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Original Research

Evolution of Match Technical-Tactical Performance Indicators According to Age Category in Men's National Football Teams (World Cups 2003-2019)

Sergio Caicedo-Parada*[1,2], Enrique Ortega-Toro‡[2,3], Jose M. Palao‡[3,4]

[1]Faculty of Administrative and Social Sciences, Higher Institute of Rural Education, Pamplona, Colombia; [2]Department of Physical Activity and Sport, Faculty of Sport Science, Regional Campus of International Excellence "Campus Mare Nostrum," University of Murcia, Murcia, Spain; [3]Sport Performance Analysis Association, Murcia, Spain; [4]Department of Health, Kinesiology, and Sport Management, University of Wisconsin–Parkside, Wisconsin, United States

*Denotes student investigator, ‡Denotes established investigator

Abstract

International Journal of Exercise Science 18(3): 575-590, 2025. https://doi.org/10.70252/KNPB8178 Performance in football depends on different dynamic interactions between players that occur at technical, tactical, physical, psychological, or sociological levels. The objective of this study was to analyze the evolution of match technical-tactical performance indicators according to age category in men's national football teams (U-17, U-20 and senior). A non-experimental retrospective observational design was used. Variables studied were ball possession, goal chances, shots off target, shots on target, corner kicks, effectiveness; goals, offsides, fouls committed, yellow cards, red cards, and second yellow cards. Data were drawn from 917 matches (195 senior, 369 U-20, and 353 U-17) played by teams from 97 nations. For the study of the differences between winners and losers, a T-test and a discriminant analysis were performed. To analyze the change between the different tournaments, a linear regression and its slope were used. Goal chances, shots on target, and effectiveness are the variables that best discriminated match winners. As players' ages increased, their effectiveness increased, there was a decrease in their shots and goal chances, and game actions were more balanced. The evolution of technical-tactical performance indicators between 2003-2009 and 2010-2019 showed a decrease in fouls committed and yellow cards for all categories. In general, the results show an evolution in the game towards strategies that seek to generate more effective situations with a greater chance of scoring. Data can serve as references to understand players' and teams' evolution and factors that correlate with winning (chances, shots on target, and effectiveness).

Keywords: Sport, football, evolution, match analysis

Introduction

Performance in football depends on different dynamic interactions between players that occur at technical, tactical, physical, psychological, and sociological level, among others.[1] The

technical-tactical performance indicators provide information about how teams perform in competition. Technical-tactical performance indicators are a combination of actions or variables done during the game that provide insight about the player's and/or teams' performance regarding the application of the game actions and strategies in the match (adapted from).[2] An analysis of different technical-tactical performance factors facilitates an understanding of competition and objectives.[3,4] Knowing what technical-tactical aspects correlate with winning or losing a match can help train players and prepare them for matches. Research to date has shown that, in older age groups have higher physical and technical differences.[5] However, studies in these developmental stages with elite have been limited, and it is not clear how the players evolution could affect technical-tactical performance indicators. Previous studies[6] indicated the need to improve our knowledge about the evolution of the game in developmental categories (U-17, U-20). The study of technical-tactical performance indicators in players that compete at international level in different age groups would allow us to assess how the game evolves and the factors that affect the outcome of the match.

Table 1. List of studies that analyze technical-tactical performance indicators in senior and developmental men's international football teams.

	World Cup	Continental Cups	UEFA Championship
Ball possession	11, 3, 10, 12, 18	2*, 11, 21, 28, 31	16
Shots	3, 6, 7, 8, 12, 14, 18, 22, 24, 32	2*, 11, 21, 22, 27, 28	9, 16
Passes	12, 18, 24	2*, 11, 22, 28	16
Fouls	12	2*, 21(-)	9
Yellow / Red Cards	12, 18	21(-)	
Shot effectiveness		2*, 31	16
Passing accuracy	1, 10, 12	2*, 27, 28,	16
Corner kicks	12, 24	2*, 21(-), 28	9
Assists	6	27	
Offsides	12(-)	2*	9(-)

Legend: The value (-) indicates a negative correlation between the indicators and match success. Goals scored are not included as a performance indicator of the match result. *Studies carried out in developmental age groups. Numbers refer to the reference of the article that analyzed this technical-tactical performance indicator. **Note**: Table 1 groups the variables studied in the reviewed bibliography related to technical-tactical performance indicators in the men's senior category.

