Incidence of tactical formations on the results of soccer matches played at altitude
Incidencia de las formaciones tácticas en los resultados de encuentros de futbol disputados en altitud

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Abstract. Background: The Ecuadorian Professional Soccer League is a tournament that has teams that reside in cities at altitude and at sea level, for such reason the applied tactical formations differ with the objective of achieving a positive result when the encounter ends. Objective: To determine the incidence and effectiveness of the tactical formations applied in the results of soccer matches played in cities at altitudes between 2500 and 3250 meters above sea level. Method: Non-experimental quantitative study of correlational approach, in a study sample of 123 soccer matches played between 2020 and 2021 under these conditions, analyzed through the Instat Scout platform and the opinion of experts to determine the tactical formations of visiting teams residing at sea level, taking into account the effectiveness of points and goals obtained. Results: There were no differences between the means of goals scored and goals conceded by tactical formation; however, at a descriptive level, there was evidence of greater effectiveness in the 1-4-3-3 tactical formation due to the number of matches analyzed in relation to a higher mean of goals scored and a lower mean of goals conceded; statistically, there was a high positive correlation between the 1-3-4-3 tactical formation and goals scored with a significance level of $P<0.01$. Conclusion: The data obtained shows that the formations that use a line of 4 defenders obtain better results in comparison with the formations that use only 3 defenders, being the 1-4-3-3 tactical formation the one that obtained better results in contrast with the 1-3-5-2 formation that obtained the worst results.
Keywords: Altitude; Tactical Formations; Away games; Points and goals effectiveness; Instat Scout Platform.

Resumen. Antecedentes: La Liga de Futbol Profesional Ecuatoriana es un torneo que cuenta con equipos que residen en ciudades de altitud y a nivel del mar, por tal razón los sistemas tácticos aplicados difieren con el objetivo de obtener un resultado positivo del encuentro. Objetivo: Determinar la incidencia y efectividad de las formaciones tácticas aplicadas, en los resultados de encuentros de futbol disputados en ciudades de altitud entre 2500 y 3250 msnm. Método: Estudio cuantitativo no experimental de enfoque correlacional, en una muestra de estudio de 123 partidos de fútbol disputados entre los años 2020 y 2021 bajo dichas condiciones, analizados a través de la plataforma Instat Scout y la opinión de expertos para determinar las formaciones tácticas de los equipos visitantes que residen a nivel del mar, tomando en cuenta la efectividad de puntos y goles obtenidos. Resultados: No existió diferencias entre las medias de goles convertidos y recibidos por sistema táctico, no obstante, a nivel descriptivo se evidencio una mayor efectividad en el sistema táctico 1-4-3-3 por el número de partidos analizados en relación a una media mayor de goles ejecutados y una media menor de goles recibidos, estadísticamente se presenta una correlación positiva alta entre el sistema táctico 1-3-4-3 y los goles ejecutados con un nivel de significación de $P<0.01$. Conclusión: Los datos obtenidos indican que las formaciones que utilizan una línea de 4 defensores obtienen mejores resultados en comparación con las formaciones que utilizan únicamente 3 defensores, siendo la formación táctica 1-4-3-3 la que obtuvo mejores resultados en contraste con la formación 1-3-5-2 que obtuvo los peores resultados.
Palabras clave: Altitud; Formaciones Tácticas; Partidos en condición de visitantes; Efectividad de puntos y goles; Plataforma Instat Scout.

Introduction

The results obtained in professional soccer matches played in altitude cities has been scarcely investigated and the few existing scientific documentation has been elaborated mainly in the last 15 years. Despite of the above mentioned, the effects of altitude on the human organism are well known, both in resting conditions and at the moment of physical activity.

During the South American qualifiers between 1980 and 2007, teams such as Bolivia, Colombia and Ecuador played their matches at more than 2500 meters above sea level (masl) and managed to win 56, 55 and 63 percent of their home matches, while as visitors they won only 6, 24 and 9 percent of their matches, respectively (Gore et al. 2008). For Cabrera et al. (2021) in their study during the Copa Conmebol Libertadores, they concluded that home teams scored an average of 2 or more goals and their chances of winning were 2.5 times higher when the visiting team ascended the

equivalent of 3 altitude categories or 3605 m approximately.

It is evident that the advantage which the home teams have is greater when matches are played at moderate and high altitudes, i.e. between 2000 and 3600 masl, due to the physiological effects expressed numerically in the results obtained in various tournaments, where matches are played in cities at high altitude.

