

## Comparison of Estimated-1RM and 225-lb (102-kg) bench press performance between starters and non-starters among a NCAA Division I college football team

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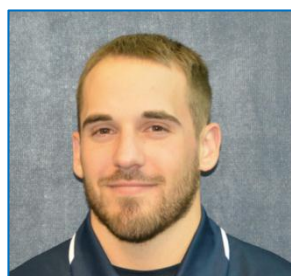
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**Abstract:** The estimated one-repetition maximum (1RM) bench press and NFL-225 (225-lb or 102-kg) repetition test are commonly used to assess upper-body muscular strength and endurance among football players. However, little research has been focused on the relationship of these tests to playing status. Therefore, the purpose of this study was to determine if significant relationships exist between these tests and playing status in Division I football athletes. Archival data from 31 NCAA Division I football players (age: 20.1±1.4 yrs., height: 188.07 ± 5.93 cm, body mass: 112.4 ± 19.5 kg) on the 1RM Bench press test, NFL-225 test and playing status were utilized for this analysis. A one-way ANOVA was used to detect any differences in 1RM and NFL-225 performance between skill groups: big (linemen), medium (linebackers, quarterbacks, tight ends) and small (receivers, backs, and corners) ( $p < 0.05$ ). Playing status (starters vs. non-starters) were compared within position groups. A point bi-serial correlation was then utilized to examine the relationship in test performance between groups, as well as between starters and non-starters. Significant differences were discovered in NFL-225 test performance between big and small skill groups. Moderate-to-strong relationships between playing status and performance on the 1RM bench press ( $r = .660$ ) and the NFL-225 test ( $r = .685$ ) for the big skills group. The results of this study suggest that playing status and upper-body strength and endurance are strongly related for the big skills position group.

**Key Words:** NFL-225, bench press, performance testing, playing time.



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## 1. Introduction

The success of collegiate American Football programs are dependent on coaches being able to identify and recruit athletes with a high level of football playing ability. The key determining physical characteristics of an athlete that are essential for “success” in sport are often difficult to quantify due to the wide variation in a given characteristic or attribute between players [1]. Identifying and understanding physical performance measures that may show a relationship between performance tests and playing status (i.e., starters vs. non-starters) could be extremely beneficial for coaches. Numerous studies have reported findings of physical performance measures being associated with identifying and differentiating players based in a number of areas: predictors of recruit rankings [2, 3], starters vs. nonstarters, playing positions, competition level, future potential in the NFL draft and NFL [4-28].

American football requires each athlete to possess the physical capacity to exert high levels of power, strength, and speed [15, 16, 18, 19]. However, the physical skills required to be successful at one position are not necessarily the same for each position on the field. Previous research using physical performance measures has shown the presence of position specific skill requirements [4-22]. The research has commonly grouped like positions (i.e., big skills = linemen – offensive and defensive, small skills = backs – offensive and defensive, mid skills = linebackers + tight ends). These positions have been grouped because consistent findings have shown that they display similar results/measures with regards to a multitude of categories: body composition & size, distances covered, strength, speed, cardiovascular capabilities, and other physical measures [5-9, 12, 13, 15-18, 20, 22]. The tasks required for the different positions also support grouping the positions into three distinct groups. Success on the offensive or defensive line is related to an athletes’ ability to execute a variety of movements such as charging, blocking, and/or tackling with a high amount of strength and power [19, 15, 16, 18]. Studies have consistently found that the big skills

group is typically taller, heavier, display significantly higher absolute strength and power values, cover less distance per play and during a game compared to the other two groups [4-18, 22]. The small skill positions have been shown to have the lowest values for size and strength, lower body fat percentages, greater distances covered, and generally better performance in tests of speed, change of direction, and cardiovascular capabilities [5-9, 12, 13, 15, 16-18, 20, 22, 29]. The mid skills group has commonly displayed results that fall midway between those of the big skills group and small skills group. Those findings are mostly likely a product of this group being required to perform tasks that cross into the other two groups requirements. Linebackers are primarily tasked with tackling a ball carrier that breaks past the line of scrimmage but may also be required to cover tight ends or offensive backs running downfield [30]. Tight ends may be required to performing tasks similar to the linemen (i.e., blocking defensive players) as well as the backs (i.e., running routes). Anecdotally, it makes sense that given the duality of the required demands for these positions that they need to possess size, strength and speed values that fall between the two other groups. Physical performance characteristics (i.e., power, speed, and agility) have been shown to differentiate players within in the different positions based on starters vs. non-starters, level of play, drafted as professional vs. undrafted, and also by order of draft status.

