1

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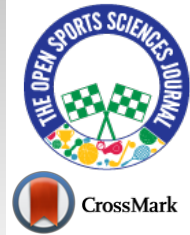
RESEARCH ARTICLE

The Influence of Pass Length and Height in Europe's Top 5 Leagues in Men's Football

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Abstract:

Aims:

The goal is to investigate how the length and height of passes impact a team's performance in national championships. A predictive model will be developed to analyse the success of different pass characteristics, including short, medium, and long length and ground, low, and high height. The model will be based on the points earned and will determine which combination of pass characteristics is most effective.

Background:

Passing is a critical aspect of technical skill for any football team. It involves transferring the ball from one player to another. Using a multiple linear regression model makes it possible to determine the most effective combination of pass length and height for scoring points. This model can help establish an equation that relates the three types of passes to the points scored.

Objective:

The objectives of this study are to develop a predictive model of pass length and height with the points obtained to know which type or combination of pass characteristics is most successful.

Methods:

We analyse match data from the 2017-2018 to 2020-2021 seasons of the 5 main European leagues. The variables analysed are based on pass length (short, medium and long) and height (ground, low and high). The correlation coefficient was used to measure the relationship between the variables and the points. A hierarchical multiple regression model was applied to determine the influence.

Results:

The results obtained showed that short passes explained 51% of the points scored by the teams, and the combination of the three types of distance improved the prediction to 54% of the points. About the height of the pass, when the three types were combined in the model, they managed to explain 54% of the points, where a great difference was observed between low and high passes, the high ones being more important.

Conclusión:

It can be concluded that the length and height of the pass are variables to be taken into account in obtaining points and in the team's performance.

Other:

Teams should prioritise short passes and pass along the ground, seeking to combine them with other types of passes promptly.

Keywords: Performance indicators, Performance analysis, Tactical behaviour, Soccer, Pass, Europe.

1. INTRODUCTION

Football is a complex sport with many random variables that constantly affect the game. It involves two teams playing on the same field, making it even more challenging due to the interaction between players and the game rules. The difficulty

is further increased by the need to use one's feet to control the ball, which creates emergent and self-organized behaviours [1 - 6]. To score more goals than the opponent, the team needs to synchronize their actions both in offense and defense [7 - 9] during the match. This requires coordination before every action.

To achieve the goal, technical actions are predicted more accurately than physical indicators [10, 11]. Specifically, shots on target are one of the best variables to discriminate between successful and unsuccessful teams [11 - 13]. Also indicators of success are ball possession [14 - 16], total number of shots [17 - 19], ball retrieval location [20, 21], number of passes and success rate of completed passes [11, 18, 19, 22, 23].

The fastest way to get the ball to the goal is bypassing [24]. When a team player has possession of the ball, it is best for them to aim to receive it in the most advantageous position. This position can be improved by 7% if they receive the ball while separated from the nearest direct defender and away from their partner or by 5% if they receive the ball while approaching [25]. In addition, the receiver should make a diagonal run, resulting in a 7% higher success rate for completing the play (goal, shot on target, free kick) [25].]. The success of a play, whether it is an organised attack, counter-attack or very short attack [20, 26 - 28] is closely related to passing accuracy.

In football, every goal except for set pieces, such as direct free kicks and penalties, involves at least one pass. This requires precise execution and coordination among teammates. The technical action of passing must be done accurately to ensure the ball is received by the intended player on the team. Reep & Benjamin [29] showed that 80% of goals occur with three passes or less, establishing the prevalence of direct play. However, Hughes & Frank [23] replicated these authors by showing that there were significantly more shots per possession in longer passing sequences than in shorter passing sequences for successful teams, but the conversion ratio of shots to goals is better for direct play than for possession play. Moreover, successful teams tend to adapt the sequence of passes depending on the moment of the match [30].