The home advantage (HA) is defined as the percentage of points obtained in home condition compared to the points obtained in away condition and has been well documented by several studies around the world (Ponzo & Scoppa; Pollard 2008; Neville et al., 2013; Armatas & Pollard 2014; Staufenbiel et al., 2015; Pollard & Armatas 2017; Martinez & Gonzales 2019).

Martinez and Gonzales (2019) claim the HA in the top 5 leagues in the world is 61.04%, while for Pollard (2008) there are 8 well identified indicators that could explain the home advantage: 1. crowd effects, 2. travel effects, 3. familiarity, 4. referee bias, 5. territoriality 6. special tactics,

7. rule factors, 8. psychological factors.

According to this classification, the research of Ponzo and Scoppa (2016) states that the HA associated only with the presence of public is 0.45 goals more than the opponent and the probability of winning is 15 additional percentage points; on the other hand, when visiting teams from European and African leagues traveled between 500 km to 5000 km, according to Goumas (2014), the HA increased by 11 percent.

About familiarity, studies have determined that the HA barely decreases when local teams change stadiums (Pollard 2002; Leite et al., 2022).

While for Nevill et al. (2013) despite the decrease in crowd influence on refereeing decisions, the presence of fans alone still has a significant effect on home team advantage.

Armatas and Pollard's (2014) study in Greece on territoriality concluded that the HA was between 60.14% and 74.54%, considering that the lowest values corresponded to Athens teams and the highest values, to teams with different ethnic populations, remote locations, or both. In addition, offensive strategies according to Staufenbiel et al. (2015) increase when a team plays as a home team, its predisposition is more courageous and dominant, even more so in the second half, and with the changes of players when the team is not winning during the match.

The altitude, important part of this study, is also an incident factor in the HA and in the results of matches played at moderate and high altitude. For example, Pollard and Armatas (2017) determined during 3 World Cup qualifying events that, the advantage per 1000 meters of altitude and taking into consideration other variables is 0.115 points in favor of the home team. However, taking into account only the match results and altitude, the percentage of points obtained at home by teams such as Bolivia is 92.7% and Ecuador is 78.9%. For McSharry (2007) for every 1000m difference in altitude, the home team obtains an advantage of 0.5 goals in favor, which at moderate or high altitudes has a significant importance.

While it is true that the home advantage can be attributed to several well-determined factors, altitude gives a considerable strength to home teams compared to other variables that are the subject of multiple investigations.

According to Bärtsch et al. (2008) an altitude from 0 to 500 m is considered near sea level, from 500 to 2000 m is considered low altitude, from 2000 to 3000 m is considered moderate altitude, from 3000 to 5500 m high altitude and from 5500 m and above extreme altitude. However, it is important to mention that the differences in altitude between teams at low altitude and teams at high altitude should always be considered.

During the 2010 FIFA World Cup Nassis (2013) found that the total distance traveled in soccer matches above 1200m decreased by 3.1% up to 1600m. Furthermore, for every 305m of altitude the air density decreases by 3%, affecting aerodynamics and ball flight ability. For Pullinger et al. (2019), cognitive decision making responses were 15% and 9% more efficient at sea level and at 1500 m respectively, compared to 3000 m of altitude.

Additionally, the systematic review prepared by Montañez et al. (2023) concluded that competing at altitude produces a decrease in aerobic capacity, which leads to a decrease in power, strength in the shot, speed and motor coordination.

Notwithstanding, the physiological effects of altitude have been more strongly noticed in the decrease of endurance by a direct affectation in the maximum oxygen intake (VO2 max), since according to the study of Clark et al. (2007) in well-trained cyclists, this decreased approximately 7% for every 1000 m of altitude difference, while Wehrlin and Hallén (2006) determined that this decreased an average of 6.3% in trained athletes, which can be contrasted with the research of Gore et al. (2008) in professional soccer players, where they found a decrease of approximately 7% in the same altitude difference.

On the other hand, this diminution of VO2 max has an impact on the repeated-sprint ability (RSA), which according to Bishop et al. (2011) is one of the most significant performance parameters in athletes; for Girard et al. (2017) it is fundamental in soccer and is seriously compromised in hypoxic environments, decreasing arterial O2 saturation and increasing cardiorespiratory and metabolic response. In addition, Padilla and Lozada (2013) mention that RSA depends on 30% of VO2max and if changes of directions are included, it depends on 35.8%.

Regardless of the sport specialty, VO2max is reduced in hypoxia conditions, which has a direct impact on RSA and consequently on physical performance.

