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Original Investigation

How defense performance affects the outcome of matches in elite futsal

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Purpose: To identify and explain the connection between futsal players' situational efficiency in the defense phase and game outcome.
Methods: 111 elite male futsal players (age 25.5 [4.7] y, start of training 16.9 [4.8] y, experience in playing competitively 5.2 [4.1] y from all 10 clubs of the 1st Croatian Minifootball Division took part in the research and were observed in all 45 games in the first half of the 2020/2021 season. The participants sample is based on players who met the criteria of 600 seconds successive play. Therefore 90.24% of players were observed (11.1 [1.66] per club). With situational efficiency, the used pattern, defined as the game's outcome, is the club's competitive performance, goal difference. Predictor variables notated as performance indicators are defense phase variables: knocking the ball away, taking away the ball and intercepting the ball, all with regard to the outcome: successful/failed.
Results: The results show a significant correlation between futsal players' situational efficiency in defense phase and the game outcome. The correlation between predictor variables and the criteria variable of club competitive performance, goal difference in this research is a significant 0.40 (P= .022). Of all things determining goal difference in every game, in this case with 6 predictor variables, is explained with 16%.
Conclusions: Performance indicators in the defense phase, whose manifestation leads to a positive result, are unsuccessful ball interception and a successful action of knocking the ball away. This helps to conclude that the preparation of players with regards to efficient ball possession by reading the ball passing and intercepting the ball and temporarily stopping the opponent's offense by knocking away the ball is of great importance because its quality can be connect to performance.

Keywords: Futsal, game efficiency, game strategy, performance; strategy game; team sport.

Introduction

Futsal is a sport played all over the world[1] and the number of its players is continually growing in European, Asian and South American countries.[2,3] As futsal continues to grow as a sport, a demand for more information in terms of profession, players and sports science is also growing.[3] Futsal is an unpredictable high intensity team sport with intermittent actions.[2,4,5] Small futsal court dimensions and often changes in direction call for fast decision making and speed under pressure during offense and defense.[4,6] During the game of futsal, which is divided into two 20 minute halves of actual game, it is possible to notate a large number of various specific events which represent the level of players' and teams' situational efficiency.[7] By analysing these events, it could be determined why certain players, or a team, obtained an advantage over another player or a team, i.e. it could be determined which course of action brought about the final game result. In order to assess and analyse the game and steer the training process in a more precise way, it is necessary to notate a larger number of relevant situations during a futsal game. Therefore, notational analysis, as a method of recording events during a sports match is used, and it includes video analysis and statistical data processing. The main aim of notational analysis is to optimize feedback in order to improve performance.[8,9]
According to Hughes[10] the successful use of data collected through notational analysis is possible if we meet the criterion of selecting relevant performance indicators and if the reliability of the collected data is ensured. Although futsal continues to grow in popularity, as well as the number of research on futsal, the figures are still low, in terms of better understanding the game.[1,2,6,11-13] Literature review shows that most literature is in Spanish or Portuguese[2] with a lack of research in English.[1] Research also lacks consistency and coherence and it is therefore hard to provide precise conclusions regarding futsal and specific performance indicators.[1]
A review of the literature did not find much scientific content on the topic of performance indicators in futsal. According to Agras, Ferragut and Abraldes[14] most research papers on futsal are based on simple descriptive analysis, analysis of game dynamics and system's complexity. They also determine that the most research is based on the topic of the end of actions, which appears in 46% of papers and is precisely the area that attracts the most attention. The focus is on the analysis of scored goals, given that goals are one of the most important performance indicators in game analysis. Some researches[15, 16] have shown the advantage of scoring goals through an organized attack in approximately 30% of situations, and the use of a counterattack, after the ball has been taken away, between 23% and 28% of cases. In some other researches[17, 18] a greater contribution of counterattacks was recorded, i.e. transitions after the possession of the ball in 34% to