The literature reviewed about international football teams (Table 1) shows that number of shots, ball possession time, number of passes, pass accuracy, and effectiveness are variables that positively correlate with match success.[7] These variables are included in the FIFA match report because they provide a basic view of the technical-tactical performance indicators of the matches.[8] The number of offsides is a variable that correlates with losing the match. These studies show that, in the senior category, winning teams performed more offensive actions and with greater precision. The occurrence of the different game actions provides information about the techniques and the tactics or game style used by teams. For example, a higher number of goal chances and shots on goal involves a more offensive game style. However, a higher number of fouls and fewer passes usually indicate a defensive game style. In younger age groups, there are few studies on technical-tactical indicators of performance.[6] In developmental age groups (U-17, U-20), the ball possession are the most important indicators of match outcome in national

teams.[9,10] The existing literature shows that in lower age groups (U-17, U-20), there are physical and technical differences that can affect team performance.[10] Theoretically, older players have more experience and greater physical capacities. However, studies in these age groups and level of competition are limited. It is unknown how these factors can affect the technical-tactical performance indicators and their evolution.

Data about the evolution of the technical-tactical football performance indicators can provide reference values regarding how national players and teams evolve through their developmental process. These indicators can serve as a comparative guide for the development of players in training. Match analysis allows us to know the technical-tactical performance indicators that differentiated winners and losers. The study of the evolution of these indicators provides insight into whether there has been a change in technical-tactical performance indicators.[22] This study provides a general evaluation of the technical-tactical match variables and their evolution as a function of the match result and age groups. The objective of the study was to analyze the evolution of match technical-tactical performance indicators between winners and losers according to age category in men's national teams (U-17, U-20, and senior, World Cups 2003-2019).

Methods

Sample

The sample was 917 matches played between 97 men's national teams (U-17, U-20, and senior) at the World Cup between 2003 and 2019. Matches that ended in a tie after regulation time were excluded (234 of 1152 matches, 20.31% of the total). Table 2 describes the sample of the study by championship and age group (353 U-17 matches, 369 U-20 matches and 195 senior matches). The study variables were obtained from the official reports of each match published in open access by the Federation International Football Association (FIFA). These reports were extracted from the competitions and archive sections of the FIFA website (www.fifa.com). This research was carried out fully in accordance to the ethical standards of the *International Journal of Exercise Science*.[28] The study did not go through the IRB, due to the first author's university not requiring IRB review for studies that do not involve human subjects and that use public datasets.

Table 2. Number of matches included in the study by championship and age group (Men's World Cup, 2003 - 2019).

Age group	2003	2005	2006	2007	2009	2010	2011	2013	2014	2015	2017	2018	2019	Total
U17	24(8)*	26(6)		42(10)	42(10)		42(10)	43(9)		42(10)	46(6)		47(5)	353
U20	44(8)	43(9)		40(12)	40(12)		38(14)	39(13)		41(11)	40(12)		44(8)	369
Senior			47(17)			48(16)			49(15)			51(13)		195

Legend: * One match report was not available. "(n)" Number of matches tied by championship and age group.

Design

A non-experimental retrospective observational design was used. The variables about the sample were the year of the tournament, the age group (U17, U20, or senior), and the result of

the match (win or loss). The technical-tactical variables studied were ball possession, chances, shots off target, shots on target, corner kicks, effectiveness, goals scored, offsides or offside offenses, fouls committed, yellow cards or cautions, red cards or send-offs, and red cards for second yellow cards (or second cautions). The chances variable was obtained from the sum of shots off and on target. Effectiveness was calculated by multiplying the number of goals by 100 and dividing by the total number of chances [26]. The unit of analysis was the match (for one team).

To establish the reliability of observers that collected the information in the match report, a researcher observed 12 matches of different age groups and tournaments, four matches for each age group. The observer had a master's degree in Sport Science and more than five years of experience with sports analytics in football. The observation was done using the software Lince Plus (Open source, v 1.3.2). The reliability was calculated using Cohen's Kappa for categorical variables and Interclass Correlation Coefficient (ICC) for continuous variables. All the variables studied had a value of 1, except the possession time which has an ICC of 0.794.

Statistical Analysis

Three levels of analysis were done in this study (win and loss, age groups, and evolution between tournaments). For the study of the differences between winners and losers in each age group, a univariate T-test and a multivariate discriminant analysis were performed. Significance was set at $p<0.05$. The effect size was established with Cohen's d. The following scale was used to assess effect size: N=No effect (< 0.20), S=Small (0.20 - 0.49), M=Medium (0.50 - 0.79), L=Large (0.80 - 1.19), XL=Extra Large (>1.2) [29]. In the multivariate analysis, structural coefficients (SC) were used to discriminate the variables that differentiate winning and losing teams. The threshold was set at $SC < 0.30$. To study the differences between age groups, an ANOVA with post-hoc comparison (Tukey) was performed. Significance was set at $p<0.05$. The effect size was established with Eta squared. The following scale was used to assess effect size: N=No effect (< 0.01), S=Small (0.01 - 0.06), M=Medium (0.061 - 0.140), L=Large (>0.14) [30]. To analyze the analysis of the evolution during the different tournaments, two approaches were followed. We compared the differences between the 2003-2010 and 2011-2019 decades using a T-test and the same criteria described above. We analyzed the change between the different tournaments using a linear regression and its slope. Significance was set at $p<0.05$. The threshold for the slope of the linear regression was set at $r \pm 0.70$. All analyses were performed with the statistical package for the social sciences (SPSS, version 28.0, IBM, Boston, IL, USA).

