The Relationship Between the National Football League Scouting Combine and Game Performance Over a 5-Year Period

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Abstract

Cook, J, Ryan, GA, Snarr, RL, and Rossi, S. The relationship between the National Football League scouting Combine and game performance over a 5-year period. *J Strength Cond Res* 34(8): 2492–2499, 2020—There has been doubt on the ability of the National Football League (NFL) Scouting Combine to predict successful future game performance. This study analyzed data from athletes who participated in the Combine between 2013 and 2017 ($n = 1,537$) and their subsequent year's performance in the NFL. Data from 6 athletic measures were normalized for each athlete when compared with all other athletes (avgCZ) and athletes of the same position (avgPZ). Correlational analysis was used to ascertain whether the physical performance tests were associated with subsequent year's game performance (avgS). A multiple linear regression was performed to examine whether individual event Combine performance could predict the subsequent year's avgS in the NFL. Of the 35 correlations found when examining relationships, only 2 correlations were found to be moderately strong, avgCZ—avgS2 ($r = 0.320$), avgPZ—avgS2 ($r = 0.332$), whereas most were found to be weak ($r < 0.3$). Furthermore, data analysis suggests that Combine measures can only explain approximately 2.6% of the variance in avgS 1 year after the Combine when using 3 (vertical jump, bench press, and PRO) performance tests as predictors. The primary results of this study suggest that the NFL Combine lacks predictive ability when examining first year game performance. Furthermore, it also lacks correlational strength when examining relationships between performance and subsequent 5-year performance in the NFL. Caution should be used if coaches, general managers, and other front office staff are considering the use of Combine data as a possible selection for the upcoming NFL Draft.

Key Words: predictive analytics, correlational analysis, regression analysis, sports performance, physical performance testing, data normalization, American football

Introduction

Every year, the National Football League (NFL) invites the top prospects from collegiate football to showcase individual talents in a series of performance and psychological tests, as part of the NFL Combine (Combine). The purpose of the Combine is to provide insight into the medical history, athletic abilities, psychological state, and skill level when performing positional drills of future potential prospects. In addition, the Combine is an avenue used by coaches, scouts, and general managers as additional criteria for potential selection in the upcoming NFL Draft (18,22).

The physical examination and medical history collected at the Combine is used to grade the athlete on their ability to participate in the NFL. Although research is limited, the grade of athlete has been reported to offer insight into the probability of playing in the NFL with high-, low-, and fail-grade athletes having a 58, 55, and 36% chance of playing at least one game in the NFL, respectively (5). Furthermore, higher-grade athletes having an extended career (41.5 games) compared with those of a low-grade (34.3 games) and failing-grade (19 games) (5). Athletes are also asked to complete the Wonderlic test, a psychological test used to briefly assess the athlete's mental capability and intelligence (7,20). For quarterbacks (QB), scoring well on this test could be advantageous due to positive relationships observed between test score and future performance (i.e., games started, approximate value, NFL wins, and NFL pass yards) (23). Although, despite the relationship between performance and test score research observed no relationship with draft status (23).

The most publicized aspects of the Combine are the physical performance tests. The physical performance tests are designed to assess athletic abilities and fitness associated with American football. The important physical attributes associated with of American football players (i.e., strength, speed, and power) are well studied, and research has highlighted the importance of them within the game (2,3,10,13,25). Furthermore, research has suggested that these attributes can also differentiate between starters and nonstarters (10), level of competition (i.e., Division 1 vs. Division 2) (13), and draft status (i.e., drafted vs. nondrafted) (27). The Combine uses 6 performance tests; the 40-yard dash (40yd), proagility shuttle (PRO), 225 lb bench press (BP) repetition max test, 3-cone drill (3C), vertical jump (VJ), and broad jump (BJ), all which have been thoroughly researched in their ability to measure these athletic characteristics stated above (24). Therefore, since the physical characteristics being tested at the Combine seem to be in line with the attributes identified as important to American football performance, it offers good face validity. However, there has been doubt on the ability of the NFL Combine to predict future success of athletes within the NFL (i.e., predictive validity).

Work by Kuzmits and Adams (18) examined the predictive validity of the Combine for QBs, wide receivers (WRs), and running backs (RBs) from 1999 to 2004. It was found that