39% of cases and organized attacks in 15% of actions.[19] Among other findings from the analysis of matches related to the defense phase, according to available research, the research of Leite, [17] of the Portuguese futsal team in 3 matches of the EU Championship in 2010 can be highlighted, where it was determined that 17.36% of the attack endings were from counterattacks and 25.75% from the action after the ball has been taken away. It was also determined that most goals were scored from breaks (46%), followed by counter attacks; that is, after the ball has been taken away (38%) and by organized play (16%). Gioldasis,[2] states in a review paper that taking away the ball or a dribbling error are the most common ways to start a counter attack.[20] Another reason for the high frequency of realized counterattacks is that there are no special tactics to stop them.[21] Nemčić, [19] notes performance indicators for the defense and attack phase, indicators of interruptions, fouls, cautions and player exclusions, and performance indicators for the goalkeeper in 50 matches of the 1st HMNL in the 2015/16 season. and determines the degree of reliability of operationally defined parameters, the connection of competitive performance indicators with the final outcome of the match and competition, the differences between winning and defeated teams in defined competitive performance indicators. The statistical significance of the differences between the winning and losing teams was not established in the parameters of the competitive performance: unsuccessful blocking of shots, clearance of the ball, interception of the ball and possession of the ball. The application of standardized research conditions would probably provide a better understanding of certain indicators.[22]

Literature on this subject is not comprehensive and therefore research is not comparable, there is no standardized methodology and research often lacks review.[1] Due to limited knowledge of this sport, futsal is in need of additional research.[23] The major problem of this study lies in the fact that there is an obvious deficit in research and lack of knowledge on situational efficiency, and therefore lack of knowledge on how various factors affect futsal performance. There is also a lack of studies on futsal excellence.[24] Scientific auditorium is in search of new, exact information and scientific knowledge needed to better understand the game.

Accordingly, the aim of this research was to identify and explain the correlation between futsal players' situational efficiency in the defense phase and the game outcome. Correlation of performance indicators in the defense phase and the outcome of the match can show us how and why a certain team gained an advantage. Ultimately, the information that is of crucial importance to coaches is the differences in individual performance indicators between winning and losing teams in order to determine the pattern and structure of the game that brings performance improvements and the best results.

The research is of outstanding importance as it managed to identify more precisely the situational efficiency of futsal players in defense phase, which was measured by the ratio of the sum of selected performance indicators and actual playing time. In this way, the variability in understanding the less explored segment of the game was further explained. Previous research was based on the entire sample of participants playing and the overall number of performance indicators, without the indicator and time efficiency ratio.

Methods

Participants

The research included elite male futsal players, of average age 25.5 [4.7]; who started training at the age of 16.9 [4.8]; with the experience in playing competitively for 5.2 [4.1] years, from all ten clubs of 1st HMNL (UEFA Men's Futsal National Team Coefficients = 6)[25] in the first part of season 2020/2021. In the period from 2nd October to 16th December 2020 all 45 games (100%) in the 9th round half-season were played and notated. By observing the overall duration of games, 98.46 per cent of time in all 45 games was notated. The participants sample is based on players who met the criteria of 600 seconds successive play. Therefore 90.24% of players were included in the study. On average, 11.1 [1.66] players per club were measured.

Sample variables

Situational efficiency was described by using notational analysis during all matches in the first half of the 1st HMNL 2020/2021 season. An average value for the sum of selected performance indicators in all analyzed games with 600 seconds playing time was calculated for all players. With situational efficiency, the used pattern, defined as the game's outcome, is the club's competitive performance, goal difference – GOLR. It is measured by scored and conceded goals in every game. Predictor variables notated during the game as performance indicators are defense phase variables: Knocking the ball away in reference to the outcome: successful SEIL-U/unsuccessful SEIL-N – a defense situation was tested, in which the player, who cannot take away the ball from its opponent, temporarily stops the opponent's attack by knocking the ball away, outside the maneuver area and goal area; Taking away the ball in reference to the outcome: successful SEOL-U/unsuccessful SEOL-N – a defense situation was tested, in which the player tries, with or without foul, to get ball possession, which is in the opponent's team possession; Intercepting the ball in reference to the outcome: successful SEPR-U/unsuccessful SEPR-N – a defense situation was tested, in which the player tries to get ball possession by successfully reading ball passing and intercepting the opponents' ball.

