlifting competition were conducted prior to the overreach week (T1) and either 2D (47.8 ± 0.4 hours) or 4D (96.3 ± 0.4 hours) after the completion of the last training session of the taper week (T2) (Figure 1). Prior to each testing session, participants were instructed to arrive at the laboratory in a fully rested, hydrated state. For standardization purposes, participants recorded all food consumption over 48-hour period before T1 and were instructed to replicate the 48-hour log prior to T2. Following the first testing session, the participants were ranked according to Wilks scores (i.e., a coefficient used in powerlifting to compare relative strength across weight classes and sex categories) and matched pairs were randomly assigned to either the 2D (n = 5) or 4D (n = 5) group by an assistant unaffiliated with the study. An equal number of men and women were assigned to each group (i.e., four men and one woman in each group).

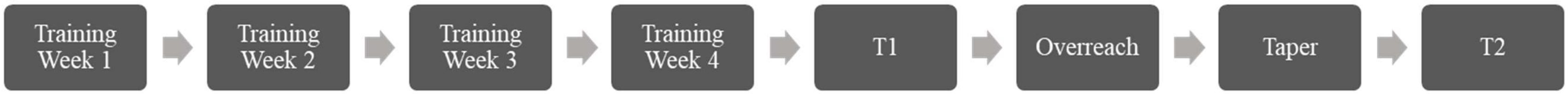

Figure 3.1. *Schematic Representation of the Training and Testing Timeline.* T1 = pre-overreach testing session. T2 = post-training cessation testing session. Testing sessions included the assessment of hydration, body composition, perceived recovery and stress state, and one-repetition maximum strength in the Back Squat, Bench Press, and Deadlift.

Subjects

Ten individuals (*n* = 8 men, *n* = 2 women) volunteered to participate in this study. All participants completed the study (Table 1). Participants were competitive (*n* = 6) and recreational (*n* = 4) powerlifters (i.e., individuals who trained the BS, BP, and DL but had no competition experience). Participants were required to have a minimum of one year of powerlifting-style training experience, be injury free, and meet the following strength criteria: male - BS and DL >1.75 body mass (BM), BP >1.25 BM; female - BS and DL >1.5 BM, BP >1.0 BM. Any individual under the age of 18, with an injury or known health condition, or an inability to meet the strength criteria was excluded from the study. Prior to data collection, athletes received information about the purpose of the study and provided written informed consent. The study received approval from East Tennessee State University's institutional review board (IRB# 0122.1).

Table 3.1: Descriptive Characteristics at Baseline

	Combined	2-Day Group ($n = 5$)	4-Day Group ($n = 5$)
Age (yrs)	22.2 ± 2.3	22.1 ± 2.8	22.3 ± 2.1
Height (cm)	174.6 ± 8.3	176.5 ± 2.7	172.6 ± 11.7
Mass (kg)	94.4 ± 21.5	90.9 ± 12.3	97.8 ± 29.3
1RM Back Squat (kg)	197.2 ± 50.9	189.6 ± 50.5	204.9 ± 55.9
1RM Bench Press (kg)	134.2 ± 40.8	127.9 ± 36.7	142.2 ± 49.9
1RM Deadlift (kg)	218.0 ± 48.4	223.4 ± 45.0	213.7 ± 55.8
Powerlifting Total (kg)	564.6 ± 139.9	566.4 ± 117.8	562.7 ± 178.2
Relative BS (kg/bm)	2.1 ± 0.3	2.1 ± 0.4	2.1 ± 0.3
Relative BP (kg/bm)	1.4 ± 0.2	1.4 ± 0.3	1.4 ± 0.2
Relative DL (kg/bm)	2.3 ± 0.3	2.4 ± 0.3	2.2 ± 0.3
Relative Total (kg/bm)	5.8 ± 0.9	6.0 ± 1.0	5.6 ± 0.7
Wilks Score	362.6 ± 51.0	353.8 ± 65.2	371.4 ± 40.1

1RM = one-repetition maximum, BS = back squat, BP = bench press, DL = deadlift

Training Procedures

All participants completed a 6-week peaking regimen designed to improve powerlifting performance. Training took place 3-days per week at the same time of day on nonconsecutive days. A standardized dynamic warm-up consisting of jumping jacks, leg swings, trunk twists, lunges, and body weight squats were completed prior to every training and testing session. The first four weeks of training served to standardize participant readiness prior to T1, as well as mimic the final phase of a pre-competition powerlifting training protocol. After T1, the participants performed a 1-week planned overreach consisting of 150% volume relative to Weeks 1-4 (150.1%), followed by a 1-week step taper consisting of 50% volume relative to the overreach week (48.6%) (24,26,29,31,33). Volume load (VL) was determined by load x sets x reps. Barbell warm-ups were considered in VL calculations (Figure 2). 9/10 lifters completed 100% of their sessions. 1/10 lifters missed a single session due to sickness. All participants completed all training sessions during the overreach and taper weeks. 2/10 lifters were unable to provide maximal efforts on the bench press and deadlift, respectively, and therefore did not produce a powerlifting total (i.e., sum of the best successful BS, BP, and DL) or Wilks score. All training and testing sessions were supervised by members of the study staff. See Table 2 for training details.

