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Article

Is the NFL Combine predictive of a defensive lineman's NFL career?

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SUMMARY

Many employers test the productivity and skills of potential employees prior to hiring them. The National Football League (NFL) uses the NFL Combine to put potential players through a series of five athletic drills (40-yard dash, 20-yard shuttle, vertical jump, broad jump, and bench press) before they are drafted. However, there is little evidence on whether the NFL Combine predicts future success for one key position: defensive linemen. A defensive lineman's job is to tackle the quarterback and stop run plays. We measure their success in two ways: pass rush grade (a player's ability to tackle the quarterback before they can pass the football) and run defense grade (a player's ability to tackle the running back). We used multiple linear regression analysis to test the hypothesis that a defensive lineman's Combine performance is not correlated with their performance in the NFL over their observed career. We controlled for college performance, weight, and height because these factors can predict NFL performance on their own. We found no statistically significant correlation between Combine drills and a player's NFL performance, with the exception of the 40-yard dash, which showed slightly significant correlation with a player's NFL pass rush grade. This suggests that NFL scouts should focus on college performance for defensive linemen, but could place some weight on the 40-yard dash done at the NFL Combine.

INTRODUCTION

Like all employers, National Football League (NFL) teams try to predict which candidates (college football players) will become successful employees (NFL players), in the hope of recruiting them. The NFL sends out scouts to watch college players and identify good candidates. Many scouts and coaches seek players who are more athletic than their peers. These players are deemed to have higher potential with more room to grow. A common saying in the NFL is, "you can't teach speed." This refers to coaches being able to teach players how to use their athletic prowess strategically, but only if there is an underlying level of athleticism. This is why naturally gifted athletes are so sought-after. One way that scouts observe college players' athleticism is by watching them perform at the NFL Combine. The Combine includes five athletic drills that players participate in: bench press, 40-yard dash, 20-yard shuttle, vertical jump, and broad jump. Scouts and coaching staff from all 32 NFL teams attend the event in Indianapolis, Indiana every year. A good Combine performance can substantially boost a prospect's draft stock (increasing their chance of being drafted earlier), while a poor showing can cause their stock to fall substantially. For example, wide receiver John Ross set the record for the 40-yard dash at the 2017 NFL Combine, which contributed heavily to him being drafted 9th overall (1).

However, while these drills demonstrate athletic prowess, there is little evidence for whether the Combine is a useful indicator of future NFL performance. One prior study examined whether Combine performances have predictive value for future NFL success for quarterbacks, running backs, and wide receivers (2). In this study, they tested for statistically significant correlations between each NFL Combine drill and various measures of player success. The authors found one significant correlation, with sprint tests relating to running back success (2). However, defensive players often go unnoticed; to our knowledge, no studies have examined whether the NFL Combine drills add predictive value to a defensive lineman's future NFL success.

Therefore, we wanted to determine whether the athletic drills at the NFL Combine add value in predicting a defensive lineman's NFL success after controlling for their college performance. We then wanted to further look at which specific drills added the most value, if any. We measured success using a player's pass rush grade (a player's ability to tackle the quarterback before they can pass the football) and run defense grade (a player's ability to tackle the running back). We found that only the 40-yard dash has additional predictive power (beyond college performance) in determining the success of defensive linemen. All other NFL Combine drills showed no statistically significant evidence of predicting the success of defensive linemen in the NFL. This suggests that the NFL should reconsider the resources it puts into the NFL Combine.

RESULTS

We used a multiple linear regression model to estimate the predictive value of NFL Combine drills on future NFL performance. While prior literature has tested for individual correlations, we used a multiple linear regression model to control for other factors that might affect NFL performance (2). We measured NFL performance using two variables: NFL pass rush grade (how well a player pressured the quarterback) and NFL run defense grade (how well a player stopped the run). These grades are assigned by expert analysts from Pro Football Focus. These analysts assign a score of -2 to +2 to every play, then aggregate the scores from all analysts and all plays to assign a grade (3). We regressed both run defense grade and pass rush grade on the Combine drills and four

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control variables (height, weight, college pass rush grade, college run defense grade) and calculated summary statistics (**Table 1**).

There were a total of 106 players in the final dataset after cleaning. Many of the drills and control variables had varying levels of correlation with one another (**Figures 1 and 2**). This was likely because certain aspects of a player's athleticism are positively or negatively related to specific factors. For example, someone who weighs more would likely have a slower 40-yard dash (a negative correlation) but might be able to bench more repetitions (a positive correlation). Our goal was to estimate whether the NFL Combine gives any additional information on a player's future performance in the NFL beyond what we can estimate from other observable player characteristics. Because many of these variables were correlated with one another, we used a multiple linear regression model to estimate the predictive value of each Combine event, adjusted for all of the other Combine events, weight, height, and college performance.