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Combine exercises were not correlated with NFL success for QBs, as defined by draft order, yearly salary, games played (GP), and quarterback rating, or WR, as defined by draft order, yearly salary, GP, and yards per catch. For RBs, strong correlations were observed for sprints times (40, 20, and 10 yard) and measures of success in the NFL (draft order, yearly salary, GP per season, and average yards per carry). Furthermore, work by Teramoto et al. (30) similarly examined the predictive validity of the NFL Combine for RBs and WRs. For RBs they observed, the best predictor of performance (rushing yards per attempt) for the first 3 years and over the career of the athlete was the 10-yard sprint time. Vertical jump was observed at being significantly associated with performance (receiving yards per reception) over the first 3 years and career in the NFL when examining WR. Similarly, McGee and Burkett (22) examined the 2000 NFL Combine to determine whether performance measures could predict draft status. A total of 7 positions were analyzed; quarterback, wide receiver, running back, offensive line (OL), defensive line (DL), defensive backs (DBs), and linebackers (LBs) using prediction equations. Results indicated and the study concluded that the Combine accurately predicts draft status for RBs ($r^2 = 1.00$), WRs ($r^2 = 1.00$), and DBs ($r^2 = 1.00$). Furthermore, it can also be used for offensive linemen ($r^2 = 0.70$), defensive linemen ($r^2 = 0.59$), LBs, ($r^2 = 0.22$, and QBs, ($r^2 = 0.84$), but with less accuracy.

With previous research being limited in its scope by either number of years or number of positions examined (e.g., WRs, QBs, and RBs), little scientific analysis into the totality of the Combine is available. Furthermore, with all Combine and NFL game data being publicly accessible on web-based domains, it is interesting that greater amount of scientific analysis has not been published. The primary intent of this study was to investigate possible relationships between Combine performance and subsequent year(s) performance in the NFL for QBs, WRs, DBs, DL, LBs, OL, RBs, and tight ends (TEs) over a 5-year period from 2013 to 2017. Second, it was to examine whether performance in individual events is predictive of first year performance in the NFL.

Methods

Experimental Approach to the Problem

This study analyzed the NFL Combine data of college football players who participated in the Combine between 2013 and 2017 and their subsequent year's performance in the NFL. The measures used for analysis were the NFL combines 6 different measures of athletic performance: 40yd, VJ, BJ, 3C, PRO, and BP. Measures of NFL performance were total (offensive, defensive, and special teams) snaps (TS) and GP for each position over the sample timeframe. For example, a player who attended the 2013 NFL Combine would have 5 years of performance data available in comparison with a player who attended the 2017 Combine would only have single year of performance available. The number of active players for each respective Combine over the 5-year period is listed in Table 1. Within each year, TS was divided by GP to calculate average snap count (AVGS).

Subjects

This research study included a total of 1,568 subjects' data who attended the NFL Combine within a 5-year sample between 2013 and 2017. For the purpose of this study, positions were grouped together to form 9 groups; QBs, WRs, DBs, DL, LBs, OL, RBs, ST, and TEs. A total of 79 QB, 229 WR, 287 DB, 257 DL, 182 LB, 249 OL, 167 RB, 31 ST, and 87 TE NFL Combine data were examined. Because of the low sample size associated with the ST group, the position group was removed from the data set. For analysis, subject data were broken down by position in addition to being separated by year, as demonstrated in Table 2. Because of this study only requiring secondary analysis of data which is publicly available on web-based domains, which do not disclose individual's health information, Institutional Review Board approval was not required. The study was approved by Georgia Southern University, however.

Table 1
Number of subjects separated by position and year drafted from the National Football League Combine.*

Position group	2013	2014	2015	2016	2017	Total
QBs	14	18	14	18	15	79
RBs	37	33	35	29	33	167
TEs	18	16	18	15	20	87
OL	52	44	53	53	47	249
DL	42	50	53	63	49	257
LBs	34	34	39	39	36	182
DBs	57	56	56	59	59	287
WRs	35	50	45	43	56	229
Total	289	301	313	319	315	1,537

*QBs = quarterbacks, RBs = running backs, TEs = tight ends, OL = offensive linemen, DL = defensive linemen, LBs = linebackers, DBs = defensive backs, WRs = wide receivers.

Procedures

The data obtained for this study were collected from pro-football-reference.com and nflcombineresults.com. Data from each NFL Combine year were collected from www.nflcombineresults.com; snaps and GP were collected from www.pro-football-reference.com. First, athletes who attended and participated in the NFL Combine between 2013 and 2017 were identified using nflcombineresults.com. Once identified, their Combine data were then collected, including performance in the: 40yd, PRO, BP, VJ, BJ, and 3C. Second, annual career performance statistics of TS and GP was collected for each athlete's entire NFL careers up to the 2017 season.

Table 2
Number of subjects categorized by years out from National Football League Combine.*

	Years out from NFL Combine				
Position group	1 y	2 y	3 y	4 y	5 y
QBs	79	64	46	32	14
RBs	167	134	105	70	37
TEs	87	67	52	34	18
OL	249	202	149	96	52
DL	257	208	145	92	42
LBs	182	146	107	68	34
DBs	287	228	169	113	57
WRs	229	173	130	85	35
Total	1,537	1,222	903	590	289

*NFL = National Football League, QBs = quarterbacks, RBs = running backs, TEs = tight ends, OL = offensive linemen, DL = defensive linemen, LBs = linebackers, DBs = defensive backs, WRs = wide receivers.