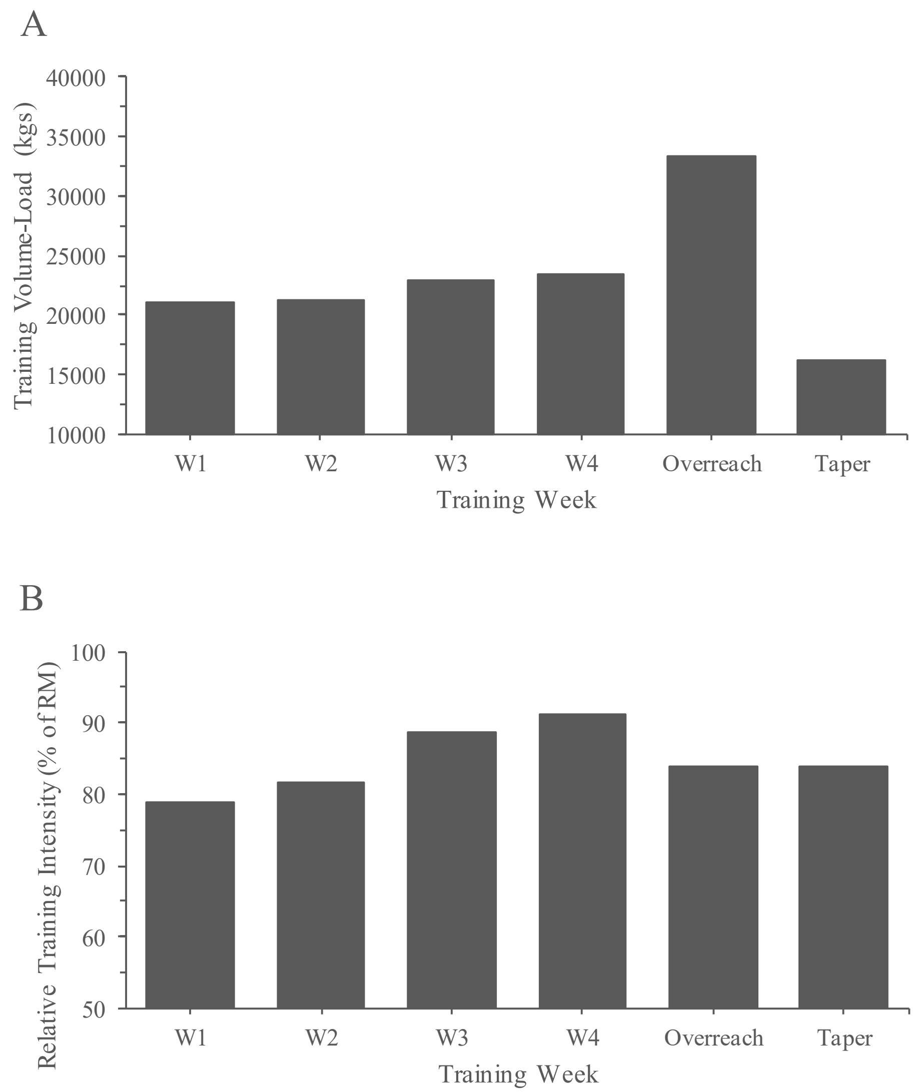

Figure 3.2. *Volume-Load (A) and Relative Training Intensity (B) from all Training Weeks.*

Table 3.2: Training Details

Training Program	Day 1			Day 2			Day 3		
	Relative Intensity	Sets x Reps	Exercises	Relative Intensity	Sets x Reps	Exercises	Relative Intensity	Sets x Reps	Exercises
Week 1	80.0 ± 2.5%	3x3 + 1x5; 3x5	BS, BP, OHP, PU	77.5 ± 2.5%	3x3 + 1x5; 3x5	DL, PR, Dips	72.5 ± 2.5%	3x3 + 1x5; 3x5	BS, BP, CGBP, PU
Week 2	85.0 ± 2.5%	3x3 + 1x5; 3x5	BS, BP, OHP, PU	82.5 ± 2.5%	3x3 + 1x5; 3x5	DL, PR, Dips	77.5 ± 2.5%	3x3 + 1x5; 3x5	BS, BP, CGBP, PU
Week 3	90.0 ± 2.5%	3x3 + 1x5; 3x5	BS, BP, OHP, PU	87.5 ± 2.5%	3x3 + 1x5; 3x5	DL, PR, Dips	82.5 ± 2.5%	3x3 + 1x5; 3x5	BS, BP, CGBP, PU
Week 4	95.0 ± 2.5%	3x3 + 1x5; 3x5	BS, BP, OHP, PU	92.5 ± 2.5%	3x3 + 1x5; 3x5	DL, PR, Dips	87.5 ± 2.5%	3x3 + 1x5; 3x5	BS, BP, CGBP, PU
Overreach	85.0 ± 2.5%	6x3; 5x5	BS, BP, OHP, PU	82.5 ± 2.5%	6x3; 5x5	DL, PR, Dips	77.5 ± 2.5%	6x5; 5x5	BS, BP, CGBP, PU
Taper	92.5 ± 2.5%	1x1 + 3x2	BS, BP, DL	87.5 ± 2.5%	3x2 + 1x5	BS, BP	72.5 ± 2.5%	3x2 + 1x5	BS, BP