Description of experimental procedure

In the first phase of research, an interview was conducted with 1st HMNL and teams' representatives planned for testing. In parallel with arranging the testing, the team of three people who carried out the measurements were trained. Additionally, all variables were determined and defined, and 3 independent matches were jointly observed and measured before the start of the measurement of the 1st HMNL matches. The second phase included measuring. Performance indicators were collected through match videos, which are mandatory for every 1st HMNL game. They were collected after every game has been played, in cooperation with 1st HMNL commissioner and were randomly forwarded to the persons who performed the measurement. For each observed match, each measurer calculated the average value of the sum of the selected performance indicators and the time duration of the game for all futsal players.

Statistical Analysis

Data processing method included the calculation of descriptive statistics parameters. Means, standard deviations (SDs), minimum (Min) and maximum (Max) values were calculated after verifying the normality of the distributions using the Kolmogorov-Smirnov procedure. Significance for all the statistical tests was accepted at $P < .05$. In order to determine reliability, Pearson's test and retest correlation coefficient was used on the sample of four games, where the first was taken by one measurer and the second by a different measurer. With the aim of confirming significant correlation, multiple regression analysis was used. The data was processed through a computer

program Statistics ver.13.0. To determine the reliability of the applied variables, the Pearson correlation coefficient between the measurement particles was used. The statistical significance of the differences between the obtained results and the results generated by the regression model was tested with a *t*-test for dependent samples. No statistically significant differences were obtained between the obtained results and the results generated by the regression model for futsal players, and satisfactory validity was additionally confirmed.

Results

Table 1 shows the variables' reliability on the sample of four games, where the first was taken by one measurer and the second by a different measurer. The value of correlation coefficient (r) between test-retest method with applied variables to confirm reliability is between 0.95 – 1.00 with all significant coefficients. The results of the performed correlation analysis suggest that, apart from successful instances of kicking the ball away (r= .267) and unsuccessful ball interception (r= .219) other indicators are not in significant correlation with GOLR. Most performance indicators are in a low correlation with other parameters. In order to additionally explain the correlation between situational efficiency of futsal players in defense phase and game outcome, the players were ranked, based on their clubs, into three categories of club competitive performance index (Table 2): IKNU3 – club competitive performance index 3, the most successful futsal clubs (club rank = 1st - 3rd place); IKNU2 – club competitive performance index 2, successful futsal clubs (club rank = 4th - 6th place); IKNU1 – club competitive performance index 1, less successful futsal clubs (club rank = 7th - 10th place). The results in Table 3 show a significant correlation between futsal players' situational efficiency in defense phase and the game outcome. Therefore, it could be stated that successful instances of kicking the ball away and unsuccessful ball interceptions could impact the final game outcome. The correlation between predictor variables and the criteria variable of club competitive performance, goal difference in this research amounts to 0.40. Of all things determining goal difference in every game, in this case with 6 predictor variables, is explained with 16%. In forecasting a result with a goal difference, according to this research, unsuccessful ball interception and successful instances of knocking the ball away can significantly attribute to a chance of success and enable a distinction between the winning and

Table 1. Correlations of test and retest

Variable	Test	Retest	r
	M (SD)	M (SD)	
SEIL-U	1.10 (1.30)	1.16 (1.21)	.965*
SEIL-N	1.38 (1.77)	1.42 (1.60)	.969*
SEOL-U	.63 (1.01)	.73 (1.03)	.958*
SEOL-N	1.14 (1.27)	1.21 (1.15)	.954*
SEPR-U	2.58 (2.07)	2.52 (1.92)	.969*
SEPR-N	2.66 (2.11)	2.77 (1.92)	.961*

M - arithmetic mean; SD - standard deviation; r - Pearson correlation coefficient between measuring particles; * - statistically significant coefficient at the level of $P< .01$