Table 3

Number of participants per National Football League Combine event over a 5 year period from 2013 to 2017.*

Position	40 yd Count (Avg ± *SD*) (s)	BP Count (Avg ± *SD*) (reps)	VJ Count (Avg ± *SD*) (cm)	BJ Count (Avg ± *SD*) (cm)	PRO Count (Avg ± *SD*) (s)	3C Count (Avg ± *SD*) (s)
DBs	265 (4.53 ± 0.10)	232 (15.06 ± 4.05)	240 (90.32 ± 6.91)	240 (309.83 ± 14.58)	188 (4.18 ± 0.14)	185 (6.95 ± 0.18)
DL	241 (4.97 ± 0.22)	211 (24.82 ± 5.03)	214 (78.64 ± 9.83)	211 (282.85 ± 21.69)	189 (4.55 ± 0.21)	188 (7.48 ± 0.34)
LBs	164 (4.73 ± 0.12)	144 (21.47 ± 4.05)	149 (85.37 ± 8.00)	157 (299.62 ± 15.14)	117 (4.33 ± 0.15)	109 (7.13 ± 0.22)
OL	235 (5.25 ± 0.18)	205 (25.28 ± 4.99)	210 (68.91 ± 7.75)	202 (260.32 ± 16.31)	200 (4.76 ± 0.19)	191 (7.83 ± 0.30)
QBs	73 (4.84 ± 0.16)		71 (78.31 ± 7.19)	71 (284.05 ± 16.71)	67 (4.73 ± 0.15)	63 (7.11 ± 0.21)
RBs	156 (4.60 ± 0.13)	141 (19.50 ± 4.92)	149 (86.49 ± 8.28)	146 (301.35 ± 14.68)	100 (4.30 ± 0.15)	99 (7.08 ± 0.21)
TEs	76 (4.76 ± 0.13)	72 (20.26 ± 4.32)	67 (83.64 ± 7.42)	66 (297.23 ± 15.04)	56 (4.40 ± 0.13)	54 (7.18 ± 0.20)
WRs	216 (4.52 ± 0.10)	180 (13.50 ± 4.04)	209 (88.44 ± 8.00)	207 (307.57 ± 14.94)	175 (4.23 ± 0.15)	167 (6.95 ± 0.20)

*Avg = average; reps = repetitions; 40 yd = 40 yard dash; BP = bench press; VJ = vertical jump; BJ = broad jump; PRO = pro agility; 3C = 3-cone drill; DBs = defensive backs; DL = defensive linemen; LBs = linebackers; OL = offensive linemen; QBs = quarterbacks; RBs = running backs; TEs = tight ends; WRs = wide receivers; No QBs completed the BP over the 5 year period.

Statistical Analyses

Initially, individual athletic performance measures were normalized through Z-scores for each event completed at the NFL Combine. Average Z-scores were calculated for every athlete when compared with all other athletes (avgCZ) and athletes who played the same position (avgPZ). This method of normalization of various data for analysis has been previously supported (6,25). Average snaps played (avgS) was then calculated, by dividing TS by GP, for each season for each athlete. To then determine whether the 6 athletic performance measures were related to future performance in the NFL, both avgCZ and avgPZ were correlated against avgS for each season (i.e., avgS1 = avgS 1 year out from the Combine, avgS2 = avgS 2 years out from the Combine). After examination, it was found the data violated assumptions of normality, thus Spearman's rho correlations were used for analyses. Next, a forward-selection multiple linear regression (MLR) was performed to examine whether individual event Combine performance could predict the subsequent years' performance in the NFL. Data were excluded pairwise to allow for use of cases that contain some missing data (i.e., individuals who did not complete every event). Furthermore, additional forward selection MLR was performed to examine whether individual event Combine performance could predict the subsequent years' performance in the NFL when categorized by position. Data were analyzed using SPSS (version 25.0; SPSS, Inc., Chicago, IL). An a priori 5% level of significance ($p \leq 0.05$) was used to ascertain statistically significant correlations.

Results

Descriptive Statistics

Of the 1,536 athletes whose data were collected, a total of 1,504 were used for the correlational and regression analysis. A total of 32 subjects were excluded from analysis because they did not perform any of the 6 Combine measures; therefore, an avgCZ or avgPZ could not be calculated. Of the 1,504 athletes used for analysis, 802 (53.5%) completed all 6 events. When broken down by event, 1,426 (94.8%) completed the 40yd (4.78 ± 0.30 seconds), 1,185 (78.8%) completed BP (20.00 ± 6.00 repetitions), 1,309 (87.0%) completed VJ (82.68 ± 10.87), 1,300 (86.4%) completed BJ (293.12 ± 9.31), 1,092 (72.6%) completed PRO (4.40 ± 0.26 seconds), and 1,056 (70.2%) completed 3C (7.26 ± 0.41 seconds). Further breakdown of events completed by position group can be seen in Table 3. When examining snaps played, 1,096 athletes went on to average at least 1 snap played in the NFL. When examining this more closely by separating the athletes by position group, 221 (78.6%) DBs, 198 (79.5%) DL, 136 (77.7%) LBs, 172 (69.6%) OL, 39 (51.3%) QBs, 116 (70.3%) RBs, 65 (76.5%) TEs, and 149 (65.9%) WRs went onto average at least 1 snap in the NFL.