BS = back squat, BP = bench press, OHP = overhead press, PU = pull-ups, DL= deadlift, PR = Pendlay row, CGBP = close-grip bench press. Sets x reps schemes such as 3x3 + 1x5 indicate that the primary work of competition exercises (3x3) was followed by additional work (1x5). If assistance/accessory exercises were included in the session, the set and rep scheme for that work preceded by a semicolon (e.g., 3x3 + 1x5; 3x5).

Testing Procedures

Hydration and Anthropometrics. Upon arrival to the laboratory, hydration was evaluated using a refractometer (ATOGO, Tokyo, Japan). The athletes were considered hydrated if urine specific gravity (USG) was <1.020. If an athlete failed testing, they continued to consume water until passing the test. A calibrated scale (Tanita BF-350, Arlington Heights, IL, USA) was used to measure BM to the nearest 0.1 kg. Height measurements were recorded to the nearest 0.5 cm using a stadiometer (Cardinal Scale Manufacturing Co., Webb City, MO, USA).

Short Recovery Stress Scale. After the evaluation of hydration and anthropometrics, the Short Recovery and Stress Scale (SRSS) was administered (17). The SRSS consists of eight items: four relating to recovery and four relating to stress. The following subcategories for recovery-related items are as follows: physical performance capability, mental performance capability, emotional balance, and overall recovery. The following subcategories for stress-related items are as follows: muscular stress, lack of activation, negative emotional state, and overall stress. Subject responses were listed on a scale ranging from 0 (does not apply at all) to 6 (fully applies). The validity and reliability of the SRSS as a psychological instrument has been previously demonstrated (17).

Body Composition. A medical body composition analyzer (SECA mBCA 515 v1.1Hamburg, Germany) using bioelectrical impedance analysis was used to assess fat mass and fat-free mass. Impedance was measured at frequencies ranging from 1 to 1,000 kHz. Measurements were performed segmentally in the following sequence: right arm, left arm, right leg, left leg, trunk, right body side, and left body side (33). Test-retest reliability was nearly perfect for all SECA variables with an ICC = 0.99 to 1.00 (95% confidence intervals, 0.97-1.00) and CV = 0.9 to 1.8%.

One Repetition Maximum (1RM) Testing. Validated 1RM and attempt selection procedures were used to assess the true 1RM of participants during mock powerlifting competitions at T1 and T2 (30–32,37). The primary investigator used athlete feedback from a rating of perceived exertion scale to select load increases (37). A true 1RM was identified under the following conditions: a) an RPE of 10 being recorded and the investigator determining that further increases in load would result in a failed attempt or b) an RPE of 9 or 9.5 being recorded and the subject failing a subsequent attempt with a load increase of ≤ 2.5 kg (30,33). The success of a lift was determined according to USA Powerlifting procedures (34).

Statistics

The dataset was initially screened for outliers (mean ± 3 SD) followed by a Shapiro-Wilks test to assess normality and Mauchly's test to assess sphericity. A 2x2 (group x time) mixed ANOVA was used to assess within- and between-group differences for each dependent variable. Post-hoc tests were conducted following significant main group or time effects using a Bonferroni adjustment (7). Alpha criterion was set at $p \leq 0.05$. Within- and between-group effect sizes were assessed using Hedge's g with 95% confidence intervals. Effect size magnitude was assessed using the following scale: 0.0-0.2 (trivial); 0.2-0.6 (small); 0.6-1.2 (moderate); 1.2-2.0 (large); 2.0-4.0 (very large); >4.0 (nearly perfect) (13). Analyses were performed using JASP (JASP Version 0.14) and Microsoft Excel 2016 (Microsoft Corporation, Redmond, WA, USA).

RESULTS

Body Composition and Stress and Recovery State

There were no statistically significant main effects for any body composition variable (i.e., body mass, fat mass, fat-free mass). Additionally, there were no statistically significant main effects for any SRSS item.