Table 2. Descriptive indicators of different club competitive performance index

Variable	IKNU1 (N=49)			IKNU2 (N=30)			IKNU3 (N=32)		
	M (SD)	Min	Max	M (SD)	Min	Max	M (SD)	Min	Max
SEIL-U	.63 (.48)	.00	2.51	.62 (.42)	.00	1.68	.71 (.35)	.00	2.00
SEIL-N	.90 (.54)	.00	3.08	.86 (.39)	.00	1.76	.84 (.35)	.32	1.69
SEOL-U	.35 (.29)	.00	1.36	.41 (.25)	.00	1.07	.38 (.27)	.00	1.02
SEOL-N	.99 (.63)	.00	4.30	1.20 (.55)	.41	2.53	.94 (.63)	.31	3.33
SEPR-U	1.50 (.70)	.00	3.71	1.48 (.58)	.00	2.69	1.47 (.53)	.63	3.08
SEPR-N	1.57 (.68)	.00	2.73	1.63 (.78)	.00	4.52	1.42 (.43)	.25	2.30

M - arithmetic mean; SD - standard deviation; Min - minimum result; Max - maximum result; IKNU3 - club competitive performance index 3; IKNU2 - club competitive performance index 2; IKNU1 - club competitive performance index 1

Table 3. Differences and effect size between responders and not responders.

Variable	b*	b	t	*P*
SEPR-N	.26	.42	2.29	.024*
SEPR-U	.05	.08	.41	.682
SEOL-N	.00	.00	-.01	.992
SEOL-U	.05	.17	.45	.655
SEIL-N	.01	.03	.14	.890
SEIL-U	.32	.73	2.96	.004*
R	.40			
R^2	.16			
F (6.83)	2.62			
P	.022*			

b* - partial regression coefficient; b - regression coefficient, t - t-test value; *P* - level of significance; R - multiple correlation coefficient; R2 - coefficient of determination; F - F test result; * - statistically significant coefficient at the level of *P*< .05

the losing team. It is important to point out that in the defense phase in the total of 45 games in this research, there were 2225 instances of knocking the ball away, 1925 instances of taking the ball away and 4531 instances of ball interception.

Discussion

The main scope of the research was to identify and explain the connection between futsal players' situational efficiency in the defense phase and game outcome. Of all things determining goal difference in every game, in this case with 6 predictor variables, is explained with 16 per cent. In forecasting a result with a goal difference, according to this research, unsuccessful ball interception and successful instances of knocking the ball away can significantly attribute to a chance of success and enable a distinction between the winning and the losing team and they might be predictors of success.

It should also be noted that the value of data recorded in this research lies in the information on the number of performance indicators which occurred in a time unit, in other words, what is the actual situational efficiency of a futsal player, which is measured by the ratio of the sum of selected performance indicators and actual playing time.

A big number of performance indicators supports the claim that futsal is an extremely dynamic game where situations are created within a few seconds.[23,26-30] According to observed variables in this research, there are on average 192.91 instances of knocking the ball away, taking the ball away and ball interceptions per game. Situations in which a player tries to get ball possession by successfully reading opponents' ball passing and intercepting the ball usually happen within the competitive performance indicators' ratio (ball interception = 50.8%, taking the ball away = 23.8%, knocking the ball away = 25.4%).

On average, there are more than 4.77 instances of knocking the ball away, taking the ball away and intercepting the ball per minute, as it was noted in this research. Although the overall number of situational efficiency indicators in defense phase is larger, this research did not include all the situations that happened during the game, as well as players. Descriptive indicators could be of great usage to coaches while defining the values necessary for certain variables and could in this way additionally explain the variability of understanding the game. Also, this type of analysis and the given indicators could also optimize feedback to players and coaches in order to improve knowledge on their own or opponent's team.[31]

In futsal, the dynamics of defense and offense are changed within a few seconds; transitioning from offense phase into defense phase and vice versa.[32] Small field dimensions with constant change of direction demand a quick decision-making process and the ability of speed under pressure during offense and defense.[4,6] Also, a smaller field dimension causes constant pressure and the proximity of opponent players that are constantly marked in 1:1situations.[33] In order to assess and analyze the game and steer the training process in a more precise way, it is necessary to record a larger number of relevant situations during a futsal game.

