THE EVALUATION OF A POSITION-SPECIFIC TASK

IN NCAA DIVISION I LINEMEN

By

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Bachelor of Science in Health and Human Performance

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2010

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
December, 2012

THE EVALUATION OF A POSITION-SPECIFIC TASK

IN NCAA DIVISION I LINEMEN

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Date of Degree: DECEMBER, 2012

Title of Study: THE EVALUATION OF A POSITION-SPECIFIC TASK IN NCAA DIVISION I LINEMEN

Major Field: HEALTH AND HUMAN PERFORMANCE

Abstract: It is the responsibility of the strength and conditioning professional to implement quality training programs and properly evaluate each athlete's physical performance. It is essential that strength and conditioning professionals have access to an evaluative tool that provides a practical, position-specific assessment of playing ability in collegiate linemen. The purpose of this study was two-fold: To compare the performance of a position-specific task on the MAXX Football Sled Device (MFSD) between NCAA Division I offensive and defensive linemen. Also, to investigate any associations among selected strength and power variables with performance on the MFSD in NCAA Division I offensive and defensive linemen. Twenty-six NCAA Division I offensive (n=12) and defensive linemen (n=14) (age 20.11± 1.49yrs) performed ten "fire-and-drive" repetitions on the MFSD. Upon an auditory signal rendered from the MFSD, subjects exploded in to the breast plate region of the dummy as forcefully and rapidly as possible. After each repetition subjects reset themselves in a three point stance. Timing between repetitions was an automatically randomized duration of 6 to 10 sec. The MFSD measured average force (AVGF) across the ten trials and movement time (MT), the time from the auditory signal to initial contact on the dummy, for each of the ten repetitions. Secondary data including 1 RM of the squat, bench press, and power clean, along with vertical jump, 10 yd. sprint, 40 yd. sprint, and body fat percentage were gathered from the team's strength and conditioning staff. Defensive linemen were found to produce significantly lower movement times when compared to offensive linemen ($p = 0.032$). There were no significant relationships found between the dependent variables gathered from the MFSD and any independent variables. Test-retest reliability demonstrated strong reliability with the device for both AVGF (ICC = .813; SEM = 93.4) and MT (ICC = .828; SEM = .022). Results of this study indicate that defensive linemen accelerate out of the three point stance quicker than offensive linemen. Further exploration for the purpose of finding exercises that correlate with a position-specific task in these athletes is warranted.

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CHAPTER I

INTRODUCTION

The popularity of American college football has grown over the last several years with more people gaining interest in this high-energy, physically demanding sport (Miller, White, Kinley, Congleton, & Clark, 2002). Because of the physical demands of the game, a great deal of time and effort is spent on the development and implementation of strength and conditioning programs designed to optimize physical athletic development. The primary focus for most collegiate strength and conditioning programs is directed at improving physical performance characteristics such as strength, power, and speed, therefore maximizing the ability of each athlete to contribute to the success of the team (Hoffman, Ratamess, & Kang, 2011). It is the responsibility of the strength and conditioning professional to implement quality training programs and properly evaluate each athlete's physical performance. Comparatively, the roles of the offensive and defensive linemen are considerably different than the roles associated with the various other positions in the sport of football. Consequently, it is essential that strength and conditioning professionals have access to an evaluative tool that provides a practical, position-specific assessment of playing ability in collegiate linemen.

Previous efforts have been made to analyze relationships between physical attributes and specific exercise performance, as well as football playing ability (Miller et al., 2002). A number of investigators and strength and conditioning professionals have assessed strength with one repetition maximum (1 RM) tests using free weights and have determined power and running abilities with vertical jump and sprint tests. Although 1 RM strength tests and related assessments such as sprint and jump tests are not measures of football ability; they are believed

to reflect the physical performance characteristics representative of football playing potential (Fry & Kraemer, 1991). Many studies have investigated relationships between 1 RM performance and various field tests performances such as sprint tests, jumping tests, and medicine ball throws in collegiate football players to explore possible associations. However, many of these commonly used field tests are limited to movements that generally occur through a single plane of motion, involve isolated musculature, or do not challenge the proprioception or kinesthetics necessary for the football environment (B. A. Stockbrugger & R. G. Haennel, 2003). Therefore, it can be said there is no known field test that provides strength and conditioning professionals with a practical, position-specific assessment of playing ability in collegiate linemen.

One repetition maximum performance and field tests performances have been determined to be sport-specific and have even allowed player positions to be correctly classified based on performance tests (Fry & Kraemer, 1991). With that said, few studies were found that examined offensive and defensive linemen as separate groups with regard to their 1 RM and field test performance. This is because previous studies have failed to discriminate between the two positions and have elected to categorize these athletes as one common group. Consequently, even less information comparing 1 RM and field test performance between offensive and defensive linemen can be found in the literature. The lack of research on these athletes may be due to the unique physical characteristics they possess which deem field tests that are commonly conducted for the purpose of evaluating playing ability, inappropriate. Finally, the roles and expectations of these athletes vastly differ from many of the other positions in the sport of football which further elucidates the need for a practical, position-specific assessment of playing ability in collegiate linemen.

It is essential that strength and conditioning professionals be able to effectively evaluate playing ability in collegiate football players on an individual basis. Currently, many of the techniques used for evaluating playing ability in collegiate linemen are poor indicators of their skill due to their lack of specificity. A more accurate assessment of offensive and defensive linemen playing ability could be gained through a position-specific evaluation that involves a task specific to these positions. Further research for the purpose of exploring alternative evaluative tools of playing ability in collegiate linemen is necessary.

