5-9-2013

The Effects of Resistance Training Prioritization In NCAA Division I Track and Field Athletes

Dylan Dombrowski
Student, Dylan.Dombrowski13@gmail.com

The Effects of Resistance Training Prioritization In NCAA Division I Track and Field Athletes.

Dylan H. Dombrowski

B.S., The University of Connecticut, 2011

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Masters of Science

at the

University of Connecticut

2013

APPROVAL PAGE

Master of Science Thesis

The Effects of Resistance Training Prioritization In NCAA Division I Track and Field Off Athletes.

Presented by

Dylan H. Dombrowski, B.S.

Major Advisor ______________________________

William J. Kraemer, Ph.D.

Associate Advisor ______________________________

Carl M. Maresh, Ph.D.

Associate Advisor ______________________________

Michael Joseph, Ph.D., P.T.

University of Connecticut

2013

Acknowledgements

To Dr. William J. Kraemer: Thank you a thousand times over. As a student, athlete, coach, researcher and man you gave me one simple message to work by – be passionate about what you do and be driven to be the best. Thank you for instilling a personal desire to achieve excellence in a field where perfection is deeply desired and always sought after.

To Dr. Carl M. Maresh and Dr. Michael Joseph: Thank you for being on my committee and helping me further my growth and knowledge in the greatest program in the country.

To Coach Maureen Butler: You helped me go from an awkward freshman, unconfident and under prepared, to an individual who learned the meaning of progress. More than anything thank you for teaching me to work harder everyday to create success.

To UConn Strength and Conditioning and the Human Performance Laboratory: Thank you for supporting me and becoming the family which I so desperately needed once my home became Storrs. I will forever be in debt for the path you all helped set me on.

To my teammates and all UConn undergrads, graduate students, and professors: You guys are the reason why I continue on in this profession. I have cherished having you all as friends, co workers, and family. I hope that the greatest satisfaction in life which you shared with me I can instill in others.

To UConn: Thank you for the absolute time of my life. When I applied as a high school student I thought it was a long shot to get in, and now it has become my second home. I will forever have a place in my heart for the University of Connecticut for exposing me to the world of adulthood and turning me into the man I am glad to say I am today. Not for school, but for life.

To my friends and family: Thank you for being my backbone along my long winding road. Most of all thank you for driving me and telling me that it is always more fun at the end of the day to have someone come up and congratulate you on your accomplishments, then it is to have to go and congratulate them on theirs. I am blessed beyond all comparison for the love and support you give unconditionally.

Table of Contents

Abstract

Resistance training (RT) is a powerful systemic stimulus known to improve a multitude of physiological variables. These include but are not limited to musculoskeletal strength, power, muscle mass, bone mass, and connective tissue. The sport of track and field is composed of many different events that focus on strength, power, and muscular endurance. Thus, resistance training is typically a vital part of athletic preparation for track and field athletes. PURPOSE: The purpose of this study was to investigate specific manipulations of the acute program variables within the context of an off-season resistance training program. METHODS: 34 male NCAA Division I track and field student-athletes (age: 20.3 ± 1.9 y; body mass: 83.9 ± 11.1 kg) participated in 12 weeks of a non-linear periodized training program between the months of September and December. Groups were separated by athletic event and thus, performance goals (Group 1: n=12, age: 20.1±1.10, body mass: 87.8±13.3 kg; Group 2: n=12, age: 21.1±1.10, body mass: 82.9±10.4 kg; Group 3: n=10, age: 18.9±0.8, body mass: 80.4±8.1 kg). The training groups prioritized training for power, local muscular endurance, and general strength, respectively. Performance variables were assessed at the beginning and end of this training program and consisted of counter movement vertical jump with arm swing (CMVJ), 1-repetition-maximum (1RM) in the barbell bench press, and barbell back squat. RESULTS: The primary findings of this investigation are Group 1 saw significant ($p \leq 0.05$) statistical increases in vertical jump (4.4±.1 cm), and back squat maximum (13.1±3.6 kg). Group 2 saw significant ($p \leq 0.05$) statistical increases in bench press maximum (14.2±0.5 kg), and back squat maximum (15.0±0.6 kg). Group 3 saw significant ($p \leq 0.05$) statistical increases in vertical jump (4.7±0.7 cm) and maximum back squat (20.0±5.0 kg). Our data indicate that the prioritization of strength within a 12

week off-season training program had the best overall effect on the performance variables. Further, it seems that the flexibility of a non-linear periodization model is successful at addressing the multiple stressors of the academic school year and athletic preparation for competition in NCAA Division I track and field events.

Chapter 1

INTRODUCTION

The track and field offseason is designed to have athletes make training increases which will hopefully aid in their sport specific performance increases. The track and field offseason training program was set up as to create gains for athletes in their specific event disciplines. Resistance training (RT) is seen as a vital portion of creating success in all college sports. By increasing musculoskeletal power, strength, muscle mass, bone mass, and connective tissue, athletes are increasing their likelihood of "on the field" success.

In the sport of track and field the desire to create the highest amount of force is sought after. Accomplishing these high levels of force with minimal effort is where the RT portion of training directly corresponds to performance increases. Resistance training has been shown to have many influences on changing power and strength in athletes (7). The increase of power and strength in the offseason is anticipated to be translated into better on-the-track performances by producing better athletes (1, 6, 13). As track and field athletes train almost year round, the offseason is one of the best times of the academic year to create and measure changes in performance markers. Strength and power are just some of the factors of the performance program that can be affected through resistance training (RT).

In the scientific literature, there are few studies that retrospectively look at a resistance training program completed by track and field student athletes. Painter et al. (13) examined the efficiency of NCAA Division I track and field resistance training programs. Their results found that based on calculated training efficiency scores, block training model is more efficient than a DUP model in producing strength gains. Values for estimated volume of work (volume load) and the amount of improvement per volume load between block and DUP groups were observed. Aside from this study there seems to be a shortage of performance data information concerning the actual resistance training program as a focus of the investigation at the NCAA Division I level. This study aims to bridge the gap between the practice world of strength and conditioning coaches and the scientific literature. This study observed a normal training routine set up by a NCAA Division I program with the hope of creating ideal athletes within their own event disciplines. Strength and conditioning as well as performance coaches strove to create better athletes by increasing athletes' vertical jump, back squat, and bench press

With the high number of athletes one strength and conditioning coach must write programs for, there still may lie more specific programming and better methods of testing each individual group. Other variables such as nutrition status and stressors like academic load are not covered. Over ten thousand athletes across the country, just on the colligate level compete in the sport of track and field. It must be seen of vital importance that the scientific community as well as the coaches look to improve the efficiency of the training of athletes. Efficiency not only for the highest level of performance increases, but as to use the best method and get the "most bang for your buck" for students who's time outside the classroom is already spread thin.

Statement of the Problem

The purpose of this study was to investigate specific manipulations of the acute program variables within the context of an off-season resistance training program in a NCAA Division I track and field team grouped by performance goals. With thousands of athletes across the country competing in the sport of track and field, coaches must look to improve the efficiency of the training these athletes.

Chapter 2

REVIEW OF LITERATURE

Understanding the Track and Field Disciplines

The sport of track and field has its roots in human prehistory. Track and field-style events are among the oldest of all sporting competitions, as running, jumping and throwing are natural and universal forms of human physical expression. The first recorded examples of organized track and field events at a sports festival are the Ancient Olympic Games in 776 BC in Olympia, Greece. The track and field of today contains many of these same events but in a modernized form. The main groupings of events include: throwing, jumping, short/long sprints, long distance, and combined events. These events which, when taken as a whole, cover the full spectrum of physiological needs. This separates track and field from most sports as full use of the body's three energy systems (ATP-PC system, Anaerobic system, Aerobic system) is rare.