Performance Outcomes

Statistically significant main effects for time were observed in the BS ($p = 0.02$), DL ($p = 0.05$), powerlifting total ($p = 0.01$), and Wilks score ($p = 0.01$). There was a statistically significant interaction (time x group) for BP ($p = 0.001$). Post-hoc analyses revealed statistically significant increases in BP ($p < 0.001$, $g = 0.07$) and Wilks score ($p = 0.03$, $g = 0.12$) following the 2D protocol, as well as statistically significant increases in DL ($p = 0.03$, $g = 0.14$) following the 4D protocol. However, BP performance significantly decreased ($p = 0.04$, $g = -0.14$) following the 4D protocol. Additionally, powerlifting total experienced near statistically significant improvements in the 2D group ($p = 0.051$, $g = 0.10$). There were no interaction or main effects for any other performance measure. See Table 3 and Figure 3 for all performance measures.

Table 3.3: Performance Measures

Variables	2-Day Group				4-Day Group			
	T1	T2	*p*-value	Hedge's *g* [95% CI]	T1	T2	*p*-value	Hedge's *g* [95% CI]
1RM BS (kg)	189.6 ± 50.5	196.9 ± 48.9	0.13	0.15 [-0.05, 0.34]	204.9 ± 55.9	214.2 ± 60.8	0.07	0.16 [-0.01, 0.33]
1RM BP (kg)	127.9 ± 36.7	130.6 ± 37.2	<0.01	0.07 [0.03, 0.12]	142.2 ± 49.9	135.5 ± 47.1	0.04	-0.14 [-0.27, -0.01]
1RM DL (kg)	223.4 ± 45.0	224.5 ± 41.1	0.72	0.03 [-0.13, 0.19]	213.7 ± 55.8	221.4 ± 57.0	0.03	0.14 [0.02, 0.26]
Total (kg)	566.4 ± 117.8	577.8 ± 113.4	0.05	0.10 [0.00, 0.20]	562.7 ± 178.2	569.3 ± 182.4	0.17	0.04 [-0.02, 0.09]
Wilks Score	353.8 ± 65.2	361.5 ± 61.7	0.03	0.12 [0.02, 0.22]	371.4 ± 40.1	375.8 ± 38.5	0.22	0.11 [-0.08, 0.30]

1RM = one-repetition maximum, BS = back squat, BP = bench press, DL = deadlift, CI = confidence intervals

