2014

A Comparison of Anthropometric and Maximal Strength Measures in Rugby Union Players

Thomas Gamazo
University of Central Florida

A COMPARISON OF ANTHROPOMETRIC AND MAXIMAL STRENGTH MEASURES IN RUGBY UNION PLAYERS

by

THOMAS GAMAZO

A thesis submitted in partial fulfillment of requirements
for the Honors in the Major Program in Sport and Exercise Science
in the College of Education and Human Performance
and in the Burnett Honors College
at the University of Central Florida
Orlando, Florida

Fall Term 2014

Thesis Chair: Thomas J. Fisher, Ph.D.

Abstract

To examine differences in body composition and maximal strength between collegiate (CLG) and men's club (CLB) rugby union players, as well as between the forward (FW) and back (BK) positions, seventeen resistance-trained men (24 ± 2.4 yrs; range: 20 – 27 yrs; 179.3 ± 5.4 cm; 93.7 ± 12.9kg) from a collegiate rugby team (n=11) and a local men's rugby club (n=6) were recruited to participate in the present investigation. Prior to strength testing, height (±0.1 cm), body mass (±0.1 kg), and body composition via dual energy x-ray absorptiometry were assessed to determine total percent body fat (%FAT), lean body mass (LBM), lean arm mass (LAM), and lean leg mass (LLM). Maximal upper- and lower-body strength were determined from each participant's one-repetition maximum (1RM) in the bench press and squat, respectively. Additionally, athletic history, resistance training experience, and distractors (e.g. work, school, and sleep) were determined via questionnaire. Significant ($p<0.05$) differences were observed between clubs in age (CLG: 22.3 ± 1.3y; CLB: 26.2 ± 1.1y), years played (CLG: 2.9 ± 2.4y; CLB: 7.5 ± 2.1y), and starting experience (CLG: 1.7 ± 2.6y; CLB: 5.2 ± 3.4y). In terms of position, LAM was significantly ($p = 0.037$) greater in FW (10.6 ± 1.7kg) than in BK (9.0 ± 0.5kg). These findings suggest rugby union players possess similar strength and size characteristics, regardless of age, playing experience, or position.

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Chapter One: Introduction

Rugby union (rugby) is a full contact team sport consisting of 15 players. In which, two teams compete for 80 minutes and attempt to score by means of tries, free kicks, drop kicks, or penalty kicks. The teams go through series of backward/lateral passes and kicks to create chances to score. Throughout the entirety of a match, players are involved in both contact (e.g. scrums, mauls, rucks, lineouts, and tackles) and non-contact (e.g. passes and kicks) plays. The scrum resets gameplay after an infraction. While mauls and rucks are similar, they are in game plays that differ depending whether the ball is in a team's possession or on the ground. A rugby team is divided into two main positions: forwards (those involved in the scrum) and backs (those not in the scrum). Forwards (FW) are primarily responsible for gaining and maintaining possession of the ball by winning scrums, lineouts, rucks, mauls, making tackles, and generally following the ball at all times (Cunniffe, Proctor, Baker, & Davies, 2009; Marshall, 1892; Sedeaud, Marc, Schipman, Tafflet, Hager, & Toussaint, 2012). In contrast, backs (BK) cover a larger portion of the field via complex passing plays, longer sprints, and maintaining the back-line (Austin, Gabbett, & Jenkins, 2011; Cunniffe, Proctor, Baker, & Davies, 2009; Marshall, 1892; McCann, 2006). Consequently, forwards are traditionally larger and stronger than backs, which tend to be leaner and faster (Duthie, Pyne, Hopkins, Livingstone, Hooper, 2006; Cunniffe, Proctor, Baker, & Davies, 2009; Maud, 1983). When comparing the level of play in opposing countries it is easier to see competitive differences (Carney, Smolianov, & Zakus, 2012). Versus the unknown of whether these differences are consistent at both the collegiate and men's club levels in the United States.

In the United States, organized rugby typically occurs at the collegiate and men's club

levels, though the sport is also gaining popularity in high school (Carney, Smolianov, & Zakus, 2012; Collins, Micheli, Yard, & Comstock, 2007). However, the differences between these two levels of play have not been well established. As opposed to traditional American sports (e.g. soccer, baseball, football, and basketball), rugby is often picked up later in life (Carney, Smolianov, & Zakus, 2012); thus affecting the degree of experience at both levels. Furthermore, personal responsibilities (school, work, and family) may affect individual commitment in terms of practices made, game-experience, and regularity in strength/speed conditioning. Previously, Hortobágyi and colleagues (1993) demonstrated how lapses in strength training could negatively influence sports performance (Hortobágyi, Houmard, Stevenson, Fraser, Johns, & Israel, 1993). Given the importance of muscular size and strength on performance in contact sports (Mcbride, Blow, Kirby, Haines, Dayne, Triplett, 2009; Olds, 2001; Wisløff, Castagna, Helgerud, Jones, Hoff, 2004), monitoring these physical traits would be beneficial for optimizing performance, as well as reducing the risk for injury (Mcbride et al., 2009; Wisløff et al., 2004).

In terms of United States rugby, very little information related to strength and size is available at any level of competition. Consequently, the purpose of the present investigation is to provide normative anthropometric (human body measurements) and strength data for players from a collegiate rugby union team and a local men's league club; as well as to examine differences in physical activity and lifestyle distractors between positions and competitive levels. The hypothesis is there will be a significant difference in both greater lean body mass and maximal strength in the collegiate rugby team, while forwards will possess greater total mass, lean mass, and absolute strength in comparison to backs.