It is well characterized that each of these systems are dominant in different types of activities. The ATP-PC system is used only for very short durations of up to 10 seconds. This is the primary system behind very short, powerful movements like a 100 meter (m) sprint. The anaerobic system predominates in supplying energy for exercises lasting less than 2 minutes. An activity of the intensity and duration that this system works under would be a 400 m sprint. The Aerobic system is the long duration energy system like in the marathon run it provides 98% or more energy. Not coincidentally, the separations of track and field events align with these energy systems. For the remainder of this chapter, I will focus on the events of the throws, jumps, sprints, and combined events.

Throwing events include the shot put, discus, hammer, and javelin, which require strength, power, speed, and technical skills. The commonality amongst all the throwing events is to propel an implement of varying weights and shapes as far as possible from behind a designed point into a field. Competitors take their throw from inside an area with a foul line at the front of the circle or runway. The distance thrown is measured from the foul line to the nearest mark made in the ground by the falling implement, with distances rounded down to the nearest centimeter. In almost all major competitions an athlete is given three preliminary throws, and then the top competitors with the highest marks will return for a final three attempts. The athlete with the furthest mark in either the preliminary or final will be crowned the victor.

The shot put event involves propelling a heavy 7.257 kg, metal ball as far as possible. The two putting styles in current general use are 1) the glide and 2) the spin. Competitors take their throw from inside a marked circle, with a stop board at the front of the circle. Athletes who throw the shot must have tremendous levels of strength both in the upper and lower bodies.

The discus event is much like the shot put but different because the thrower must alter the technique to optimize distance specific to the implement. The rules of competition for discus are virtually identical to those of shot put, except that the circle is larger, and a stop board is not used. Namely, discus throwers need to add a wide reach, and a sense of rhythm to the shot-putter's skills to whirl the 2 kilogram plate out into a field. The thrower typically takes an initial stance facing away from the direction of the throw, and then spins around one and a half times through the circle to build momentum.

The hammer event is much like the shot put and discus as it occurs in a marked circle and the measured mark from the end of the circle to the nearest mark made in the ground by the falling hammer. The event differs because the thrower must use multiple rotations to optimize distance specific to the implement. The hammer is a ball attached to a wire, and the thrower propels this item by gripping the handle. The ball weight 7.257 kilograms and the wire with handle measures 121.5 centimeters in length. Although commonly thought of as a strength event, technical advancements have developed hammer throw competition to a point where more focus is on speed in order to gain maximum distance. The throwing motion involves a stationary position, then three or four rotations of the body in circular motion using a complicated heel-toe movement of the foot. The ball moves in a circular path, gradually increasing in velocity with each turn with the high point of the ball toward the sector and the low point at the back of the circle.

Javelin throwing is unique to the other types of throws because it weighs significantly less than the other throwing implements (800 g) and requires a fast run-up, smooth acceleration, and power for a fast throw. Javelin throwers are seen as the slightest of the throwing athletes. The spear is about 2.5 m in length. Unlike the other throwing events, the "non-orthodox" techniques are not permitted. The javelin must be thrown overhand. Javelin throwers have a runway which they typically use this distance to gain momentum in a "run-up" to their throw. More than in other events the javelin strongly relies on the stretch reflex as athletes create tremendous torque and force across joints to propel the item forward. (12).

The second major type track and field discipline are the jumps. The jumps commonalities involve using speed and quick reactive forces to propel athletes and to try and create the highest resistance to the gravitational forces pulling them down. The jumps include high jump, pole vault, long jump, and triple jump. The high jump requires tremendous force to take off on one foot and boost an athlete over a crossbar. A jump is considered a fail if the bar is dislodged by the action of the jumper or if they break the plane, near edge of the bar before clearance. Three consecutive missed jumps, at any height or combination of heights, will eliminate the jumper from competition. The landing area was originally a heap of sawdust or sand where athletes landed on their feet. Today's high-tech mats are foam usually and mats are growing larger in area as well to minimize risk of injury. Proper landing technique is on the back or shoulders.

Pole vaulting is included in the jumping events but is very unique. The pole vault is the only jumping event where an athlete uses an object outside of their own body to aid in achieving a successful attempt. Furthermore the pole vault requires strong core strength, and gymnast's kinesthetic awareness. Because the high jump and pole vault are both vertical jumps, the competitions are conducted similarly. Both of which are conducted by successful clearances of a bar and landing on a foam mat. Competitive pole vaulting began using solid ash poles. As the heights attained increased, the bamboo poles gave way to tubular aluminum, which was tapered at each end. Today's pole vaulters benefit from poles produced by wrapping pre-cut sheets of fiberglass that contains resin around a metal pole mandrel, to produce a slightly pre-bent pole that bends more easily under the compression caused by an athlete's take-off.

Unlike the other two jumping events and similarly to the throws, in both of these horizontal jumping events the distance jumped is measured from the take off board to the nearest mark made in the ground by the falling athlete. Distances are rounded down to the nearest centimeter. A long jumper transforms running movement into flight by using powerful legs and an elastic take-off, all the while maintaining a sprinters speed. Similarly the triple jumper requires a precise approach, producing kinetic energy from an almost maximum approach speed.

There are three phases of the triple jump: the "hop" phase, the "bound" or "step" phase, and the "jump" phase. These three phases are executed in one continuous sequence. In almost all major competitions an athlete is given three preliminary jumps, and then the top competitors with the highest marks will return for a final three attempts. The athlete with the furthest mark in either the preliminary or final will be crowned the victor. (12).

The third type of event discipline to be described here are the sprints. Sprits are timed using a F.A.T. (fully automatic timing) and results are published up to the hundredth measure (example 9.69 seconds). Short sprinters consisted of shorter distances mostly 100 m and 200 m (indoors at the colligate level either the 55 or 60 m is run), these events produce maximum speed, coordination, and relaxation. Sprinters begin the race by assuming a crouching position in the starting blocks before leaning forward and gradually moving into an upright position as the race progresses and momentum is gained. Body alignment is of key importance in producing the optimal amount of force. Races are focused upon acceleration to and maintaining an athlete's maximum speed. The long sprinters cover up to 500 m and have a near maximum capacity of both aerobic and anaerobic training. These athletes push the limits of the lactic acid system, which predominates in supplying energy for exercises lasting up to two minutes. (12).

The final type of event being discussed in this review is combined events. The combined event athletes participate in decathlons (outdoor) and heptathlons (indoor).These competitors display a wide variety of technical skills. Events are held over two consecutive days and the winners are determined by the combined performance in all. Performance is judged on a points system in each event, not by the position achieved. The decathlon day one consists of 100 m, long jump, shot put, high jump, and 400 m. Day two consists of the 110 m high hurdles, discus, pole vault, javelin, and 1500 m. The heptathlon day one consists of the 55 m or 60 m, long jump, shot put and high jump. Day two consists of the 55 m or 60 m high hurdles, pole vault, and 1000m (12).Traditionally, the title of "World's Greatest Athlete" has been given to the man who wins the Olympic decathlon.

Resistance Training in Track and Field

With the current demands of the sport, frequency of competition, and the desire to break personal, national, and world records, resistance training is seen as a vital portion to the success equation in serious track and field athletes, namely those competing at the NCAA Division I level. Strength and conditioning coaches have seen that by increasing musculoskeletal power, strength, and speed, athletes can increase their sport performance. The NCAA Division I offseason has been investigated by this study to see if athletes who make increases in their training measures will also replicate increases in their “on the track” marks.