In terms of pass length, the analysis of Euro 2016 found no significant differences between the pass length variables (divided into three distances: 0-17m, 17-34m, and 34m+) of the teams that were able to qualify in the group stage and those that did not, observing that the probability of scoring decreased as the number of 34m and longer passes increased [31]. Also, his short passing game dominated Spain's victory at the 2010 World Cup [32, 33]. However, in the analysis of goal and pass length from Euro 2012, it was observed that the highest number of goals were scored with passes longer than 10 m (18.4%), while this rate decreased to 17.1% with passes shorter than 10 m [34]. On the other hand, in the 2014 World Cup, goals were scored at a rate of 22.2% from passes between 10-24 m [35].

Although the length of the pass has been studied, its height

is equally important in understanding its connection to team success and resolving previous literature debates. By analyzing the height of a pass, we can gain insight into how successful teams seek out free space, sometimes on the opposite side of the play, to surprise their opponents and gain an advantage. Consequently, this study aims to determine the relationship between pass length and height and the final classification of a team in national championships and develop a predictive model for pass length (short, medium and long) and height (ground, low and high) with the points obtained to know which type or combination of pass characteristics is most likely to result in success, *i.e.*, points scored.

2. MATERIALS AND METHODS

2.1. Sample and Measures

To assess the relationship between the points obtained and the variables analysed, we conducted a retrospective observational study, using historical of all team data in Europe's top 5 leagues in men's football from the 2017-2018 season to the 2020-2021 season, with a total of 392 teams (for example in LaLiga we used data from 4 seasons by 20 teams, being a total of 80 teams), extracted from the public website FBref.com [36] which obtains the data from Opta Sports data. This uses software that generates live match statistics. All possible types of ball touches and ball actions in the match are covered by a rigid set of definitions that are recorded in the system. The analysts are strictly trained to know the definitions thoroughly and become familiar with the keyboard shortcuts of the different actions in the system before they start working formally. Two groups of experienced operators were required to analyse a match independently. The results showed that team events coded by independent operators achieved very good agreement (kappa values were 0.92 and 0.94) [37]. Publicly available data were collected that did not require any formal approval by an institution.

2.2. Design and Procedures

The raw data for the variables of the four seasons have a sample of 392 teams. Variables are included directly by the data provider, whereas variables that are not in line with the proposed definitions are excluded. All definitions were obtained from either the official Opta F24 (Table **1**). This data was divided by the number of matches each team had played in the season to make a proper comparison. This was done because the Bundesliga does not have the same number of matches per season, with each team playing 34 matches and in the 2019-2020 season, Ligue 1 ended with teams having played 27 to 28 matches. LaLiga, Premier League, Serie A and Ligue1 play a total of 38 matches per team.

2.3. Statistical Analysis

Descriptive statistics (mean, minimum, maximum and standard deviation) was calculated for all variables. To assess an initial analysis of the effect of each variable on points, a correlation coefficient and a linear regression model were applied. The aim is to know which variables correlate more with obtaining points. Secondly, to find out the joint influence of the different types of pass length (short, medium and long)

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and pass height (ground, low and high), a hierarchical multiple regression model was used, where each model has 3 variables of the type of pass (length and height). The hierarchical order of the variables was established from highest to lowest correlation. Regression analysis statistics were estimated, including regression coefficients (B), standardised regression coefficients (β), standard error (SE), $R2$ and $\Delta R2$ (identify the percentage of variance in the target field explained by the input(s)). The Durbin-Watson test was used to check for collinearity effects. The models were run for each variable (length and height) without problems of heteroscedasticity in residuals or multicollinearity among regressors [38]. The following multiple linear regression model was used [39]:

$$Points = \beta 0 + \beta 1 \bullet Var1 + \beta 2 \bullet Var2 + \beta 3 \bullet Var3 + \varepsilon i$$

where: Var = variable; β0 is the intercept of the regression model; βx are the effects of the regressors; and εi is the disturbance term.

The effect size (*ES*) was calculated for a given $R2$ using Cohen's f2. The interpretation of ES was based on the following rank values: .2 = small effect, .5 = medium effect, .8 = large effect [40]. All statistical analyses were performed using Excel spreadsheets and SPSS 25.0 (IBM Corp., Armonk, NY, USA). G*Power was used to calculate the effect size. The significance level was set at $p \leq .05$.

Table 1. Variables.