Combine Correlation Analysis

The results of the correlation analysis for avgCZ and avgPZ for the Combine as a whole are presented in Table 4. A Spearman's rho correlation coefficient was calculated for the relationship between avgCZ, avgPZ, and avgS1–5 for the Combine as a whole. AvgCZ had significant, weak, positive correlations with avgS1 and avgS2. Furthermore, significant, weak, positive correlations were found between avgPZ and avgS1 and avgS3. Athletes who performed better at the Combine on average played more snaps over the first 2 years of their career than their competitive peers.

Positional Correlation Analysis

The results of the correlation analysis for avgCZ and avgPZ for the Combine as a whole are presented in Table 5. A Spearman's rho correlation coefficient was calculated for the relationship between avgCZ, avgPZ, and avgS1–5 for each of the 8 position groups. No significant relationships were observed for DL and QBs when examining avgCZ or avgPZ and the first 5-year performance.

Defensive Backs

Table 5 presents the correlation analysis for DBs. Significant, weak, positive correlations between avgCZ and the first 4 years of performance were found. Similar relationships were found

Table 4

Spearman's rho correlation matrix of average positional and total Combine Z-scores and average snaps played in the National Football League over a 5-year period.*

	avgCZ	avgPZ	avgS1	avgS2	avgS3	avgS4	avgS5
avgCZ	1	0.793†	0.133†	0.103†	0.045	0.016	0.006
p		0.01	0.01	0.01	0.17	0.69	0.92
N		1,504	1,504	1,202	899	587	289
avgPZ		1	0.148†	0.146†	0.132†	0.044	0.097
p			0.01	0.01	0.01	0.29	0.1
n			1,504	1,202	899	587	289

*AvgCZ = average Combine Z-score; avgPZ = average positional Z-score; avgS1 = average snaps played 1 year out from the Combine; avgS2 = average snaps played 2 years out from the Combine; avgS3 = average snaps played 3 years out from the Combine; avgS4 = average snaps played 4 years out from the Combine; avgS5 = average snaps played 5 years out from the Combine.
†Correlation is significant at the 0.01 level.

Table 5

Spearman's rho correlation matrix of average positional and total Combine Z-scores and average snaps played in the National Football League over a 5-year period for all position groups.*

Position group	avgCZ	avgPZ	avgS1	avgS2	avgS3	avgS4	avgS5
DBs							
avgCZ	1	0.797‡	0.279‡	0.292‡	0.242‡	0.211†	0.175
p		0.01	0.01	0.01	0.01	0.02	0.19
n		281	281	224	169	113	57
avgPZ		1	0.266‡	0.259‡	0.240‡	0.173	0.101
p			0.01	0.01	0.01	0.17	0.1
n			281	224	169	113	57
LBs							
avgCZ	1	0.957‡	0.280‡	0.320‡	0.254‡	0.194	0.239
p		0.01	0.01	0.01	0.01	0.12	0.17
n		175	175	142	106	67	34
avgPZ		1	0.289‡	0.332‡	0.269‡	0.203	0.227
p			0.01	0.01	0.01	0.1	0.2
n			175	142	106	67	34
OL							
avgCZ	1	0.698‡	0.150†	0.269‡	0.188†	0.074	0.042
p		0.01	0.02	0.01	0.02	0.47	0.77
n		247	247	201	149	96	52
avgPZ		1	0.057	0.167†	0.044	−0.039	0.104
p			0.37	0.02	0.6	0.71	0.46
n			247	201	149	96	52
RBs							
avgCZ	1	0.937‡	0.240‡	0.215†	0.197†	0.102	0.209
p		0.01	0.01	0.01	0.04	0.4	0.22
N		165	165	132	105	70	37
avgPZ		1	0.232‡	0.237‡	0.234†	0.128	0.187
p			0.01	0.01	0.02	0.29	0.27
n			165	132	105	70	37
TEs							
avgCZ	1	0.916‡	0.225†	−0.087	0.01	0.023	0.208
p		0.01	0.04	0.49	0.95	0.9	0.41
N		85	85	66	52	34	18
avgPZ		1	0.163	−0.12	0.046	0.03	0.299
p			0.14	0.34	0.75	0.86	0.23
n			85	66	52	34	18
WRs							
avgCZ	1	0.866‡	0.146†	0.192†	0.132	0.087	0.013
p		0.01	0.03	0.01	0.13	0.43	0.94
n		226	226	172	130	85	35
avgPZ		1	0.223‡	0.210‡	0.203†	0.157	0.117
p			0.01	0.01	0.02	0.15	0.5
n			226	172	130	85	35