Chapter Two: Literature Review

As a whole, rugby has intervals of both anaerobic and aerobic bouts throughout the play of a match. With a majority spent in a lower-intensity state (Duthie, Pyne, & Hooper, 2005). However, when comparing positions total distances traveled/sprinted in a match varies by position (Cunniffe, Proctor, Baker, & Davies, 2009; Lacome, Piscione, Hager, & Bourdin, 2014). For example, a front-row forward travels an average of 4662 meters versus an inside back who can travel up to 6389 meters (Austin, Gabbett, & Jenkins, 2011). With the increasing numbers of high impact collisions, (Quarrie & Hopkins, 2007) resulting in changes of build and physical demands of each player are as well.

In rugby, each position has its own preferred physical characteristics. It is shown that an adequate height and a suitable amount of lean body mass has an association with success in both teams and as individuals (Olds, 2010; Sedeaud et al., 2012). This is evident in players of greater mass, who are generally capable of contributing greater amounts of force during a scrum than players of lesser weight (Quarrie & Wilson, 2010). Furthermore, a greater momentum generated while sprinting creates a harder individual to tackle (Higham, Pyne, Anson, Dziedzic, & Slater, 2014; Quarrie, Handcock, Waller, Chalmers, Toomey, & Wilson, 1995). As such, over the last century the average size of rugby forwards and backs has increased from 92.7kg to 103.7kg and 80kg to 84.7kg respectively (Olds, 2010). However, body mass appears to vary among players from different countries (Quarrie, Handcock, Waller, Chalmers, Toomey, & Wilson, 1995). For example, average masses of the top five teams (New Zealand, South Africa, Australia, England, and Ireland) forwards and backs are 113.2kg (± 6.59 kg) and 92.5kg (± 5.97 kg) respectively (ESPN Scrum (n.d)). By comparison, the United States' forwards and backs weigh an average of

109.4kg (± 7.98 kg) and 92.3kg (± 7.84 kg) respectively (Men's Eagles Player Pool. (n.d.). This comparison of the top five teams versus the ninth ranked team illustrates the performance differences that may be related to the excess body mass in the forward positions.

In previous research, body composition of rugby players has been estimated by means of sum of skinfold thickness (Duthie et al., 2006; Holway, & Garavaglia, 2009). Though this methodology is quick and simple, the element of human error is ever present and it does not actually describe adiposity; it can only be used to monitor changes in body fat. In contrast, dual energy X-ray absorptiometry (DEXA) utilizes algorithms to calculate body fat mass, in addition to lean tissue mass and bone mineral density. Furthermore, it is capable of calculating these measures within several regions of interest (e.g. arms, legs, torso, etc.). In this capacity, DEXA has been shown to be capable of providing reliable results in young, healthy adults (Fuller, NJ. Assessment of the composition of major body regions by dual-energy X-ray absorptiometry (DEXA), with special reference to limb muscle mass).

Considering that body mass is influential of maximal strength, it is possible that maximal strength is also different between forwards and backs. Previously, forwards have exhibited superior upper-body (i.e. bench press) strength in comparison to backs (Maud, 1983). However, given the changes in body mass over the past three decades among forwards and backs, it is possible that these differences no longer exist.

Chapter Three: Methods

Seventeen resistance-trained men (24 ± 2.4 yrs; range: 20 – 27 yrs; 179.3 ± 5.4 cm; 93.7 ± 12.9kg) from a collegiate rugby club (CLG; n=11) and a local men's rugby club (CLB; n=6) were recruited to participate in the present investigation. All participants had been recruited for a larger training investigation (In preparation by a doctoral student), and had recently completed a baseline resistance-training phase (Appendix A, Table 1) to ensure training status and exercise familiarity prior to testing. The baseline phase consisted of four workouts during the first week and two on the second week. On the last two days of the second week, anthropometrics followed by maximal strength data was collected in all participants. All participants were free of any physical limitations that would affect their ability to complete the maximal testing assessments as determined by medical history questionnaire (see Appendix B) and PAR-Q (see Appendix C). Prior to participating in the base resistance-training phase, all participants provided their written informed consent. The New England Institutional Review Board approved this investigation (see Appendix D).

Base resistance training phase

Each of the participants completed the same base resistance as indicated in Table 1. This phase encompassed a total of six workouts: four workouts (Monday, Tuesday, Thursday, and Friday) during the first week and two workouts (Monday and Tuesday) during the second week. Main purpose of this protocol was to ensure proper lifting technique and have the participants familiarized with the lifts prior to testing (Mangine et al., 2008.) Prior to all weight-lifting sessions, a general warm up of five minutes on the bike followed by a specific warm-up dynamic

protocol including: 10 body weight squats, 10 alternating lunges, 10 walking knee hugs and 10 walking quadriceps stretches.

Anthropometric assessments

Prior to strength testing (approximately 24 hours), height ((±0.1 cm) and body mass (±0.1 kg) were determined using a Health-o-meter Professional (Patient Weighing Scale, Model 500 KL, Pelstar, Alsip, IL, USA) with the participants standing barefoot, with feet together, in their normal daily attire. Subsequently, body composition was determined via dual energy x-ray absorptiometry (DEXA) scans (ProdigyTM; Lunar Corporation, Madison, WI). Total percent body fat (%FAT), total body mass (LBM), lean arm mass (LAM), and lean leg mass (LLM) were determined by the regions of interest (Appendix A, Figure 1) feature using the company's recommended procedures and supplied algorithms. Quality assurance was assessed by daily calibrations performed prior to all scans using a calibration block provided by the manufacturer. The same certified radiological technician performed all DEXA measurements.

