ORIGINAL ARTICLE

SECTION

Correlations of passes and playing formations with technical-tactical elements during the 2022 FIFA World Cup

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ABSTRACT

BACKROUND: This study on the 2022 Qatar FIFA World Cup examined: a) the existence of correlations between passes with other technical-tactical elements, b) the differences in technical-tactical elements in relation to team formation, and c) the characteristics of the key passes created during games.
METHODS: Sixty-four games were analyzed. Match-analysis data were collected using InStat database.
RESULTS: Spearman correlation revealed that the number of passes and key passes correlated with number of goals, chances and shots (P<0.05). Team ball possession was correlated with number of passes, key passes, chances, shots and the organized attacks (P<0.001). Kruskal-Wallis H non-parametric test revealed that the teams with the higher percentages of team ball possession, and the higher number of chances, shots and crosses used formations 1-4-2-3-1 and 1-4-3-3. Finally, most of the key passes performed in axis of the field and they were short low passes.
CONCLUSIONS: In conclusion, the ability of teams to keep the possession of the ball, looking for the key pass, and final action can be a factor in the team's success. A characteristic finding of the study was the preference of groups to manifest their attack from the axis. The equal distribution of attacks between the axis and the sides of the field makes the team's offensive function more unpredictable. Also, most formations concentrate several players on the axis, making it more difficult to complete an attack from this area.

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KEY WORDS: Soccer; Athletes; Sports medicine.

In modern football, technique and tactics are two areas that play an important role in the success of a team. High-level soccer players are characterized by a high level of technical skills, high tactical knowledge of the game combined with a high level of physical fitness. The tactic is intertwined with the technique as it is not possible to implement tactical offensive actions if the level of fitness[1] or the technique is limited.

The planned movements of the team to deal with specific situations in the match is called tactics. For the best implementation of tactics each team uses a formation.[2] The formation can be defined as "A specific structure defining the distribution of players based on their positions within the field of play".[3] Coaches, knowing the strengths and weaknesses of their players, choose the formation that will best serve their team. In modern literature there are several studies dealing with the effect of formations on technical-tactical elements during matches.[4, 5]

As mentioned above, the choice of formation is usually based on the strengths and weaknesses of the team, i.e. the advantages and disadvantages of the soccer players.[6] Also, the choice of formation has to do with the strength of the opposing team and its formation. The literature shows that studies dealing with the formation of teams and their effect on technical - tactical and fitness factors have been increasing over the last decade. Several methods have been

reported for the analysis of formations in recent years[5, 7, 8] but in many cases it starts with the visual observation of players' positions.[9, 10] Previous studies have investigated the relationship of formation with ball possession,[4] match location[11] or running performance in the match.[12] However, each coach uses a formation to achieve the technical-tactical goals he wants, and these goals can be differentiated by the quality of his players and their characteristics. Analysis of formations can help coaches understand which formation will best serve their plans.

A technical element that is especially important for a team's offensive play is passing. Information about the pass is also used to predict and evaluate the offensive function of a team. More specifically, the number of passes, their success rate or the forwarded passes are considered important factors predicting success of a team.[13-16]

In the 2014 World Cup many teams executed over 500 passes during a match.[17] But do all passes have the same value? The answer is obviously no.[18] Especially in the offensive half of the field, passes that create scoring chances have more value.[19, 20] Passes in relation to direction can be divided into parallel or vertical, while passes that create conditions for scoring or interrupt the opponent's defensive organization by increasing the chances of scoring can called key passes.

This world cup was described as one of the best in spectacle and the most productive in goals of all that has preceded it. As has been mentioned in previous studies, possession of the ball can produce scoring opportunities especially in an unorganized defense.[21, 22] We noticed teams trying to find the key pass after a large number of passes (possession game), but also teams playing direct football trying to find fast the key pass to score.

The analysis of major football tournaments helps to understand the evolution of the sport of football. The literature shows that studies concerning such tournaments on the effect of team formation with technical-tactical elements are very limited. This study will contribute to the knowledge of coaches and performance analysts on the relationships between technical and tactical elements.