In designing resistance training programs, the strength and conditioning coach manipulates the acute program variables (8, 9, 15). The acute program variables defined by Kraemer (8) are exercise choice, exercise order, number of sets of an exercise, training intensity, and length of rest in-between sets and exercises. These can be changed, according to priorities, needs, and goals, to produce outcomes specific to the combination of these variables. Long-term planning of the acute program variables is termed periodization, as defined by Kraemer (8). The evaluation of "periodized" strength training methods has been a focus of both exercise and sport science throughout the duration of this study. Strength and conditioning coaches have the responsibility of manipulating the acute program variables in a periodized manner for a program that will increase strength and power and improve performance of athletes. Non linear periodization, using daily alterations in repetitions, has been developed as a superior method of training (13). Nonlinear periodization is the continuous variation of increased or decreased intensity and volume throughout a training period (whether it be day by day or week by week) (7). The harsh demands of the academic school year placed upon Division I NCAA student-athlete creates a great need for the flexibility of a nonlinear periodization model and allows for multiple factors to be trained over a period of time. For example, the majority of training sessions could be prioritized on increasing strength, but training sessions focused on increasing size or increasing power could be administered throughout. This model still allows for hypertrophy and power to be trained, but allows for strength to be the priority. This suites the needs of those athletes whom daily training status may be altered due to a high number of variables, most of which are outside the control of the coaches.

Differentiating the Training Groups

It has been proposed that the majority of initial strength gains in untrained subjects are because of neural adaptations rather than hypertrophy (11, 14). Muscle strength can be easily increased during intensive strength training by initially untrained subjects as well and previously less highly trained non-athletes (4, 14). However, motor unit recruitment is poorly displayed in untrained individuals. Neural and muscular adaptations play important roles in strength development during strength-training periods lasting for several weeks or a few months. These neural adaptations, resulting in increased motor unit activation and by gradual increase in the synthesis of contractile proteins will lead to muscular hypertrophy (11, 14). Elite-strength athletes with several years of an intensive training background may represent an interesting subject population in which to examine physiological adaptations to training. In more trained individuals the magnitude of these adaptive neuromuscular responses during training are much smaller and changes may differ considerably with respect to their time courses (11, 14). However, trained individuals in a competitive environment such as in a collegian team may be driven to exceed or to continue to make large improvements despite the physiological restraints of the training adaptations.

Phases of NCAA Division I Track and field Offseason

The NCAA Division I track and field offseason consists of five phases. The general dates and objectives are listed below in Table 3.1. The time from July to December is termed the noncompetitive season. It is typically used to develop the athletes' physical performance characteristics as well as event-specific skill in preparation for the spring competitive season. Below Table 2.1 are further explanations and details about each phase.

Table 2.1: Overview of Off-season Training Progression

Phase	Dates	Objectives
1	Late May- Mid July	Recovery From Season
2	Mid July - Late Aug	Preparation for Pre-Testing
3	Sep - Oct	Testing and Beginning Pre-Season Training
4	Oct - Nov	Pre-season Training and Event Work
5	Nov - Dec	Post-Testing and Season Start

Phase 1 of the offseason starts after the last official meet until the first day of "real" summer workouts. The summer offseason performance program helps prepare the athletes for the rigors of their preseason training, as well as their competitive season. Phase 1 is preceded by championship meets at the end of the regular season. The length of this time heavily depends on if and when an athlete no longer qualifies for championship meets, as well as the starting date of the Fall semester. The previous seasons championship meets started on May 4th and they ran depending on level of competition until June 7th. The start date of the 2012 Fall semester was August 27th. Athletes are off-campus during Phase 1, which limits the available resources to the athlete (facilities, equipment, coaching, and sports medicine personnel). Because of the limited resources, as well as the need to recover from a 5-7 month long season, most Phase 1 workouts are lighter in volume compared to the rest of the phases of the offseason.

Phase 2 is a very important time for strength, power, and speed development because physical activity is dictated by the coaching staff. As most students do not have the harsh demands of the academic course load, during this period of time athletes are their most rested and should be able to handle a high training volume. Phase 2, also commonly known as "Summer Workouts," will be about eight weeks. During Phase 2, the minimum amount of time most strength and conditioning coaches will have available to them is six hours for summer open hours. In the current model, most programs devote time to increase the conditioning of the athletes to prepare for Phase 3. It is also during this period of time that athletes will be training leading up to the fall testing period. Minimal if any event specific training is occurring during this time.

The performance measures and the data collected for this investigation starts during Phase 3. Phase 3 is set as the return of the athletes from their Summer break to the university, and is also commonly known as the "Fall Testing." The non-competitive in season label means 20 hours of track and field-related activities are allowed per week. Many of the acute program variables vary in the weight room, specifically the frequency (how many sessions per week), exercise selection (implement, plyometrics, or running), volume (total amount of reps), and intensity (% of 1RM) (8,10)(20, 21). The testing results from this period will dictate training loads for the rest of the offseason conditioning program.

Phase 4 is also important time in training as it is the most demanding. This period is usually during students midterm period of academic testing. This time segments and preps the student athletes for the final phase of Fall training or pre-testing. Furthermore, this time is also occurring during the most rigorous period of track interval and technical sessions. During this phase event groups begin to separate and become more event specific (e.i. throwers become hammer/shot put), whereas phase 3 was still fairly broad (throwers). Because of the strain inthe classroom, weight room training, track, and event specific work, Phase 4 leading into phase 5 has the most frequent occurrence of injury in the offseason (2).

Phase 5 is shortened ever so slightly due to the thanksgiving break week, but consists of a higher intensity bout with lower volume then phase 4. Phase 5 is another very important time for strength, power, and speed development because all resources at the university are available, Phase 5 leads up to the season, which is the first phase of the in season schedule. Phase 5, also commonly known as "pretesting." This phase will end immediately before the teams intersquad or "blue white" meet, this is the start of the indoor season. Phase 5 usually has the most power of the offseason to prepare the athletes for the highly competitive start of competition. However it must not be forgotten and coaches must take into the consideration the highly stressful end of the academic semester load imposed upon student athletes.

Summary

Athletes were from all disciplines within the sport of track and field, and therefore coaches must have an understanding of the demands put on each athlete to compete at the highest level. Resistance training (RT) can lead to improvements in performance, and is therefore a vital part of a NCAA Division I Track and field training program. NCAA Division I track and field student-athletes used a manipulation of the acute program variables and used a nonlinear or daily undulating periodization training model to see increases in the training measures. Coaches have limited hours and must focus on working efficiency with these variables to overcome the stressors put upon the student athletes both within the realm of training, and outside it. Lastly the athletes trained in a five phase program, each incorporating another periodized goal to improve on the three testing variables.

Hypotheses

1) Group 1 will see the greatest increase in maximum counter movement vertical jump height with arm swing (power measure).

2) Group 2 will see increase in bench press maximum.

3) Group 3 will see the largest increase in back squat maximum and will significantly increase in all three testing measures pre to post.

Chapter 3

METHODS

Experimental Approach to the Problem

To retrospectively assess the effects of a prioritized non-linear periodization scheme on track and field athletes, we used a between groups design. Thirty four male NCAA Division I track and field athletes were assessed for maximum counter movement vertical jump (CMVJ) with arm swing height, 1-repetition maximum (1RM) barbell bench press, predicted 1RM barbell back squat, and body mass before and after a 12 week non-linear training program. Strength and conditioning staff tested the athletes during the 2012 fall semester, in September and then in December. All subjects had a minimum of three months of resistance training experience, and were placed into three different training groups based on performance goals.