Identifying performance variables that can be used for predicting future success (i.e., level of play, starters vs nonstarters, potential for professional career) can be used by coaches and athletes at all levels to assist in targeting recruits and developing training programs. A common finding in previous research has been that starters (regardless of level of play in college athletes) outperform non-starters in measures of strength (bench press, squat, 1RM clean, isometric maximal voluntary contractions), power (seated medicine ball toss, vertical jump, broad jump), and speed (sprints and agility drills). Further support for the importance of developing high levels of strength and power can be drawn from the multiple studies that have reported greater performance in measures of

strength, power, and speed by athletes at the Division I level compared to Division II & III [12, 23, 13]. Furthermore, players drafted into the NFL tend to be more powerful and faster than non-draftees in the same positions [24-28]. When examining combine performance results with future success (receiving elite performance award, i.e., Pro-Bowl or All-Pro selections) Helund [30] reported the following results for players who received awards for their positions compared to those not selected. Generally, big skill players were able to jump higher, complete more repetitions in the NFL 225 bench press test (in this study this test will be referred to as the NFL-225 test), and displayed better performance in measures of change of direction (shuttle runs, 3-cone drill). Middle skills players tended to be taller, weighed more, ran faster 40yd dashes, jumped higher, complete more repetitions in the NFL-225 test, and had faster 3-cone drill times. In the small skills players, weighed more, jumped higher, and ran faster 40 yd dash times. This group displayed varying results with regard to strength and change of direction measures. Running backs displayed slower times in the shuttle runs and 3-cone drill but completed more repetitions in the NFL-225 test. Wide receivers ran faster 3-cone drills whereas defensive backs completed fewer repetitions in the NFL-225 test and slower shuttle run times.

Strength and conditioning coaches predominantly use the supine bench press to assess upper-body strength in football players [33-40]. One of the most common methods of evaluation is to conduct periodic one repetition maximum (1-RM) testing. However, this method can be time consuming and with maximal testing comes the potential for injury. A valid and well documented alternative method that coaches can employ is to estimate the athletes' 1-RM from testing using submaximal repetitions to fatigue [33-40]. The inclusion of the NFL-225 test at the NFL combine has resulted many football programs at different levels of play to utilize this submaximal test as the primary tool for assessing upper-body muscular performance. The NFL-225 test requires an athlete to perform as many bench press repetitions as possible with a load of 225 lbs (102.3kg) without

resting. Debate exists as to whether the NFL-225 test is an appropriate measure of muscular endurance. Because the test requires ever athlete to use the same constant load, it is actually measuring absolute muscular endurance [28, 31]. Absolute muscular endurance tests tend to favor athletes who are larger or stronger. Findings from the literature confirm this assumption, with the majority of studies reporting that larger or stronger individuals tend to complete more repetitions. The reality is that larger players most likely have higher 1-RMs than smaller players and therefore the 225lbs results in smaller players lifting a load that is a greater percent of their actual 1-RM than larger players [1, 7, 20, 21, 26-33]. Anecdotally, due to the inherent nature of football specific demands such as blocking which requires players to have their hands in a position that appears to resemble the hand position in the bench press, the bench press may appear to be the most appropriate measure of upper-body strength. However, further research is warranted to continue to examine the relationships between upper-body performance measures and the relationship to player success/ability.

There have been numerous investigations which have reported high correlations between 1-RM bench press performance and the NFL-225 test. To date, only the Hedlund study [30] reported information regarding the NFL-225 test and its potential relationship for identifying/differentiating players. Thus far, there has not been a study that has aimed to use the NFL-225 test for predicting playing status in college football. Given that previous research has shown a relationship between the NFL-225 test and potential future success in the NFL, it would be worthwhile for coaches to understand how the NFL-225 can differentiate players at a younger age. The information provided from such investigations could aid in the development of a players training and career. The purpose of this study was to compare results of physical performance measures (estimated 1-RM bench press and the NFL-225 test) between different position groups as well as starters vs. non-starters within and between groups. Additionally, a secondary goal to determine if relationships exist

between 1-RM bench press and the NFL-225 and playing status in Division I football athletes.