Thus, the aim of this study was to investigate the characteristics of the key passes created during the World Cup in Qatar. More specifically, we investigated the place where the key passes took place, the actions that followed the pass and the result of these actions. Another purpose of the study was to investigate the existence of correlations of passes with other technical-tactical elements. Finally, the existence of a) correlations between team formations with technical-tactical elements and the existence of b) differences in technical-tactical elements in relation to team formation were investigated. The results of the study can affect both the attacking and the defensive phase of the game.

Materials and methods

Sample

The sample consisted of the 64 games of the football World Cup in Qatar. Thirty two teams from all over the world participated and for the first time it took place before the conclusion of the national championships (month of December). Moreover, the study was approved by the ethical committee of the Aristotle University of Thessaloniki (136/2023) in accordance with the ethical standards in sport and exercise research.

Experimental design

Technical-tactical data from all matches of the 2022 FIFA World Cup in Qatar were analyzed. Data were obtained from the InStat database, a web-based platform for sports performance analysis. The accuracy of the InStat data has been reported to be within acceptable limits, with alpha values ranging from good ($\alpha=0.82$) to excellent ($\alpha=1.00$).[23]

Formation

Playing formation was determined by two researchers and qualified coaches UEFA A diploma according to player distribution over the entire 90-minutes of match-play in accordance with previous researchers.[4] Inter-rating agreement of playing formation was evaluated by Cohens' kappa coefficients (k=0.92). A total of six playing formations were analyzed: 1) 1-3-4-3; 2) 1-3-5-2; 3) 1-4-1-4-1; 4) 1-4-2-3-1; 5) 1-4-3-3; 6) 1-4-4-2.

Technical variables

The variables used in the study are related to: 1) team formation (*e.g.* 1-4-3-3 or 1-3-5-2); 2) passes (*e.g.* number of passes, number of successful passes); 3) scoring (*e.g.* goal, shot on target); 4) execution area of attack or pass (axis or sideways of the field); 5) way of execution of the attack (counterattack or possession attack). The operational definitions of these technical variables are shown in Table I.[24-27]

Statistical analysis

Data normality were checked using Kolmogorov-Smirnov Test. Spearman correlation was used to assess the rela-

TABLE I.—*Technical performance measures and their definitions.*

Variables	Description
Pass	Any deliberate attempt by a player to play the ball to a teammate
Successful pass	A successful transfer of the ball from one player to another
Key pass	The final pass or pass-cum-shot leading to the recipient of the ball having an attempt at goal without scoring
Team possession	The percentage of match time the reference team is in possession of the ball not including the time the ball is out of play
Short pass	An attempted pass of less than 25 yards.
Long pass	An attempted pass of 25 yards or more
Cross	A pass from a wide position into a specific area in front of the goal
Attempt to score	An attempt to score a goal made with any (legal) part of the body, either on or off target
Goal	Score a goal
Shot	A touch aimed at goal with the intention of scoring
Shot on target	A shot that will hit within the posts. If the shot is blocked by a player within the penalty area it is still on target as long as the operator can see that it would have hit within the posts. If the ball hits the post or crossbar and goes directly into goal without having touched any players it is considered on target
Possession attack	Attack through many passes
Counterattack	Fast attack with few passes before the opponent organizes defensively
Variables related to spacing of pass or attack	
Final 3rd entry	An event that occurs in the opposition's final 3rd of the field where the previous event occurred outside of the final 3rd
Goal box entry	An event that occurs in the opposition's penalty box of the field where the previous event occurred outside of the penalty box
Attack from left side	Attack from the left side of the field
Attack from axis	Attack from the axis of the field
Attack from right side	Attack from the right side of the field
Team formation	A specific structure defining the distribution of players based on their positions within the field of play

tionships between key passes and passes with the other technical actions. Also, Spearman correlation was used to assess the relationships between playing formation with the other technical actions. Magnitudes of correlation coefficients (90% CI) were considered trivial ($r\leq0.1$), small ($0.1<r\leq0.3$), moderate ($0.3<r\leq0.5$), large ($0.5<r\leq0.7$), very large ($0.7<r\leq0.9$) and nearly perfect ($0.9<r\leq1.0$) according to Hopkins (2000).[28] Differences between the place of passing (center, right, left), the way of passing (high, low), the distance of passing (long, short) and the result of passing (goal, out, repulse, beam, block, new pass, penalty/foul) were investigated with Chi-square (χ^2) goodness of fit test. Comparisons between ball possession variables, and technical actions according to playing formation (*e.g.* 1–4–2–3–1 *vs.* 1–4–4–2 *vs.* 1–4–3–3) were performed using Kruskal-Wallis H non-parametric test. When necessary, nonparametric Bonferroni post hoc test was used. Statistical analysis was performed using the software IBM SPSS Statistics for Windows, v. 28.0 (IBM Corporation, Armonk, NY, USA). The statistical significance was set at P<0.05.