Statement of the Problem

It is the responsibility of the strength and conditioning professional to implement quality training programs and properly evaluate each athlete's physical performance. It is essential that strength and conditioning professionals be able to effectively evaluate playing ability in collegiate football players on an individual basis. Comparatively, the roles of the offensive and defensive linemen are considerably different than the roles associated with the various other positions in the sport of football. Currently, many of the techniques used for evaluating playing ability in collegiate linemen are poor indicators of their skill due to their lack of specificity.

Purpose of the Study

The primary purpose of the study was to compare the performance of a position-specific task on the MAXX Football Sled Device between NCAA Division I offensive and defensive linemen. A secondary purpose of the study was to investigate any associations among selected strength and power variables with performance on the MAXX Football Sled Device in NCAA Division I offensive and defensive linemen.

Hypotheses

H_0^1: There will not be a significant difference in performance on a position-specific task between NCAA Division I offensive and defensive linemen.

H_0^2: There will be no relationship between selected strength and power variables and performance on a position-specific task in NCAA division I offensive and defensive linemen.

Dependent and Independent Variables

Dependent Variables: Movement Time, Force

Independent Variables: 1 RM power clean, 1 RM squat, 1 RM bench press, vertical jump height, 20 yard sprint, 40 yard sprint, body fat percentage, both groups offensive and defensive linemen

Delimitations of the Study

This study was delimited to the following:

- This study was conducted on offensive and defensive linemen of the Oklahoma State University football team ages 18 to 22.
- Findings in this study apply to NCAA Division I offensive and defensive linemen.
- Subjects were free of any physical impairments and recent or current musculoskeletal injuries.
- Testing will be performed on the MFSD at the Oklahoma State University Strength and Conditioning facility.

Limitations

The study limitations included:

- Force measurements obtained from the MFSD were in a non-standard unit.
- The validity of the MFSD is unknown.
- Error associated with secondary data collection.
- Environmental considerations such as differences in motivational encouragement between subjects and repetitions.

Assumptions

The following assumptions were inherent during the study:

- All subjects answered the questionnaire accurately and honestly about past musculoskeletal injuries.
- All subjects put forth maximal effort when performing on the MFSD.
- All subjects understood the instructions for the assessment tool. All testing was monitored by the primary investigator.
- The MFSD was calibrated correctly.

Definitions

The following terms are used within this study:

- **One-Repetition Maximum (1 RM)**: The maximum resistance with which a person can execute one repetition of an exercise movement. (Nieman, 2007)
- **Velocity:** The vector rate of motion, or rate of motion in a specific direction. (McLester & Pierre, 2008)

- **Power**: Work performed per unit of time; measured by the formula: work equals force times distance divided by time. (Nieman, 2007)
- **Force:** The product of mass and acceleration. (Baechle & Earle, 2008)
- **Reliability:** A measure of the degree of consistency or repeatability of a test. (Baechle & Earle, 2008)
- **Dynamometer:** A device for measuring force, moment of force (torque), or power. (Nieman, 2007)
- **Body Fat Percentage (%):** The magnitude of fat tissue within the human body. A measure that can only be estimated. (Kaminsky, L. A. & Bonzheim, K. A., 2006)
- **Strength:** The amount of force that can be exerted. (Nieman, 2007)
- **"Fire and Drive":** A jargonistic phrase used in the sport of football to describe the act of explosively accelerating anteriorly out of a three-point stance and driving back opponent or dummy.

CHAPTER II

REVIEW OF LITERATURE

The primary focus for most collegiate strength and conditioning programs is directed at improving physical performance variables, therefore maximizing the ability of each

athlete to contribute to the success of the team (Hoffman et al., 2011). Furthermore, it is essential that strength and conditioning professionals be able to effectively evaluate playing ability in collegiate football players on an individual basis. Additionally, knowledge of the relationships between the characteristics of football players and their status as starters or nonstarters should enable coaches to develop training programs that prepare players to be more successful at a specific position (Black & Roundy, 1994). However, many of the techniques used for evaluating playing ability in collegiate offensive and defensive linemen provide a poor assessment since these tests are many times jumping or sprinting tests, consequentially lacking mechanical specificity with respect to these positions. Currently, there is no position-specific tool in the literature that serves the purpose of evaluating playing ability in offensive and defensive linemen.

A review of the offensive and defensive linemen positions and their roles indicates the need for a position-specific tool for the purpose of evaluating these athletes. As previously mentioned, many of the field-based techniques used to evaluate offensive and defensive linemen involve sprinting or jumping. These are many times the same techniques used to evaluate other positions found in the game of football such as linebackers, defensive backs, running backs, and receivers. The athletes in these positions, commonly referred to as skill positions, are generally faster and quicker for the purpose of being elusive or avoiding contact in the open field. However, in reviewing the roles of the offensive and defensive linemen positions it is apparent that their positional roles are substantially different when compared to the roles of skill positions. Offensive and defensive linemen are more massive athletes whose roles include blocking, rushing, and tackling in very tight spaces. These athletes usually start each play in a three-point stance lined up a short distance from one another across the line of scrimmage. Since these

athletes are lined up so close to each other it is essential they develop an explosive start off the line of scrimmage (Bass, 2004). A position-specific tool that evaluates these characteristics in offensive and defensive linemen has yet to be established in the literature.