Subjects

Data from thirty-four male experienced trained NCAA Division I track and field athletes (age: 20.3± 1.9 y; body mass: 83.9 ± 11.1 kg) were retrospectively analyzed. The subjects were classified in one of three groups that differed in training focus for performance goals for the offseason training period. Group 1 consisted of athletes who lifted four times each week, and focused most on strength and power (throwers, jumpers, short sprinters). Group 2 contained athletes who lifted three times a week, and had the most strenuous out of the weight room fall conditioning (pole vaulters, multi's, long sprinters). These athletes were all anaerobically trained individuals, and had an interval training program, demanding two running workouts per week. All first-year athletes were placed in group 3. This group was considered novice to the rigors of colligate training and had a strong focus on general preparation for the competitive season. This novice group also trained three days a week. Athletes in this group were anaerobically trained as well, however they had a less rigorous interval training program to follow outside of the weight room. The descriptive statistics for each group is listed in Table 3.1. The study was approved by the University of Connecticut Institutional Review Board for the use of human subjects in research (Appendix A).

Table 3.1 Descriptive Statistics

	N	Age (years)	Body Mass (kg)
Group 1	12	20.1±1.10	87.8±13.3
Group 2	12	21.1±1.10	82.8±10.4
Group 3	10	18.9±0.8	80.4±8.1

Values are Average ± SD

Training Groups

As previously mentioned, the subjects were classified in one of three groups that differed in training focus for performance goals for the offseason training period. Workouts were generally characterized as being predominantly Power, Strength, or Hypertrophy, based on the volume, intensity or type of exercises performed within the session. Table 3.2 summarizes the frequency and type of training for each group over the 12 week period. A power workout was based on ballistic exercises such as bench throws, jump squats, cleans, and variations of the Olympic lifts. The rate of acceleration is controlled by adjusting the amount of weight on the bar. Strength workouts were training to gain size and strength multiple (4+) sets with fewer reps must be performed using more force. Hypertrophy workouts achieve muscle growth with anaerobic strength training. Muscular hypertrophy can be increased through short duration, high intensity anaerobic exercises.

Table 3.2 Characteristics of each type of training day

	Training goal		
Variable	**Strength**	**Power**	**Hypertrophy**
Load (% of 1RM)	80-90	45-60	60-80
Reps per set	1-5	1-5	6-12
Sets per exercise	4-7	3-5	4-8
Rest between sets (mins)	2-6	2-6	2-5
Duration (seconds per set)	5-10	4-8	20-60
Speed per rep (% of max)	60-100	90-100	60-90
Training sessions per week	3-6	3-6	5-7

Table 3.2 Training Goals and Goal Frequency within the Training Program

Group	PWR	STR	HYP	Total
1	24	16	8	48
2	11	18	4	33
3	7	12	14	33

PWR = Power, STR = Strength, HYP = Hypertrophy.

Group 1 used a planned non-linear periodization split program. Group 1's RT program consisted of at least one power exercise daily, three strength exercises and a few local muscular endurance exercises last. See Table 3.3 listed below for Group 1's training week template. Group 2 also used a planned non-linear periodization program. RT program consisted of at least one power exercise daily, three strength exercises and a few local muscular endurance exercises last. See Table 3.4 listed below for specific acute program variables of the workout for Group 2.Group 3 also used a planned non-linear periodization program. RT program consisted of at least one power exercise daily, three strength exercises and a few local muscular endurance exercises last. This program is based off a modified version of The Black Book of Training Secrets (32). The first two power workouts (one for upper and one for lower) were done as general strength. See Table 3.5 listed below for specific acute program variables of the workout for Group 3.Specific sample workouts can be seen in Appendix B.

Table 3.3 Group 1 Training Week Template

Day	Lift	Resistance	Volume
1	Oly Push	BB	5x7
	Oly Pull	BB	8x2
	UB Pull	BB	5x4
	UB Push	DB	5x6
	LB Push	BW	3x5
2	LB Pull	BB	5x3
	LB Push	BB	8x2
	LB Push	BW	5x7
	UB Push	BW	4x8
	UB Pull	CC	3x10
	LB Pull	DB	3x8
3	UB Push	BB	5x3
	UB Push	MB	8x5
	UB Pull	BW	4x8
	LB Push	BW	3x10
4	Ply	BW	8x5
	Oly Push	BB	6x2
	LB Push	BB	5x4

Note: Value are Average ± SD; BB = Barbell, BA = Band, BW = Body Weight, CC = Cable Column, DB = Dumbbell, LB= Lower Body, MB = Medicine Ball, Oly = Olympic, Ply = Plyometric, SB = Stability Ball, UB = Upper Body

Table 3.4 Group 2 Workout Template

Day	Lift	Resistance	Volume
1	Oly Pull	BB	4x4
	LB Push	BB	4x10
	LB Push	DB	4x10
	UB Pull	DB	3x20
	UB Pull	BW	3x10
	UB Pull	CC	3x10
2	LB Pull	BA	3x10
	Oly Pull	BB	4x4
	UB Push	BB	4x10
	UB Push	DB	4x15
	UB Push	BA	3x15
	LB Push	BW	3x6
	LB Pull	BB	4x10
3	Oly Pull	DB	4x3
	LB Pull	BW	4x8
	LB Push	BB	4x8
	UB Push	BB	4x8
	UB Push	BW	3x10
	UB Pull	BW	4x10
	UB Pull	DB	4x10

Note: Value are Average ± SD; BB = Barbell, BA = Band, BW = Body Weight, CC = Cable Column, DB = Dumbbell, LB= Lower Body, MB = Medicine Ball, Oly = Olympic, Ply = Plyometric, SB = Stability Ball, UB = Upper Body

Table 3.5 Group 3 Workout Template

Day	Lift	Resistance	Volume
1	Oly Pull	BB	2x5
	Oly Push	BB	3x4
	LB Push	BB	4x10
	UB Pull	DB	4x10
	LB Pull	SB	3x8
	UB Push	BB	3x8
2	Oly Push	BB	2x5
	Oly Pull	BB	3x4
	UB Push	BB	4x10
	LB Pull	BB	4x10
	UB Pull	CC	4x10
	LB Push	DB	4x20
3	Oly Pull	BB	4x4
	LB Push	BB	4x8
	UB Push	DB	4x8
	LB Pull	BW	4x8
	UB Pull	BW	4x8

Note: Value are Average ± SD; BB = Barbell, BA = Band, BW = Body Weight, CC = Cable Column, DB = Dumbbell, LB= Lower Body, MB = Medicine Ball, Oly = Olympic, Ply = Plyometric, SB = Stability Ball, UB = Upper Body

Counter movement vertical jump

Counter movement vertical jump (CMVJ) height was measured using a Vertec (Sports Imports, Columbus, OH, USA). The Vertec is used amongst most university athletic teams as it has a high validity to the “gold standard” of a force plate. CMVJ was tested as it is a strong indicator of an athlete’s power. Hoffman et al.’s (5) testing protocol was used for measuring the CMVJ. Each athlete’s standing vertical reach was measured before the vertical jump height test. The subjects were allowed three attempts till failure at each new setting at a CMVJ with arm swing and no step. The highest height of three attempts was then used and the standing reach was subtracted from it (CMVJ touch – standing vertical touch = CMVJ height).

Strength Measures

To measure the predicted 1RM of the back squat, athletes tested at a designated weight and did as many as five reps and as few as three reps or failure in technique. A modified version of Hoffman's (5) strength testing protocol was used. Only one attempt at the test was allowed. Then, the Epley Equation of ((0.033 x reps) x weight)+weight was used to determine their predicted 1RM (3). Back squat was tested as it is a strong indicator of lower body strength. The predicted 1RM was used instead of the actual as it was a way for strength coaches to be able to get testing numbers for over 34 athletes done within a one hour testing time block.