Considering that HA can be strongly influenced by the physiological effects of matches played at altitude, tactical formations could help reduce this unfavorable condition for visiting teams.

Tactics according to Fradua et al. (2013) refers to the management of space, time and individual actions of players with the aim of achieving a positive result. According to the research of Rein and Memmert (2016) tactics can be classified into individual, group, team and match tactics, while for Grunz et al. (2012) team tactics define team formations or tactical formations, which according to Muller et al. (2019) explain the spatial location of players within the field of play, example: 1-4-4-2.

In view of the foregoing, it is concluded that the tactical formation or team formation can be defined as the predetermined location of a team on the field of play, which is influenced by team tactics, match tactics, opponent tactics and changing game situations, such as injury or expulsion.

During the last FIFA World Cup Russia 2018 Guedea et al. (2019) reported 8 tactical formations: (1) 1-4-2-3-1, (2) 1-4-4-2, (3)1-4-3-3, (4) 1-3-4-3, (5) 1-3-5-2, (6) 1-4-5-1, (7) 1-5-4-1, (8) 1-5-3-2 and determined that the most used tactical formation was 1-4-2-3-1. Moreover, both France and Croatia, champion and vice-champion of the tournament respectively, used it frequently, while Tierney et al. (2016) determined that the most used tactical formations in

elite players in England are: (1) 1-4-4-2, (2) 1-4-3-3, (3) 1-3-5-2, (4) 1-3-4-3, (5) 1-4-2-3-1 and concluded that the formation that generates greater physical wear is 1-3-5-2 in contrast to the 1-4-4-2 formation, which presented less physical demand.

The objective of this study was to determine the incidence of tactical formations in the results of soccer matches played in cities at altitudes between 2500 and 3250 masl, of the Ecuadorian Professional Soccer League, as well as which tactical formation obtains better sports results in these cities.

Material and Method

Research design

The investigation is based on a quantitative approach, of a basic type, due to its non-experimental design with a cross-sectional correlational scope. In this paper, the analytical method was applied for the theoretical foundation used, and the hypothetical-deductive method, for the construction of knowledge.

Population and sample

The study population is composed from the matches played during the 2020 and 2021 seasons of the Ecuadorian Professional Soccer League and the study sample was a total of 123 soccer matches played by teams from the lowlands, as visitors, in cities at altitude.

Instruments

With the objective to analyze the tactical formations applied in the study sample in matches played at altitude, with the validation of experts, the data provided by the InStat Scout platform (Dublin, Ireland) was used. This performance analysis software of European origin bases its operation on video and data parameterization, to deliver in a general way around 40 parameters per player and 70 parameters per team in each soccer match. It offers its services to more than 15.000 users worldwide and is used by soccer teams such as France, Belgium, Brazil and clubs such as Real Madrid, Manchester United, Manchester City, Barcelona F.C. among others.

Procedure

The Technological Institute of Soccer of Quito authorized access to the Instat Scout platform to proceed with the review of the videos, tactical formations and results of each of the teams based in cities at sea level that played a total of 123 matches during the 2020 and 2021 seasons of the Ecuadorian soccer league, in cities between 2500 and 325 0masl. For each match, the platform selected 1 of the 7 formations that it has configured by default, based on the one that was most predominant in the match, and also the validation of 2 experts was used to check the playing formations.

In order to deepen the analysis, the following parameters were calculated:

- Tactical formations applied in matches at altitude (% of each tactical formation in relation to the 123 matches analyzed).

- Results of matches at altitude by tactical formations applied in the study sample (% of results of loss, draw or win by tactical formation in relation to the 123 matches analyzed).

- Average, sum and effectiveness of points obtained in matches at altitude (minimum, maximum, sum, mean, standard deviation and percentage of effectiveness of points per tactical formation in relation to the 123 matches analyzed).

- Average goals per tactical formation applied at altitude in the study sample (mean and standard deviation for goals scored and conceded per tactical formations in relation to the 123 matches analyzed).

- Correlation between match results and away goals scored and conceded.

It is important to mention that the vast majority of matches were played without an audience, due to the confinement caused by COVID 19; only a few matches were played with an audience, and others, with very limited capacity.

Statistical analysis

The SPSS version 24.0 IBM statistical package was used, applying a Kolmogorov-Smirnov normality test, which determined the application of the non-parametric Kruskal-Wallis H test for independent samples, considering $p \leq 0.05$ as the significance level and the Spearman's Rho correlation test with a $p \leq 0.01$.