We tested whether NFL pass rush grade was significantly correlated with any of the combine drills, weight, height, college pass rush grade, or college run defense grade at a significance level of 0.1. We found *p*-values of less than 0.1 for two of these variables: 40-yard dash ($p = 0.088$) and college pass rush grade ($p = 0.0012$) (**Table 2**).

For context, we considered how a one standard deviation decrease affects NFL pass rush grade. Assuming a normal distribution, 68% of the observations fall within one standard deviation of the mean. For a one-standard-deviation decrease (0.22 seconds) in the 40-yard dash, a player's NFL pass rush grade increased by 4.93 points. As a point of comparison, for a one-standard-deviation increase in a player's college pass rush grade, a player's NFL pass rush grade increased by 4.40 points.

We tested whether these results were robust to potential multicollinearity in the Combine drills, weight, height, or college performance by calculating the correlation coefficient between each pair of these variables. If two of these variables are highly correlated (close to collinear), then we may not be able to accurately estimate the relationship between each of them and NFL performance at the same time. We found that three had an absolute value greater than 0.75 (suggests a strong correlation): broad jump and vertical jump (0.78), broad jump and 40-yard dash (-0.84), and 40-yard dash and weight (0.83). We ran additional versions of the model, dropping broad jump only or dropping broad jump and vertical jump together. We chose not to remove weight because it was an important control variable. In both cases, we found that the 40-yard dash became significant at the 5% confidence level ($p = 0.016$ when we dropped just broad jump and $p = 0.031$ when we dropped broad jump and vertical jump). The coefficients on the 40-yard dash were similar to the original estimates (-26.63 when we dropped just broad jump and -21.99 when we dropped broad jump and vertical jump). This indicates that our results are robust to removing variables from the model that are potentially collinear. The 40-yard dash remained a significant predictor of future NFL pass rush performance.

Variables	Min	1Q	Median	Mean	3Q	Max	Std Dev	Obs	Missing
Dash (Seconds)	4.51	4.79	4.93	4.94	5.07	5.48	0.22	106	0
Vert (Inches)	23.5	29	31	31.28	33.38	41	3.55	98	8
Broad (Inches)	89	108	113.50	112.40	118.00	133	8.35	96	10
Shuttle (Seconds)	4.14	4.38	4.52	4.53	4.66	5.15	0.21	87	19
Bench (Reps of 225 lbs)	14	22	25.00	25.78	28.75	42	5.40	78	28
Weight (Pounds)	237	269	289.50	289.80	309	347	24.05	106	0
Height (Inches)	72	75	76	75.60	76	79	1.51	106	0
College Pass Rush Grade	56.8	71.5	76.5	78.4	88.3	93.1	9.8	97	9
College Run Grade	49.6	74.3	79.2	78.8	85.6	96.6	9.7	97	9
NFL Pass Rush Grade	44.2	56.7	62.4	63.8	70.2	89.8	8.9	106	0
NFL Run Grade	29.5	53.6	59.9	58.5	64.8	77.1	10.2	106	0

Table 1: Summary statistics. We calculated the minimum, maximum, mean, median, 1st and 3rd quantiles (1Q + 3Q) for each variable. The last column shows the number of missing observations for each variable. Obs = number of observations for each variable.

We tested whether NFL run defense grade was significantly correlated with any of the Combine drills, weight, height, college pass rush grade, or college run defense grade at a significance level of 0.1. We found *p*-values of less than 0.1 for one of these variables: college run defense grade ($p = 0.063$) (**Table 3**). This was similar to the finding that NFL pass rush grade was significantly correlated with college pass rush grade (**Table 2**). The best college run defenders are usually better NFL run defenders.

We tested whether these results were robust to potential multicollinearity in the Combine drills, weight, height, college pass rush grade, and college run defense grade. As above, we ran additional versions of the model, dropping broad jump, then broad jump and vertical together. In both cases, the results did not change. None of the NFL Combine tests were significant predictors of NFL run defense grade.

DISCUSSION

We tested the hypothesis that the NFL Combine was not predictive of a defensive lineman's success in the NFL. We tested this hypothesis by running multiple linear regressions of NFL pass rush grades and NFL run defense grades on Combine data, controlling for college pass rush grades, college run defense grades, height, and weight.