Results

A total of 429 key passes were performed in 64 games (mean: 6.7 key passes/match). Moderate correlations were observed between the number of passes and: 1) the number of chances (r=0.372, P<0.001); 2) the number of

shots (r=0.440, P<0.001); 3) the number of shots on target (r=0.301, P<0.001). It also showed a very high correlation with organized attacks (r=0.708, P<0.001) and percentage of team possession (r=0.885, P<0.001). Key passes ranged from small to large correlations with all indicators (P<0.001). The percentage of team possession of the ball showed moderate to large correlations with: 1) the number of key pass (r=0.373, P<0.001); 2) the number of chances (r=0.379, P<0.01); 3) the number of shots (r=0.465, P<0.001) and the number of organized attacks (r=0.716, P<0.001). All the correlations are presented in Table II.

The results from Kruskal-Wallis non-parametric test showed that the possession of the ball by the team (χ^2=13.773, P<0.017), crosses (χ^2=11.480, P=0.043), chances (χ^2=14.631, P<0.012) and shots (χ^2=16.628, P=0.005) are differentiated by team formation. The results of the analysis are presented in the Table III and the differences between the formation are presented in Figure 1.

The statistics showed that most key passes were made from the area of the central axis (χ^2=134.531, P<0.001). Passes made on the sides did not differ from each other (Figure 2). Differences were also found between the categories of the outcome of the key pass. More specifically (χ^2=163.897, P<0.001) most of the passes resulted in rebounds (23.8%), outs (22.1%) and goals (21.4%) (Figure 2). Differences were also observed in the type of pass in relation to height (χ^2=250,000, P<0.001). Most of those key passes were low in percentage of 58.3% (Figure 2).

TABLE II.—*Correlations.*

Parameter		Goals	Chances	Passes	Key passes	Shots	T. shots	Organ. attacks	Counterat-tacks	Team pos-session
Formation	r	0.017	0.123	0.005	0.056	0.018	0.139	0.028	-0.07	0.027
	P value	0.872	0.173	0.951	0.534	0.838	0.132	0.755	0.439	0.760
Passes	r	0.084	0.372	–	–	0.440	0.301	0.708	-0.065	0.885
	P value	0.438	<0.001	–	–	<0.001	<0.001	<0.001	0.464	<0.001
Key passes	r	0.493	0.688	–	–	0.566	0.520	0.296	0.299	0.373
	P value	<0.001	<0.001	–	–	<0.001	<0.001	<0.001	<0.001	<0.001
Team possession	r	0.100	0.379	–	–	0.465	–	0.716	-0.094	–
	P value	0.355	<0.001	–	–	<0.001	–	<0.001	0.291	–

TABLE III.—*The statistic indexes of Kruskal-Wallis Test.*

Variable	χ^2	P value
Passes	10.646	0.059
S. passes	10.658	0.059
Key passes	10.102	0.072
Goals	8.247	0.143
Chances	14.631	0.012
Shots	16.628	0.005
Team possession	13.773	0.017
Organized attack	3.186	0.671
Counterattack	4.374	0.497
Crosses	11.480	0.043