Maximal strength testing

Maximal strength testing occurred following anthropometric data collection. Prior to testing, all participants completed the same warm-up utilized before each weight-lifting session. Subsequently, maximal dynamic variable resistance and maximal isometric strength was assessed. All testing occurred during each participant's normal training time during the base resistance phase. All strength tests were completed under the supervision of a Certified Strength and Conditioning Specialist (CSCS).

Maximal dynamic variable resistance strength

To assess maximal upper- and lower-body strength, standardized procedures were used for the one-repetition maximum (1RM) barbell bench press and barbell back squat, respectively (Hoffman, 2006; Mangine et al., 2008). For each exercise, a warm-up set of 5 to 10 repetitions was performed using 40 to 60% of the perceived maximum 1RM. After a one-minute rest period, a set of 2 to 3 repetitions was performed at 60 to 80% of the perceived maximum 1RM. Subsequently, 3 to 5 maximal trials (1-repetition sets) were performed to determine the 1RM. For the bench press, proper technique was enforced by requiring all participants to maintain contact between their feet and the floor; their buttocks, shoulders, and head with the bench; and use a standard grip (slightly wider than shoulder-length) on the bar. Furthermore, upon lowering the bar to their chest, participants were required to pause briefly and wait for an "UP!" signal before initiating concentric movement. The purpose for this pause was to eliminate the influence of bouncing. Any trials that involved "cheating," such as excessive arching of the back or bouncing of the weight were discarded. For the back squat, a successful attempt required the participant to descend to the "parallel" position, where the greater trochanter of the femur was aligned with the knee. At this point, a CSCS located lateral to the participant, provided an "UP!" signal, indicating that proper range of motion had been achieved; no pause was required for the squat exercise. Rest periods in between trials were 2 to 3 minutes in length.

Athletic History and Daily Activity Questionnaire

To obtain background information, all participants completed an athletic and daily activity questionnaire (Appendix A, Figure 2). Asked first was a polar question for the

separation of participants from the original study. Followed by two open-ended questions that were used for further separation of participants and the grouping of teams and positions (CLG vs. CLB and FW vs. BK). In addition, questions four and five were two open-ended questions providing quantitative data on athletic background (i.e. playing/starting experience). Questions six through eight were all close-ended questions providing information about physical activity and resistance training frequency and history. Lastly, questions nine through fourteen were all possible distractors and their possible changes over the previous six months (e.g. work and/or class hours per day, work and/or class frequency per week, and hours of sleep). The questionnaire was developed in accordance with previously defined recommendations for survey design (de Leeuw, Edith, Dillman, 2008).

Statistical Analysis

Statistical Software (V. 21.0, SPSS Inc., Chicago, IL) was used for all analyses. Initially, all dependent data was assessed for normality using the Shapiro-Wilk test and for equality of variance using Levene's test. Subsequently, an independent t-Test was used to determine whether significant differences existed between clubs (CLG & CLB) and between forwards (FW) and backs (BK) in body composition, maximal strength, and physical activity. A criterion alpha level of $p \leq 0.05$ was used to determine statistical significance. All data is reported as mean ± standard deviation.

Chapter Four: Results

The purpose of the present investigation was to provide normative anthropometric and strength data for players from a collegiate rugby union team and a local men's league club; as well as to examine differences in physical activity and lifestyle distractors between positions and competitive levels. The hypothesis was there will be a significant difference in both greater lean body mass and maximal strength in the collegiate rugby team, while forwards will possess greater total mass, lean mass, and absolute strength in comparison to backs.

The hypothesis previously stated was not met. Significant differences were observed between clubs in age (CLG: 22.3 ± 1.3y; CLB: 26.2 ± 1.1y; $p < 0.001$), years played (CLG: 2.9 ± 2.4y; CLB: 7.5 ± 2.1y; $p < 0.001$), and starting experience (CLG: 1.7 ± 2.6y; CLB: 5.2 ± 3.4y; $p = 0.034$). No other anthropometric or strength differences were observed between clubs despite differences in age and experience (Appendix A, Table 2). In terms of position, LAM was significantly ($p = 0.037$) greater in FW (10.6 ± 1.7kg) than in BK (9.0 ± 0.5kg). No other differences were observed by position (Appendix A, Table 3). No differences were observed between clubs or position in resistance training experience or distractors (Appendix A, Figures 3 and 4).

Chapter Five: Discussion

In the present investigation, there were no differences between positions in muscle size or strength, except for lean arm mass; though lean leg mass had a tendency ($p=0.051$) to be greater as well in forwards. Traditionally, the forward and back positions require different playing styles (Austin, Gabbett, & Jenkins, 2011), which generally require forwards to be larger individuals. However, our data only partially supports this difference. It is possible that the similarities observed in muscular size and strength are related to team strategy and weight training experience. Since 1994, the typical size of back position players has increased at a greater rate than concurrent increases in size of forward position players (Quarrie & Hopkins, 2007). Though forwards are typically larger and stronger than backs (Duthie et al., 2006; Maud, 1983), team strategy may necessitate backs to perform similar tasks as forwards (e.g. mauling and rucking) (Quarrie & Hopkins, 2007). Thus lending a preference towards recruiting larger and stronger individuals for the backs positions. This notion is supported by the similarities observed between positions in resistance training experience, which may have negated any possible differences in lean mass or body composition (Hass, Feigenbaum, & Franklin, 2001).