We found that college pass rush grades were predictive of NFL pass rush grades and college run defense grades were predictive of NFL run defense grades. This strong evidence of correlation between college grades and NFL grades was not unexpected, as it is commonly accepted that the best college players are more likely to perform better at the professional level. We also found that the 40-yard dash showed slight evidence of correlation with NFL pass rush performance. No other Combine drill showed any statistically significant predictive value for NFL pass rush grade. The usefulness of the 40-yard dash has been widely debated. On one hand, when a player performs well in the 40-yard dash, the media and fans tend to assume that the player will move up the draft board (4). On the other hand, skeptics argue that many people overvalue the 40-yard dash (5). Our results suggest that the 40-yard dash does provide NFL scouts with some additional information about a player's future success in the NFL.

However, none of the Combine drills showed any statistically significant predictive value for NFL run defense grade. This was somewhat surprising, as players with a faster

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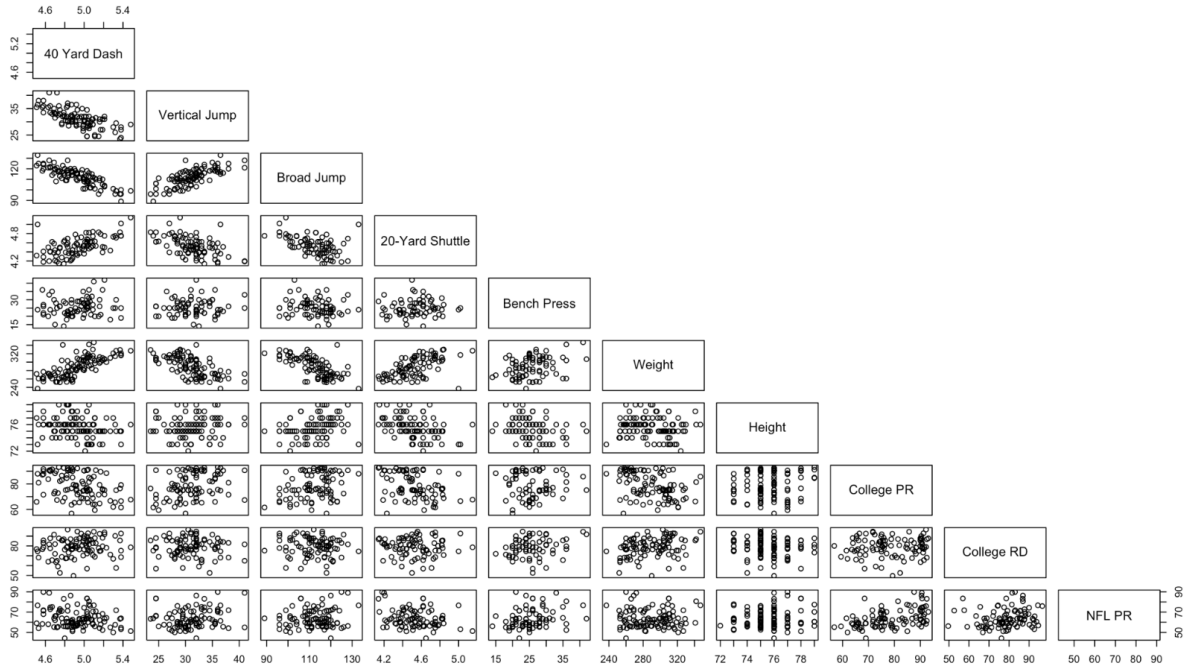

Figure 1: Correlations of variables to and NFL Pass Rush Grade. Each box shows the relationship between the variable in each row and column. A positive slope indicates a positive correlation between the two variables, and a negative slope indicates a negative correlation between the two variables. For example, the top left box shows a negative correlation between 40 yard dash time and vertical jump height. As the 40 yard dash time increases, vertical jump height decreases. The bottom row compares all variables to NFL pass rush grade. College PR = College Pass Rush Grade. College RD = College Run Defense Grade. NFL PR = NFL Pass Rush Grade.