Finally, the short key passes constituted the majority (55.2%) of these passes (χ^2=237,000, P=0.034) (Figure 2). Of the 429 passes, 59.7% were made on the central axis, 21.7% from the right and 18.6% from the left. Statistics showed that low passes are mainly used on the central axis (χ^2=33.759, P<0.001) (Figure 2). The statistic showed that the outcome of the key pass did not depend on the type of pass (low or high) (χ^2=3.889, P=0.692) nor from which axis the pass was made (χ^2=12.729, P=0.389). It was observed that there was a relationship between the type of the
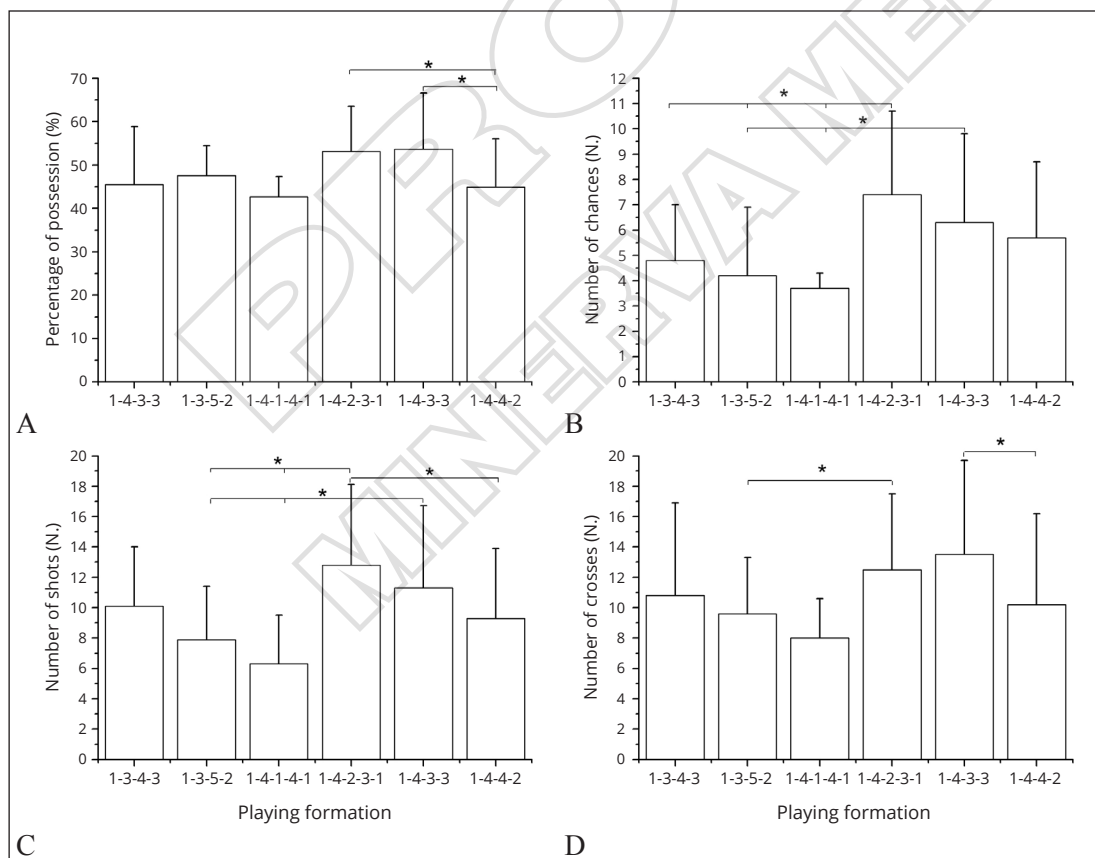