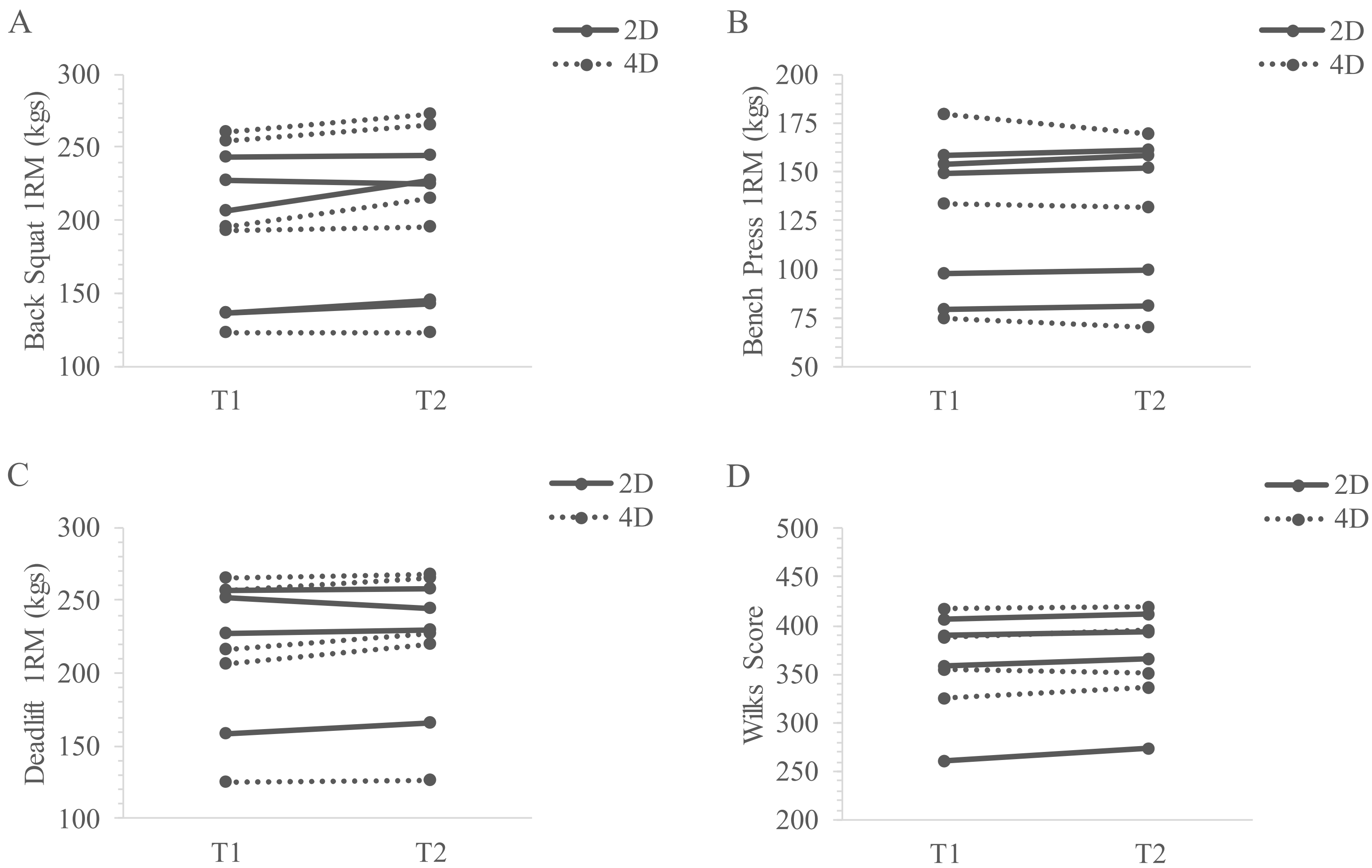

Figure 3.3. *Individual Changes in Back Squat (A), Bench Press (B), Deadlift (C), and Wilks (D) from Pre-Overreach (T1) to Post-Training Cessation (T2).*

DISCUSSION

The purpose of this study was to compare the effectiveness of two common training cessation periods following a taper. The main findings indicate that a step taper followed by 2D of training cessation improves overall powerlifting performance (i.e., Wilks, powerlifting total), while a step taper followed by 4D of training cessation was not as efficacious and may have resulted in some detrimental effects. Deadlift performance, however, was improved following the 4D protocol, yet BP performance significantly decreased. The 2D protocol was successful in improving BP, powerlifting total, and Wilks score. These findings support the use of shorter periods of training cessation following a step taper to improve maximal strength performance.

Our results agree with recent literature suggesting shorter periods of training cessation to be preferred for maximal strength performance (10,30,35). Weiss et al. (35) found two, three, four, and five days of training cessation to increase 1RM bench press performance in strength trained males, yet reported the highest 1RM improvement after two and three days of training cessation. Notably, Travis et al. (30) found isometric bench press performance was preserved after three days of training cessation, but significantly decrease after five days of training cessation, while isometric back squat performance was maintained with both periods of training cessation. These findings agree with the current study, which found 1RM bench press performance to significantly improve following the 2D protocol (2.1%Δ) and decrease following the 4D protocol (-4.7%Δ) while 1RM BS performance was maintained similarly in both groups (3.8%Δ, 4.5%Δ, respectively).

However, some research has shown that longer periods of training cessation can preserve maximal strength (23). Pritchard et al. (23) found both 3.5 and 5.5 days of training cessation to preserve isometric bench press peak force in strength trained males. This discrepancy may be explained by the use of a tapering protocol preceding the training cessation in the present study. Previous literature has only experimentally examined the effects of training cessation on strength performance following normal training (23,30,35), while the protocol of the current research may have mitigated fatigue prior to the onset of training cessation through the implementation of the tapering protocol. Furthermore, differences in testing procedures may resolve the disparities between this study and previous literature that utilized isometric measurements of strength (23). Although Weiss et al. (35) found two and three days of training cessation to produce greater improvements in BP 1RM compared to four and five days of training cessation, isometric bench press performance was greatest following four days of training cessation. Travis et al. (30) suggested that dynamic maximal strength performance (e.g., 1RM) is influenced by motor control and skill acquisition, and thus may be influenced by training specific to that performance. Therefore, isometric measures of strength may not fully reflect changes in dynamic maximal strength (1,11,30).

The present study is the first to experimentally examine periods of training cessation following a taper. This has been previously identified as a limitation in the current literature surrounding tapering and training cessation (30). However, recent research has experimentally compared different tapering protocols (22,26,33). Notably, Travis et al. (33) demonstrated a one-week step taper and a three-week exponential taper to improve 1RM BS and BP similarly, while 1RM DL improved only in the exponential group. Although studies have shown similar acute recovery patterns for BS, BP, and DL (2,6), Travis et al. (33) suggests that a one-week step taper may not provide sufficient recovery for the DL due to the cumulative effects of repeated training sessions. Therefore, a need for increased recovery time for the DL may help explain why the 4D protocol produced more favorable effects on the DL (3.6%Δ) compared to the 2D protocol (0.5%Δ) in the current study.

Furthermore, several qualitative studies have been conducted that elucidate the findings of this study (12,25,31,36). Grgic & Mikulic (12) surveyed Croatian powerlifters, finding the final heavy BS, BP, and DL sessions to be performed 7 ± 1, 6 ± 2, and 8 ± 2 days out from competition, respectively (12). For New Zealand's powerlifters, the final heavy BS, BP, and DL sessions were performed 8.0 ± 2.9, 7.3 ± 2.7, and 10.9 ± 4.0 days out from competition, respectively (25). The largest of these surveys examined the tapering practices of North American Powerlifters (31). Among this population, the final heavy BS and DL sessions were completed 7-10 days out from competition, while the final heavy BP session was performed <7 days away from competition (31). In the current study, the final heavy BS, BP, and DL session was performed 7 and 9 days out from T2 in the 2D and 4D protocols, respectively. The 2D group noted superior increases in BP, yet the 4D protocol demonstrated significant improvements in DL. Therefore, the findings of this study largely support common tapering practices in the powerlifting community.