Results

Between 9 and 11 matches per selected team were analyzed, 62.5% of the teams had matches in both years of analysis, 25% only during 2020 and 12.5% during 2021 (Table 1).

Table 1.
Characterization of the study sample

Teams visitors at altitude	2020		2021		Total	
	n	%	n	%	n	%
Barcelona S.C.	11	18.6	9	14.1	20	16.3
C. S. Emelec	10	16.9	10	15.6	20	16.3
Guayaquil City F. C.	9	15.3	9	14.1	18	14.6
Orense S.C.	10	16.9	9	14.1	19	15.4
Delfín S. C.	9	15.3	9	14.1	18	14.6
Liga de Portoviejo	10	16.9	-	-	10	8.1
Manta F. C.	-	-	9	14.1	9	7.3
9 de Octubre F. C.	-	-	9	14.1	9	7.3
Total	59	100.0	64	100.0	123	100.0

The tactical formations applied by each of these teams in their matches played in cities with an altitude between 2500 and 3250 meters above sea level were established (Table 2).

In general, the tactical formation most applied in matches at altitude is 1-4-2-3-1 followed by 1-4-4-2.

The 1-4-3-3 tactical formation obtained the most wins, while the 1-4-2-3-1 formation obtained the most points from draws (Table 3).

Table 2.
Tactical formations applied in matches at altitude

Tactical formation	2020		2021		Total	
	n	%	n	%	n	%
1-4-4-2	11	18.6	21	32.8	32	26.0
1-4-4-2-D	2	3.4	2	3.1	4	3.3
1-4-2-3-1	23	39.0	19	29.7	42	34.1
1-4-3-3	8	13.6	8	12.5	16	13.0
1-3-4-3	5	8.5	8	12.5	13	10.6
1-3-5-2	8	13.6	6	9.4	14	11.4
1-4-1-4-1	2	3.4	-	-	2	1.6
Total	59	100.0	64	100.0	123	100.0

Table 3.
Match results at altitude by tactical formation applied in the study sample

Tactical formation	Lost		Drawn		Won		Total	
	n	%	n	%	n	%	n	%
1-4-4-2	15	46.9	9	28.1	8	25.0	32	100.0
1-4-4-2-D	3	75.0	-	-	1	25.0	4	100.0
1-4-2-3-1	21	50.0	12	28.6	9	21.4	42	100.0
1-4-3-3	6	37.5	4	25.0	6	37.5	16	100.0
1-3-4-3	9	69.2	3	23.1	1	7.7	13	100.0
1-3-5-2	9	64.3	3	21.4	2	14.3	14	100.0
1-4-1-4-1	-	-	1	50.0	1	50.0	2	100.0

The 1-4-1-4-1 formation is not taken into account due to the small number of matches played.

The 1-4-3-3 tactical formation scored the most points, followed by the 1-4-4-2 formation, and the 1-4-1-4-1 formation was not taken into account due to the small number of matches analyzed, on the other hand, the 1-3-4-3 and 1-3-5-2 formations scored the fewest points (Table 4).

Table 4.
Mean, sum and effectiveness of points scored in high altitude matches

Tactical formation	N	Points obtained					
		Minimum	Maximum	Sum	Mean	Standard deviation	Percentage of effectiveness
1-4-4-2	32	0	3	33.00	1.03	1.23	34.38%
1-4-4-2-D	4	0	3	3.00	0.75	1.50	25.00%
1-4-2-3-1	42	0	3	39.00	0.93	1.18	30.95%
1-4-3-3	16	0	3	22.00	1.38	1.36	45.83%
1-3-4-3	13	0	3	6.00	0.46	0.88	15.38%
1-3-5-2	14	0	3	9.00	0.64	1.08	21.43%
1-4-1-4-1	2	1	3	4.00	2.00	1.41	66.67%

In relation to goals scored, the 1-4-3-3 formation had the highest average value and the 1-3-5-2 formation had a higher average value in relation to the number of goals conceded (Table 5).