A number of studies have attempted to identify factors that correlate with success in collegiate football (Black & Roundy, 1994). Despite the emphasis by strength and conditioning programs placed on enhancing physical characteristics and functional measures, only a few studies have attempted to investigate the relationship among physical characteristics and functional measures of athletic performance in Division I collegiate football players (Davis, Barnette, Kiger, Mirasola, & Young, 2004). The focal point of these past investigations have been on performance measures such as 1 RM strength, jumping tests, and sprinting tests in these athletes. Even fewer studies in which specific positions were examined can be found, especially in the case of offensive and defensive linemen, since most studies categorize these two positions as one common linemen group. The following sections will review previous research in which the focus was aimed at investigating associations between physical and performance characteristics of collegiate offensive and defensive linemen.

Black and Roundy (1994) examined 1 RM bench press, 1 RM squat, vertical jump height, and the 36.6-m sprint in starters and nonstarters of 16 specialized positions on NCAA Division I football teams. Eleven universities provided these data on 1,618 players which was collected and reported by each team's strength and conditioning staff. A biserial correlation coefficient was computed to assess the strength of the relationship between the criterion variables (starter vs. nonstarter) and each of the four performance variables. One-repetition maximum bench press strength was found to be greater for starters compared to nonstarters at all offensive line positions ($p < 0.05$). With regard to offensive and defensive linemen, this was the only measure

found to be significantly different between starters and nonstarters. Interestingly, similar scores were observed between starters at defensive tackle and offensive guard for body weight, 1 RM bench press, 1 RM back squat, vertical jump, and 36.6-m dash.

Carbuhn et al., (2008) investigated various performance factors in 12 NCAA Division I offensive and defensive linemen. Performance measurements were gathered by strength and conditioning coaches in early August for a period of three years. These measures included 1 RM bench press, 1RM squat, 1 RM power clean, and vertical jump. Additionally, calculated power from the vertical jump was derived using the Lewis formula protocol used in Mathews and Fox (1979). Investigators found offensive linemen to be significantly heavier than defensive linemen. Furthermore, vertical jump height was found to be significantly greater in defensive linemen when compared to offensive linemen ($p < 0.05$). Although, when explosive ability relative to body mass during the vertical jump was examined through calculated power there was no significant difference between the groups. Also, no significant differences were observed in 1 RM strength measures between the two groups.

Barker et al., (1993) studied 16 offensive linemen and 8 defensive linemen at a NCAA Division I university. Researchers assessed numerous physical characteristics and performance factors including body fat percentage, 1 RM squat, vertical jump, static vertical jump, power, and takeoff velocity. Power was calculated in the manner used by Carbuhn et al. (2008) using the Lewis equation. Takeoff velocity and static takeoff velocity were calculated by dividing vertical jump power and static vertical jump power by the subject's body mass. Defensive linemen performed better than offensive linemen in the static vertical jump with significantly greater jump height and takeoff velocity ($p < 0.05$). Although not significant, defensive linemen

produced greater scores with respect to vertical jump height and takeoff velocity as well. There were no significant differences in body mass or 1 RM squat between the groups.

Berg et al., (1990) surveyed 40 NCAA Division I football teams from 7 conferences requesting data on all offensive and defensive starters. The data requested included height, weight, 40 yd. dash time, vertical jump height, percent body fat, and 1 RM bench press and squat. Researchers did not specifically compare the offensive and defensive linemen positions, but provided means for all measures of both groups. Sample size for each measure varied, ranging from 134 to 200 for offensive linemen and 99 to 160 for defensive linemen. An alpha level of .01 was established to reduce the probability of error. Offensive linemen were found to be heavier and to possess more body fat than defensive linemen. Also, offensive linemen were stronger with regard to 1 RM bench press and squat compared to defensive linemen. This study supported previous studies that concluded defensive linemen are superior to offensive linemen in the vertical jump performance.

Fry and Kraemer (1991) conducted a similar study; however their focus was to compare performance tests by position, playing ability (starter versus nonstarters) and caliber of play (NCAA Division I, II, III). Nineteen collegiate teams were surveyed with the request to collect performance measures including 1 RM bench press, 1 RM squat 1 RM power clean, vertical jump, and 36.6 meter sprint. Only data for the tests used by each individual university were reported. As a result, although a total of 981 subjects were involved, sample sizes for the individual tests ranged from n = 776 for the bench press to n = 297 for the squat. Although, researchers in this study did not directly compare the test results of offensive and defensive linemen information can still be gained from the means of these measures. One RM strength measures including the bench press, squat, and power clean were relatively similar between

offensive and defensive linemen across Divisions I, II, III. Once again, findings in this study support the conclusion that defensive linemen perform better than offensive linemen in the vertical jump.

As previously mentioned, the focus of this investigation was to compare performance measures by position, playing ability, and caliber of play. In that regard, researchers found main effect significant differences between starter and nonstarters for both the bench press and vertical jump, with starters performing better ($p < 0.05$). This was not the case for back squat, power clean or 36.6 meter sprint. Furthermore, in all three divisions defensive linemen starters performed superior to nonstarters in all tests as indicated by significant main effects, except the squat ($p < 0.05$).

Secora et al., (2004) conducted a study similar in design to Berg et al. (1990) for the purpose of comparing their data from division I NCAA football players to the results found in the Berg et al. study. Researchers in this study collected physical and performance data including body mass, body fat percentage, 40 yd. dash time, 1 RM bench press, 1 RM squat, vertical jump height, and power which was derived from the Lewis equation. Although researchers did not examine differences between offensive and defensive linemen, means for each performance measure were recorded for both positions. Similar to Berg et al., this study found offensive linemen to be heavier and to carry more body fat compared to defensive linemen. However, 1 RM strength in the bench press and squat were found to be almost identical in offensive and defensive linemen. Defensive linemen did perform better than offensive linemen in the vertical jump once again, but offensive linemen were found to be more powerful.