*AvgCZ = average Combine Z-score; avgPZ = average positional Z-score; avgS1 = average snaps played 1 year out from the Combine; avgS2 = average snaps played 2 years out from the Combine; avgS3 = average snaps played 3 years out from the Combine; avgS4 = average snaps played 4 years out from the Combine; avgS5 = average snaps played 5 years out from the Combine; DBs = defensive backs; LBs = linebackers; OL = offensive linemen; RBs = running backs; TEs = tight ends; WRs = wide receivers.

†Correlation is significant at the 0.05 level.

‡Correlation is significant at the 0.01 level.

between avgPZ and performance measures where significant, weak, positive correlations were found in relationship with avgS1, avgS2, and avgS3. DBs that performed better at the Combine had a greater snap average for the first 4 years of their career. Furthermore, those who performed better than other DBs had a greater snap average for the first 3 years of their career.

Linebackers

Table 5 presents correlations between average Z-score (avgCZ and avgPZ) and avgS over a 5-year period for LBs. AvgCZ had significant, weak, positive correlations with avgS1 and avgS3 as well as a significant, moderate, positive correlation with avgS2. AvgPZ demonstrated similar relationships, with significant, weak, positive correlations with avgS1, avgS3, and significant, moderate, positive correlation with avgS2. The positive direction of these relationships indicates LBs who performed better at the Combine had a greater snap average for the first 3 years of their career.

Offensive Linemen

The results of the correlational analysis for OL are presented in Table 5. Significant weak, positive correlations were observed between avgCZ and the first 3-year performance in the NFL. An additional significant weak, positive correlation was observed between avgPZ and second year performance (avgS2). Offensive line who had a greater avgCZ played on average a great number of snaps for 3 years out from the Combine.

Running Backs

Table 5 presents the results of the correlational analysis for RBs. Weak positive correlations between avgCZ and the first 3 years of performance were found. Similarly, again for avgPZ, weak positive correlations were found for the first 3 years of performance indicating a significant relationship between the variables. RBs that had greater avgCZ and avgPZ scores played on average a greater number of snaps for the first 3 years of the career.

Tight Ends

Table 5 presents correlations found between average Z-score (avgCZ and avgPZ) and avgS over a 5-year period for TEs. A weak positive correlation was found between avgCZ and avgS1. The positive direction of these relationships indicates TEs who performed better at the Combine on average had a greater snap average the following season.

Wide Receivers The results of the correlational analysis for WRs are presented in Table 5. Weak positive correlations were observed between avgCZ and the first 2-year performance in the NFL. Additional weak positive correlations were observed between avgPZ and the first 3-year performance in the NFL indicating a significant relationship between the variables. Wide receivers who had a greater avgCZ played on average a great number of snaps for 2 years out from the Combine. Similarly, WRs who performed better examining the Combine as a whole had a greater snap average for the first 3 years of their career.

Combine Regression Analysis

The data were inspected to check for any violations of assumptions. The normal probability and residual plots were examined to ensure that the assumptions of normality, linearity, and homoscedasticity were not violated. The observed tolerance levels for each of predictor used in each of the models were above 0.1 indicating no multicollinearity (9). Durbin-Watson values were all within recommended values, which are accepted as normal, and as no values were less than or greater than 1.0 or 3.0, respectively, there was no definite cause for concern (9). However, after inspection, 3 models (Total Combine, DL, and LBs) had standard residual values of above 3.0 or below −3.0, which suggests potential outliers (9). Although, Cook's distance was not seen to be greater than 1.0 for any of the models produced

Table 6

Summary of regression analysis of average Combine performance in physical performance tests over a 5-year period on predicting average snaps played one year out from the National Football League Combine.*

							95% CI	
Significant predictors	B (*SE*)	β	*t*	*p*	r_a^2	*SEE*	Lower bound	Upper bound
VJ	0.471 (0.248)	0.093	1.902	0.06	0.017	21.0577	−0.015	0.957
BP	0.373 (0.132)	0.11	2.832	0.01	0.022	21.4587	0.114	0.631
PRO	−9.290 (4.283)	−0.113	−2.169	0.01	0.026	21.411	−17.697	−0.883

*VJ = vertical jump; PRO = shuttle run; BP = bench press; dependent variable = average snaps played; CI = confidence interval.

suggesting that no one case had any excessive influence on the regression coefficients (29); thus, they were not removed for the regression models.