Although age and playing/starting experience were significantly different between the team and club, no differences were observed in muscular strength or size. This is likely the consequence of similarities between the team and club in resistance training experience (Hass, Feigenbaum, & Franklin, 2001). Though rugby clubs are becoming more popular in high school, American rugby players are typically introduced to the sport in college or later (Carney, Smolianov, & Zakus, 2012; Collins, Micheli, Yard, & Comstock, 2007). On average, the typical American male begins resistance training in high school (Faigenbaum, Kraemer, Cahill,

Chandler, Dziados, Elfrink, Forman, Gaudiose, Micheli, Nitka, & Roberts, 1996). Thus it appears likely that many first-time rugby players possess experience with resistance training. Due to the way American rugby players encounter more head injuries opposed to other countries, it is suggested that there is a carryover of American football tendencies. Additionally, anecdotal evidence suggests that American rugby prefers a more physical gameplay style, in comparison to European and Australian clubs (Yard & Comstock, 2006). Consequently, American rugby clubs, regardless of competitive level, attract larger and stronger athletes for all positions.

This appears to be the first investigation to examine differences in competitive level and position in American rugby players. Predominantly, the research involving rugby union players has examined European and/or Australian players (Argus, Gill, Keogh, Hopkins, & Beaven, 2009; Crewther, Gill, Weatherby, & Lowe, 2009; Tong & Wood, 1997). This data appear to suggest that American players are dissimilar to traditional physical attribute expectations between playing position and competitive level (Duthie, Pyne, Hopkins, Livingstone, & Hooper, 2006; Lacome, Piscione, Hager, & Bourdin, 2014; Quarrie, Handcock, Waller, Chalmers, Toomey, & Wilson, 1995;Sedeaud, Marc, Schipman, Tafflet, Hager, & Toussaint, 2012).

Future Research

Though our data may have been affected by limitations in sample size and unequal variance, it warrants future investigation into the unique characteristics of American rugby players. In addition, possible research in characteristic changes throughout the several competitive levels as rugby gains popularity/structure in the United States.

Appendix A

Figure 1. Regions of interest for dual energy X-ray absorptiometry measurement of lean mass (A. Upper limb – right; B. Upper limb – left; C. Lower limb – right; and D. Lower limb – left)

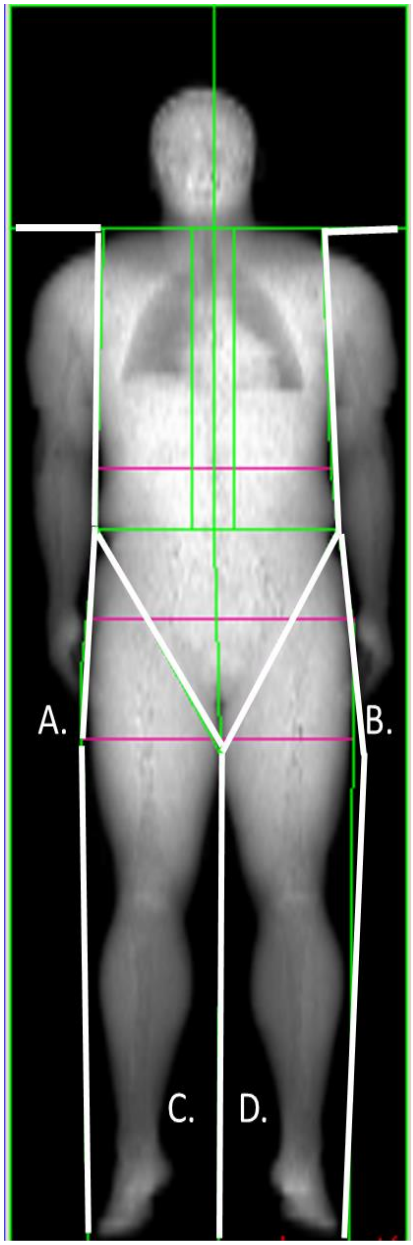


Figure 2: Athletic History and Daily Activity Questionnaire

Athletic History and Daily Activity Questionnaire

Please answer the following questions, regarding your athletic history, to the best of your knowledge.

1. Do you currently belong to sport club/team? YES NO
2. If so, for which team(s) do you play? Please indicate your primary team and any secondary teams.

3. For your primary sport, what is your main position?

4. For your primary sport, how many years of playing experience do you have?

5. For your primary sport, how many years of experience do you have as a starter?

Please answer the following questions regarding your general physical activity during the <u>month</u> prior to this study.

6. How many days per week were you physically active (e.g. sport, general cardiovascular, weight training, etc.)?
   0 – 1 2 – 3 4 – 5 6 – 7 N/A
7. How many days per week were you training with weights?
   0 – 1 2 – 3 4 – 5 6 – 7 N/A
8. How many years of weight training experience do you have?
   0 – 1 2 – 3 4 – 5 6 – 7 8+

Please answer the following questions regarding your daily schedule.