Figure 1.—Technical characteristics according to playing formation: A) percentage of possession; B) number of chances; C) number of shots; D) number of crosses.
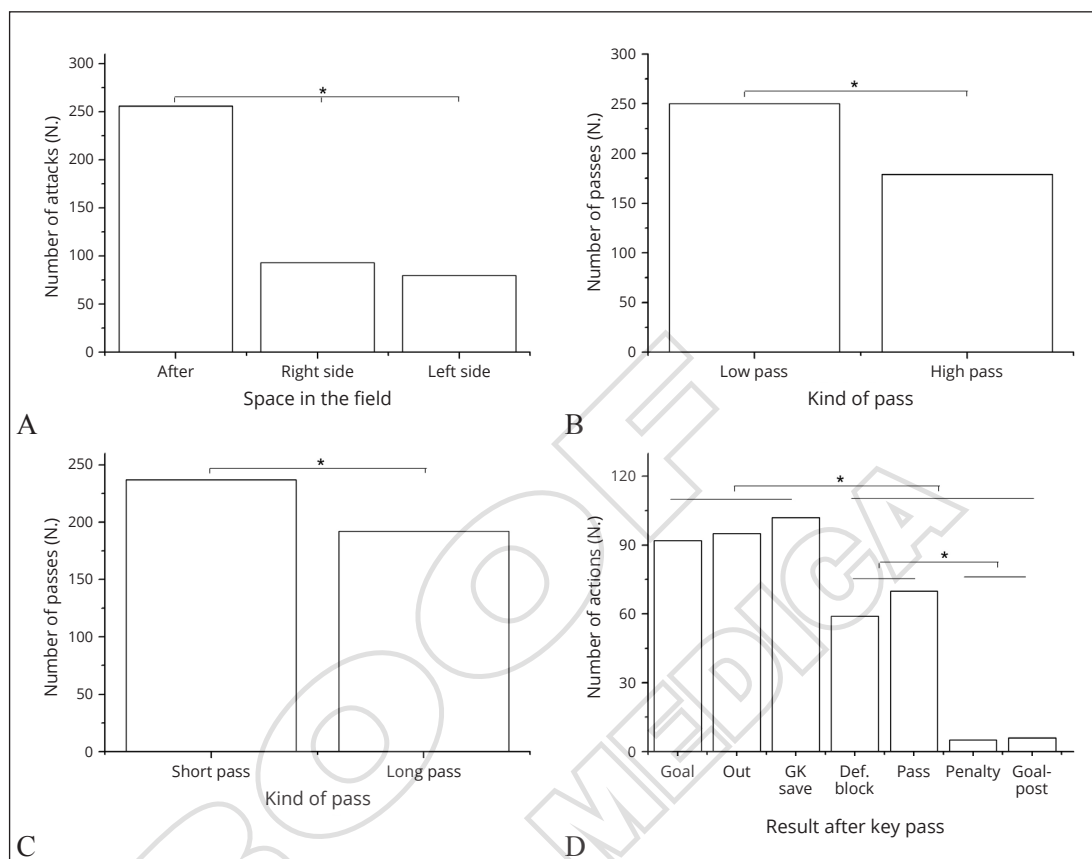*Statistically significant difference.

Figure 2.—Characteristics of key passes: A) space of key pass; B) low or high pass; C) short or long pass; D) result of the key pass. *Statistically significant difference.

key pass (distant - close) and the space from which it was made (central axis - oblique) (χ^2=60.079, P<0.001). On the sides most key passes were long while on the central axis most passes were short. From the statistic it appeared that the type of pass (long or short pass) also influenced its outcome (χ^2=24.199, P<0.001). More specifically, short passes more often resulted in goals while more penalties were won after a long key pass.

Discussion

The results of the statistics for the Qatar football World Cup showed that passes and key passes are correlated with technical actions that can affect the outcome of the game (*e.g.* shots, chances, goals). Also, formations seem to differentiate technical and tactical actions of the team's offensive play (crosses, chances, shots, possession).

The pass is one of the technical elements widely studied both in terms of its characteristics and the effectiveness of its use.[29, 30] In the present study, there was a moderate correlation between the number of passes and chances,

shots and goals and a large correlation with the percentage of ball possession. In a study involving the FIFA World Cup 2018,[31] researchers compared African and European teams and found that ball possession was an important factor in team success. In a previous study at the FIFA World Cup 2014 it has been reported that the high number of passes and the high percentage of possession of the ball is a characteristic of successful teams, especially when the percentage of possession occurs in the attacking third.[32] Similar results are reported by other studies.[33, 34] However, there are also studies that report that possession is not a determining factor in the outcome of a match.[18, 35] Possession can be effective when it appears in dangerous spaces for the opponent such as in front of his goal and is combined with many shots on goal. This finding is confirmed by a recent study by Casal *et al.* (2017)[36] who found that successful teams in the final phase of the UEFA Euro 2016 France showed longer possession times in the middle of the offensive zone in contrast to less successful teams where they showed longer possession times in the middle of their defensive zone. Teams that have more pos-

session of the ball have the ability to execute more attacks and create more goal opportunities. Also, possession of the ball increases the team's confidence while at the same time acting negatively on the psychology of the opposing team. Finally, a study that investigated the offensive behavior of three ethnic teams (France, Spain, Germany) at the 2010 and 2018 World Cups, noticed that too many passes in a short period of time increase the chance of scoring a goal.[37]