By observing performance indicators of futsal players in defense phase, according to this research, the situations of knocking the ball away, taking the ball away and ball interception result in 48 attempts (8 players = 47.7) in 600 seconds actual playing time. By observing all four players, ball interception is a more often event (12.13 in 600 sec) than taking the ball away (5.63 in 600 sec) or knocking the ball away (6.10 in 600 sec). Each event in the defense phase, where a player unsuccessfully tries to possess the ball by reading ball passing and intercepting the opponents' ball, can mean a step towards defense stabilization, shortening opponent's ball possession and prevent finding a player and creating an opportunity to strike and score a goal. According to this research, 4 players create on average more than 12.13 ball interceptions during 600 seconds of actual playing time (successful = 5.95 and unsuccessful = 6.17). Intercepting the ball successfully can offer an opportunity to take possession of the ball, counterattack and a quick finish. The significance of intercepting and taking away the ball and getting to the opponent's goal is researched by Leite,[17] who states that 25.75% of futsal finalization resulted in scored goals through organized game, most of the goals were scored through stopped balls (46%) and through a counterattack (38%).

By observing performance indicators of players with different index of club competitive performance, it is apparent that IKNU3 players, from the most successful futsal clubs, have the lowest average values in unsuccessful ball interception variable, while the players of less successful clubs, have higher average values (IKNU1 = 1.57 [0.68]; IKNU2 = 1.63 [0.78]; IKNU3 = 1.42 [0.43]). Players of less successful football clubs have more

successful and unsuccessful ball interceptions, as compared to players from the most successful clubs, because they are mostly in a subordinate position and spend more time in the defense phase. Nevertheless, by observing successful interceptions, relative to overall interceptions, IKNU3 players have the highest average value (IKNU3 = 50.7%, IKNU2 = 46.8%, IKNU1 = 47.9%). Also, every event in the defense phase, where a player successfully temporarily stops the attack by knocking the ball away can put a stop to opponents' offense and potential danger to the goal. According to average results values, players from the most successful clubs have the highest average results value only in kicking the ball away successfully (IKNU1 = 0.63 [0.48]; IKNU2 = 0.62 [0.42]; IKNU3 = 0.71 [0.35]). The efficiency in kicking the ball away with the aim of keeping it in the defense phase can be of huge importance because its quality can be assessed as performance predictor. By analyzing successful instances of kicking the ball away relative to overall instances, IKNU3 players again possess the highest average value (IKNU3 = 45.5%, IKNU2 = 38.5%, IKNU1 = 39.2%). Taking the ball away in the defense phase, where a player tries to possess the ball, with or without a foul, according to this research, doesn't affect the final result. Nevertheless, it is also shown that successful events of taking the ball away are relative to overall instances in which IKNU3 players have the highest average value (IKNU3 = 30.5%, IKNU2 = 26.2%, IKNU1 = 26.9%).

With regard to the outcome of all analyzed performance indicators, futsal players are the most successful in ball interception and least successful in taking the ball away. It has also been stated that when it comes to the analyzed performance indicators in the defense phase, the players from less successful clubs have more frequent attempts. Based on these results, it can be noted that less successful futsal players more often use the actions of knocking the ball away, taking the ball away and ball interception as a defense mechanism. Against a stronger opponent, weaker teams play the defense in a disciplined way with many ball interceptions and actions of knocking and taking the ball away or trying to break opponent's offense. With this tactic they wait for mistakes and use offense transition after taking away the ball. Data on higher success average values of players from the most successful clubs is expected and points to players' individual qualities which enable better teamwork with the aim of effective offense transition. Futsal is a sport characterized by fast movements in small space. Defense organization depends on the quality of efficient collective collaboration and organization, as well as the physical condition and technical and tactical development of the team. Due to limited space, players in the defense phase can, by appropriate positioning, constant pressure and efficient reaction, create a complicated situation for their opponents and get ball possession. The results in ball interception, knocking away and taking the ball emphasize the results of collective game finished individually by players, and more successful futsal players have better individual qualities for a more efficient realization. A more frequent and efficient performance leads to a positive score and a better rank.

The overall situational efficiency includes only that part of the overall success in the game that can be objectively measured by statistical game records of the match, so it represents a partial success in the game.