Subjective measures of psychological state are common in tapering and training cessation research (5,23,27,28,30). Decreases in negative mood state and overall stress as well as increases in overall recovery have been consistently demonstrated following tapering in athletic populations (5,27,28). However, the present study found no differences in stress or recovery items as measured by the SRSS. The duration of tapering may explain the discrepancies between this study and the aforementioned research. The current study employed tapering protocols lasting 7-9 days, while the aforementioned studies utilized tapering protocols 2-3 weeks in length (5,27,28). Recent research examining subjective changes in psychological state in response to training cessation has found minimal/no changes in psychological measures following 3-5.5 days of training cessation (23,30). Therefore, the use of relatively short tapering protocols in the current study may explain the absence of alterations in psychological state following tapering.

Alterations in body composition have been observed during training cessation and tapering in strength athletes (5,14,28,30,33). Generally, fat mass has been reported to increase (30,33), while local and systemic fat-free mass has been shown to decrease (5,14,30). The findings of this study conflict with the existing research as no statistically significant alterations to body composition were seen in either group. However, previous research has noted how shorter tapering and/or training cessation protocols may result in the maintenance of body composition (4,30). Furthermore, the use of an overreach microcycle has been proposed to maintain previously accrued muscular adaptations during a taper (4). Therefore, it is possible that the overreach microcycle paired with the relatively short tapering protocols utilized in the current study deterred any significant alterations in body composition from taking place.

Noteworthy aspects of the present study are the trivial effect sizes observed in performance outcomes. Previous literature has demonstrated tapering to elicit moderate improvements in powerlifting performance (g = 0.25-0.55) (33). Although several performance variables were statistically improved following the 2D (i.e., BP, Wilks) and 4D (i.e., DL) protocols in the current study, the effect sizes were trivial (g = 0.07-0.14). However, testing sessions were only separated by two weeks in order to isolate the overreach and taper weeks, whereas previous research often has 4-6 weeks between testing sessions (18,33), thus limiting the potential increases in performance in the present study. Additionally, the participants in this study were well trained (362.6 ± 51.0 Wilks score). Mujika et al. (21) found the difference in performance between 1st and 4th place among Olympic swimmers during the 2000 Sydney Olympics to be 1.62 ± 0.80%, similar to the performance increases observed in the 2D group for powerlifting total and Wilks score (2.0%Δ, 2.2%Δ, respectively). Therefore, small changes in performance can result in large differences in placement at high levels of competition.

There are several limitations to the current study. Few studies have compared changes in performance resulting from tapering and/or training cessation with concurrent adaptations to skeletal muscle at the fiber and molecular level among strength athletes (33), an addition that may have shed light on the performance outcomes of the present study. However, the main limitation of the present research was its sample size, leaving the possibility of an underpowered study. Due to this limitation, only two protocols were implemented. Future research should seek to amass a larger sample size, allowing for the comparison of multiple protocols that include varying methods of tapering (e.g., step, exponential) and training cessation (e.g., 1, 3, 5 days), as well as employ methods to examine the adaptations taking place at an ultrastructural level to elucidate the explanation for performance outcomes.

Overall, the data from this study indicates that 2D of training cessation can produce statistically significant improvements in maximal strength performance following a step taper in strength athletes. Such improvements did not result from 4D of training cessation following a step taper. The outcomes of this study suggest that strength athletes may benefit from employing shorter periods of training cessation (i.e., 2D) following a taper before competition.

PRACTICAL APPLICATIONS

The findings of this study demonstrate how shorter periods of training cessation following a taper can be beneficial for strength performance, specifically in powerlifting. Therefore, athletes seeking to maximize strength performance through the implementation of tapering may benefit from limiting the time of training cessation ending the taper. However, the longer period of training cessation ending the taper in the current study favored the DL, although this is contingent upon the tapering methods used. Thus, if the DL is a competitive lift for an athlete (e.g., powerlifter, strongman), that athlete may benefit from tapering the DL farther out from competition. Taken together, practitioners can implement tapers followed by short periods of training cessation to improve maximal strength performance, provided particularly fatiguing exercises (i.e., DL) are tapered far enough from competition.

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Chapter 4. Summary and Future Investigations

The purpose of this study was to compare the effectiveness of two common training cessation periods following a taper. In order to achieve this objective, differences in maximal strength, perceived recovery and stress state, and body composition were analyzed in strength athletes undergoing a 2-day (2D) or 4-day (4D) period of training cessation following a step taper. The primary findings of this study indicate that 2D of training cessation following a step taper improves overall performance in powerlifters (i.e., increased Wilks and powerlifting total), while 4D of training cessation following a step taper was not as efficacious. These findings support the use of shorter periods of training cessation (i.e., 2D) following a step taper to improve maximal strength performance.