Table 5.
Average number of goals per tactical formation applied at altitude in the study sample

Tactical formation	N	Goals scored			Goals conceded		
		Mean	Standard deviation	P	Mean	Standard deviation	P
1-4-4-2	32	1.28	±1.05		1.84	±11.22	
1-4-4-2-D	4	1.25	±0.96		2.50	±11.91	
1-4-2-3-1	42	0.95	±0.82		1.62	±11.21	
1-4-3-3	16	1.38	±1.26	0.374*	1.40	±11.59	0.461*
1-3-4-3	13	0.69	±0.85		1.85	±10.99	
1-3-5-2	14	0.71	±0.91		2.00	±11.18	
1-4-1-4-1	2	1.50	±2.12		1.00	±11.41	

Note. Significant differences at one level of P>0.05 (*)

The 1-4-1-4-1 and 1-4-4-2-D formations were not taken into account due to the s number of matches played

The Kruskal-Wallis H test applied to determine the existence of significant differences between the means of goals scored and goals conceded by tactical formation, obtained a value of P>0.05, which shows that there are no differences and assigns an statistical equality; however, at a descriptive level, a greater effectiveness is evident in the 1-4-3-3 tactical formation due to the number of matches analyzed in relation to a higher mean of goals scored and a lower mean of goals conceded.

Statistically, there is a high positive correlation between the 1-3-4-3 tactical formation and the goals scored, followed by a moderate positive correlation between the 1-4-2-3-1 and 1-4-3-3 formations in relation to the goals scored and a weak positive correlation with the 1-4-4-2 formation, all cases supported with a significance level of P≤0.01. In relation to goals conceded and the different tactical formations, there were no positive correlations, with the 1-3-4-3 formation presenting a negative value close to 0 (Table 6).

Table 6.
Correlation between match results, away goals scored and goals conceded

Tactical formation	Variable of analysis	Rho de Spearman	Result of the match	Goals scored	Goals conceded
1-4-4-2		Correlation coefficient	1.000	0.474**	-0.672**
		Sig. (bilateral)	.	0.006	0.000
		N	32	32	32
1-4-4-2-D		Correlation coefficient	1.000	0.544	-0.816
		Sig. (bilateral)	.	0.456	0.184
		N	4	4	4
1-4-2-3-1	Result of the match	Correlation coefficient	1.000	0.598**	-0.695**
		Sig. (bilateral)	.	0.000	0.000
		N	42	42	42
1-4-3-3		Correlation coefficient	1.000	0.689**	-0.398
		Sig. (bilateral)	.	0.003	0.142
		N	16	16	15
1-3-4-3		Correlation coefficient	1.000	0.835**	-0.224
		Sig. (bilateral)	.	0.000	0.461
		N	13	13	13
1-4-1-4-1		Correlation coefficient	1.000	1.000	1.000
		Sig. (bilateral)	.	.	.
		N	2	2	2

Note. Correlation is significant at the level of P≤0.05 (*) y P≤0.01 (**)

Discussion

According to the authors, this is the first study that correlates tactical formations and the results obtained in soccer matches played at moderate and high altitude

In this research the most used tactical formation was the 1-4-2-3-1, with a frequency of 39%, followed by the 1-4-4-2 and 1-4-3-3 in 123 matches analyzed, which coincides with the research of Guedea et al. (2019) and Aquino et al. (2019) in the Russia 2018 World Cup.

The main finding of the study determined the incidence of tactical formations on sports results, specifically that the 1-4-3-3 formation obtained the best results in visiting condition in altitude cities, at more than 2500 masl with a winning percentage of 37. This was followed by the 1-4-4-2 formation with a winning percentage of 25% and draws of 28.1%, while the 1-4-2-3-1 formation was in third place with a winning percentage of 21.4% and 28.6% of draws, i.e., it was the one that achieved the most draws.

If it is considered that RSA is a very important physical performance parameter in soccer, due to the large number

of high intensity actions and the relatively short rest times that it handles, the results of this study suggest that, in hypoxia situations, a tactical formation that handles less RSA actions at more than 2500 masl could obtain better results in altitude cities, since its physical wear and tear would be lower. These data can be correlated with physical performance parameters such as total distance covered in the form of sprints, very high intensity and high intensity actions in normoxia, raised in research such as Tierney et al. (2016) where it indicates that the 1-4-3-3 and 1-4-4-2 formations have a lower number of high intensity actions, accelerations and decelerations compared to the 1-3-5-2, 1-3-4-3 and 1-4-2-3-1 formations. In the same way Aquino et al. (2019) mentioned that the distances covered in high intensity and distance covered in sprints at more than 25 km/h are lower in the 1-4-4-2 and 1-4-3-3 formations, compared to formations such as the 1-3-4-3, 1-3-3-2-2, the 1-4-3-2-1 and the 1-4-2-3-1 respectively; however, the distance covered at very high intensity and amount of sprints at more than 25 km/h are higher for the 1-4-3-3 formation, which is interesting, since a higher amount of sprints, but a lesser distance covered in sprints could be caused by longer recovery times, which would affect RSA to a lesser extent and lead to better physical performance. This coincides with the data of Borghi et al. (2021) which manifests a higher amount of sprints for the 1-4-3-3 formation, but a lower amount of distance covered in high speed, compared to the 1-4-4-2 and 1-3-5-2 formations. In addition, Riboli et al. (2020) concluded that the 1-4-4-2 and 1-4-3-3 formations had lower amount of accelerations and decelerations, as well as lower amount of distance traveled over 20 km/h in 1-minute peaks, compared to the 1-3-4-2-1, 1-3-4-1-2 and 1-3-5-2 formations.