For the bench press an estimated 1RM was attempted, and with successful attempts athletes were allowed to continue up to the next designated weight. A maximum of two failures were allowed until an athlete was finished testing. The last successfully completed number was considered an athlete's new 1RM. Bench press was tested as it is a strong indicator of upper body strength. Though not all subjects had been highly resistance trained previous to this study and actual 1RM was attempted in the bench press as there were spotters available to aid an athlete in case of failure.

Track and field Performance Program

The off-season resistance training program was four days per week (Monday, Tuesday, Thursday, and Friday) or a three day per week (Monday, Wednesday, Friday), for twelve weeks. Week ten was the athletes' Thanksgiving break and was used as active recovery with light resistance training and light conditioning. Also, week twelve was the athletes' pre testing week.

Each group had a dedicated strength and conditioning coach and graduate assistant (also a Certified Strength and Conditioning Specialist (CSCS) by the National Strength and Conditioning Association (NSCA)) monitoring them for the entirety of the Fall training period. Each session started with a full body dynamic warm-up conducted by the performance coaching staff. Outside the weight room athletes conditioned during the week in linear speed, general conditioning, and sport-specific training. The demands of these conditioning and technical sessions varied. At the end of each strength and conditioning workout a Muscle Milk Collegiate shake was given to each athlete (250 kcal, 7g fat, 28g carbohydrate, 18g protein).

Statistical Analyses

Data are presented as mean ± SD unless otherwise noted. All data sets met the assumptions for linear statistics. Data were analyzed using a group (3) by time (2) mixed methods analysis of variance (ANOVA), with a Fishers LSD post-hoc analysis. Significance was set at $p \leq 0.05$. Also, if athletes failed to achieve a 1RM during a testing period, the strength and conditioning staff predicted a 1RM to their first training phase, that estimate guided replacement values of 1RM bench press and squat. Reasons for not having complete data included medical restrictions or suspensions.

Chapter 4

RESULTS

The primary findings of this investigation are Group 1 saw significant ($p \leq 0.05$) statistical increases in vertical jump, and back squat maximum. These increases were 5.8%, and 7.8% respectively. Group 2 saw significant ($p \leq 0.05$) statistical increases in bench press maximum, and back squat maximum. these increases were 15.1%, and 9.4% respectively. Group 3 saw significant ($p \leq 0.05$) statistical increases in vertical jump and maximum back squat. These increases were 6.3%, and 15.0% respectively. Athletes with specific training performance goals for each event reacted differently to the resistance training program. The resulting energy systems use and need, athletes improved in their testing variables concededly with these demands.

Countermovement Vertical Jump

As expected, with training, increases in vertical jump height were seen in all groups, as shown in Table 4.1 and Figure 4.1. Significant differences ($p \leq 0.05$) from pre-values were observed in Group 1 and Group 3, but not Group 2. No between group differences were observed. Percent increases between pre-and post-testing for the groups were Group 1) 5.8%, Group 2) 2.9%, Group 3) 6.3%. Two out of the 34 subjects were non-responders to the performance program for significantly increasing countermovement vertical jump height.

Table 4.1 Summary of Vertical Jump Data

Group	Pre (cm)	Post (cm)	% Change
1	76.5±7.3	80.9±7.9*	5.8
2	76.5±7.6	78.7±8.7	2.9
3	75.1±10.6	79.8±11.3*	6.3

Values are Average ± SD; * Significantly different ($p \leq 0.05$) from corresponding Pre value. No between group differences were observed.

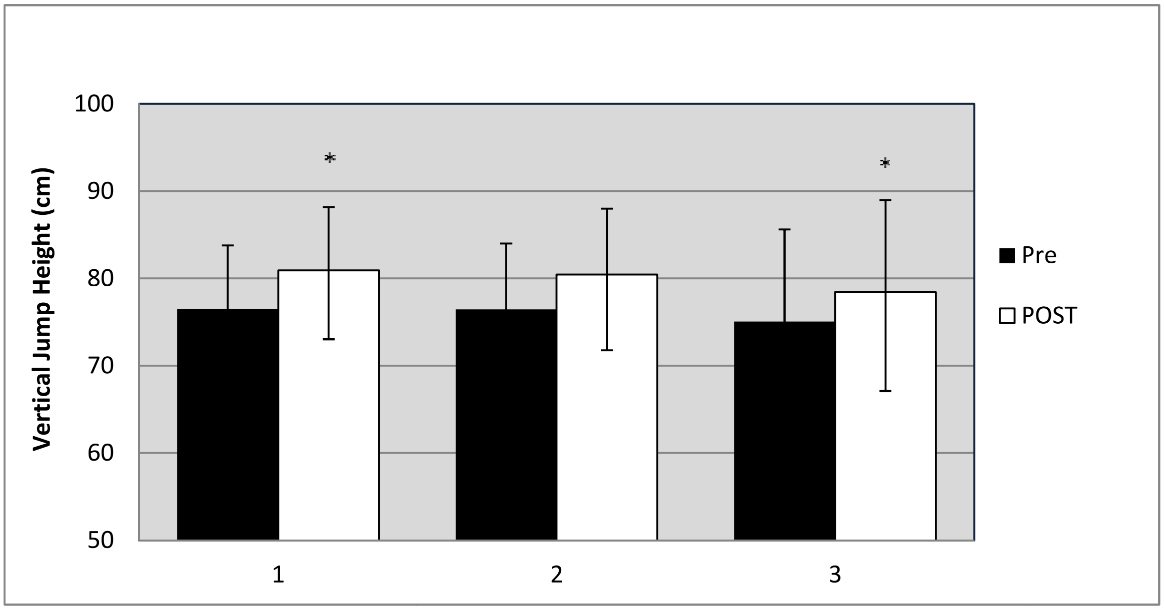

Figure 4.1 Comparison of average Vertical Jump Performance between training groups. Values are Average ± SD; *Significant difference ($p \leq 0.05$) between corresponding Pre value

Bench Press Strength

As expected, with training, increases in bench press maximum were seen in all groups as shown in Table 4.2 and Figure 4.2. Group 1 was significantly greater ($p \leq 0.05$) than both Group 2 and Group 3 at the Pre time point,. After training, Group 1 was significantly greater ($p \leq 0.05$) than Group 3, but not Group 2. Group 2 showed a significant increase ($p \leq 0.05$) between Pre and Post training. Lastly, no significant differences were observed between Groups 2 and 3 at any time point. Percent increases between pre and post testing for the groups were Group 1) 1.1%, Group 2) 15.1%, Group 3) 9.9%.

Table 4.2 Summary of Bench Press 1RM Data

Group	Pre (kg)	Post (kg)	% Change
1	118.9 ± 19.9†	120.2 ± 24.9	1.1
2	94.1 ± 21.5	108.3 ± 40.5*	15.1
3	82.8 ± 17.2	91.0 ± 16.3‡	9.9

Values are Average ± SD; † Group 1was significantly greater ($p \leq 0.05$) than Groups 2 and 3 at Pre. ‡Group 1 significantly greater than Group 3 at Post. * Significantly different ($p \leq 0.05$) from corresponding Pre value. No significant differences were observed between groups 2 and 3 at any time point.

