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## Home Advantage in Matches at the Stadium and Indoor Football Arena: A Comparative Study on the Example of Yenisey FC

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**Abstract.** Home advantage is a phenomenon of professional football and a hot topic for researchers. A comparative statistical analysis of the results of home matches of the Yenisey football club (Krasnoyarsk) from 2013 to 2022 was carried out at the Central stadium of the Krasnoyarsk Olympic Reserve School and the indoor “Football-Arena Yenisey” in the regular championship of the Football national league (Russia). The existence of an additional home advantage for the Yenisey football club was revealed when holding matches in an indoor football arena. The result obtained can be explained by the influence of noise support for spectators in the stands and the structural and infrastructural features of the indoor Football-Arena Yenisey. The information obtained can be useful for managers, coaches, professional players and used to improve sports results.

**Keywords:** home advantage, Football national league, indoor football arena, stadium, crowd noise, football club Yenisey, Wilcoxon test, Chi-square test.

Research area: sports theory and technique.

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## Домашнее преимущество в матчах на открытом стадионе и крытом футбольном манеже: сравнительное исследование на примере ФК “Енисей”

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**Аннотация.** Домашнее преимущество – феномен профессионального футбола и актуальная тема для исследователей. Проведен сравнительный статистический анализ результатов домашних матчей, сыгранных футбольным клубом “Енисей” (Красноярск) в регулярном чемпионате российской Футбольной национальной лиги с 2013 по 2022 гг. на крытом манеже “Футбол-Арена Енисей” и открытом Центральном стадионе Красноярского училища олимпийского резерва. Выявлено существование дополнительного домашнего преимущества для клуба “Енисей” при проведении матчей на крытом футбольном манеже по сравнению с матчами на открытом стадионе. Полученный результат объяснили положительным влиянием шумовой поддержки зрителей на трибунах на игроков домашней команды и конструктивно-инфраструктурными особенностями крытого футбольного манежа. Представленная в статье информация может быть полезной для менеджеров, тренеров, профессиональных игроков и использована для повышения спортивных результатов.

**Ключевые слова:** домашнее преимущество, Футбольная национальная лига, крытый футбольный манеж, стадион, шум толпы, футбольный клуб “Енисей”, критерий Вилкоксона, критерий Хи-квадрат.

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### Introduction

It is known that environmental conditions (air temperature, humidity, precipitation, illumination, etc.) have a significant impact on the physical activity and quality of technical actions of football players in matches at a high competitive level (for example, Trewin et al., 2017; Chmura et al., 2021). A reliable way to reduce the dependence of professional players on the influence of changing environmental factors is to hold football matches in indoor arenas or

stadiums with a closing roof. Modern ventilation and energy systems make it possible to create optimal conditions for players and spectators inside indoor stadiums in terms of temperature, humidity, wind currents, and lighting (Chen, Li, 2020; Losi et al., 2021). The construction and use of indoor football stadiums began in the seventies of the last century and continues to this day. Despite such a long history of operation of indoor stadiums, there is no unequivocal opinion among football researchers about the existence

(or absence) of an additional home advantage in matches at indoor stadiums compared to matches at open stadiums.

Home advantage (HA) is the one that the host club receives over the guest team (Leite, 2017). This is a well-known phenomenon throughout the world of professional football (Lago-Penas, 2021; Hopkins, 2022; Kolmakov, Chernyakova, 2022). According to Jamieson (2010), football has the highest level of HA among popular team sports. In previous studies, it was found that HA in football is facilitated by a complex of factors, among which the effect of fan support in the stands, familiarity with the venue of the match, and better adaptation of home team players to the conditions of the match are highlighted (Pollard, 2008; Kolmakov, 2022). In order to achieve the best sports results, the leaders of football clubs, within the framework of the Competition Rules, create conditions for strengthening the influence of HA factors. For example, the club cooperates with an organized “fan” movement, a significant part of the training process is carried out at the home stadium in order to better familiarize the players with the features of the pitch, etc. Information about HA in matches at indoor stadiums can also be used by sports managers, coaches and players to achieve the best sports results of an individual professional club.

The Football national league (FNL) is the second most important professional football league in Russia. FNL brings together clubs with diverse geographic affiliation and high variability in climatic conditions (ambient air temperature, humidity, rainfall). In accordance with the Regulations of the FNL, clubs can play home matches at two stadiums (main and reserve), including indoor football arenas with artificial turf. This is especially important for teams from the Northern, Siberian and Far Eastern regions. The question arises: does the local team get an additional advantage when playing matches in indoor football arenas with artificial turf compared to matches in outdoor stadiums with natural grass lawn?

To answer this question, we compared the statistical data of home matches of FNL foot-

ball club Yenisey (Krasnoyarsk), from 2013 to 2022. This club uses the Central stadium of the Krasnoyarsk Olympic Reserve School (opened in 1967, stands for 15,000 spectators, natural grass lawn) and the indoor “Football-Arena Yenisey” (opened in 2014, stands for 3000 spectators, artificial plastic coating). In the literature available to us, there are no data on comparative studies of the results of matches in open and closed stadiums for individual football clubs.

### Methods

The FNL is a league with a double round system (match away, match at home). Therefore, the quantitative level of HA was determined in the classical way, as the percentage of home wins out of the total number of wins for the season (Pollard, 1986; Courneya, Carron, 1992). Additionally, the indicator of the number of points scored by the team on average per match was used (Peeters, Van Ours, 2021) as an indicator of the HA of the Yenisey FC in matches at two home stadiums. In addition, we compared the number of goals scored and conceded by the Yenisey FC in home matches at two stadiums.