The topics of tapering and training cessation have recently drawn interest in relation to strength and power athletics (Bazyler et al., 2017, 2018a; Pritchard et al., 2015, 2018, 2019; Seppänen & Häkkinen, 2020; Travis et al., 2020b, 2021a, 2021b, 2021d). However, the current study provides unique insight into the effects of tapering and training cessation. In practice, tapers are typically followed by or include a period of training cessation (Pritchard et al., 2015; Travis et al., 2020b). Nonetheless, this is the first study to date to experimentally examine periods of training cessation following a taper, a need that has been identified in previous literature (Travis et al., 2021a). This study identified a protocol that improved maximal strength performance (i.e., 2D) and one that failed to improve maximal strength performance (i.e., 4D). Therefore, in light of the findings of this study, the importance of identifying combinations of tapering and training cessation protocols that favor increases in strength performance is evident.

Although the current study sought to fill a gap in the literature by comparing two periods of training cessation following a step taper, the need for further research is highlighted. There are a plethora of tapering models and practices, many viable periods of training cessation, and a myriad of combinations of the two. The current study simply introduced the present deficiency in the literature, much work is needed to fill this void. Additionally, there are several limitations to this study. Few studies have compared changes in performance resulting from tapering and/or training cessation with concurrent adaptations to skeletal muscle at an ultrastructural level among strength athletes (Travis et al., 2021d), an addition that may have shed light on the performance outcomes of the present study. The current study was also limited by a small sample size. Future research should seek to address varying methods of tapering (e.g., step, exponential) and training cessation (e.g., 3 days, 5 days), employ strategies to examine the adaptations taking place at an ultrastructural level to elucidate the explanation for performance outcomes, and amass a larger sample size to strengthen the findings.

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APPENDICES

Appendix A: Dietary Log

DIETARY LOG

1. Use the Dietary Record Forms provided to record everything you eat or drink for each day of this study.
2. Indicate the name of the FOOD ITEM, the AMOUNT eaten, how it was PREPARED (fried, boiled, etc.), and the TIME the food was eaten. If the item was a brand name product, please include the name. Try to be accurate about the amounts eaten. Measuring with measuring cups and spoons is best, but if you must make estimates, use the following guidelines:

   Fist is about 1 cup

   Tip of Thumb is about 1 teaspoon

   Palm of the hand is about 3 ounces of meat (about the size of a deck of cards)

   Tip of Thumb is about 1 ounce of cheese

3. Try to eat what you normally eat and record everything. The project will only be useful if you are HONEST about what you eat. The information you provide is confidential.
4. MILK: Indicate whether milk is whole, low fat (1 or 2%), or skim. Include flavoring if one is used.
5. VEGETABLES and FRUITS: One average serving of cooked or canned fruits and vegetables is about a half cup. Fresh whole fruits and vegetables should be listed as small, medium, or large. Be sure to indicate if sugar or syrup is added to fruit and list if any margarine, butter, cheese sauce, or cream sauce is added to vegetables. When recording salad, list items comprising the salad separately and be sure to include salad dressing used.
6. EGGS: Indicate method of preparation (scrambled, fried, poaches, etc.) and number eaten.
7. MEAT / POULTRY / FISH: Indicate approximate size or weight in ounces of the serving. Be sure to include any gravy, sauce, or breading added.
8. CHEESE: Indicate kind, number of ounces or slices, and whether it is made from whole milk, part skim, or is low calorie.
9. CEREAL: Specify kind, whether cooked or dry, and measure in terms or cups or ounces. Remember that consuming 8 oz. of cereal is not the same as consuming one cup of cereal. 1 cup of cereal generally weighs about 1 ounce.
10. BREAD and ROLLS: Specify kind (whole wheat, enriched wheat, rye, etc.) and number of slices.
11. BEVERAGES: Include every item you drink excluding water. Be sure to record sports drinks and any liquid supplements, cream and sugar used in tea and coffee, whether juices are sweetened or unsweetened and whether soft drinks are diet or regular.
12. FATS: Remember to record all butter, margarine, oil, and other fats used in cooking or on food.
13. MIXED DISHES / CASSEROLES: List the main ingredients and approximate amount of each ingredient to the best of your ability.
14. ALCOHOL: Be honest. Record amounts in ounces. Specify with "light" or "regular" beer.

DIETARY RECORD FORM

Day of the Week:

Date:

Ver. 11/23/21

FOOD ITEM	AMOUNT	TIME

Express approximate measures in cups (C), tablespoons (T), teaspoons (t), grams (g), ounces (oz.), pieces, etc.

Ver. 11/23/21

Appendix B: Questionnaire

Name____________________

Questionnaire

Health History

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?