On the other hand, taking into consideration that hypoxia causes a decrease in correct decision making, Pullinger et al. (2019) determined that certain parameters of technical tactical performance can also be affected to a greater extent by a particular tactical formation. For example, the research by Bradley et al. (2011) mentions that parameters such as: more passes per possession, more dribbles, and more successful tackles is higher for the 1-4-3-3 formation compared to the 1-4-4-2 and 1-4-5-1 formation respectively, while more percentage of successful passes, passes received and possessions generated is higher for the 1-4-4-2 formation compared to the 1-4-3-3 and 1-4-5-1 formation. To some extent, this coincides with the information of Arjol-Serrano et al. (2021) which indicates that the 1-4-4-2 formation presented higher volume of total play, volume of offensive and defensive play, interceptions, free spaces, passes in general, shots on goal and dribbles compared to the 1-4-2-3-1 formation. In addition, Aquino et al. (2019) determined in their variables on ball possession that, the 1-4-3-3 and 1-4-4-2 formations had higher possession in the defensive zone and lower possession with the midfield zone compared to formations such as the 1-4-3-3, 1-3-3-2-2, 1-4-2-3-1 and the 1-4-3-2-1.

These data show that the 1-4-3-3 and 1-4-4-2 formations present a more defensive behavior and better technical and tactical parameters in normoxic conditions, which could be very beneficial in hypoxic conditions at altitude. Since the team would remain compact in the defensive zone, in theory, this would further improve its physical, technical and tactical performance

The number of goals scored is in full correlation with the tactical formation that obtained the best results, i.e. the 1-4-3-3 formation scored more goals and conceded fewer goals, followed by the 1-4-4-2 and 1-4-3-2-1 formations in terms of goals scored, while the 1-4-2-3-1 formation ranked second in terms of the number of goals conceded, which could explain the fact that it was the one that obtained the most draws. On the other hand, the 1-3-4-3 and 1-3-5-2 formations received the most goals, this may be due to the fact that, according to (Forcher et al., 2022) the 3 central defenders have more distance to cover across the width and length of the field compared to a defensive line made up of 4 defenders, Additionally. the outside lanes are covered by a single player, which could also explain a lower number of goals scored.

It is hoped that future research can analyze other variables such as the game model, the predisposition of attack or defense, the strength of the team, the climate, the differences in altitude, the economic power, among others, in soccer matches played in cities at altitude.

Conclusions

The data indicate that the tactical formations formed by 4 defenders obtain better results than the formations with only 3 defenders in cities over 2500 masl.

The 1-4-3-3 formation was the one that obtained the best results in cities at altitude, and also scored the most goals and conceded the fewest goals, followed by the 1-4-4-2 formation in terms of results obtained and goals scored, while the 1-4-2-3-1 formation was the one that obtained the most draws. The 1-3-5-2 formation was the one that obtained the worst results in cities at altitudes above 2500 masl.

The statistical results of the 1-4-4-2D (Diamond) and 1-4-1-4-1 formations were not taken into account for the analysis, since the number of matches played was not considerable.

Referencias

Aquino, R., Machado, J., Clemete, F., Praça, G., Gonçalvez, L., Melli-Neto, B., Ferrari, V., Palucci, L., Puggina, E., Carling, C. (2019). Comparisons of ball possession, match running performance, player prominence and team network properties according to match outcome and playing formation during the 2018 FIFA World Cup. *International Journal of Performance Analysis in Sport*, 1026 - 1037. https://doi.org/10.1080/24748668.2019.1689753

Arjol-Serrano, J. L., Lampre, M., Castillo, D., Sanz-l, F., & Lozano, D. (2021). The Influence of Playing Formation on Physical Demands and Technical-Tactical Actions According to Playing Positions in an Elite Soccer Team. *International Journal Environmental Reserach and Public Health, 18(8),* https://doi.org/10.3390/ijerph18084148