The results of the MLR analysis on the Combine measures and subsequent years' performance in the NFL are presented in Table 6. A MLR was calculated to predict subjects' avgS based on performance in each of the 6 Combine measures (i.e., 40yd, BJ, VJ, 3C, PRO, and BP) using every athlete who participated in the Combine over the 5-year period. A statistically significant regression model was found ($F = 8.516$, $p = 0.01$), with an adjusted r_a^2 of 0.026, when using VJ, BP, and PRO as predictors. The regression model explained 2.6% of the variance in avgS played the year after the Combine. The positive regression coefficient for both VJ and BP indicates that a greater jump height and more repetitions, for each test, respectively, were associated with a greater avgS count. The negative regression coefficient for PRO indicates that a faster time is associated with a greater avgS count. However, BJ ($p = 0.39$), 40yd ($p = 0.10$), nor 3C ($p = 0.21$) was significant to the regression model.

Positional Regression Analysis

The results of the MLR analysis on the Combine measures and subsequent year's performance in the NFL are presented in Table 7. A MLR was calculated to predict subjects' avgS based on performance in each of the 6 Combine measures (40yd, BJ, VJ, 3C, PRO, and BP) for every athlete over the 5-year period when separated by position. No regression equation could be calculated for the position of QBs due to lack of significant predictors.

Defensive Backs

A significant regression equation was found ($F = 8.973$, $p = 0.01$), with an r_a^2 of 0.095, when using 40yd and VJ as predictors. The regression model explained 9.5% of the variance in avgS played the year after the Combine for DBs. The positive regression coefficient for VJ indicates that greater jump heights were associated with a greater avgS count. The negative regression coefficient for 40yd indicates that a faster time is associated with a greater avgS count. However, BP ($p = 0.43$), BJ ($p = 0.30$), PRO ($p = 0.70$), nor 3C ($p = 0.89$) was significant to the regression model.

Defensive Linemen

A significant regression equation was found ($F = 7.056$, $p = 0.01$), with an r_a^2 of 0.043, when using PRO as a predictor. The regression model explained 4.3% of the variance in avgS played the year after the Combine for DL. The negative regression coefficient for PRO indicates that a faster time is associated with a greater avgS count. However, 40yd ($p = 0.11$), BJ, BP ($p = 0.05$), VJ ($p = 0.83$), BJ ($p = 0.29$), nor 3C ($p = 0.71$) was significant to the regression model.

Linebackers

A significant regression equation was found ($F = 12.906$, $p = 0.01$), with an r_a^2 of 0.202, when using PRO and 40yd as predictors. The proposed regression equation was indicated to be as follows:

$$\text{avgS} = 423.609 - (46.344 \times \text{PRO}) - (42.240 \times 40\text{yd}),$$

where both PRO and 40yd are measured in seconds. The regression model explained 20.2% of the variance in avgS played the year after the Combine for LBs. The negative regression coefficient for 40yd and PRO indicates that a faster time is associated with a greater avgS count. However, BJ ($p = 0.24$), VJ ($p = 0.86$), BP ($p = 0.39$), nor 3C ($p = 0.83$) was significant to the regression model.

Table 7

Summary of regression analysis of average positional performance in physical performance tests over a 5-year period on predicting average snaps played one year out from the National Football League Combine.*

								95% CI	
Position	Significant predictors	B (*SE*)	β	*t*	*p*	r_a^2	*SEE*	Lower bound	Upper bound
DBs	40yd	−54.335 (20.112)	−0.218	−2.701	0.01	0.068	23.319	−94.082	−14.589
	VJ	1.666 (0.713)	0.188	2.337	0.02	0.095	22.983	0.257	3.075
DL	PRO	−15.827 (5.958)	−0.207	−2.656	0.01	0.043	16.042	−27.595	−4.059
LBs	PRO	−46.344 (13.378)	−0.334	−3.464	0.01	0.164	18.747	−72.915	−19.773
	40yd	−42.240 (16.594)	−0.245	−0.245	0.01	0.219	18.218	−75.197	−9.283
OL	PRO	−32.843 (10.932)	−0.231	−3.004	0.01	0.053	27.001	−54.433	−11.253
RBs	BJ	0.648 (0.261)	0.262	2.488	0.02	0.069	13.925	0.13	1.166
TEs	3C	−28.026 (11.608)	−0.339	−2.415	0.02	0.115	15.942	−51.407	−4.649
WRs	40yd	−39.366 (16.329)	−0.204	−2.411	0.02	0.042	19.164	−71.661	−7.071

*40yd = 40yard dash; VJ = vertical jump; PRO = shuttle run; BJ = broad jump; 3C = 3-cone drill; dependent variable = average snaps played; DBs = defensive backs; DL = defensive lines; LBs = linebackers; OL = offensive linemen; RBs = running backs; TEs = tight ends; WRs = wide receivers; CI = confidence interval.