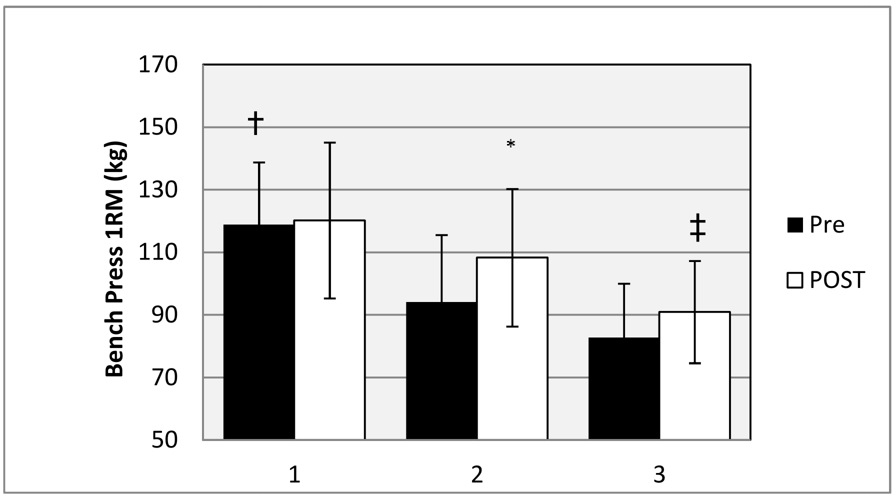

Figure 4.2 Comparison of average Bench Press 1RM between training groups. Values are Average ± SD; †Group 1was significantly greater ($p \leq 0.05$) than Groups 2 and 3 at Pre. ‡Group 1 significantly greater than Group 3 at Post. * Significantly different ($p \leq 0.05$) from corresponding Pre value. No significant differences were observed between groups 2 and 3 at any time point

Back Squat Strength

Significant increases ($p \leq 0.05$) in back squat 1RM were seen in all groups, from Pre to Post, as seen in Table 4.3 and Figure 4.3. Group 1 was significantly greater ($p \leq 0.05$) than Group 3, but not Group 2 at Pre. Group 1 was significantly greater than Group 3, but not Group 2 at Post. No significant differences were observed between groups 2 and 3 at any time point. Percent increases between pre and post testing for the groups were Group 1) 7.3%, Group 2) 9.4%, Group 3) 15.0%.

Table 4.3 Summary of Back Squat 1RM Data

Group	Pre (kg)	Post (kg)	% Change
1	180.3 ± 40.5	193.4 ± 44.1*	7.3
2	159.9 ± 29.5	174.9 ± 30.1*	9.4
3	133.6 ± 31.3 †	153.5 ± 36.3*‡	15.0

Values are Average ± SD; † Group 1was significantly greater ($p \leq 0.05$) than Group 3, but not Group 2at Pre. ‡Group 1 significantly greater than Group 3, but not Group 2 at Post. * Significantly different ($p \leq 0.05$) from corresponding Pre value. No significant differences were observed between groups 2 and 3 at any time point.

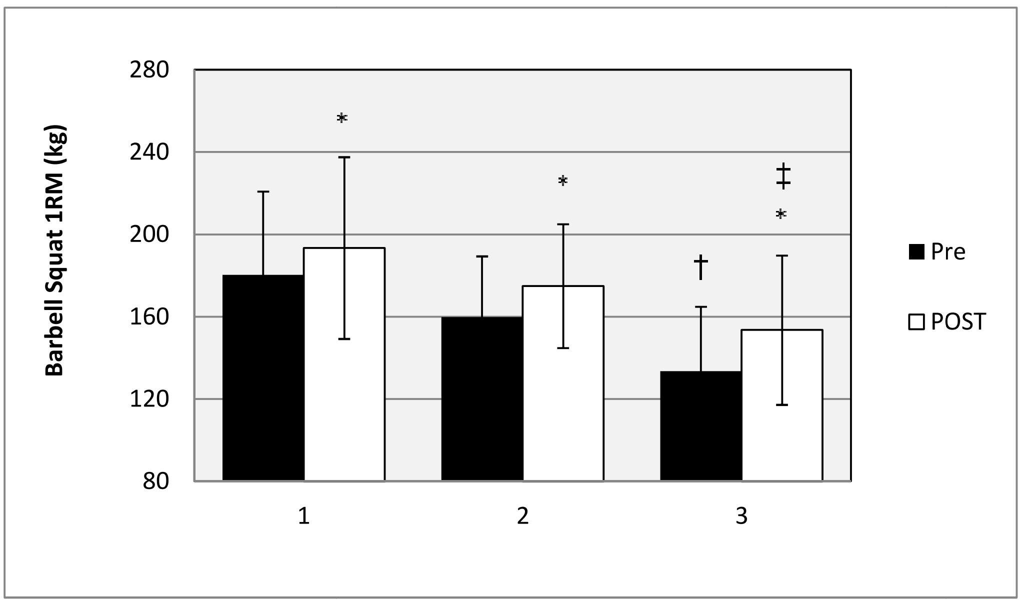

Figure 4.3 Comparison of average Bench Press 1RM between training groups. Values are Average ± SD; † Group 1 was significantly greater ($p \leq 0.05$) than Group 3, but not Group 2 at Pre. ‡ Group 1 significantly greater than Group 3, but not Group 2 at Post. * Significantly different ($p \leq 0.05$) from corresponding Pre value. No significant differences were observed between groups 2 and 3 at any time point.

Chapter 5

DISCUSSION

As expected the primary findings of this investigation coincided with many of our original hypotheses. Athletes with specific training performance goals for each event discipline reacted differently to the resistance training program. The power athletes were able to attain increases in power and strength variables as Group 1 saw significant ($p \leq 0.05$) statistical increases in vertical jump and back squat maximum. The strength athletes saw increases in their strength measures as Group 2 saw significant ($p \leq 0.05$) statistical increases in bench press maximum and back squat maximum. The general preparation group was able to create improvements across the board as a higher level of physical maturity was reached by the end of the study as Group 3 saw significant ($p \leq 0.05$) statistical increases in vertical jump, bench press maximum, and back squat maximum.

Athletes whose disciples in track and field were more power based were able to see the highest increase in vertical jump over the twelve week training period. Group one were athletes who's events were ATP based and had the highest need for quick, powerful movements (5.8% increases between pre and post testing). Group two was more Anaerobic based and therefore saw a slightly lower increase (2.9% increase between pre and post testing). However athletes with a low training age are about to make high performance increases during early development (6.3% increase between pre and post testing).

As expected, with training, increases in bench press maximum were seen in all groups. Group 2 had the smallest demands of the three groups with their out-of-the-weight- room upper body conditioning (15.1% increases between pre and post testing). Group three was the least trained and had the highest possibility of strength increases over the time periods (9.9% increases between pre and post testing). Conversely the athletes in group one were the most highly trained and would not be expected to see dramatic increases during a twelve week period. (1.1% increases between pre and post testing).

In line with our hypothesis, increases in back squat maximum were seen in all groups (Group one 7.3%, Group two 9.4%, Group three 5.0%). With increase in vertical jump heights it was to be expected that groups would also improve lower body strength. Furthermore Group 3 made the highest increase from September to December (15%) which could be associated with their neurological improvements and physical maturity during the twelve week period.

This study was observed by the researchers in all program variables, and testing design was assigned by the strength and conditioning coach. Though this approach to the question does appear more practical, there are other variables which are outside the vision of the researcher. Kraemer et al (15) states that the upper regulatory elements such as nutrition, hydration, and sleep habits, etc would be modifiable. Concerns arising from this study design are problematic. The program could be separated even more distinctly for each training group, but with the limitation of a small coaching staff the higher specific measures may be hard to accomplish. The resulting energy systems use and need, athletes improved in their testing variables concededly with these demands. Though the energy system requirements maybe the same for a shot putter and a sprinter, there is a world of difference in the adaptations to the program variables in each group. There also maybe more applicable testing measures for athletes who have to withstand two days of repeated maximum efforts with rest over athletes who just have to maximally exert for up to one minute.