## 2. Methods

### 2.1 Experimental Approach to the Problem

Many Division I college football programs use either the NFL-225 test or variations of measuring 1-RM bench press to judge upper body strength performance in players. Lacking is further investigation into how these tests may relate to playing status (starter vs. nonstarter) and position. This study was designed to compare the relationship between performance in the NFL-225 test and an estimated 1-RM in the bench press with regards to playing status and position. Players were tested as a part of their pre-season training period done in July. The bench press (estimated 1-RM) and NFL-225 test were performed in separate sessions with the estimated 1RM being performed on Monday and the 225 test being performed on Thursday.

### 2.2 Subjects

The participants ( $n=31$ ) were football players from a successful Division I program that was consistently ranked in the top 25 in the country were recruited for this study. All players had previous experience with heavy resistance training, were proficient in performing the bench press exercise and had performed the NFL-225 test on previous occasions. Only players who were free of any upper body injuries with the previous year were eligible to participate.

Players were divided into three position groups by the football coaches in conjunction with the strength and conditioning coaches based on playing position: big skills (offensive tackles, offensive guards, and defensive tackles,  $n = 13$ ), medium skills (offensive backs, tight ends, linebackers, defensive ends, and quarterbacks,  $n = 9$ ), and small skills group (wide receivers and defensive backs,  $n = 9$ ). Demographic and performance variables for the participants by each of these groups are presented in Table 1. Players were also divided into two performance groups

based on if they were a starter or non-starter. Demographic and performance variables for the groups based on starters vs. non-starters are presented in Table 2. Participants were informed of the risks and benefits of the testing program and signed an informed consent document before testing. All testing protocols were approved by both university's Institutional Review Boards for studies involving human subjects.

### 2.3 Procedures

All testing was performed between 0700 and 1300 hours. No player was allowed to perform either test if he had any upper-body injury within the previous three months of the test date. Players were encouraged to be well hydrated before testing and had personal water bottles in the facilities at all time. The time of day was kept consistent for both testing sessions to limit circadian effects on strength results. The testing was performed as a part of their pre-season training period done in July. Height was recorded by the utilization of a custom height chart measured to the nearest 1/8<sup>th</sup> of an inch and converted to cm. Body mass was recorded to the nearest 0.1lb and converted to kg on a calibrated Metler Toledo scale. Body composition was measured by Dual-energy X-ray absorptiometry (DXA). The anthropometric measures were done during the same testing session prior to the testing of bench press. Bench press and 225 were performed in separate sessions with the estimated 1RM being done on Monday and the 225 test being performed on Thursday.

### 2.4 Estimated One Repetition Maximum Test.

Standard Olympic bars and plates were used for all lifts, and the player used a grip of their preference (approximately 15-35 cm greater than shoulder width). A spotter assisted the player in lifting the bar from support racks. All attempts required the player to lower the bar to touch the chest before pressing it immediately to full-arm extension in the "touch-and-go" method. The head, shoulders and buttocks remained in contact with the bench throughout the lift. Players were not allowed to bounce the bar off of their chest. Each player was



allowed to warm up according to personal preference using light weights until approximately 60% of the estimated 1RM. They then performed 3 repetitions at 70% of 1RM, 2 at 75% of 1RM, 1 at 80% of 1RM, and then the athlete attempted a 5RM at 87% of their estimated 1RM. If the athlete had the ability to perform more than 5 repetitions, then an additional load of 5 to 10kg was added on to the barbell. A minimum of 5-minute rest was allowed and the second trial was attempted. The objective was to have most players reach their 5RM within 3-5 attempts and was converted to 1RM via the Brzycki equation. Reliability for the estimated 1RM procedure has been established at greater than 0.99.

**2.5 National Football League 225-Test.** During the week after the 1RM testing, each player performed the NFL-225 test using a load of 225-lbs (102.3 kg), attempting to complete as many repetitions as possible without pause (2729). Warmups were individualized and based off of their estimated-1RM (table 1). After individual warm-ups, the player grasped the bar at the same position used during the 1RM procedure. No mandatory cadence was imposed for the repetition test, although each player was encouraged to maintain a constant pace of his own choosing. No more than a 2-second pause between each repetition was allowed. The bar was required to touch the chest on each repetition (but not allowed to bounce off it) and be returned to full-arm extension. The head, upper back, and buttocks were required to remain in contact with the bench throughout the test. The test was terminated by the strength and conditioning staff when the subject could not complete a repetition with proper form. Reliability for this procedure had previously been determined to be 0.987 [34, 35].