Armatas, B., & Pollard, R. (2014). Home Advantage in Greek Football. *European Journal of Sport Science*, 116-122.
https://doi.org/10.1080/17461391.2012.736537

Bärtsch, P., Saltin, B., & Dvorak, J. (2008). Consensus statement on playing football at different altitude. *Scandinavian Journal of Medicine & Science in Sports*, *18 Suppl 1*, 96–99. https://doi.org/10.1111/j.1600-0838.2008.00837.x

Bishop, D., Girard, O., & Mendez-Villanueva, A. (2011). Repeated-sprint ability part II: Recommendations for training. *Sports Medicine*, *41*(9), 741–756. https://doi.org/10.2165/11590560-000000000-00000

Borghi, S., Colombo, D., La Torre, A., Banfi, G., Bonato, M., & Vitale, J. A. (2021). Differences in GPS variables according to playing formations and playing positions in U19 male soccer players. *Research in Sports Medicine*, *29*(3), 225–239. https://doi.org/10.1080/15438627.2020.1815201

Bradley, P. S., Carling, C., Archer, D., Roberts, J., Dodds, A., Mascio, M. Di, Paul, D., Diaz, A. G., Peart, D., & Krustrup, P. (2011). *The effect of playing formation on high-intensity running and technical profiles in English FA Premier League soccer matches*. *September 2013*, 37–41. https://doi.org/10.1080/02640414.2011.561868

Cabrera, M., Garcia, S., Povea, C., Tafur, L., Hurtado, H., Tovar, J., Mosquera, C., & Grijalba, D. (2021). CONMEBOL Libertadores Cup: Altitude impact on goals and results in 16 years of soccer matches. *Journal of Human Sport and Exercise, 18*, 1-12. https://rua.ua.es/dspace/bitstream/10045/114887/6/JHSE_18-1_InPress_04.pdf

Clark, S. A., Bourdon, P. C., Schmidt, W., Singh, B., Cable, G., Onus, K. J., Woolford, S. M., Stanef, T., Gore, C. J., & Aughey, R. J. (2007). The effect of acute simulated moderate altitude on power, performance and pacing strategies in well-trained cyclists. *European Journal of Applied Physiology*, *102*(1), 45–55. https://doi.org/10.1007/s00421-007-0554-0

Fradua, L., Zubillaga, A., Caro, O., Fernandez-Garcia, A. R.-R., & Tenga, A. (2013). Designing small-sided games for training tactical aspects in soccer: extrapolating pitch sizes from full-size professional matches. *Journal of Sports y Sciences*.

Forcher, L., Forcher, L., & Jekauc, D. (2022). The Influence of Tactical Formation on Physical and Technical Match Performance in Male Soccer : A Systematic Review (Issue May). https://doi.org/10.1177/17479541221101363

Girard, O., Brocheire, F., & Gregoire, M. (2017). Effects of Altitude/Hypoxia on Single- and Multiple-SprintPerformance: A Comprehensive Review. *Sports Medicine*, 1931-1949. https://doi.org/10.1007/s40279-017-0733-z

Gore, C. J., McSharry, P. E., Hewitt, A. J., & Saunders, P. U. (2008). Preparation for football competition at moderate to high altitude. *Scandinavian Journal of Medicine & Science in Sports*, *18 Suppl 1*, 85–95. https://doi.org/10.1111/j.1600-0838.2008.00836.x

Goumas, C. (2014). Tyranny of distance: Home advantage and travel in international club footbal. *International Journal of Performance Analysis in Spor*, 1-13. https://doi.org/10.1080/24748668.2014.11868698

Grunz, A., Memmert, D., & Perl, J. (2012). Tactical pattern recognition in soccer games by means of special self-organizing maps. *Human Movement Science*, 334 - 343. https://doi.org/10.1016/j.humov.2011.02.008

Guedea, F., Najera, J., Nuñez, O., Candia, R., & Gastelum, G. (2019). Sistemas tacticos y resultados de la competicion del mundial de la FIFA Rusia 2018. *Retos: nuevas tendencias en Educación Física, Deporte y Recreación*, 503-509. https://doi.org/10.47197/retos.v36i36.69296

Leite, W., Giardina, M., Almeida, C. H., & Pollard, R. (2022). Home advantage in football after moving to a new stadium: Evidence from european professional teams. *International Journal of Sport and Exercise Psychology,* https://doi:10.1080/1612197X.2022.2078855