The limited previous findings connected in similar studies shows the need for further research within the field, both within the practical and laboratory setting. By retrospectively looking at data from an offseason that was employed with a team in a collegiate strength and conditioning setting, science has been able to quantify and implicate probable changes in training status for these athletes. Having an insight into the track and field athletes training methods we are able to continue to crosslink the two domains of the science community and the practical world of strength and conditioning.

Practical Applications:

The best overall effect on the RT portion during an offseason track and field performance program was the prioritization on strength over the 12 week training program for these the three testing variables. As mentioned with the harsh demands of the academic school year placed upon Division I NCAA student-athlete, creates a great need for the flexibility of a nonlinear periodization model and allows for multiple factors to be trained for over a period of time. This suites the needs of those athletes whom daily training status may be altered due to a high number of variables, most of which are outside the control of the coaches. With thousands of athletes across the country competing in the sport of track and field and the NCAA limiting the amount of hours student-athletes are allowed to train, coaches must attempt to make the most time-efficient, and appropriate program train these athletes.

1. Berg K, Latin RW, and Baechle T. Physical and performance characteristics of NCAA Division I football players. *Res Q Exerc Sport* 61: 395-401, 1990.

2. Dick R, Ferrara MS, Agel J, Courson R, Marshall SW, Hanley MJ, and Reifsteck F. Descriptive epidemiology of collegiate men's football injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. *J Athl Train* 42: 221-233, 2007.

3. Epley B. Poundage Chart. *Boyd Epley Workout*, 1985.

4. Hakkinen K, Pakarinen A, Alen M, Kauhanen H, and Komi PV. Neuromuscular and hormonal adaptations in athletes to strength training in two years. *J Appl Physiol* 65: 2406-2412, 1988.

5. Hoffman JR, Ratamess NA, and Kang J. Performance changes during a college playing career in NCAA division III football athletes. *J Strength Cond Res* 25: 2351-2357, 2011.

6. Kraemer WJ, Duncan ND, and Volek JS. Resistance training and elite athletes: adaptations and program considerations. *J Orthop Sports Phys Ther* 28: 110-119, 1998.

7. Kraemer WJ and Fleck SJ. *Optimizing strength training : designing nonlinear periodization workouts.* Champaign, IL: Human Kinetics, 2007.

8. Kraemer WJ and Ratamess NA. Fundamentals of resistance training: progression and exercise prescription. *Med Sci Sports Exerc* 36: 674-688, 2004.

9. Kraemer WJ and Ratamess NA. Hormonal responses and adaptations to resistance exercise and training. *Sports Med* 35: 339-361, 2005.

10. Kraemer WJ, Ratamess NA, and French DN. Resistance training for health and performance. *Curr Sports Med Rep* 1: 165-171, 2002.

11. Moritani T and deVries HA. Neural factors versus hypertrophy in the time course of muscle strength gain. *Am J Phys Med* 58: 115-130, 1979.

12. National Collegiate Athletic Association. NCAA men's and women's track and field and cross country rules. Overland Park, Kan.: National Collegiate Athletic Association, 1993, p v.

13. Painter KB, Haff GG, Ramsey MW, McBride J, Triplett T, Sands WA, Lamont HS, Stone ME, and Stone MH. Strength gains: block versus daily undulating periodization weight training among track and field athletes. *Int J Sports Physiol Perform* 7: 161-169, 2012.

14. Sale DG. Neural adaptation to resistance training. *Med Sci Sports Exerc* 20: S135-145, 1988.

15. Spiering BA, Kraemer WJ, Anderson JM, Armstrong LE, Nindl BC, Volek JS, and Maresh CM. Resistance exercise biology: manipulation of resistance exercise programme variables determines the responses of cellular and molecular signalling pathways. *Sports Med* 38: 527-540, 2008.

APPENDIX A

University of Connecticut
Office of Research Compliance

DATE: October 21, 2010

TO: William J. Kraemer, Ph.D.
Craig R. Denegar, Ph.D., PT, ATC
Kinesiology, Unit 1110

FROM: Deborah Dillon McDonald, RN, Ph.D. DDM/lw
Chair, Institutional Review Board
FWA# 00007125

RE: Exemption #X10-094: "Retrospective Analysis of Conditional Progressions"
Please refer to the Exemption# in all future correspondence with the IRB.
Funding Source: Unfunded
Approved on: **October 21, 2010**

The Institutional Review Board (IRB) reviewed the "Request for Exemption" for the research study referenced above. According to the information provided, the IRB determined that this research is exempt from continuing IRB review under 45CFR46.101(b)(4): Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Because this study involves the review of a de-identified data set, the IRB has determined that the study referenced above meets the criteria for Waiver of Informed Consent stated in 45 CFR 46.116(d) as follows:

- The research involves no more than minimal risk to the subjects;
- The waiver or alteration will not adversely affect the rights and welfare of the subjects;
- The research could not be practicably carried out without the waiver or alteration; and
- Whenever appropriate, the subjects will be provided with additional pertinent information after participation in the study.

All investigators at the University of Connecticut are responsible for complying with the attached IRB "Responsibilities of Research Investigators".

Any proposed changes that may affect the exempt status of the research study must be submitted to the IRB for review and approval prior to their implementation.

Attachments:
1. Validated Appendix A Form
2. Validated IRB-5
3. "Responsibilities of Research Investigators"

An Equal Opportunity Employer

438 Whitney Road Extension, Unit 1246
Storrs, Connecticut 06269-1246

Telephone: (860) 486-8802
Facsimile: (860) 486-1044
web: compliance.uconn.edu

APPENDIX B

Monday Phase 1 - Sprinters			**Monday Phase 2 - Sprinters**			**Monday Phase 3 - Sprinters**		
Pull Over Throw	BB	5x7	Power Clean	BB	5x3	Power Clean	BB	3,2x2,3x1
Split Jerk	BB	3x2	Band Back Squat	BB	8x2	Band Safety Squat	BB	8x2
Bench Press	BB	5x4	Hurdle Jumps	BW	5x6	Squat Jumps	BW	5x6
Incline Row	DB	5x6	Dips	BW	4x8	Pullover to Press	EZ	3x10
1 Leg Squat to Low Box	BW	3x5ea	Eccentric Gluet Hams	BW	3x6	Eccentric Gluet Hams	BW	3x6
Tuesday Phase 1 - Sprinters			**Tuesday Phase 2 - Sprinters**			**Tuesday Phase 3 - Sprinters**		
Deadlift	BB	5x3	Explosive Plate Push ups	BW	5x6	4pt Stance Throw	MB	5x6
Safety Squat	BB	3x2	1 Arm Split Stance Rotational Row	CC	5x3ea	Push Pull	CC	5x3ea
Box Step off to V Jump	BW	5x7	Inverted Row Iso/Dyn	BW	5x4	Yates Row	BB	4x8
Dips	BW	4x8	Box Lunge off	DB	3x5ea	Reverse Lunge off Box	DB	3x5ea
45 Degree Pulls	CC	3x10	**Thursday Phase 2 - Sprinters**			**Thursday Phase 3 - Sprinters**		
1 Leg RDL	DB	3x8ea	2 Board Bench Press	BB	5x2	Bench Press	BB	3,2x2,2x1
Thursday Phase 1 - Sprinters			Eccentric Glute Hams	BW	3x6	Eccentric Gluet Hams	BW	3x6
Incline Bench Press	BB	5x3	1 Arm Push Press	DB	5x6ea	Push Jerk	BB	5x6
Push Press	MB	3x5	Pull Ups	BW	4x8	Chin Ups	BW	4x6
Pull Ups	BW	4x8	Hip Lift	BB	3x10	1 Leg Hip Lift	BB	3x8ea
Hip Lift	BB	3x10	**Friday Phase 2 - Sprinters**			**Friday Phase 3 - Sprinters**		
Friday Phase 1 - Sprinters			Elevated Split Jumps	BW	5x6	Hang Snatch	BB	4x4
Box Jumps	BW	3x5	Speed Pulls w/ Band	BB	5x2	Bulgarian Deadlift	BB	5x2ea
Clean	BB	5x2	Front Squat	BB	4x2	Back Squat	BB	3,2x2,2x1
Back Squat	BB	5x4	Reverse Pullovers	CC	3x10	1 Arm Row	DB	3x8ea
						Pullaparts Palms Up	Band	3x10