Points: Most leagues are ordered by points. Three for a win and one for a draw.
Possession: One or more sequences in a row belonging to the same team. A possession is ended by the opposition gaining control of the ball.
Goals: Goals scored. The team or participant that scores the most goals is considered the winner of the match.
Shots: Total shots, not including penalty kicks.
Shots on target: Shots on goal, shots on target do not include penalties.
Assists: The final touch (pass, pass-cum-shot or any other touch) leading to the recipient of the ball scoring a goal. If the final touch is deflected by an opposition player, the initiator is only given a goal assist if the receiving player is likely to receive the ball without the deflection having taken place. Own goals, directly taken free kicks, direct corner goals and penalties do not get an assist awarded.
Passes completed: Total passes successfully received by teammate.
Passes attempted: Total passes made by the team.
Passes completed (%): Pass completion rate.
Distance progressed: The total distance, in yards, completed passes have travelled towards the opponent's goal. Note: Passes away from the opponent's goal are counted as zero yards progressed.
Short passes completed: Passes between 5 and 15 yards successfully received by the teammate.
Short passes attempted: Passes between 5 and 15 yards.
Short passes completed (%): Pass completion percentage of passes between 5 and 15 yards.
Medium passes completed: Passes between 15 and 30 yards successfully received by a teammate.
Average passes attempted: Passes between 15 and 30 yards.
Average passes completed (%): Pass completion percentage of passes between 15 and 30 yards.
Long passes completed: Passes over 30 yards successfully received by a teammate.
Long Passes Attempted: Passes over 30 yards
Long passes completed (%): Pass completion percentage of passes over 30 yards.
Passes in the final third: Completed passes that enter the final third of the area closest to the goal. Does not include set pieces
Passes completed in the area: Passes completed in the 18-yard box. Does not include set play
Ground passes: Passes that go along the ground or very close to the ground.
Low passes: Passes that leave the ground, but remain below shoulder level.
High passes: Passes that are above shoulder level at the highest point.

Table 2. Coefficients of the linear regression model and descriptive statistics.

Variable	$R2$	B	SE	SEE	t	M ± SD	Min-Max
Points per game	1	-	-	-	-	1.37 ± .46	.42-2.63
Possession	.715**	.051	.003	.32	20.19	50.03 ± 6.45	34.3-71.1
Goals	.833**	.838	.028	.25	29.74	1.34 ± .46	.5-2.88
Shots	.699**	3.367	.175	.49	19.29	12.36 ± .35	.34-2.24
Shots on target	.794**	1.69	.066	.59	25.78	4.12 ± 90.69	190.61-668.82
Assists	.784**	1.014	.041	.29	24.93	.92 ± 85.75	309.08-763.68
Passes completed	.726**	.004	.000	.32	20.86	387.09 ± .05	.62-.89
Passes attempted	.733**	.004	.000	.31	21.29	489.8 ± 312.65	1888.58-3782.85
Passes completed (%)	.611**	5.827	.382	.36	15.24	78 ± 42.88	78.16-338.89

(Table 2) contd.....

Variable	R2	B	SE	SEE	t	M ± SD	Min-Max
Distance progressed	.696**	.001	.000	.33	19.14	2621.26 ± 43.42	98.37-369.76
Short passes completed	.703**	.008	.000	.33	19.52	153.59 ± .03	.76-.93
Short passes attempted	.708**	.007	.000	.32	19.82	176.61 ± 42.27	71.84-299.32
Short passes completed (%)	.515**	7.533	.635	.39	11.87	86 ± 41.62	100.79-328.05
Medium passes completed	.694**	.008	.000	.33	19.04	167.27 ± .04	.71-.92
Medium passes attempted	.700**	.008	.000	.33	19.36	195.24 ± 9.84	37.55-95.65
Medium passes completed (%)	.528**	6.34	.516	.39	12.28	85 ± 9	77.53-132.71
Long passes completed	.558**	.026	.002	.38	13.29	59.9 ± .07	.4-.77
Long passes attempted	.205**	.01	.003	.45	4.14	100.92 ± 7.15	16.68-55.18
Long passes completed (%)	,653**	4.557	.268	.35	17.02	59 ± 2.28	3.95-15.74
Passes in the final third	.778**	.05	.002	.29	24.43	29.26 ± 90.74	138.79-623.47
Passes completed in the box	.742**	.149	.007	.31	21.87	7.94 ± 12.61	34.84-113.34
Ground passes	.712**	.004	.000	.32	20.01	320.41 ± 14.91	60.89-154.42
Low passes	.293**	.011	.002	.44	6.06	65.56 ± 82.66	150-592.16
High Passes	-.363**	-.011	.001	.43	-7.69	103.82 ± 48.92	115.71-409.39
Short and Medium Passes	.720**	.004	.000	.32	20.47	320.85 ± 50.17	109.39-379.74
Short and Long Passes	.729**	.007	.000	.31	21,003	213.49 ± 89.55	187.55-655.68
Medium and Long Passes	.694**	.006	.000	.33	19.06	227.17 ± 50.17	109.39-379.74
Short, Medium and Long Passes	.726**	.004	.000	.32	20.82	380.76 ± 89.55	187.55-655.68