This research does not cover all the characteristics, abilities and knowledge that can influence the success of futsal players. Also, not all performance indicators that can influence the assessment of situational efficiency are covered. The information obtained is limited to isolated observed events, while the game is dynamic and includes the interrelationship of different variables (events in the game without the ball, tactical patterns of clubs, technical-tactical elements) as well as all the cooperation and competition of players that cannot be determined in this way. An additional limitation is related to the way of data collection. During part of the measurement of the time duration of the player's game, when the official game time was not visible, a stopwatch was used. It was used by experienced measurers, but there was still the possibility of error by the measurers. Also, not all parts of the video show the exact moment of entry/exit of the player, which could be eliminated by using multiple cameras The sample of this research consisted of the matches of one half-season. For future research of this type, it would be desirable to have a longitudinal approach to the problem on a sample of the entire season where all clubs have the same number of home and away games. In this way, the results of situational efficiency would be evaluated more concisely.

As the deficit of research and the lack of knowledge and consistency in the field of determining the situational efficiency of futsal players are emphasized, the researches are not comparable, the standardization of tests for assessing the situational performance while emphasizing the indicators in the time interval are the subject of interest for future research.

Practical Applications

This research included only the part of overall performance which could be measured by statistical game records. The information obtained is limited to isolated observed events, while the game is dynamic and includes the interrelationship of different variables (events in the game without the ball, tactical patterns of clubs, technical-tactical elements) as well as all the cooperation and competition of players that cannot be determined in this way. The greater value of the recorded data is the information on how many performance indicators occur in a unit of time, that is, the actual situational efficiency of futsal competitors, measured in this research. In this way, the total variability of the understanding of the game was additionally explained in the so far less researched segment. The knowledge gained from the research should serve for a better understanding of the futsal game and to improve the performance and development of futsal competitors. The results of the research will probably be useful during the selection and orientation of future generations of young futsal competitors and so that coaches can objectively observe and analyse matches and direct the training process even more precisely. Further improvement of knowledge on performance indicators and their correlation should be based on a larger number of research and standardized tests with an emphasis on time interval indicators.

Conclusions

The results of research in this unpredictable game have shown how performance indicators in the defense phase affect the game outcome. Of all things determining goal difference in certain elite futsal games, in an unexplored field and non-standardized performance interactions in defense phase, in this case with 6 precisely defined predictor variables, is explained with 16%. This research does not include all performance indicators that can affect the assessment of situational efficiency, so even this relatively lower value of the result of the explanation of the performance in the defense phase can contribute to a better explanation of the overall variance of the understanding of the futsal game. Performance indicators in the defense phase, the manifestation of which leads to a positive result according to this research, are events in the game in which the player tries to

gain possession of the ball by successfully reading the play/line of passing the ball, i.e. by intercepting the ball of the opposing team, although unsuccessful. These are also events in the game in which the player, due to the impossibility of taking the ball away from its opponent, successfully temporarily interrupts the development of the opponent's offensive action by kicking the ball out of the area of action and potential danger for his own goal. The results in knocking the ball away, taking away the ball and intercepting the ball emphasize the result of the collective game that the players finish individually, and more successful futsal players have better individual characteristics to realize them more effectively. This helps to conclude that the preparation and improvement of futsal players in terms of intercepting the ball and knocking the ball away can be of great importance because the quality of this performance can be seen as a predictor of success.

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Ethical Committee approval

Ethical approval was waived for this study, as it is documentary research with no risks, because during the research, all matches from the 1st Croatian Minifootball Division were publicly available through various public channels, including Youtube channel. Specifically, all collected data and all official video recordings of the matches were obtained in cooperation with the Croatian Football Association directly from the President of the Futsal Commission, Croatian Football Association.

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Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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Declaration if used ChatGPT

We don't used ChatGPT.

Author-s contribution

Conceptualization, H.S. and M.M.; methodology, M.M; software, H.S.; validation, H.S. and M.M.; formal analysis, H.S. and M.M. A-R.; investigation, H.S. and A.R.; resources, H.S. and A.R.; data curation, H.S., M.M. and A.R.; writing—original draft preparation, H.S. and M.M. A-R.; writing—review and editing, H.S. and M.M.; visualization, H.S. and M.M. A-R.; supervision H.S. and M.M.; project administration, H.S.
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