Martinez, F., & Gonzales, H. (2019). Efecto de marcar primero y la localización del partido en las principales ligas del fútbol europeo (Effect of scoring first and match location in the main European football leagues). *Retos: Nuevas Tendencias en Educación Física, Deporte y Recreación*, 242-245. https://doi.org/10.47197/retos.v0i35.64026

McSharry, P. (2007). Effect of Altitude on Physiological Performance: a statistical analysis using results of international football games. *BMJ*, 1278-1281. https://doi.org/10.1136/bmj.39393.45156.AD

Montañez, F., Sanchez, D., & Ordoñez, N. (2023). Influencia de la altitud sobre la condición física de futbolistas en situaciones de entrenamiento y competicion: una revision sistematica. *Retos: Nuevas tendencias en Educacion Fisica, Deportes y Recreacion*, 292-299. doi:10.47197/retos.v49.94129

Muller, E., Theiner, J., Rein, R., & Ewert, R. (2019). "Does 4-4-2 exist?" – An Analytics Approach to Understand and Classify Football Team Formations in Single Match Situations. *MMSports*. https://doi.org/10.1145/3347318.3355527

Nassis, G. (2013). Effect of altitude on football performance: analysis of the 2010 FIFA World cup data. *Journal of Strength and Conditioning Research*, 703-707. https://doi.org/10.1519/JSC.0b013e31825d999d

Nevill, A., Webb, T., & Watts, A. (2013). Improved training of football referees and the decline in home

advantage post-WW2. *Psychology of Sport and Exercise*, 220-227. https://doi.org/10.1016/j.psychsport.2012.11.001

Padilla, J., & Lozada, J. (2013). Relation of Repeated Sprint Ability Representations With the Muscle Power of Lower Limb, Aerobic Power and Anthropometric Parameters in Football Young Players. *J Sport Health Res Journal of Sport and Health Research*, 5(2), 179–192.

Paraskevas, G., Smilios, I., & Hadjicharalambous, M. (2020). Effect of opposition quality and match location on the positional. *Journal of Exercise Science & Fitness*, 40-45. https://doi.org/10.3390/proceedings2019025026

Pollard, R. (2002). Evidence of a reduced home advantage when a team. *Journal of Sports Sciences*, 969-973. https://doi.org/10.1080/026404102321011724

Pollard, R. (2008). Home Advantage in Football: A Current Review of an Unsolved Puzzle. *The Open Sports Sciences Journal*, 12-14. https://doi.org/10.2174/1875399X00801010012

Pollard, R., & Armatas, V. (2017). Factors affecting home advantage in football World Cup qualification. *International Journal of Performance Analysis in Sport*, 121-135. https://doi.org/10.1080/24748668.2017.1304031

Ponzo, M., & Scoppa, V. (2016). Support? Evidence From Same-Stadium Derbies Depend on Crowd Does the Home Advantage. *Journal of Sports Economics*, 1-21. https://doi.org/10.1177/1527002516665794

Pullinger, S., Bradley, P., Causer, J., Ford, P., Newlove, A., Patel, K., Reid, K., Robertson, C., Burniston, J., Doran, D., & Waterhouse, J. &. (2019). Football-induced fatigue in hypoxia impairs. *Science and Medicine in Football*, 1-10. https://doi.org/10.1080/24733938.2019.1591633

Rein, R., & Memmert, D. (2016). Big data and tactical analysis in elite soccer: future challenges and opportunities for sports science. *SpringerPlus*. https://doi.org/10.1186/s40064-016-3108-2

Riboli, A. A., Semeria, M., Coratella, G., & Esposito, F. (2020). *Effect of formation , ball in play and ball possession on peak demands in elite soccer*. 1(September). https://doi.org/10.5114/biolsport.2020.98450

Staufenbiel, K., Lobinger, B., & Strauss, B. (2015). Home advantage in soccer – A matter of expectations, goal setting and tactical decisions of coaches? *Journal of Sport Sciences*, 1932-1941. https://doi.org/10.1080/02640414.2015.1018929

Tierney, P., Young, A., Clarke, N., & Duncan, M. (2016). Match play demands of 11 versus 11 professional football using. *Human Movement Science*, 1-8. https://doi.org/10.1016/j.humov.2016.05.007

Wehrlin, J. P., & Hallén, J. (2006). Linear decrease in VO2max and performance with increasing altitude in endurance athletes. *European Journal of Applied Physiology*, 96(4), 404–412. https://doi.org/10.1007/s00421-005-0081-9