Davis et al., (2004) specifically examined whether or not percentage of body fat, bench press, and hang clean could predict 36.6-m sprint time, 18.3-m shuttle run time, and vertical jump height in Division I college football players. One repetition maximum values for the bench press and hang clean were gathered from the team's strength and conditioning staff. They found hang clean ($p = 0.0148$) and bench press ($p = 0.0329$) to be negatively correlated with 36.6-m sprint times. Furthermore, researchers in this study found the bench press ($p = 0.0002$) and hang clean ($p = 0.0019$) to be negatively correlated with 18.3-m shuttle run. However, none of the regressor variables were found to be predictors of vertical jump performance. Although, this investigation did not examine specific positions such as offensive and defensive linemen, these results provide valuable information regarding the relationships of 1 RM performances and field test performances.

More recently, the backward overhead medicine ball (BOMB) throw has been proposed as an effective field test for the evaluation of total body explosive power (B.A. Stockbrugger & R.G. Haennel, 2003). Mayhew et al., (2005) studied the relationship between the BOMB throw and measured power production in 40 college football players. Power was measured by the performance of a countermovement vertical jump on a force plate. Additionally, researchers had a subsample ($n = 27$) of the players perform a 1 RM hang clean. The BOMB throw was only found to be moderately related to either peak or average jump power, $p = 0.59$ and $p = 0.63$ respectively. Furthermore, neither of these correlations accounted for more than 40% of the common variance between the 2 measures. The correlation between the hang clean and the BOMB throw was not significant ($r = 0.33$, $p = 0.09$). When the hang clean was combined with the best BOMB throw to predict average power, it accounted for only 7% of the common

variance. Researchers concluded that further work might be required to identify a better approach to predicting total body explosive power among football players.

Summary

After examining the research on physical and performance characteristics of collegiate offensive and defensive linemen it is evident that there is a lack of research comparing the respective measures between these two positions. Previous research suggests that defensive linemen are superior in respect to explosive ability, while offensive linemen are generally heavier and possess higher amounts of adipose tissue. However, 1 RM strength measures between the two positions are equivocal. Future research with the purpose of specifically comparing physical and performance measurements between offensive and defensive linemen is necessary. Also, new assessment tools that provide a more specific and appropriate evaluation of playing ability in these athletes may prove beneficial in distinguishing skill level.

CHAPTER III

METHODS

The primary purpose of this study was to investigate the relationship between selected strength and power variables with a position-specific task in NCAA division I linemen. A secondary purpose of the study was to compare strength and power variables and the results of a position-specific drill between offensive and defensive linemen. The hypotheses addressed will be: H_0^1: There will not be a significant difference in performance on a position-specific task between NCAA Division I offensive and defensive linemen. H_0^2: There will be no relationship between selected strength and power variables and performance on a position-specific task in NCAA Division I offensive and defensive linemen. This chapter will explain the details of the research study including subjects, instrumentation, procedures, and data analyses.

Subjects

This study utilized a convenience, nonprobability sampling to recruit offensive and defensive linemen of the Oklahoma State University football team to participate in the study. Permission was obtained from appropriate members of the Oklahoma State University Athletic department to recruit volunteers for the study. The study was comprised of two groups, including 12 offensive linemen and 14 defensive linemen between the ages of 18 and 22. Medical history showed that none of the subjects had suffered or been affected by any musculoskeletal injuries within the past 6 months.

Research Design

The present study was non-experimental in design and utilized observational research. Subjects were assigned to one of two groups as designated by their playing position, including an offensive linemen or the defensive linemen group. Data will be collected addressing individual as well as group information throughout the study.

An Institutional Review Board approved informed consent document was read and signed by all subjects before participation in this study. All subjects completed a medical history questionnaire and physical examination prior to testing by a licensed physician as part of requirements for participation on the university football team.

Instrumentation

MAXX Football Sled Device

The MAXX Football Sled Device (MFSD) (Shoot-A-Way, Upper Sandusky, Ohio) was used to assess force and movement time through a punch maneuver that is very similar to the game-like action observed from the offensive and defensive line in the game of football. The MFSD is equipped with a dynamometer allowing it to quantify force in a non-standard unit. Movement time, as measured by the device, is the amount of time in seconds (s) from the initiation of the test to the time at which contact is made with the device. Subjects of the study were familiar with the device since the team uses it frequently during practice sessions.

Reliability of MAXX Football Sled Device

Test-retest reliability of the MFSD was assessed using 10 randomly selected offensive and defensive linemen of the Oklahoma State University football team. Subjects performed the testing protocol for two sessions separated by 72 hours. All subjects completed an informed consent approved by the Oklahoma State University institutional review board before participating.

Test-retest reliability for the MFSD was analyzed using intraclass correlation coefficients (ICC) and standard error of measurements (SEM) by performing two testing sessions separated by 48 hours one week prior to data collection. Results of this analysis demonstrated strong reliability with the device for both force (ICC = .813; SEM = 93.4) and movement time (ICC = .828; SEM = .022).

Secondary Data

A 5 minute general warm-up followed by 2 light sets of the exercise being tested preceded all 1 RM testing. All 1 RM testing for the bench press, squat, and power clean exercises was performed using a 45 lb. olympic barbell. The proper testing protocols for 1 RM testing and vertical jump testing using the Vertec (Perform Better, Cranston, RI) have been previously published (Baechle & Earle, 2008). Body fat percentage was analyzed using the BOD POD (COSMED, Chicago, IL). All sprint testing was performed using a stopwatch with three trials being recorded. The average of the best two times was calculated for the score.