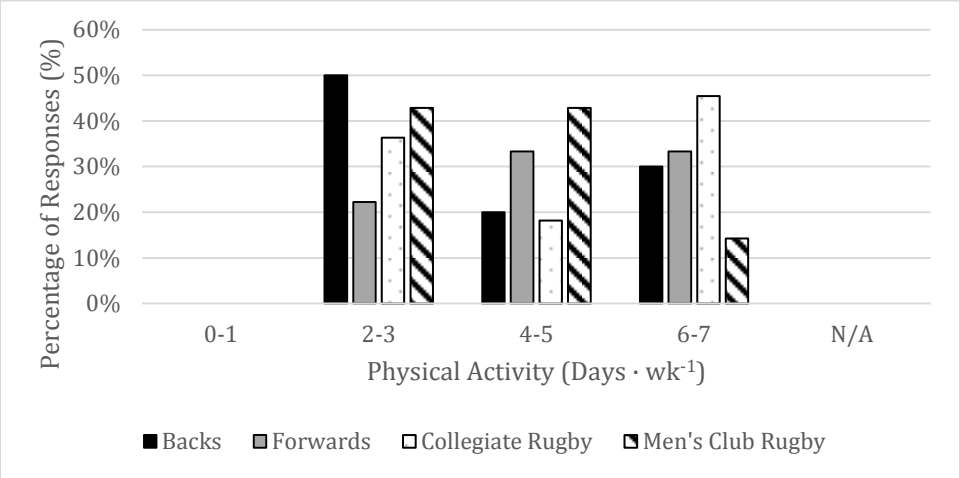
9 Over the past month, on average, how many days/week do you devote to classes at school and/or a job?
   0 – 1 2 – 3 4 – 5 6 – 7 N/A
10. Over the past 6 months, on average, how many days/week have you devoted to classes at school and/or a job?
   0 – 1 2 – 3 4 – 5 6 – 7 N/A
11. Over the past month, on average, how many hours <u>per day</u> do you devote to class and/or work?
   1 – 4 5 – 8 9 – 12 13+ N/A
12. Over the past 6 months, on average, how many hours <u>per day</u> have you devoted to class and/or work?
   1 – 4 5 – 8 9 – 12 13+ N/A
13. Over the past month, how many hours of sleep do you get per night?
   1 – 3 4 – 6 7 – 9 10 – 12 13+
14. Over the past 6 months, how many hours of sleep do you get per night?
   1 – 3 4 – 6 7 – 9 10 – 12 13+

Approved by NEIRB on 7/17/14
As Is X As Revised ____ Initials

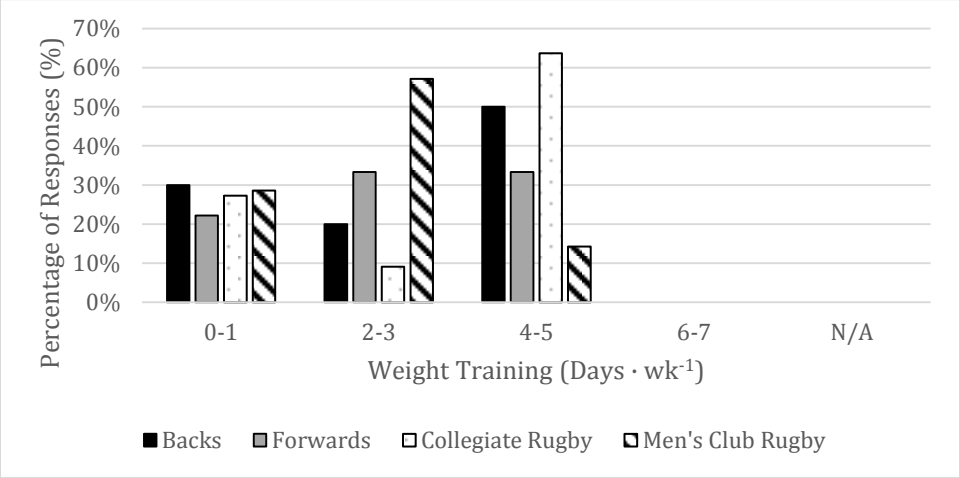
ID#_____

Figure 3. Percentage responses in relation to physical activity (A. Physical Activity; B. Weight Training days per week; C. Years Weight Training).

A.



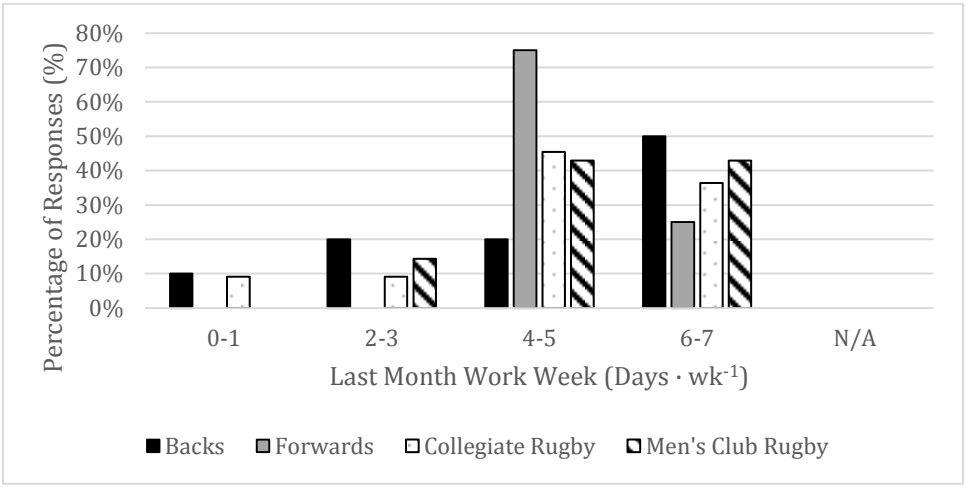
B.



C.

Figure 4. Percentage responses in relation to non-physical activity (A. Last Month Work Week; B. Last Six Months Work Week; C. Last Month Workday; D. Last Six Months Workday; E. Last Month Nightly Sleep; F. Last Six Months Nightly Sleep).

A.