Offensive Linemen

A significant regression equation was found ($F = 9.026$, $p = 0.01$), with an r^2_a of 0.053, when using PRO as a predictor. The regression model explained 5.3% of the variance in avgS played the year after the Combine for OL. The negative regression coefficient for PRO indicates that a faster time is associated with a greater avgS count. However, 40yd ($p = 0.23$), BJ ($p = 0.11$), VJ ($p = 0.24$), BP ($p = 0.33$), nor 3C ($p = 0.43$) was significant to the regression model.

Running Backs

A significant regression equation was found ($F = 6.188$, $p = 0.02$), with an r^2_a of 0.069, when using BJ as a predictor. The regression model explained 6.9% of the variance in avgS played the year after the Combine for RB. The positive regression coefficient for BJ indicates that greater jump heights were associated with a greater avgS count. However, VJ ($p = 0.25$), BP ($p = 0.18$), PRO ($p = 0.73$), 40yd ($p = 0.63$), nor 3C ($p = 0.31$) was significant to the regression model.

Tight Ends

A significant regression equation was found ($F = 5.830$, $p = 0.02$), with an r^2_a of 0.115 when using 3C as a predictor. The regression model explained 11.5% of the variance in avgS played the year after the Combine for TE. The negative regression coefficient for 3C indicates that a faster time is associated with a greater avgS count. However, BJ ($p = 0.33$), VJ ($p = 0.27$), BP ($p = 0.58$), PRO ($p = 0.60$), nor 40yd ($p = 0.26$) was significant to the regression model.

Wide Receivers

A significant regression equation was found ($F = 5.182$, $p = 0.02$), with an r^2_a of 0.042, when using 40yd as a predictor. The regression model explained 4.2% of the variance in avgS played the year after the Combine for WR. The negative regression coefficient for 40yd indicates that a faster time is associated with a greater avgS count. However, BJ ($p = 0.56$), VJ ($p = 0.66$), BP ($p = 0.73$), PRO ($p = 0.59$), nor 3C ($p = 0.37$) was significant to the regression model.

Discussion

The NFL hosts the annual Scouting Combine in which coaches, scouts, and general managers attempt to gain greater insight into potential prospects for the upcoming NFL Draft. The primary results of this study suggest that the NFL Combine lacks predictive ability when examining first year game performance. Furthermore, it also lacks strength when examining relationships between performance and subsequent 5-year performance in the NFL.

The analysis of the physical performance tests used at the Combine revealed that normalized performance (avgPZ or avgCZ) is weakly correlated with performance in the NFL. Of the 35 correlations, only 2 correlations were found to be moderately strong, avgCZ − avgS2 ($r = 0.320$) and avgPZ − avgS2 ($r = 0.332$), whereas the majority were found to be weak ($r < 0.3$). Furthermore, our data analysis suggests that Combine measures can only explain approximately 2.6% of the variance in avgS 1 year after the Combine when using 3 (VJ, BP, and PRO) performance tests as predictors. Results of this study are in line with the results found in the literature (18,30). A possible explanation as to why performance is a precursor could be explained by further examination of the tests used in the Combine. Our results indicated that tests were significantly predictive of game performance for the 8 position groups; however, with the positional regression models only explaining up to 21.9% on the variance, a significant amount is left unexplained.

Previous literature has attempted to explain why the Combine struggles to offer insight into future performance (18,25,30). An explanation which has previously been conceived is the concept of equalization of performance due to the "rigorous prep courses," which athletes attend before the NFL Combine (18,25). To further build upon this point, the athletes who attend the prep courses, and ultimately attend the Combine practice, become better and improve the skill(s) tested at the Combine (i.e., physical performance tests). The improvement of non–sport-specific performance (i.e., speed, strength, and power) does not necessarily equate to improvement in football playing ability, although it has been suggested to be a precursor (13). Therefore, athletes who have improved their ability to perform well in the tests used at the Combine may not necessarily be high performers on the field. Thus, the equalization of performance would ultimately affect the ability of the Combine to differentiate between the high and low in-game performers.

When examining each individual performance test used at the Combine, further explanation could be found. It has been reported that real-game situations are not predetermined and is most often an unpredictable visual stimulus (i.e., agility) (11,16). Both "agility" tests used at the Combine, the 3C, and PRO tests, are predetermined routes, which do not require a reaction to a stimulus. Therefore, although both tests are accurate and reliable, they are measures of change of direction (COD) speed (i.e., physical and technical factors) (28) not agility. Change of direction speed is a central component of multidirectional sports (17), but the tests fail to measure the cognitive factors associated with agility (i.e., decision-making speed and accuracy) (31). Therefore, if the Combine only reveals insight into 2 of the 3 aspects associated with agility, true insight into possible game performance would be hindered.