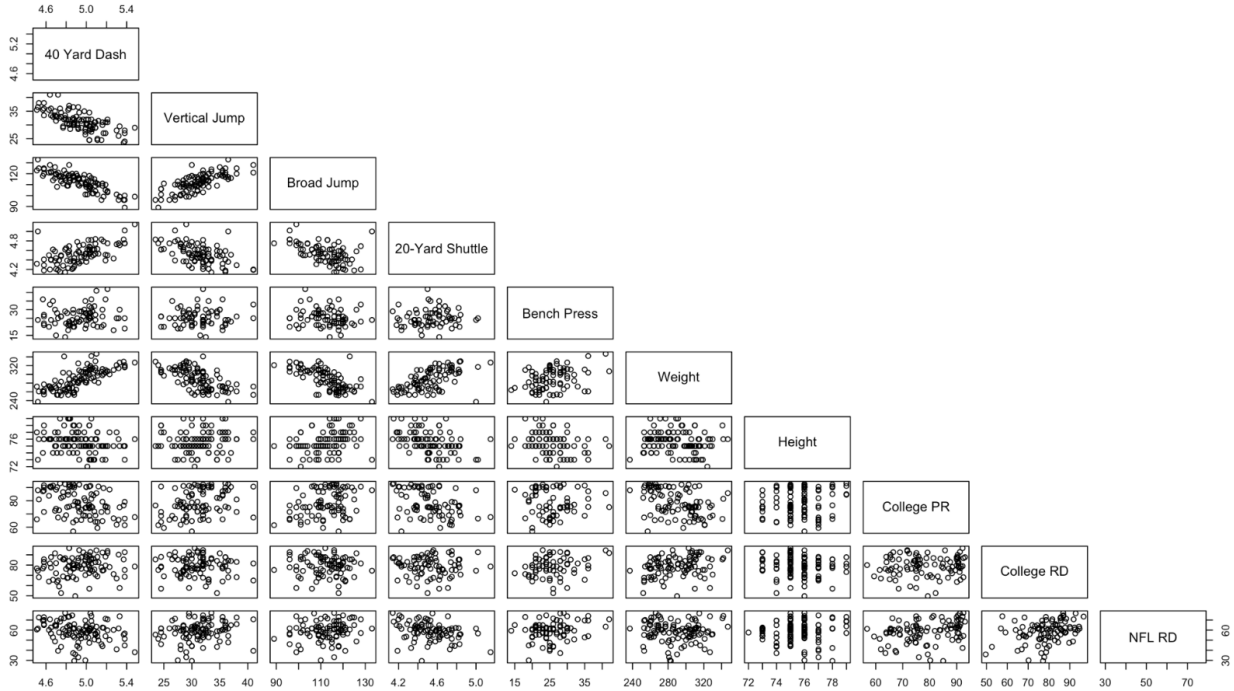

Figure 2: Correlations of variables to NFL Run Defense Grade. Each box shows the relationship between the variable in each row and column. A positive slope indicates a positive correlation between the two variables, and a negative slope indicates a negative correlation between the two variables. For example, the top left box shows a negative correlation between 40 yard dash time and vertical jump height. As the 40 yard dash time increases, vertical jump height decreases. The bottom row compares all variables to NFL run defense grade. College PR = College Pass Rush Grade. College RD = College Run Defense Grade. NFL PR = NFL Pass Rush Grade.

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Variables	Estimate	Std. Error	t-stat	p-value
(Intercept)	149.86	121.61	1.23	0.22
40 Yard Dash	-22.39	12.89	-1.74	0.088 *
Vertical Jump	-0.78	0.54	-1.45	0.15
Broad Jump	0.20	0.30	0.66	0.51
20 Yard Shuttle	-8.8	8.47	-1.04	0.30
Bench Press	0.39	0.26	1.51	0.14
Weight	0.16	0.10	1.59	0.12
Height	-0.23	0.96	-0.24	0.81
College Pass Rush Grade	0.45	0.13	3.45	0.0012 ***
College Run Grade	-0.09	0.13	-0.69	0.49

Table 2: Relationship between NFL Pass Rush Grade and Combine Drills, Weight, Height, College Run Defense Grade, and College Pass Rush Grade. We used a multiple linear regression model to find the correlation between an NFL player's NFL Pass Rush Grade and their combine performance, controlling for their college performance, height and weight. *Indicates slight evidence of correlation (p value < 0.1) ***Indicates very strong evidence of correlation (p value <0.01).

shuttle or dash, or higher bench press, are often thought to perform better at stopping the run. Stopping the run is all about using strength to beat an offensive lineman and using speed to shift side-to-side to tackle the runner. We did not find statistically significant evidence to support this idea.