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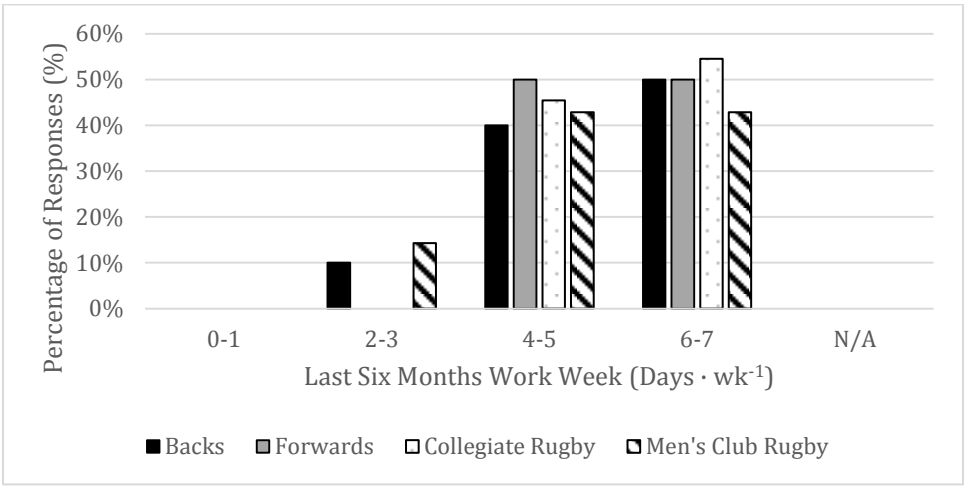
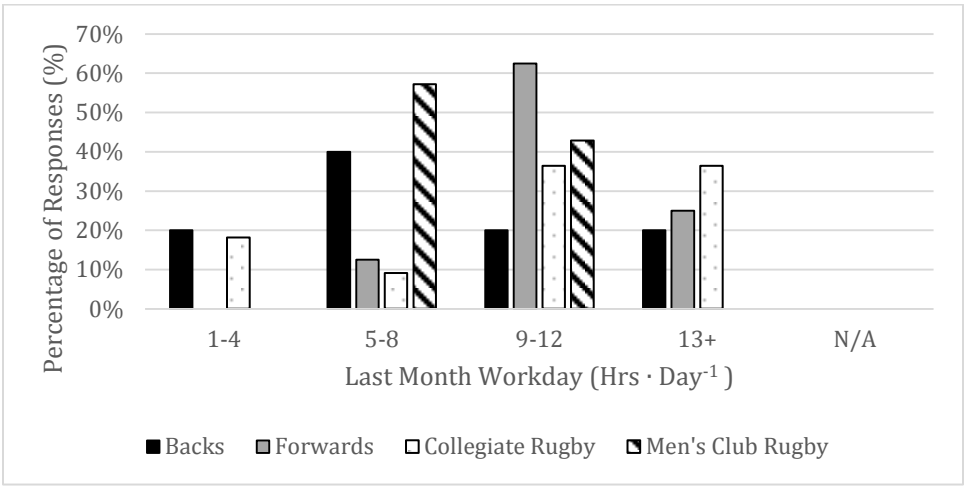
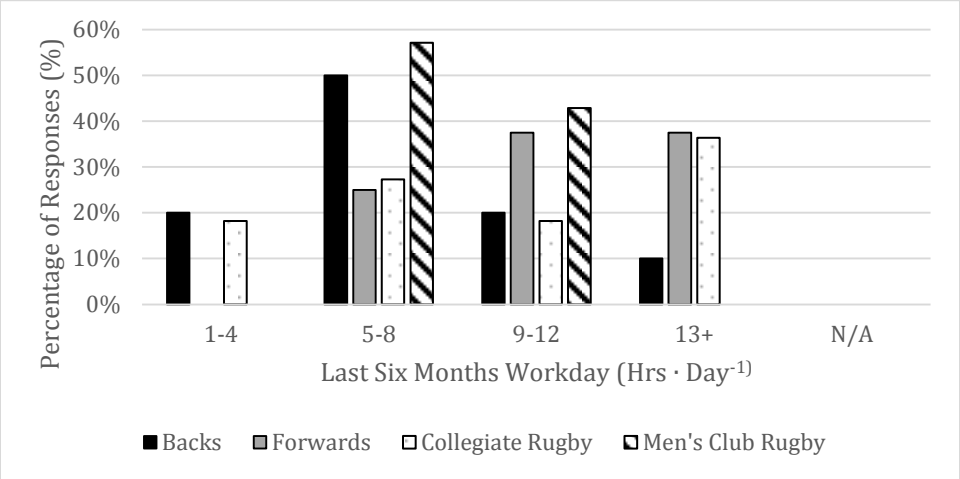

60%
50%
40%
30%
20%
10%
0%
Percentage of Responses (%)
0-1
2-3
4-5
6-7
N/A
Last Six Months Work Week (Days · wk-1)
Backs
Forwards
Collegiate Rugby
Men's Club Rugby

C.


70%
60%
50%
40%
30%
20%
10%
0%
Percentage of Responses (%)
1-4
5-8
9-12
13+
N/A
Last Month Workday (Hrs · Day-1)
Backs
Forwards
Collegiate Rugby
Men's Club Rugby

D.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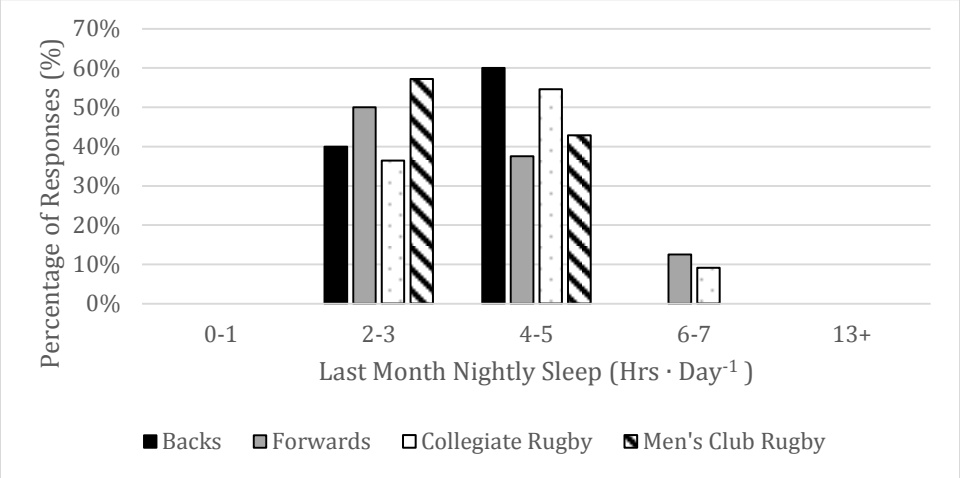
0%
Percentage of Responses (%)
1-4
5-8
9-12
13+
N/A
Last Six Months Workday (Hrs · Day-1)
Backs
Forwards
Collegiate Rugby
Men's Club Rugby