FNL regular season match results statistics from 2013 to 2022 were obtained from the FNL official website and [www.championat.com](http://www.championat.com). Matches played without spectators or with limited spectator access to the stands during the Covid-19 pandemic in 2020 and 2021 were excluded from the analysis when comparing the HA at the two stadiums. In total, 121 matches were compared, of which 62 were played at the Central stadium, and 59 at the Football-Arena Yenisey.

According to preliminary calculations, all samples differed from the normal distribution according to the Shapiro-Wilk test (Shapiro and Wilk, 1965). Therefore, to calculate the statistical data on goals scored (missed) at two stadiums, the nonparametric two-sample Wilcoxon test was used, and on the points scored and the number of wins, the Chi-square method was used. These criteria are often used in modern research to assess the level of home advantage in team sports (McEwan, 2019; Alonso et al., 2022).

## Results

The results of the football club Yenisey HA calculations are presented in Table 1 (scan QR-cod). It is evident that the club had HA in all seasons under consideration. At the same time, the level of HA did not depend on the place in the standings occupied by the club at the end of the FNL regular season. The lowest level of HA was observed during the Covid-19 pandemic in matches without spectators or with a small number of spectators in the stands (2020–2021).

The average spectator attendance of the two stadiums from 2013 to 2022 (excluding matches during the Covid-19 pandemic) was close and on average ( $M \pm m$ ) was: at Football-Arena Yenisey –  $2442 \pm 62$ , at Central stadium –  $2879 \pm 171$ . At the same time, in terms of the filling of the stands with spectators (in percent) at the matches of the Yenisey FC, the stadiums differed significantly: Football-Arena Yenisey –  $81.4 \pm 2.08$  %, Central stadium –  $19.2 \pm 1.14$  %.

The results of comparing the HA for the two stadiums are presented in Table 2 (scan QR-cod). It shows that statistically significant differences for the two stadiums were obtained by the total number of victories and points scored per match. The Yenisey FC won more often and scored more points on average per match in the indoor arena than at the Central stadium. The null hypothesis of no difference can be rejected for the number of goals scored by the club. The Yenisey FC conceded fewer goals in matches at the indoor arena. There were no significant differences in the number of goals scored against the away team at the two stadiums.



## Discussion

It is known from the literature that indoor basketball and ice hockey matches have a higher level of HA than outdoor American football

and baseball games (Pollard et al., 2017; Han et al., 2022). There is evidence of the existence of an additional HA in baseball matches at indoor stadiums compared to matches at outdoor stadiums (Romanowich, 2012). According to our calculations, this regularity can be typical for football as well. According to our assumption, a higher level of HA in matches at the indoor arena is associated with the structural and infrastructural features of the arena and increased noise support for spectators in the stands of the local team players.

Four main structural and infrastructural features of the indoor Football-Arena Yenisey in comparison with the outdoor Central stadium can explain the results of the increase in the HA level. Firstly, the presence of a roof makes it possible to exclude the adverse effect of precipitation on the tactical and technical actions of the players and at any time of the year to hold matches in stable conditions in terms of temperature, illumination, wind currents and humidity. Secondly, the ventilation and air conditioning system modifies indoor air composition, which can make it difficult for football players to breathe during heavy physical exertion, especially for unadapted players of the visiting team. Thirdly, there is evidence in the literature that artificial turf contributes more to HA than playing on natural grass (Da Silva et al., 2018). Over the past few years, the Yenisey FC has been striving to play combinational, attacking football in home matches. Therefore, a smooth artificial turf can be the reason for increasing the efficiency of individual and team actions of local team players. Fourthly, the acoustic system of the closed arena contributes to the creation of an enhanced noise effect from the spectators in the stands. A recent study by De Angeles and Reade (2023) found that the noise effect of cheerleaders in team sports is more important in indoor arenas than outdoors.

The noise effect has a twofold effect: positive on the physical activity of the home team players and negative on the away club players. The strength of the noise effect depends on the degree of filling of the stands with spectators and the proximity of the distance of the stands from the playing field. This assumption

is based on recent studies that have shown an association between crowd capacity and HA in Asian, American and European professional football leagues (Krumer et al., 2022; Nomura, 2022; Martins et al., 2023). According to Armatas and Pollard (2014), the absence of running tracks between the stands and the football field results in an average “increase” of 0.102 goals scored per game for the local team.

In the indoor stadium of the Football-Arena Yenisey, comfortable conditions have been created for spectators in the stands, contributing to increased noise support for the local team. The distance between the stands and the football pitch in the indoor arena is several times less than the similar distance at the Central stadium. The occupancy of the stands in the indoor arena exceeded the occupancy of the stands of the Central stadium by more than 4 times. Therefore, the noise support of spectators in the stands in the indoor arena could be one of the main reasons for the increase in the level of HA.

Even one extra win (or point) in a season can make all the difference in a club’s sporting

performance. For example, Yenisey FC lacked 2 points in the 2017–2018 season to take the 2nd place in order to move to the Russian Premier League. Therefore, it can be recommended to the club’s management to hold games in the indoor Football-Arena Yenisey in order to achieve high sports results.

### Conclusion

Thus, using the example of the Yenisey FC, it was shown that holding home matches in the indoor stadium of the Football-Arena Yenisey can make a significant contribution to strengthening the home advantage effect and increase the number of wins in matches for the local team compared to matches at the Central stadium. The result can be explained by the influence of noise support of spectators in the stands and the structural and infrastructural features of the indoor football arena. The information presented in this article can be used by the leaders of the FNL clubs, who can combine games on open and closed fields, to improve sports results in home matches of the FNL regular season.

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