Procedures

An informational meeting was held before both testing sessions at which time the informed consent was explained in detail and any questions about the study were addressed. At the end of this meeting the attending offensive and defensive linemen were given the opportunity to complete an informed consent. After all subjects completed an informed consent, testing began.

All testing on the MFSD occurred at the Oklahoma State University Strength and Conditioning facility. The study included two testing sessions, one per group, with the offensive line testing on a Wednesday and the defensive line testing exactly 7 days later at the same time of day. Each group performed a 5 minute dynamic warm-up conducted by the team's strength and conditioning staff prior to testing. The dynamic warm-up focused on major muscles of the legs, hips, and back. The dynamic stretches performed included high knees, butt kicks, leg swing, and inch worm. Additionally, as a part of their warm-up, subjects performed the test maneuver at approximately 50% effort. Upon completion of the warm-up, subjects were tested individually on the MFSD.

Testing on the MFSD began by having the subject position themselves in a standard three-point football stance at a distance of 12" from the device, as measured from contact dummy to hand. An auditory signal delivered by the device served as the initiation of the test. Upon the auditory signal, the subject explosively accelerated out of the three-point stance to make contact with the dummy located on the front of the device. The subject contacted and punched the breast plate region of the dummy, similar to the maneuver observed in the game of football. Each subject was instructed to perform this action as explosively and forceful as possible. Once the subject completed the punch maneuver they disengaged the dummy and repositioned themselves to the original starting position in preparation for the next repetition.

The device randomly varied the time between each repetition giving each subject approximately 6 to 10 seconds between repetitions. After the performance of 10 repetitions on the MFSD the subject's participation in the study was concluded.

Prior to testing, permission to obtain archival data was obtained from appropriate members of the Oklahoma State University Athletic Department. These secondary data, recorded by the team's strength and conditioning staff, were utilized for comparative purposes. The secondary data sought was inclusive of the team's seasonal testing sessions and included the following measures: 1 RM bench press, 1 RM squat, 1 RM power clean, 40 yd. sprint, vertical jump height, and body fat percentage.

Data Analyses

SPSS version 20.0 (SPSS Inc., Chicago, IL) for Windows was used to perform all statistical analyses. Data were analyzed using 2 separate 2 × 10 mixed model ANOVAs (Position x Trial) for force and movement time. When appropriate, follow-up analyses included independent samples t tests with Bonferroni corrections. Pearson Correlation Coefficients were used to determine any relationships associated with MFSD data and 1 RM bench press, 1 RM squat, 1 RM power clean, vertical jump height, and body fat percentage. Independent t-tests were used to compare the means of vertical jump, weight, and body fat percentage between positions. An alpha level of 0.05 was used to determine statistical significance for all analyses.

CHAPTER IV

RESULTS

Introduction

The primary purpose of the study was to compare the performance of a position-specific task on the MAXX Football Sled Device between NCAA Division I offensive and defensive linemen. A secondary purpose of the study was to investigate any associations among selected strength and power variables with performance on the MAXX Football Sled Device in NCAA Division I offensive and defensive linemen. Twenty-six NCAA Division I offensive (n = 12) and defensive (n = 14) linemen (ages = 20.11 ± 1.49) participated in this study. The study included two sessions, with offensive linemen being tested during session one and defensive linemen during session two. Both groups performed a position-specific task for a total of 10 repetitions on the MAXX Football Sled Device which measured force and movement time (s). Test-retest reliability was performed on the device one week prior to testing. Archival data was gathered from the team's strength and conditioning staff for comparative purposes. These data included 1 RM bench press, 1 RM squat, 1 RM power clean, 40 yd. sprint, vertical jump height, and body fat percentage.

Hypotheses

Two hypotheses were tested to determine if there were significant differences between the two groups. Two separate 2 × 10 mixed model ANOVAs (Position x Trial) for force and movement time were performed to compare the means of each group. Pearson Correlation Coefficients were used to determine any relationships associated with MFSD data and 1 RM bench press, 1 RM squat, 1 RM power clean, vertical jump height, and body fat percentage.

Results of Hypothesis 1

H_0^1: There will not be a significant difference in performance on a position-specific task between NCAA Division I offensive and defensive linemen. The results are shown in table 1.

ANOVA results demonstrate that a significant difference was found in movement time performance between the two groups ($p = 0.032$), thus rejecting the null hypothesis (Table 1).

TABLE 1: Tests of Between-Subjects Effects

Measure: Movement Time

Transformed Variable : Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	52.527	1	52.527	3824.368	.000
Position	.071	1	.071	5.155	.032*
Error	.330	24	.014		

*Indicates significance at $p < 0.05$ level

Furthermore, ANOVA showed no significant within-subjects effects on movement time across the 10 repetitions ($p = 0.836$), as indicated in table 2.

TABLE 2: Tests of Within-Subjects Effects

Measure: Movement Time

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Reps	Sphericity Assumed	.030	9	.003	1.323	.226
	Greenhouse-Geisser	.030	4.344	.007	1.323	.264
	Huynh-Feldt	.030	5.645	.005	1.323	.254
	Lower-bound	.030	1.000	.030	1.323	.261
Reps * Position	Sphericity Assumed	.009	9	.001	.382	.943
	Greenhouse-Geisser	.009	4.344	.002	.382	.836
	Huynh-Feldt	.009	5.645	.002	.382	.880
	Lower-bound	.009	1.000	.009	.382	.542
Error(Reps)	Sphericity Assumed	.539	216	.002		
	Greenhouse-Geisser	.539	104.260	.005		
	Huynh-Feldt	.539	135.469	.004		
	Lower-bound	.539	24.000	.022		

*Indicates significance at $p < 0.05$ level

Additionally, ANOVA revealed no significant difference in force within-subjects (p = .319) or between the groups (p = .345), as shown in tables 3 and 4.