E.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10%
0%
Percentage of Responses (%)
0-1
2-3
4-5
6-7
13+
Last Month Nightly Sleep (Hrs · Day-1)
Backs
Forwards
Collegiate Rugby
Men's Club Rugby

F.

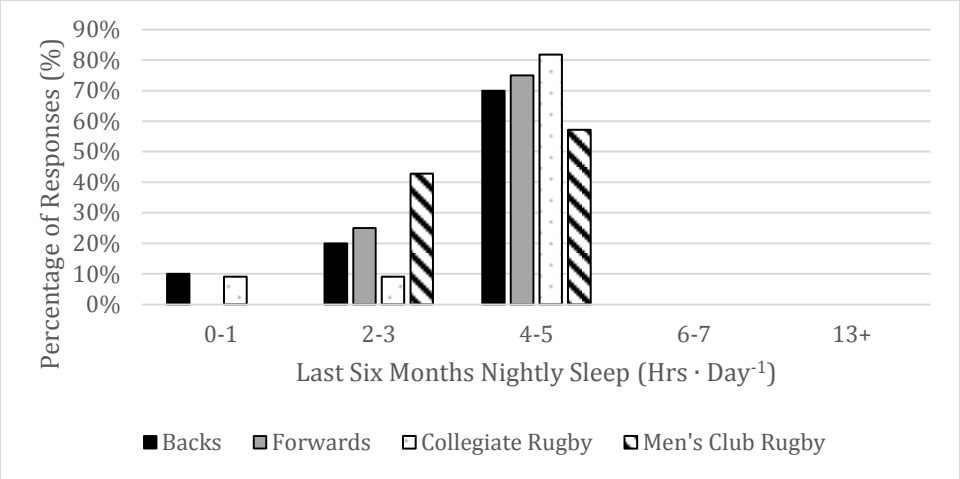

Table 1: Base resistance training program

	Base Resistance Training		
Exercises (Monday/Thursday)	**Intensity**	**Volume**	**Rest**
Back Barbell Squats Barbell Deadlifts Bilateral Leg Press Lat Pull Downs (Hammer Strength) Seated Rows (Hammer Strength) Barbell Biceps Curls	80 - 85% of Estimated 1RM	4 X 6-8	1-2 minutes
Exercises (Tuesday/Friday)	**Intensity**	**Volume**	**Rest**
Barbell Bench Press Incline Bench Press Dumbbell Flies Seated Shoulder Press Lateral Dumbbell Raise Overhead Dumbbell Triceps Extension	80 - 85% of Estimated 1RM	4 X 6-8	1-2 minutes

*Volume = Sets X Repetitions

Table 2: Team Comparison	**Collegiate**	**Men's Club**
Anthropometric Measures		
Height (cm)	179.8 ± 4.9	178.3 ± 6.6
Body Mass (kg)	92.4 ± 14.1	96 ± 11.2
Lean Body Mass (kg)	71.7 ± 8.9	70.1 ± 8.9
Lean Arm Mass (kg)	10.1 ± 1.7	9.1 ± .5
Lean Leg Mass (kg)	24.6 ± 3.5	22.9 ± 1.2
Body Fat (%)	19.2 ± 4.6	23.8 ± 8.3
Strength Measures		
Absolute Bench Press (kg)	112.3 ± 33.2	99.2 ± 25.9
Relative Bench Press ($kg \cdot Body\ Mass^{-1}$)	1.2 ± 0.3	1.0 ± 0.3
Absolute Squat (kg)	150 ± 32.7	149.8 ± 44.1
Relative Squat ($kg \cdot Body\ Mass^{-1}$)	1.6 ± 0.3	1.6 ± 0.5
Activity Measures		
Playing Experience (y)	2.9 ± 2.4	7.5 ± 2.1*
Starting Experience (y)	1.7 ± 2.6	5.2 ± 3.4*

*Significantly ($p < 0.05$) different from collegiate players.

Table 3: Position Comparison	**Forwards**	**Backs**
Anthropometric Measures		
Height (cm)	181.8 ± 6.8	177.0 ± 2.5
Body Mass (kg)	98.5 ± 14.6	89.4 ± 10.1
Lean Body Mass (kg)	74.0 ± 8.2	68.1 ± 8.6
Lean Arm Mass (kg)	10.6 ± 1.7*	9.0 ± .5
Lean Leg Mass (kg)	25.6 ± 3.5	22.6 ± 1.4
Body Fat (%)	20.9 ± 6.9	20.8 ± 6.1
Strength Measures		
Absolute Bench Press (kg)	114.8 ± 39.3	101.3 ± 20.9
Relative Bench Press ($kg \cdot Body\ Mass^{-1}$)	1.2 ± 0.4	1.1 ± 0.2
Absolute Squat (kg)	157.6 ± 35.8	143.1 ± 36.3
Relative Squat ($kg \cdot Body\ Mass^{-1}$)	1.6 ± 0.3	1.6 ± 0.3
Activity Measures		
Playing Experience (y)	4 ± 2.4	5 ± 3.8
Starting Experience (y)	2.6 ±2.9	3.2 ± 3.7