These results demonstrate that college performance is the biggest indicator of future NFL performance for defensive linemen. Practically speaking, NFL scouts who are evaluating defensive linemen should focus on college performance and place a relatively high importance on the 40-yard dash in comparison to other Combine drills. In addition, the NFL may want to rethink the drills included in the Combine and should try to find drills that are more predictive of future performance. This study had some limitations. There were varying numbers of missing observations across the variables of interest. These were the players who opted out of certain Combine drills for a variety of reasons (injury, predicted performance, etc.). There were also nine players in our study for whom we were unable to find college data, possibly because they attended small colleges or because they opted out of playing their final year of college. It is likely that the players who were predicted to perform worse on certain drills opted out of those drills. These missing data could have impacted our results, although the direction of the bias is unclear. Another limitation was that we only included players drafted since 2016. Future research could extend the research to earlier years. This could increase the sample size and increase the chance of finding significant relationships. In addition, for players who played multiple years in the NFL, we took an average of their NFL grades. The Combine could be predictive of a player's best year or worst year in the NFL, even if it is not predictive of the average. Further, it is possible that there is more predictive value in looking at Combine performances that are in the bottom or top percentiles. Therefore future research could test whether very low or very high Combine scores predict future NFL performance. Additionally, position-specific drills could be studied to determine if they have any predictive value on future NFL performance. The Wonderlic test (a test to measure players' intelligence) and interviews could also be included to determine if the mental side of the Combine is more indicative of future success (6). New drills that replicate a game scenario could be implemented and tested as well.

Overall, our findings suggest that the 40-yard dash may be a promising indicator of future NFL performance, but there is substantial room to improve the tests the NFL uses to assess players.

Variables	Estimate	Std. Error	t-stat	p-value
(Intercept)	134.97	117.97	1.14	0.26
40 Yard Dash	-20.70	12.50	-1.66	0.10
Vertical Jump	-0.30	0.52	-0.58	0.56
Broad Jump	-0.24	0.29	-0.83	0.41
20 Yard Shuttle	-8.89	8.22	-1.08	0.28
Bench Press	0.32	0.25	1.29	0.20
Weight	0.09	0.10	0.89	0.38
Height	0.49	0.93	0.53	0.60
College Pass Rush Grade	0.20	0.13	1.55	0.13
College Run Grade	0.23	0.12	1.90	0.063*

Table 3: Relationship between NFL Run Defense Grade and Combine drills, Weight, Height, College Run Defense Grade, and College Pass Rush Grade. We used a multiple linear regression model to find the correlation between an NFL player's NFL Run Defense Grade and their combine performance, controlling for their college performance, height and weight. *Indicates slight evidence of correlation (p value <0.1)

MATERIALS AND METHODS

In this study, we used a multiple linear regression model to determine the predictive value of NFL Combine drills on future NFL performance. The multiple linear regression model formula is:

$$y_i = b_0 + b_1 x_{i1} + b_2 x_{i2} \ldots + b_p x_{ip} + e_i \qquad \textbf{(Equation 1)}$$

where y_i represents NFL pass rush grade or run defense grade for player *i,* b_0 represents the intercept, bp represents the relationship between x and y, and e_i represents the error term (7).

We used two dependent variables in this study: NFL pass rush grade (how well a player stopped the pass) and NFL run defense grade (how well a player stopped the run). Data for this study were collected from Pro Football Focus. Pro Football Focus compiled these grades using an algorithm that determines a player's performance on each play (3). This study included players who were drafted between 2016 and 2022 and who participated in the NFL Combine. We included both defensive ends and defensive tackles in this study.

We tested nine variables: five Combine drills, weight, height, college pass rush grade, and college run defense grade. We gathered data on NFL Combine drills from Pro Football Reference, another source of accurate NFL statistics (8). The Combine drills we tested were the bench press (number of reps of 225 pounds a player could complete), 40-yard dash (number of seconds to run 40-yards), 20-

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yard shuttle (number of seconds to complete a shuttle run), broad jump (number of inches a player jumped forward), and vertical jump (number of inches a player jumped vertically). We also controlled for a player's weight, height, and college performance. It is commonly accepted that college performance is highly predictive of NFL performance. Therefore, we controlled for college performance, as we wanted to isolate the predictive value of the NFL Combine. We obtained the college performance data from Pro Football Focus which uses the same algorithm to evaluate college and NFL performance (3). We took college performance grades from the players' last year in college. We hypothesized that weight and height could also have a significant impact on NFL performance, therefore we took weight and height from their official measurements at the Combine.

We cleaned the raw data in several ways. We removed any player who had played fewer than an average of 200 snaps (plays) per year as both a pass rusher and a run defender in the NFL. We did this to remove players for whom we had too little data. We removed any player who did not compete in at least one of the five NFL Combine events. We took the mean of the NFL pass rush grades and NFL run defense grades for those who played more than one season in the NFL. After cleaning, we were left with 106 observations (**Table 1**). We used a multiple linear regression model in order to isolate the predictive value of each individual variable, conditional on the other variables. We tested for statistical significance using a significance level of 0.1. The models use the original values of the variables (**Tables 2 and 3**). As a robustness test, we re-ran the models after scaling all the variables by subtracting the mean and dividing by the standard deviation. This normalized our variables, ensuring they were comparable. The results were nearly identical to those reported. We ran all models using RStudio software, using the lm package.

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