Note: N= 392. Regression coefficients (B), standard error (SE), standard error of estimate (SEE), level of significance: *p<.01, **p<.001, mean (M), standard deviation (SD).

3. RESULTS

3.1. Linear Regression

Goals have the strongest correlation with achieving points (F= 884.68, $R2$=.833, p < .001), with 83% of the variance accounted for by goals, followed by shots on target (F= 664.34; $R2$ = .794; $p < .001$) with 79% as opposed to shots (F= 371.94; $R2$ = .699; $p < .001$). 001) with 79% as opposed to shots explaining 70% (F= 371.94; $R2$= .699; $p < .001$), assists (F= 621.48, $R2$=.784, p < .001) with 78% as well as passes in the final third (F= 596.98, $R2$=.778, $p < .001$). Passes attempted have a higher correlation (F= 453.29, $R2$=.733, $p < .001$) than passes completed (F= 435.14, $R2$= .726, $p <.001$), at 73%. Possession explains 71% of the points (F= 407.42, $R2$=.715, $p <.001$), being also lowers the percentage of completed passes (F= 232.24, $R2$= .611, $p <.001$), highlighting its 61% explain Table **2**.

About the distance of the pass, the short passes attempted have a higher correlation and explaining (F= 392.93, $R2$=.708, $p <.001$) than those completed (F= 381.16, $R2$=.703, $p <.001$), reducing the short passes completed when we talk about their percentage (F= 140.91, $R2$=.515, $p <.001$). In the medium passes, the same occurs as with the short passes, with a greater influence of those attempted (F= 374.95, $R2$= .700, $p <.001$) than those completed (F= 362.53, $R2$= .694, $p <.001$), reducing in percentage (F= 150.86, $R2$= 528, $p < .001$). However, the percentage of successful passes (F= 289.55, $R2$=.653, $p <.001$) was more influential in long passes than those completed (F= 176.73, $R2$=558, $p <.001$) and attempted (F= 17.15, $R2$=.205, $p <.001$).

About the height of the pass, a fairly wide difference was observed between passes along the ground (F= 400.34, $R2$=.712, $p <.001$), with high passes (F= 59.14, $R2$=-.363, $p < .001$) and with low passes (F= 36.75, $R2$=.293, $p < .001$).

3.2. Multiple Regression Short, Medium and Long Passes

The regression model was tested with 3 variables (short, medium and long passes completed), explaining a total of 54% of the points scored per game ($R2$ = .539; $p < .001$) Table **3**.

Table 3. Coefficients of the multiple linear regression model pass distance.

Models	F	R2	⊿R2	B	SE	SEE	β	p	1- β	f2
Model 1	381.16 (1, 390)	.494	.494	.22	.061	.33	-	<.001	1	.098
Short passes	-	-	-	.008	0	-	.703	<.001	-	-
Model 2	209,18 (2, 389)	.518	.024	.1	.066	.32	-	.13	1	1.07
Short passes	-	-	-	.004	.001	-	.41	<.001	-	-
Medium passes	-	-	-	.004	.001	-	.332	<.001	-	-
Model 3	151,02(3, 388)	.539	.021	-.251	.106	.31	-	.019	1	1.17
Short passes	-	-	-	.006	.001	-	.557	<.001	-	-
Medium passes	-	-	-	0	.001	-	.015	.887	-	-
Long passes	-	-	-	.011	.003	-	.245	<.001	-	-

Table 4. Coefficients of the multiple linear regression model pass height.