## 2.6 Statistical Analysis

Statistical analysis was completed using IBM SPSS (version 24.0, IBM Corporation, Armonk, NY, USA). To determine if differences existed between position groups, a one-way analysis of variance with Bonferroni post hoc follow-up testing where significance was noted. Separate independent

samples t-tests were used to assess for differences between starters and non-starters as a whole and additionally within each group. Effect size was determined using Cohen d-statistic [10]. Additionally, a point-biserial correlation was used to determine the relationship among selected variables. This statistical method is used to determine relationships between continuous variables and those that are binary (i.e., playing status).

## 3. Results

Demographic and performance variables for the subjects collectively and broken down by each of these groups are presented in Tables 2 and 3. The big skills group collectively (starters + non-starters) had a significantly higher 1RM than the small skills ( $p = 0.042$ ). Additionally, the collective big skills group performed a significantly greater number of repetitions in the NFL-225 test than the small skills group ( $p = 0.018$ ).

Results revealed significant differences between starters and non-starters (regardless of group) for the following: age ( $20.9 \pm 0.9$  vs.  $19.38 \pm 1.4$ ,  $p < 0.01$ ), body composition ( $17.8 \pm 7.4$  vs.  $23.8 \pm 8.1$ ,  $p < 0.05$ ), and 1-RM ( $p < 0.05$ ). Significant differences between starters and non-starters within each group were found mainly in the big skills group with the exception of age in the small skills group ( $p < 0.05$ , Cohen's  $d = 1.563$ , effect-size  $r = 0.6516$ ). Big skill group starters were significantly different than non-starters in all of the following: weight ( $p < 0.05$ , Cohen's  $d = 1.49$ , effect-size  $r = 0.5982$ ), age ( $p < 0.05$ , Cohen's  $d = 1.71$ , effect-size  $r = 0.649$ ), total reps in the NFL-225 test ( $p < 0.05$ , Cohen's  $d = 1.722$ , effect-size  $r = 0.6524$ ), and 1-RM ( $p < 0.05$ , Cohen's  $d = 1.656$ , effect-size  $r = 0.6378$ ).

There was a strong relationship between 1RM bench press and total repetitions in the NFL-225 test, regardless of group or playing status ( $r = .860$ ,  $p < 0.001$ ). Additionally, there was a small relationship between 1RM bench press and playing status, regardless of group ( $r = .378$ ,  $p < 0.05$ ).

**Table 1.** Descriptive for NFL-225 warm-up protocol based off of estimated 1-RM (load x repetitions).

<b>&lt; 300 lbs. estimated 1-RM</b>	<b>301 - 350 lbs. estimated 1-RM</b>	<b>351 - 400 lbs. estimated 1-RM</b>	<b>&gt; 400 lbs estimated 1-RM</b>
135 x 5	135 x 5	135 x 5	135 x 5
165 x 3	185 x 3	185 x 3	185 x 3
185 x 3	205 x 1	225 x 1	225 x 3
205 x 1	225 x 1	250 x 1	250 x 1
225 x TEST	250 x 1	275 x 1	275 x 1
	225 x TEST	225 x TEST	300 x 1
			225 x TEST

**Table 2.** Descriptive for ALL groups (combined n of starters & non-starters).

<b>Variables (Mean ± SD)</b>	<b>Big Skills (13)</b>	<b>Medium Skills (9)</b>	<b>Small Skills (9)</b>
Age (yrs.)	<b>19.4 ± 1.3**</b>	20.9 ± 1.3	20.4 ± 1.3
Height	5967.0 ± 256.1	5914.1 ± 305.5	5614.0 ± 479.9
Weight (kg.)	<b>132.7 ± 7.5*</b>	<b>104.2 ± 7.5*</b>	<b>91.1 ± 5.4*</b>
Body Comp (%)	<b>28.7 ± 3.9*</b>	<b>18.9 ± 4.6*</b>	<b>11.5 ± 2.8*</b>
~1RM (kg.)	<b>164.9 ± 27.2†</b>	156.9 ± 20.1	<b>145.3 ± 14.7†</b>
Total Reps	<b>20.9 ± 7.6†</b>	17.3 ± 5.9	<b>13.4 ± 4.7†</b>

\*Denotes a significant difference between all groups ( $p < 0.001$ )

\*\*Denotes a significant difference between Big vs. Medium ( $p < 0.05$ )

† Denotes a significant difference between Big vs. Small ( $p < 0.05$ )

**Table 3.** Descriptive for ALL groups, split between starters(S) and non-starters(NS) (Mean ± SD, Standard Error mean (SEM, Minimum, Maximum).