Yes/No

2. Do you feel pain in your chest when you do physical exertion?

Yes/No

3. In the past month, have you had chest pain when you were not doing physical activity?

Yes/No

4. Do you lose your balance because of dizziness or do you ever lose consciousness?

Yes/No

5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?

Yes/No

6. Is your doctor currently prescribing drugs (for example, water pills) for a blood pressure or heart condition?

Yes/No

7. Do you know of any other reason why you should not do physical activity?

Yes/No

If yes, please explain: ____

____

8. Please list all medications that you are currently taking. Please include vitamins or supplements.

____

____

9. Have you been lifting consistently for the past year?

Yes/No

Ver. 12/20/21

Name___________________

10. Have you ever been diagnosed with any of the health conditions below (check those applicable):

_ heart disease
_ heart surgery
_ high cholesterol
_ diabetes
_ heart attack
_ congenital heart disease
_ high blood pressure
_ stroke

11. Do any of your immediate family/grandparents have a history of (check those applicable):

_ heart disease
_ heart surgery
_ high cholesterol
_ diabetes
_ heart attack
_ congenital heart disease
_ high blood pressure
_ stroke
_ premature death

If yes, please note relationship and age: ______________________________________

____

____

12. Has there been a death in the family via heart attack, heart disease, or stroke?

Yes/No

Sport Specific

1. What is your date of birth? ____ / ____ / ____

2. How long have you been engaging in powerlifting-style training? __________

3. Are you a competitive powerlifter?

Yes/No

4. If so, how long have you been competing in powerlifting? __________

Ver. 12/20/21

Name___________________

5. What are your current one-repetition maximums (1RMs) on the competition lifts?

_____ Back Squat

_____ Bench Press

_____ Deadlift

6. Are you currently recovering from any injuries?

Yes/No

If so, please explain the type and place of injury, as well as how long ago the injury took place: ____

____

____

Stress and Recovery State

1. How many hours of sleep did you get last night? ___ hours

2. Please rate your sleep on a scale from 1-10: ___

3. Please fill out the following chart:

Ver. 12/20/21

Name___________________

Physical Performance Capability *e.g.* *strong,* *physically capable,* *energetic,* *full of power*	does not apply at all ○—○—○—○—○—○—○ fully applies 0 1 2 3 4 5 6	
Mental Performance Capability *e.g.* *attentive,* *receptive,* *concentrated,* *mentally alert*	does not apply at all ○—○—○—○—○—○—○ fully applies 0 1 2 3 4 5 6	
Emotional Balance *e.g.* *satisfied,* *balanced,* *in a good mood,* *having everything under control* *stable,* *pleased*	does not apply at all ○—○—○—○—○—○—○ fully applies 0 1 2 3 4 5 6	
Overall Recovery *e.g.* *recovered,* *rested,* *muscle relaxation,* *physically relaxed*	does not apply at all ○—○—○—○—○—○—○ fully applies 0 1 2 3 4 5 6	

Ver. 12/20/21

Name____________________

Scale									
Muscular Stress *e.g.* *muscle exhaustion,* *muscle fatigue,* *muscle soreness,* *muscle stiffness*	does not apply at all	0	1	2	3	4	5	6	fully applies
Lack of Activation *e.g.* *unmotivated,* *sluggish,* *unenthusiastic,* *lacking energy*	does not apply at all	0	1	2	3	4	5	6	fully applies
Negative Emotional State *e.g.* *feeling down,* *stressed,* *annoyed,* *short-tempered*	does not apply at all	0	1	2	3	4	5	6	fully applies
Overall Stress *e.g.* *tired,* *worn-out,* *overloaded,* *physically exhausted*	does not apply at all	0	1	2	3	4	5	6	fully applies

Ver. 12/20/21

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Burke, B. I., Travis, S. K., Gentles, J. A., Sato, K., & Bazyler, C. D. (2021, June 1-5). *The Effects of Caffeine on Jumping*

Performance and Maximal Strength in Female Collegiate Athletes [Poster presentation]. 2021 American College of Sports Medicine Annual Meeting and World Congresses.

Burke, B. I., Travis, S. K., Gentles, J. A., Sato, K., & Bazyler, C. D. (2021, February 18-19). *The Effects of Caffeine on Jumping Performance and Maximal Strength in Female Collegiate Athletes* [Poster presentation]. 2021 Southeast ACSM Annual Meeting.

Burke, B. I., Travis, S. K., Gentles, J. A., Sato, K., & Bazyler, C. D. (2020, March 27). *Determining if the Use of Caffeine to Improve Jumping Performance and Maximal Strength in Female Colligate Athletes is Justified* [Conference session]. Boland Undergraduate Research Symposium, Johnson City, TN, United States. (Conference canceled)

Honors and Awards:

Summa Cum Laude, East Tennessee State University

Dean's List, East Tennessee State University

Midway Honors Scholar, East Tennessee State University

Summa Cum Laude, Walters State Community College

President's List, Walters State Community College