Models	F	R^2	ΔR^2	B	SE	SEE	β	p	1- β	f2
Model 1	400,34 (1, 390)	.507	.507	.222	.06	.32	-	<.001	1	1.03
Ground passes	-	-	-	.004	0	-	.712	<.001	-	-
Model 2	210,81 (2, 389)	.52	.013	-.015	.093	.32	-	.869	1	1.08
Ground passes	-	-	-	.003	0	-	.681	<.001	-	-
Low passes	-	-	-	.004	.001	-	.12	.001	-	-
Model 3	151,57(3, 388)	.54	.02	-.796	.213	.31	-	<.001	1	1.17
Ground passes	-	-	-	.004	0	-	.807	<.001	-	-
Low passes	-	-	-	.004	.001	-	.112	.002	-	-
High Passes	-	-	-	.006	.001	-	.187	<.001	-	-

The variance inflated factor (*VIF*) indicates that the assumption of non-multicollinearity is met at 5.663, 9.495; 2.923. No value above 10. The linear equation is as follows:

Y= -.251 + .005956*(Short passes) + .000164(Medium passes) + .011412(Long passes) with *p* = .019. Exact model values are shown.

3.3. Multiple Regression Passing on the Ground, Low and High Passes

The regression model was tested with 3 variables (ground, low and high passes) explaining a total of 54% of the points scored per game (R^2 = .54; *p* < .001) Table **4**.

The variance inflated factor (*VIF*) indicates that the assumption of non-multicollinearity is met, at 1.884; 1.072; 1.791. No value above 10. The linear equation is as follows:

Y= -.796 + .004079*(Ground Passes) + .004080(Low Passes) + .005741(High Passes) with p < .001. Exact model values are shown.

4. DISCUSSION

This study aims to determine the relationship between pass length and height and the final classification of a team in national championships and develop a predictive model for pass length.

Although passing has been studied by different authors [11, 14 - 16, 18, 22 - 25] our study can provide additional information to understand and analyse football and help to design training sessions and matches. The results of the present study indicate that the combination of pass length explains 54% of the points obtained in the national championship. Short passes were the type of pass with the highest scoring outcome, as was the pattern of play of successful teams such as the Spain national team in the 2010 World Championship or FC Barcelona that rely on a large number of passes with little distance between the receiver and the passer [32, 33, 41]. Improving the accuracy of medium and long passes by 2% each can enhance the model. However, it is important to consider the technical ability of the players to perform such passes as they are more complex. When successful, the receiver can maintain possession of the ball. It is also important to note that the success rate of long passes is more crucial than the number of attempts or successes alone. This is in line with some studies [34, 35] but in contrast with others [31, 32]. As a result, players should weigh the risks and benefits of executing these types of passes.

When it comes to the height of passes, there is a significant difference between ground passes (71%) compared to low passes (29%) and high passes (-36%). This finding suggests that executing high passes can be challenging due to the defender having more opportunities to defend and steal the ball during its longer flight time (since high passes are usually longer passes), and the receiver may find it harder to control the ball. In contrast, low passes are typically associated with medium-length passes, where defenders have more body parts to defend or when the pass is made between two defenders. These results found in this study extend those found by other authors [42, 43] who considered that the Spanish LaLiga was characterised by more ball possession (ground passing), the English Premier League was characterised by direct play (high passing), Italian Serie A by a highly developed use of counter-attacking (possibly with high passing) and Bundesliga high tempo and speed of play (passing on the ground) in 2014 and the following seasons until 2018 the top teams assimilated in their style of play, basing their game on possession (higher number of passes on the ground) [44, 45]. This change in team style could be seen in the last ten UEFA Champions League champions (2012 to 2021) where from 2012 to 2018 the champions were 5 times Spanish teams (Real Madrid CF and FC Barcelona), 1 German (FC Bayern München) and 1 English (Chelsea FC), and from the 2019 to 2021 season it was 2 English teams (Liverpool FC and Chelsea FC) and 1 German (FC Bayern München). Based on the multiple linear regression model, 51% of the points can be explained by ground passes alone. When combined with low passes, the percentage improves by 1.3%, and with high passes, it improves by 2%. This suggests that prioritizing ground passes, followed by high passes and then medium passes, would be effective. This combination of ground passing and high passes was previously demonstrated [46] in the 2018 World Cup, where seven out of eight quarter-final teams utilized this style of play.