Key passes, by definition, can be related to the outcome of a match. In the present study key passes correlated with all the markers studied. In a recent study[16] in the Greek football league a very high correlation was observed between the percentage of possession of the ball and key passes in the attacking third. They also observed a very high correlation between key passes and goals. Moderate correlations between these factors were observed in the present study. This may be due to the different structure of a national league with the World Cup (*e.g.* knock out games), the strength of the teams and the importance of the games. In another study, Barisic *et al.*, (2016)[38] observed in Croatian football league matches that key passes can distinguish winning teams from losing teams, although little correlation was found with the team's ranking in the league.

The results showed that the formation most used in matches was 1-4-3-3 at 32% with 1-4-2-3-1 at 23.4%. In the previous World Cup 2018, the most used formation was 1-4-2-3-1 (46.4%), followed by 1-4-4-2 (13.9%) and 1-4-3-3 (10.5%).[4] From the literature it appears that studies investigating the effect of team formation on technical-tactical elements are very limited. The highest ball possession percentages were recorded by teams with a 1-4-3-3 formation, followed by those with a 1-4-2-3-1 formation. At the 2018 World Cup, the teams with the highest ball possession percentages had a 1-4-2-3-1 formation.[4] This formation showed the highest rate of use of all other formations. This placement of players ensures increased concentration of players in the central third of the field in the defensive phase and at the same time provides the opportunity for an attack with the participation of several players. In one of the three studies known to us, researchers studied the above effect in the first German Bundesliga 2018-2019.[39] The results of the study showed that there are different technical-tactical requirements between the formations. More specifically, the 1-4-3-3 and 1-4-2-3-1 formations saw the highest number of passes and the highest possession rates. In an earlier study,[40] researchers studied in 20 games of English Premier League the effect of

three formations (1-4-4-2, 1-4-5-1, and 1-4-3-3) on running performance and technical tactical elements. The results showed that ball possession did not differ between formations, however in the 1-4-5-1 formation the fewest passes were made and in the 1-4-4-2 formation the most successful passes. Also, most of the crosses were made by teams with a 1-4-3-3 formation. Most chances and shots were made by teams in a 1-4-2-3-1 formation, followed by those in a 1-4-3-3 formation.

Regarding the characteristics of key passes, it was observed that most of them took place on the axis. This may be because a pass to the sides is less dangerous as opposing defenders can adapt more easily and prevent danger. Also, the pass to the side is further away from the goal, so it is considered less dangerous. It was also observed that most of these passes were low and short. This observation can be explained if we consider that there is a large number of players on the axis, so long passes will hardly be successful. Therefore, short passes are used, the majority of which are also low. Unfortunately, there are no studies that dealt with the characteristics of key passes to be able to compare our results.

Limitations of the study

The present study has some limitations. The sample of the study was limited as the games of only one World Cup were used and therefore the results cannot be generalized. Red cards were also not taken into account in matches, which could affect the results. However, all four red cards were given after the 86th minute of the match. Future research could use larger samples using games from more national team tournaments or national championships. Another important variable to consider in future research is the effect of the team's ranking. Finally, more studies are needed on the effect of formations on soccer players' performance factors.

Conclusions

In conclusion, passing is related to several factors related to offensive play. Therefore, the ability of teams to keep the possession of the ball, looking for the key pass, and final action can be a factor in the team's success. It also appeared that the 1-4-2-3-1 and 1-4-3-3 formations influence offensive play factors such as possession, chances, shots and crosses. Therefore, the choice of formation should be taken into account by coaches when they want to achieve specific offensive goals. Also, formation should be taken into account by soccer match performance analysts. Also,

among other things, it appeared that the groups were attacking mainly from the axis. This makes them predictable and therefore manageable. Also, in the axis area, most formations gather several players, making it more difficult to manifest the attack. Therefore, an even distribution of attacks from the axis and from the sides of the field will probably help the offensive function of the team.

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