The type of running surface has been called into question. As of 2015, 17 of the 31 NFL stadiums are equipped with artificial turf, the other 14 using natural grass (8). Although research has indicated that on newer forms of artificial turf linear sprint speed is similar to natural grass, COD speed has been reported to be significantly faster ($-3.0\% \pm 2.8\%$, $p < 0.001$) (12,21). The Combine is held at Lucas Oil Stadium, IN, which is equipped with artificial, more specifically FieldTurf (FieldTurf, Calhoun, GA). Although there is an absence of an absolute difference, nearly half of the stadiums do use natural grass, which could ultimately affect COD speed and therefore in game performance. In addition, the Combine is performed in minimalist attire, whereas in games, athletes perform with pads and helmets. Works by Brechue et al. (4) reported that football equipment has seen to impair sprint performance by $-2.9\% \pm 1.8\%$ when compared with wearing shorts and t-shirt. The impairment was also seen to be significantly greater in linemen ($-3.3 \pm 1.1\%$), compared to that of backs ($-2.5\% \pm 1.5\%$). An in-game reduction in sprint performance, as well as significant differences between positions, could explain the lack of predictive strength for the 40yd in this study.

A secondary notion, as evidence builds against the current predictive validity of the NFL Combine, it opens discussion as to why the Combine is still held if it offers little relationship or predictability to future game performance. One possible reason is that it offers an already lucrative franchise, an additional chance for monetary gain. It was reported that, in 2010, approximately 5.2 million people watched the NFL Combine; in 2012, the viewing base had grown to 6.51 million (15). The removal of such a highly publicized event, which continues to engross more and more views, could be deemed as a costly move. Second, although outside the scope of this study, some research have investigated the ability for the Combine to predict draft status (14,22,25). Although research is conflicting, works by McGee and Burkett (22) reported that performance at the Combine is highly predictive of eventual draft status for RBs, WRs, and DBs; it could be financially advantageous for athletes to perform well at the Combine. According to "2017 NFL Draft Tracker" (1), the average contract value for a first round draft pick was approximately $14,947,470 with $8,854,246 being guaranteed as a signing bonus. In comparison, the average contract value for a second round draft pick was $5,518,265 with $2,153,283 being guaranteed as a signing bonus. With the potential to possibly be selected earlier in the draft and increase possible earnings, it could offer reason as to why athletes proceed to partake and train to perform well.

Nevertheless, sports performance is a complex multifaceted concept, demanding multiple physical and mental skills (19). It is important to note that the 6 physical performance tests examined in this study are only one aspect of the Combine. Although little research has examined the predictive ability of the other aspects of the Combine, i.e., medical history, Wonderlic, and sport-specific sections, tentative usefulness has been suggested in the limited research (5,23). While outside the scope of this study to comment any further on the other aspects of the Combine, this could suggest that NFL teams may weight performance in other aspects higher than that of the physical performance tests. Alternatively, it could suggest that the Combine as a whole does not bare much usefulness and thus receives little acknowledgement from NFL scouts or general managers.

There are limitations associated with this study. First, the data used for this study were public access data obtained from third party online sources. If possible, these sources manually check across a variety of reliable web sources to attempt to ensure accuracy. Second, not every athlete at the Combine completes every event. As stated in the results, only 802 (53.5%) athletes completed all 6 events between 2013 and 2017. Within our total sample, no QB participated in the BP, and only 70.2 and 72.6% of athletes completed the 3C and PRO, respectively. Thus, avgCZ and avgPZ of athletes who completed more events would offer a better representation of their athletic performance than an athlete who only completed one event. Furthermore, because of the large number of correlations performed, spurious findings could be present. Thus, some significant correlations found could be attributable to the random chance model. Finally, this study only analyzed the physical performance tests, which is one part of the NFL Combine. Unfortunately, the results in the Wonderlic, medical history, and position specific drills are not publicly accessible; therefore, we were unable to include them for analysis. The addition of these tests for analysis could offer a greater insight into the relationship between the NFL Combine and future NFL performance.

Practical Applications

Of the 1,537 athletes whose data were collected, this study found the Combine was able to explain 2.6% of the variance in average snaps played in the NFL. The results of this study add to the growing body of literature, which suggests the lack of usefulness of the Combine in predicting future NFL performance. Although, examining Combine data comparison by position group could offer greater insight to future performance. Even so, caution should be used if coaches, general managers, and other front office staff are considering the use of Combine data as an aid for possible selection in the upcoming draft. The revision of the physical performance tests used to those that could offer a greater transfer to real-game performance could aid in improvement to the predictability of the Combine. Revisions should also include position-specific modifications such as 10yd dash for OL/DL, sprint momentum for RBs, and agility for DBs. Future studies should direct research to other aspects of the Combine, which could be advantageous in providing insight into future performance (i.e., Wonderlic, medical history). In addition, an all-encompassing study of every aspect of the Combine could provide valuable insight to the predictability of the Combine as a whole and not as individual sections.

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