TABLE 3: Tests of Within-Subjects Effects

Measure: Force

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Reps	Sphericity Assumed	87858.175	9	9762.019	.599	.797
	Greenhouse-Geisser	87858.175	5.183	16949.968	.599	.707
	Huynh-Feldt	87858.175	7.056	12451.751	.599	.757
	Lower-bound	87858.175	1.000	87858.175	.599	.447
Reps * Position	Sphericity Assumed	174010.022	9	19334.447	1.186	.305
	Greenhouse-Geisser	174010.022	5.183	33570.743	1.186	.319
	Huynh-Feldt	174010.022	7.056	24661.672	1.186	.313
	Lower-bound	174010.022	1.000	174010.022	1.186	.287
Error(Reps)	Sphericity Assumed	3520476.598	216	16298.503		
	Greenhouse-Geisser	3520476.598	124.401	28299.379		
	Huynh-Feldt	3520476.598	169.341	20789.234		
	Lower-bound	3520476.598	24.000	146686.525		

*Indicates significance at $p < 0.05$ level

TABLE 4: Tests of Between-Subjects Effects

Measure: Force

Transformed Variable :Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	56149130.901	1	56149130.901	405.609	.000
Position	128214.901	1	128214.901	.926	.345
Error	3322361.902	24	138431.746		

*Indicates significance at $p < 0.05$ level

Results of Hypothesis 2

H_0^2: There will be no relationship between selected strength and power variables and performance on a position-specific task in NCAA division I offensive and defensive linemen.

Pearson correlation coefficients showed a weak relationship between 1 RM power clean strength and MFSD variables (.227- Avg. movement time, -.067 – Avg. force), thus failing to reject the null hypothesis (Table 5).

TABLE 5: CORRELATION MATRICES		**Dependent Variables**	
Independent Variables		**Avg. MT**	**Avg. F**
% Fat	Pearson Correlation	.103	.241
	Sig. (2-tailed)	.617	.236
	N	26	26
VJ	Pearson Correlation	-.122	-.095
	Sig. (2-tailed)	.554	.645
	N	26	26
1 RM Bench Press	Pearson Correlation	-.025	.278
	Sig. (2-tailed)	.904	.169
	N	26	26
1 RM Squat	Pearson Correlation	.304	.002
	Sig. (2-tailed)	.131	.994
	N	26	26
1 RM Power Clean	Pearson Correlation	.227	-.064
	Sig. (2-tailed)	.264	.755
	N	26	26
10 yd. Sprint	Pearson Correlation	.100	.121
	Sig. (2-tailed)	.643	.574
	N	24	24
40 yd. Sprint	Pearson Correlation	.185	.240
	Sig. (2-tailed)	.388	.258
	N	24	24

Three separate independent t-tests were performed to compare the mean of body fat percentage, body mass, and vertical jump between the groups. There was no significant difference found in body fat percentage ($p = .115$) or vertical jump ($p = .445$) between offensive and defensive linemen as indicated by tables 6 and 7.

Table 6: Comparison of Body Fat % Means Between Groups		Levene's Test for Equality of Variances		**Independent Samples T-test**				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Percent Fat	Equal variances assumed	.105	.748	-1.610	24	.121	-3.53571	2.19627
	Equal variances not assumed			-1.637	23.946	.115	-3.53571	2.16039

*Indicates significance at $p < 0.05$ level

Table 7: Comparison of VJ means Between Groups		Levene's Test for Equality of Variances		**Independent Samples T-test**				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
VJ	Equal variances assumed	4.639	.042	-.732	24	.471	-2.26190	3.09094
	Equal variances not assumed			-.784	15.126	.445	-2.26190	2.88371

*Indicates significance at $p < 0.05$ level

However, there was a significant difference in body mass between the two groups ($p = 0.005$), as indicated by table 8.

Table 8: Comparison of Body Mass mean between groups		Levene's Test for Equality of Variances		**Independent Samples T-test**				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Body Mass	Equal variances assumed	2.314	.141	-3.077	24	.005*	-30.88095	10.03760
	Equal variances not assumed			-3.167	22.965	.004	-30.88095	9.74966

*Indicates significance at $p < 0.05$ level

CHAPTER V

DISCUSSION

The hypotheses of this study were that movement time during a position-specific task will be significantly different between NCAA Division I offensive and defensive linemen. Also, that there will be a relationship between 1 RM power clean strength and performance on a position-specific task in NCAA division I offensive and defensive linemen. Several studies have examined the relationships among physical characteristics and performance measures between various positions in collegiate football physical characteristics and performance measures. A few of these studies have specifically categorized offensive and defensive linemen for the purpose of comparing the two positions. The findings of the present study and previous investigations are important for understanding relationships among commonly used exercises and performance measures in these athletes.

In the present study, defensive linemen displayed significantly better movement time scores compared to the offensive linemen group. This means they were significantly faster in getting out of there three-point stance and making contact with the dummy on the MFSD. Although researchers in the present study used a novel method for evaluating movement time in these athletes, it is believed there are several reasons for this finding.