		<b>Big Skills (13)</b>		<b>Medium Skills (9)</b>		<b>Small Skills (9)</b>	
		<b>S (5)</b>	<b>NS (8)</b>	<b>S (5)</b>	<b>NS(4)</b>	<b>S (5)</b>	<b>NS (4)</b>
Age (yrs.)	Mean ± SD	<b>20.4 ± 0.89*</b>	<b>18.8 ± 1.0*</b>	21.2 ± 0.84	20.5 ± 1.7	<b>21.2 ± 0.84*</b>	<b>19.5 ± 1.3*</b>
	SEM	0.4	0.37	0.37	0.87	0.37	0.65

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	Min	19	18	20	18	20	18
	Max	21	20	22	22	22	21
Height	Mean ± SD	6035.6 ± 15.2	5924.1 ± 326.9	6017.0 ± 12.5	5785.5 ± 457.1	5659.4 ± 499.4	5557.3 ± 523.4
	SEM	6.82	115.58	5.58	228.53	223.32	261.72
	Min	6016	5116	6002	5100	5112	5104
	Max	6053	6054	6031	6022	6040	6021
	Mean ± SD	<b>138.3 ± 4.87*</b>	<b>129.3 ± 7.0*</b>	106.1 ± 3.0	107.1 ± 11.1	92.1 ± 4.3	89.9 ± 7.0
Weight (kg.)	SEM	2.18	2.46	1.35	5.56	1.94	3.49
	Min	290	270	224	188	194	184
	Max	320	318	241	242	219	213
	Mean ± SD	26.2 ± 2.4	30.3 ± 3.9	16.9 ± 4.0	21.5 ± 4.4	10.3 ± 3.2	13.1 ± 1.3
Body Comp (%)	SEM	1.08	1.39	1.77	2.22	1.42	0.66
	Min	23.6	26.1	14.1	18.4	6.1	11.8
	Max	29.6	36.2	23.4	28	13.3	14.8
	Mean ± SD	<b>186.7 ± 21.7*</b>	<b>151.3 ± 21.1*</b>	160.9 ± 10.3	152.0 ± 29.6	149.5 ± 9.4	139.9 ± 19.7
~1RM (kg.)	SEM	9.7	7.46	4.62	14.8	4.19	9.84
	Min	347	265	329	255	300	258
	Max	476	429	382	415	353	353
	Mean ± SD	<b>27.2 ± 6.6*</b>	<b>16.9 ± 5.3*</b>	18.6 ± 3.6	15.8 ± 8.4	14.2 ± 5.1	12.5 ± 4.7
Total Reps NFL 225 (102.5kg)	SEM	2.96	1.88	1.6	4.21	2.27	2.36
	Min	20	6	15	6	7	9
	Max	35	24	23	26	20	19

\*Denotes a significant difference between starter and non-starter within the individual skill groups ( $p < 0.05$ )

A small non-significant relationship was found between total reps in the NFL-225 test and playing status, regardless of group ( $r = .329, p > 0.05$ ). The correlation analysis showed a moderate to strong relationship between playing status and

performance on the 1 RM bench press ( $r = .660, p < 0.01$ ) and the NFL-225 test ( $r = .685, p < 0.01$ ) for big skills group. No significant relationship was found between playing status and performance on

the 1RM and NFL-225 test for medium and small skills groups.

#### 4. Discussion

This study is believed to be the first to examine how the NFL-225 test relates to playing status between different positions in Division I college football players. The strong relationship between 1-RM bench press and the NFL-225 test is consistent with previous studies [4, 10, 31, 32, 33-40]. These results indicate that higher levels of upper body strength likely contribute to achieving more repetitions in the NFL-225 test. The small relationship between 1-RM bench press and playing status aligns with previous works that have reported greater performance in measures of strength for starters vs. non-starters across all NCAA competitions [1, 12, 13, 23]. Over the past several decades, players have become stronger and more powerful than previous decades [12, 13, 15]. Increases in strength and power have been correlated to better jump performance, acceleration, and change of direction ability in American football players. As such it seems that displaying high levels of strength would be beneficial for playing status. The previously reported link between the NFL-225 test and 1-RM bench press is likely the underlying reason that a small non-significant relationship between the NFL-225 test and playing status was found in the present study. Furthermore, the physiological energetics required may provide a rationale for the differences in the observed relationship between the NFL-225 test and playing status. A given play lasts approximately 5-6s with recovery times of up to 35s between plays and an additional 10-20s for stoppages occurring between downs, plays, injuries, and commercial breaks [15]. The primary source of energy to meet the metabolic demands for all positions would be from the anaerobic pathways (phosphocreatine and glycolysis) with oxidative pathways assisting during recovery periods from the bouts of play [15]. The NFL-225 test is considered a muscular endurance test which requires metabolic demands which are not entirely required by players in the course of a game. It is important to note that when groups were analyzed separately, only the big skills group

displayed a strong relationship between playing status and the measures of upper-body strength.