In matching the types of passes between their length and height, teams should prioritise short passes on the ground (the most common in the offensive phase of teams) [32, 33, 41, 44, 45, 47, 48]. These should be combined with passes of different lengths and their height should be combined with the high first option and the low second option to improve performance [46]. By utilizing short and ground passes, teams can catch their opponents off guard and create open spaces. This is a clever tactic that can result in a successful play.

On the other hand, attempted passes have a higher

correlation (R2=.733) than completed passes (R2= .726), which may indicate that successful teams attempt more complicated passes than those that are not [12, 14]. These data are in line with the results found by Antequera *et al.* (2020), who demonstrated the relationship between completed passes and goals in LaLiga. The possession variable explains 71% of the points studied by other authors [14 - 16]; based on the results obtained, measuring this variable alone may not accurately reflect performance about passing. The decrease in this variable could be attributed to the significance of making swift and precise passes when the team has possession of the ball, resulting in more passes in less time. On the other hand, the percentage of passes stands out for its 61% explain rate. These results go against other authors [11, 18, 23], which have shown that longer possessions (higher pass success rate) have higher shot frequencies.

As a priori expected, goals are the variable that has the highest relationship with the achievement of points, explaining 83%, since at least one goal is needed to win, followed by shots on goal with 79%, as already demonstrated by other authors [11 - 13, 23]. With little difference are assisted, possibly due to their strong relationship with the goal, with 78%48. Passes in the final third, with almost 78%, may be linked, as other authors have already shown, to the place where the ball is recovered [20, 21], being of vital importance to recover the ball as close to the opponent's goal as possible.

This study has analysed the length and height of the pass in current football by adding information to the existing literature, where it has been shown that teams must make a combination in their passes to improve performance. It has had the limitation of not being able to evaluate the characteristics of the pass (length and height) depending on the area of the field where it is performed and between which players it is performed (midfielders with forwards, defenders between defenders...), the speed of the ball and the players. The findings tell us that the teams should be analysed according to the combination and the success they have in the types of passes to understand their style of play more exhaustively. Variables such as goals and shots should continue to be taken into account to analyse a team's performance, but the metrics should be expanded to have a more global vision of football. In future research, it is essential to consider other significant variables such as the area of the field from which the pass is made, the speed of the ball and the players, the probability of gaining an advantage over the opponent and the best type of pass.

We conducted exploratory and preliminary work, urging others to cross-validate the results and proposed models to identify the most robust ones that can predict the points teams score in their championships.

CONCLUSION

The main findings of this study show how teams might prioritise short passes and pass along the ground, seeking to combine them with other types of passes promptly. The fact of using, for example, long and high passes a smaller number of times in a match should not be forgotten by coaches in their training, seeking with their practice greater effectiveness in their use, among other things, to surprise the opponent. Passing

must continue to be a key aspect in matches and training because it influences team performance. It should not be worked on analytically but rather in real or almost-game situations in training so that the player can make the best decision as to what type of pass to use depending on the situation.

AUTHORS' CONTRIBUTION

Conceptualization, A.C-C. and A.G.-A.; methodology, A.G.-A., D.M-L. and I. R.; software, A.C-C.; validation, I.R.; formal analysis, A.C-C; investigation, A.C-C, A.G.-A. and I. R.; resources, A.C-C; data curation, A.C-C; writing—original draft preparation, A.C-C; writing—review and editing, A.G.-A. and I.R.; visualization, A.G.-A., V.E.V.Á., S.C.M..; supervision, I.R.; project administration, I.R.; funding acquisition, V.E.V.Á., S.C.M. and D.M-L All authors have read and agreed to the published version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available in the FBref at https://fbref.com/en/ [36].

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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