Figure B-1 Sample Weekly Program for Group 1

Day 1 Phase 1			Day 1 Phase 2 - PV Multi			Day 1 Phase 3 - Multi			Day 1 Phase 3 - PV		
Exercise	Imp.	Reps	Exercise	Imp.	Reps	Exercise	Imp.	Reps	Exercise	n/a	Reps
Clean Pull	BB	4x4	Explosive Plate Pushups	BW	5x5	Recoil MB Shot Put	MB	5x5	Recoil MB Shot Put	MB	5x5
Back Squat	BB	2x10,3x6	Followed Throw	MB	5x5	Push-Pull	CC	5x8ea	Push-Pull	CC	5x8ea
1-Arm Rotational Row	DB	2x10ea,3x6ea	Bench Press	BB	5x8	Bench Press	BB	3,2x2,2x1	Bench Press	BB	3,2x2,2x1
Walking Lunge	DB	3x20	Incline Row iso-Dyn	BB	5x8	Yates Row	BB	4x8	Yates Row	BB	4x8
Pullups	BW+	3x8-10	Crossover Step-ups	DB	3x5ea	Reverse Lunge off Box	DB	3x5ea	Reverse Lunge off Box	DB	3x5ea
45 Degree Face Pull	CC	3x10	Day 2 Phase 2 - PV Multi			Day 2 Phase 3 - Multi			Day 2 Phase 3 - PV		
Band Goodmorning	Band	3x10	Power Clean	BB	5x3	Power Clean	BB	3,2x2,3x1	Power Clean	BB	3,2x2,2x1
Day 2 Phase 1			Band Back Squat	BB	8x2	Band Safety Squat	BB	8x2	Band Safety Squat	BB	8x2
Clean	BB	4x4	Hurdle Jumps	BW	5x5	Squat Jumps	BW	5x5	Pocket Squat Jumps	Mach	5x5
Bench Press	BB	2x10,3x6	Dips	BW+	4x8	Pullover to Press	EZ	5x10	1-leg Hurdle Jumps	BW	5x5ea
Snatch Grip RDL	BB	4x10	45 Degree Face Pulls	CC	5x10	RDL	BB	8x3	Pullover to Press	EZ	8x10
Alternating Shoulder Press	DB	4x10	1-Leg RDL iso-Dyn	DB	3x5ea				RDL	BB	5x8
1-Leg Bent Leg Hip Lift	Band	3x5ea	Day 3 Phase 2 - PV Multi			Day 3 Phase 3 - Multi			Day 3 Phase 3 - PV		
1-Leg Squat - Stand on bench	BW	3x5ea	1-Arm Push Press	DB	4x5ea	Hang Snatch	BB	4x4	Hang Snatch	BB	4x4
Band Pushups	Band	3x15	Front Squat	BB	5x8	Back Squat	BB	3,2x2,2x1	Back Squat	BB	3,2x2,2x1
Day 3 Phase 1			Incline Bench Press	DB	4x6	Push Jerk	BB	5x5	Push Jerk	BB	5x5
1-Arm Snatch	DB	4x3ea	Eccentric Glute Ham	BW	4x8	Chin-ups	BW	4x8	Chin-ups	BW	4x8
Front Split Squat	BB	4x3ea	Wide Grip Pullups	BW+	4x6	Chin-ups	BW+	4x6	Chin-ups	BW+	4x6
Incline Bench (3rd notch)	DB	4x8	1-Leg Hip Lift	BW	3x10ea	1-Leg Hip Lift	BB	8x3ea	1-Leg Hip Lift	BB	5x8ea
Alternating Incline Iso Rows (2nd notch)	BW	4x10									
Eccentric Glute Ham	BW	4x8									
Alternating L-Raise	DB	5x10									
Dips	BW+	3x10									

Figure B-2 Sample Weekly Program for Group 2

Day 1 Phase 1 - Fresh 30			Day 1 Phase 2 - Fresh 30			Day 1 Phase 3 - Fresh 30		
Bar Warm Up (RDL, Hang High Pull, Front Squat)	EB	[illegible]	Bar Warm Up (RDL, Hang High Pull, Front Squat)	EB	[illegible]	Bar Warm Up (RDL, Hang High Pull, Front Squat)	BB	[illegible]
Clean Pull	EB	[illegible]	Clean Pull	EB	[illegible]	Clean Pull	BB	4x3
Back Squat	EB	[illegible]	[illegible]	CB	[illegible]	Bulgarian Squat	DB	[illegible]
1 Arm Row	CB	[illegible]	Walking Lunges	EB	[illegible]	45 Degree Row	CB	[illegible]
Leg Curl	SE	[illegible]	[illegible]	EB	[illegible]	Incline Bench Press	BB	4x3
Incline Bench	EB	[illegible]	[illegible]	EB	[illegible]	Eccentric Glute Ham	BW	4x3
Day 2 Phase 1 - Fresh 30			Day 2 Phase 2 - Fresh 30			[illegible]	Band	[illegible]
Bar Warm Up (RDL, Hang High Pull, Front Squat)	EB	[illegible]	Bar Warm Up (RDL, Hang High Pull, Front Squat)	EB	[illegible]	[illegible]	BW	[illegible]
High Pull	EB	[illegible]	High Pull	EB	[illegible]	Day 2 Phase 3 - Fresh 30		
Bench Press	EB	[illegible]	Bench Press	EB	[illegible]	Bar Warm Up (RDL, Hang High Pull, Front Squat)	BB	[illegible]
Dead Lift	EB	[illegible]	Leg Curl	SE	[illegible]	High Pull	BB	4x3
[illegible] Row	CB	[illegible]	Bulgarian Squat	EB	[illegible]	Bench Press	BB	[illegible]
Walking Lunges	CB	[illegible]	Alt. Standing Shoulder Press	CB	[illegible]	RDL	BB	4x3
Day 3 Phase 1 - Fresh 30			Day 3 Phase 2 - Fresh 30			Leg Curl	SB	4x3
Bar Warm Up (RDL, Hang High Pull, Front Squat)	EB	[illegible]	Bar Warm Up (RDL, Hang High Pull, Front Squat)	EB	[illegible]	[illegible] Shoulder Press	DB	[illegible]
Clean	EB	[illegible]	Clean	EB	[illegible]	Dips	BW	3x10
Bulgarian Squat	EB	[illegible]	Front Squat	EB	[illegible]	[illegible]	AB	3x12
Standing Shoulder Press	CB	[illegible]	[illegible] Row	CB	[illegible]	Day 3 Phase 3 - Fresh 30		
Pull Ups	BW	[illegible]	Pull Ups	BW	[illegible]	Bar Warm Up (RDL, Hang High Pull, Front Squat)	BB	[illegible]
Eccentric Glute Ham	BW	[illegible]	Eccentric Glute Ham	BW	[illegible]	Clean	BB	5x2
						Back Squat	BB	[illegible]
						1 Arm Snap Row	DB	[illegible]
						Pull Ups	BW	4x3
						Walking Lunges	DB	[illegible]
						Alt. Incline Bench	DB	3x8
						Around The World	PB	[illegible]

Figure B-3 Sample Weekly Program for Group 3