First, it could be theorized that the ability to explode out of the three-point stance upon a signal is more consistent with the role of the defensive linemen when compared to the offensive linemen. This reasoning is developed through an understanding of the schematics of college football in present day. Many times it is the responsibility of the defensive linemen to rush up-field, whether to rush the quarterback or due to the design of the play. In these instances, a high

degree of focus is directed on the moments leading up to each play by the defensive player in an effort to minimize any delayed responses to the initiation of play. According to Bass, a defensive lineman must condition himself to concentrate on moving the instant an offensive lineman or the ball moves (2004). Therefore, the defensive linemen may be more concerned with anterior explosiveness, while offensive linemen may concern themselves more with upright blocking.

Another rationale for this finding may be that defensive linemen have superior explosive ability compared to offensive linemen with respect to the task evaluated in the present study. Previous research has characterized defensive linemen as being more explosive in the vertical jump compared to offensive linemen. The findings in the Carbuhn et al., (2008) study showed that defensive linemen performed significantly better with regard to vertical jump height when compared to offensive linemen ($p < 0.05$). Similarly, Barker et al., (1993), Fry and Kraemer (1991), and Berg et al., (1990) all provided evidence that suggests defensive linemen are superior to offensive linemen in the vertical jump. More specifically, Barker et al., (1993) found defensive linemen to produce significantly greater takeoff velocity measures during the performance of a static vertical jump. However in the current study, an independent t-test found no significant difference in vertical jump performance between offensive and defensive linemen ($p = .445$). This provides support to the theory that the superior performance by defensive linemen in movement time may be a result of their role on the field.

A very logical argument in explaining the movement time differences between these positions would be any mass and body composition differences between these athletes. Previous research has indicated that offensive linemen are typically more massive (Carbuhn et al., Berg et al., and Secora et al.) and possess more adipose tissue (Berg et al. and Secora et al.) when compared to defensive linemen. Regarding the latter, the current study found no significant

difference between offensive and defensive linemen in body fat percentage. Therefore, athletes of both groups in this study possessed similar amounts of relative body fat and fat-free mass. However, an independent t-test did reveal that offensive linemen were significantly more massive than defensive linemen in the present study ($p = 0.005$). Intuitively, it is logical that the heavier offensive linemen produce slower movement time results. This must be taken in to consideration when evaluating the movement time differences found between offensive and defensive linemen in the current study.

The present study failed to find any relationships between commonly measured physical performance tests and a position-specific task on the MFSD. There have been only a few studies that have examined associations between 1 RM performance and a practical field-based evaluation. Similar to the present study, Mayhew et al., (2005) studied the relationship between a practical, total body field test and 1 RM power clean performance in collegiate football players. Researchers compared 1 RM power clean performance with the backward overhead medicine ball (BOMB) throw, which had been previously proposed as an effective field test for the evaluation of total body explosive power. However, as was the case in the present study, the hang clean proved to be a weak predictor of field test performance with the BOMB throw performance ($r = 0.33$, $p = 0.09$). In another study, Davis et al., (2004) specifically examined the relationship between the 1 RM hang clean and vertical jump performance in collegiate football players. Surprisingly, there was no relationship found between the two measures. This study is supportive of the present study in that the 1 RM hang clean failed to predict performance in a practical field-based test.

Future Research

Future research is warranted for the purpose of identifying a position-specific tool appropriate for evaluating playing ability in offensive and defensive linemen. This can be accomplished through the efforts of practitioners and exercise scientists working together to find a practical field test that provides an effective evaluation of these athletes. Although, the MFSD was found to be reliable, it would be worthwhile for future research to assess the validity of this device.

Also, additional exploration that examines exercise performance and its relationship with tasks specific to the roles of offensive and defensive linemen is necessary. It is important that assumptions are not made regarding associations between specific exercise performances and skills specific to these athletes, hence future research that sets out to quantify these relationships can provide practitioners with useful knowledge. Research that provides information of this kind can aid collegiate football programs in meeting the demands placed on them through more effective training programs.

Summary

The primary purpose of the study was to compare the performance of a position-specific task on the MAXX Football Sled Device between NCAA Division I offensive and defensive linemen. A secondary purpose of the study was to investigate any associations among selected strength and power variables with performance on the MAXX Football Sled Device in NCAA Division I offensive and defensive linemen. The dependent variables, force and movement time, were collected from the MAXX Football Sled Device (MFSD) while the independent variables

included 1 RM bench press, 1 RM squat, 1 RM power clean, 40 yd. sprint, 20 yd. sprint, and body fat percentage. Subjects from both, the offensive and defensive linemen group performed 10 “fire and drive” repetitions separated by approximately 6 to 10 seconds on the MFSD. Secondary data, including 1 RM bench press, 1 RM squat, 1 RM power clean, 40 yd. sprint, 20 yd. sprint, and body fat percentage were gathered from the team’s strength and conditioning staff. Results revealed that defensive linemen produced significantly better movement time scores than offensive linemen. There was no statistical difference found between the groups in regards to force. There were no significant relationships revealed by Pearson’s correlation coefficients between any of the dependent variables and independent variables. This study revealed that defensive linemen display more explosive ability from the three-point stance compared to offensive linemen. Future studies are necessary to investigate relationships among various exercise performances and tasks specific to these athletes.

Conclusions

A great deal of time and effort is spent on the development and implementation of strength and conditioning programs designed to optimize physical athletic development. It is imperative that strength and conditioning professionals have access to an evaluative tool that provides a practical, position-specific assessment of playing ability in collegiate offensive and defensive linemen. The present study found defensive linemen to produce significantly better movement time scores than offensive linemen, however failed to reveal any significant relationships among strength and power measures and performance of a position-specific task. Further research should be conducted to examine the relationship among exercise performance and tasks specific to collegiate offensive and defensive linemen.