Numerous studies have reported differences in physical performance between positions and/or position groups in collegiate football players. The general tasks required for different positions provides a basic rationale for why these differences might exist. Big skill players are typically the largest players on the field and are tasked with battling similar sized opponents on nearly every play. Blocking and rushing (defensive attacking) commonly require big skill players to engage one another with their hands and elbows close to the body (within the shoulder pads of the defender for offensive players) [41, 42]. The larger stature and similarity in upper-body positioning are most likely the underlying foundation for the superior performance in strength measures of big skills players compared to other positions. Small skill players are generally leaner than other players and typically cover the greatest distances during a game [19-22]. As such, upper body strength is likely to not play as much of a factor on playing status as performance measures like the vertical jump or 40 yd dash, for the small skills group. The middle skills players in the present study displayed similar results to the previously reported values of this group [1, 4, 5, 7-13, 15, 16-23]. Middle skills players are unique in that on any given play they may be required to perform a task that typically associated with one of the other groups. These positions and players likely need to possess a balanced or equal amount of muscular strength and endurance in order to complete tasks such as blocking big skills defensemen or covering small skills receivers down field. The relationship between the NFL-225 test and playing status for different positions had not been previously addressed even though the NFL-225 test is the upper-body muscular performance test for the NFL.

Positions that fall under the big skills group are required to repeat quick and powerful movements over and over throughout the entirety of a game. As such, big skill players must be able to meet the taxing metabolic demands of those movements. Players who possess high levels of



muscular strength and endurance are likely to be able to meet those demands than those who may be lacking in one or both of those areas. This assumption appears to lend explanation as to why big skills starters have consistently been found to be larger and display greater levels of strength, power, speed, and agility than non-starters. The results of the present study and those before it, may indicate that tests of upper body strength and endurance like the 1-RM bench press and NFL-225 test relate to playing ability and performance in big skills positions but not necessarily in the other groups.

There are limitations for this study that need to be considered. Participants for this study were all from the same university and therefore do not represent the entirety of Division I college football players. The results from this study may serve as providing insight into performance testing and training considerations for other Division I football players. The sample size and subsequent group sizes for this study was 31 (13 big, 9 mid, 9 small) which is considerably smaller than the sample sizes used in previous studies that reported on playing status. Thus, the power of the study and the generalization of the results may not portray the entirety of the population of DI football players. The observed differences in the dependent variables between starters and non-starters, specifically within the big skills group may have been influenced by the significant differences in age within each group. Older athletes may have a greater training age, be more developed physically and mentally, mostly likely are already a starter, and thereby might have an inherent edge compared to younger players.

Regardless, within the context of these limitations, the results from this study indicate the importance of continuing to collect data on the relationship between selected measures of upper body strength and playing ability. The greater size and strength results of the big skills group highlight the fact that the NFL-225 test and 1-RM bench press may be important assessment tests for those positions. The lack of a moderate or strong relationship between either physical performance test and playing ability in the other groups likely indicate that these positions do not have to possess

high levels of strength and endurance in order to be successful. Rather the demands of these tests do not accurately match the game demands of those positions. The results of this study indicate that high levels of upper body strength and endurance are important qualities to aim at developing for big skill positions.

## 5. Conclusion

The values found in the present study may be representative of the physical performance characteristics of starters and non-starters in the stated groups in NCAA division IA football players. Athletes and coaches can use this knowledge of performance testing results and how they relate to starters and non-starters at different positions. This can be beneficial in identifying positions at which a given athlete may have the best chance of success. Additionally, this information can be used by strength and conditioning coaches to make off-season training programs more position specific based on the players playing status. This would make the training program more efficient for each player, particularly incoming freshmen who may possibly have the option to start their second year

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## Conflict of interest

None of the authors have any conflicts of interest to declare.

## Informed consent

All participants gave written informed consent to participate in this study.

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