*Significantly ($p < 0.05$) different from backs

Appendix B

Human Performance Laboratory
University of Central Florida

Confidential Medical and Activity History Questionnaire

Participant #_____ Date of Birth: _____

When was your last physical examination? _____

1. List any medications, herbals or supplements you currently take or have taken the last month:

Medication	Reason for medication
_____	_____
_____	_____
_____	_____
_____	_____

2. Are you allergic to any medications? If yes, please list medications and reaction.

3. Please list any allergies, including food allergies that you may have?

4. Have you ever been hospitalized? If yes, please explain.

Year of hospitalization	Reason
_____	_____
_____	_____
_____	_____

5. Illnesses and other Health Issues

List any chronic (long-term) illnesses that have caused you to seek medical care.

Have you ever had (or do you have now) any of the following. Please circle questions that you do not know the answer to.

Sickle cell anemia	yes	no
Cystic fibrosis	yes	no
Water retention problems	yes	no
Heart pacemaker	yes	no
Epilepsy	yes	no
Convulsions	yes	no
Dizziness/fainting/unconsciousness	yes	no
Asthma	yes	no
Shortness of breath	yes	no
Chronic respiratory disorder	yes	no
Chronic headaches	yes	no
Chronic cough	yes	no
Chronic sinus problem	yes	no
High blood pressure	yes	no
Heart murmur	yes	no
Heart attack	yes	no
High cholesterol	yes	no
Diabetes mellitus or insipidus	yes	no
Rheumatic fever	yes	no
Emphysema	yes	no
Bronchitis	yes	no
Hepatitis	yes	no
Kidney disease	yes	no
Bladder problems	yes	no
Tuberculosis (positive skin test)	yes	no
Yellow jaundice	yes	no
Auto immune deficiency	yes	no
Anemia	yes	no
Endotoxemia	yes	no
Thyroid problems	yes	no
Hyperprolactinemia	yes	no
Anorexia nervosa	yes	no
Bulimia	yes	no
Stomach/intestinal problems	yes	no
Arthritis	yes	no
Back pain	yes	no
Gout	yes	no
Hepatic encephalopathy	yes	no
Mania	yes	no
Hypermania	yes	no
Monosodium glutamate hypersensitivity	yes	no
Seizure disorders	yes	no

Any others (specify):_____

_____

_____

Do you smoke cigarettes or use any other tobacco products?	yes	no
Do you have a history of drug or alcohol dependency?	yes	no
Do you ever have any pain in your chest?	yes	no
Are you ever bothered by racing of your heart?	yes	no
Do you ever notice abnormal or skipped heartbeats?	yes	no
Do you ever have any arm or jaw discomfort, nausea, or vomiting associated with cardiac symptoms?	yes	no
Do you ever have difficulty breathing?	yes	no
Do you ever experience shortness of breath?	yes	no
Do you ever become dizzy during exercise?	yes	no
Are you pregnant?	yes	no
Is there a chance that you may be pregnant?	yes	no
Have you ever had any tingling or numbness in your arms or legs?	yes	no
Has a member of your family or close relative died of heart problems or sudden death before the age of 50?	yes	no
Has a health care practitioner ever denied or restricted your participation in sports for any problem	yes	no

If yes, please explain: _____

_____

Are you presently taking any nutritional supplements or ergogenic aids? (if yes, please detail)

_____

_____

_____

_____

_____

Appendix C

Physical Activity Readiness
Questionnaire - PAR-Q
(revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO		
☐	☐	1.	**Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
☐	☐	2.	**Do you feel pain in your chest when you do physical activity?**
☐	☐	3.	**In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	4.	**Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	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?**
☐	☐	6.	**Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	7.	**Do you know of any other reason why you should not do physical activity?**

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

→

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME _____

SIGNATURE _____ DATE _____

SIGNATURE OF PARENT or GUARDIAN (for participants under the age of majority) _____ WITNESS _____

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

CSEP | SCPE

Appendix D

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Notice that UCF will Rely Upon Other IRB for Review and Approval

From **:** **UCF Institutional Review Board**
FWA00000351, IRB00001138

To : **Gerald T. Mangine**

Date : **June 12, 2014**

IRB Number: **SBE-14-10276**

Study Title: **MAGNITUDE OF HYPERTROPHY IN RESPONSE TO TRAINING VOLUME VERSUS INTENSITY IN RESISTANCE-TRAINED MEN**

Dear Researcher:

The research protocol noted above was reviewed by the University of Central Florida designated Reviewer on **June 12, 2014**. The UCF IRB accepts the New England Institutional Review Board's review and approval of this study for the protection of human subjects in research. **The expiration date will be the date assigned by the New England Institutional Review Board and the consent process will be the process approved by that IRB.**

This project may move forward as described in the protocol. It is understood that the New England IRB is the IRB of Record for this study, but local issues involving the UCF population should be brought to the attention of the UCF IRB as well for local oversight, if needed.

All data must be retained for a minimum of five years (six if HIPAA applies) past the completion of this research. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

Failure to provide a continuing review report for renewal of the study to the New England IRB could lead to study suspension, a loss of funding and/or publication possibilities, or a report of noncompliance to sponsors or funding agencies. If this study is funded by any branch of the Department of Health and Human Services (DHHS), an Office for Human Research Protections (OHRP) IRB Authorization form must be signed by the signatory officials of both institutions and a copy of the form must be kept on file at the IRB office of both institutions.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Patria Davis on 06/12/2014 11:25:49 AM EDT

IRB Coordinator

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