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APPENDICES

APPENDIX A

Informed Consent for the MAXX Football Sled Device Study

Project Title: The evaluation of a position-specific task on the MAXX Football Sled Device in NCAA Division I Linemen.

Investigators: Garrett Hester B.S., School of Applied Health and Educational Psychology
Doug Smith Ph.D., School of Applied Health and Educational Psychology
Bert Jacobson Ph.D., School of Applied Health and Educational Psychology
Matt O'Brien Ph.D., School of Applied Health and Educational Psychology

Purpose: The purpose of this study is to test the reliability of a functional power test on the MAXX Football Sled Device on NCAA Division I football players and compare the result of the MAXX data to pre-existing data inclusive of selected strength, speed and power measures as recorded by the Strength and Conditioning staff at OSU

You are being asked to read and sign this consent form because you are over 18 years of age and are being asked to participate in this research study that involves your ability to hit and drive the MAXX sled. We want to see your maximum effort produce force on 5 repetitions on the MAXX football sled device. Power output and reaction time will be collected on each of the trials and these results will be compared to the results of your off-season football test scores (i.e., power clean, squat, bench, vertical jump, etc.)

Procedures: You will be asked to come to the strength and conditioning facility on two separate scheduled occasions separated one week apart. When you arrive, you will warm-up for five minutes with your team's Strength and Conditioning staff. Once finished with your warm-up, you will perform 5 maximal effort punch and drive on the MAXX Football Sled Device. This will involve starting from a three point stance in front of the MAXX and upon a light or sound signal you will drive out of your stance and contact the MAXX, extending the arms while simultaneously driving the sled back to its stopping point. The second session will be identical to the first one with each session requiring approximately ten minutes of your time.

Risks of participation: The study poses minimal risks that are no greater than the risks associated with standard drills that are performed in your team's practices. Certified Athletic Trainers will be present at all times during this study. In case of injury or illness resulting from this study, emergency medical treatment will be available to you immediately by athletic training staff and if necessary other professional medical assistance will be given. No funds have been set aside by Oklahoma State University to compensate you in the event of illness or injury. Although, such injuries are not expected.

Benefits: Possible benefits from this study include an enhanced understanding by strength and conditioning practitioners on training methods for the purposes of increasing performance.

Confidentiality: No identifying information from this study will distributed to any persons or members of the OSU Athletic Department. Only the investigators involved in the study will have access to this information. Identifying data will be destroyed once the data has been transferred to a spread sheet and only numerical data in aggregate form will be available for distribution as a professional presentation and/or publication. While the data contains identifying information it will be kept in a locked file cabinet

that can only be accessed by the investigators of this study.

Contacts: This study and been reviewed and approved by the Oklahoma State University Review Board (IRB). If you have any questions about this research project you may contact Garrett Hester B.S. at ghester@okstate.edu, Doug Smith Ph.D. at doug.smith@okstate.edu, Bert Jacobson Ph.D. at bert.jacobson@okstate.edu, or Matt O'Brien Ph.D. at matthew.obrien@okstate.edu. If you have any questions regarding your rights as a researcher volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu.

Participant Rights: Your participation in this study is voluntary and you have the right to discontinue or quit this study at any time without receiving penalty of any kind.

Signatures:

I have read and fully understand the consent form. I sign it freely and voluntarily. A copy of this form has been given to me.

_____ _____

Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant sign it.

_____ _____

Signature of Researcher Date

Oklahoma State University Institutional Review Board

Date:	Tuesday, February 14, 2012
IRB Application No	ED1219
Proposal Title:	The Reliability of the MAXX Football Sled Device and the Relationship Between MAXX Performance and Selected Strength and Power Variables in Division I Football Players
Reviewed and Processed as:	Expedited

Status Recommended by Reviewer(s): Approved Protocol Expires: 2/13/2013

Principal Investigator(s):

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Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Shelia H. Kennison

Shelia Kennison, Chair
Institutional Review Board

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Education

Master of Science in Health and Human Performance (Applied Exercise Science Emphasis)
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Oklahoma State University; Stillwater, OK; GPA: 4.0
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Master's Thesis: The Evaluation of a Position-Specific Task in NCAA Division I Linemen

Bachelor of Science in Health and Human Performance, 2010
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Research

Regional Conference Abstract Presentations:

1. **Hester G. M.,** B. H. Jacobson, T. B. Palmer, M. J. Hawkey, D. B. Smith, M. S. O'Brien, Z. D. Ruedy. Relationship between power clean and a sport-specific task in division I collegiate football linemen. Accepted for presentation at the Central States Chapter of ACSM regional conference. Columbia, MO. Oct. 18-19, 2012.

2. Conchola, E. C., **Hester, G. M.,** Hawkey, M.J., Palmer, T. B., Emerson, S. R., Mackey, C.S., Thompson, B.J., and Smith, D.B. Effects of two high intensity training protocols on caloric expenditure during free weight squats. Accepted for presentation at the Central States Chapter of ACSM regional conference. Columbia, MO. Oct. 18-19, 2012.

3. M. J. Hawkey, T. B. Palmer, E. C. Conchola, **Hester G.M.,** and D. B. Smith. Power Output Comparison between Different age groups for Female youth soccer players. Accepted for presentation at the Central States Chapter of ACSM regional conference. Columbia, MO. Oct. 18-19, 2012