Results

In the U-17 category (Table 3), the univariate analysis shows that total values for winning teams were significantly higher in ball possession, chances, shots on target, effectiveness, and goals. The magnitude of these differences was extra-large for chances, shots on target, effectiveness, and goals and was large for ball possession. Losing teams presented significantly higher values for red cards and second yellow cards. The magnitude of these differences was small for red cards and minimal for second yellow card. Regarding specific tournaments, winning teams had significantly higher values in some tournaments for shots on target (2007, 2013, 2017), offside, (2011, 2013, 2019); corner kicks (2009, 2011 tournaments and effectiveness (2011). Losing teams

had significantly more red cards in seven of nine tournaments, red cards for a second yellow one in three tournaments (2003, 2009, 2015), and fouls committed in two tournaments (2011, 2015).

Table 3. Descriptive and univariate statistical analysis of technical-tactical match performance indicators in the U-17 Men's World Cup (2003-2019).

Year			Ball possession	Chances	Shots off target	Shots on target	Corner Kick	Efficacy	Goals	Offside	Fouls committed	Yellow card	Red cards	2nd yellow card
2003	W	M	51.2	15.0	6.92	8.17	7.29	18.5	2.92	2.62	14.3	1.79	0.13*	0.00*
		SD	12.3	6.31	3.27	4.38	3.64	11.3	1.79	2.30	6.47	1.32	0.34	0.00
	L	M	44.5	9.50	5.04	4.46	4.04	6.55	0.71	1.54	15.3	2.21	0.25*	0.04*
		SD	11.0	5.57	3.22	2.99	2.99	10.3	0.91	1.69	5.44	1.69	0.53	0.20
		ES	-	-	-	-	-	-	-	-	-	-	.445S	.144N
2005	W	M	50.8	16.8	7.96	8.92	5.81	19.6	2.92	2.35	17.7	2.00	0.08†	0.08
		SD	5.36	7.10	4.34	3.44	3.20	10.7	1.20	2.17	6.31	1.20	0.39	0.27
	L	M	49.1	12.8	6.58	6.23	5.50	8.36	0.88	1.69	18.1	2.54	0.38†	0.08
		SD	5.36	5.32	3.78	3.12	3.02	10.6	0.99	1.72	5.63	1.75	0.70	0.27
		ES	-	-	-	-	-	-	-	-	-	-	.566M	-
2007	W	M	51.7	18.6	10.1	8.55*	5.90	15.8	2.81†	1.98	17.0	1.76	0.14	0.00
		SD	5.83	5.00	4.08	2.90	2.70	7.79	1.42	2.04	4.88	1.48	0.35	0.00
	L	M	48.2	12.5	8.21	4.29*	4.81	6.04	0.69†	1.90	13.5	1.83	0.14	0.00
		SD	5.83	4.67	3.55	1.93	3.21	6.76	0.72	2.14	4.07	1.36	0.35	0.00
		ES	-	-	-	2.46XL	-	-	1.12L	-	-	-	-	-
2009	W	M	52.1	16.2	8.86	7.40	6.00†	14.7	2.31*	2.19	13.5	1.74	0.10*	0.05*
		SD	8.16	5.64	4.00	3.15	3.68	6.35	1.12	1.67	4.57	1.17	0.30	0.22
	L	M	47.9	13.2	8.26	4.98	4.10†	5.79	0.67*	2.19	14.8	2.10	0.19*	0.12*
		SD	8.16	5.44	4.02	2.41	2.45	7.05	0.79	2.82	5.65	1.30	0.40	0.33
		ES	-	-	-	-	3.12XL	-	.965L	-	-	-	.351S	.277S
2011	W	M	50.4	17.3	10.2	7.07	5.19*	16.7*	2.60	2.57*	11.6*	1.48	0.02†	0.02
		SD	6.66	5.86	4.56	3.04	3.14	9.47	1.17	2.07	3.50	1.11	0.15	0.15
	L	M	49.5	14.0	9.38	4.67	5.19*	4.30*	0.64	1.29*	12.4*	1.86	0.17†	0.05
		SD	6.66	6.04	4.54	2.50	2.44	5.77	0.82	1.29	5.09	1.34	0.44	0.22
		ES	-	-	-	-	2.81XL	7.83XL	-	1.72XL	4.36XL	-	.328S	-
2013	W	M	53.8	16.3	6.95	9.37*	4.72	18.6	2.81†	1.49*	14.8	1.35	0.00†	0.05
		SD	10.7	6.29	2.85	4.38	2.46	9.99	1.52	0.98	5.41	1.19	0.00	0.21
	L	M	46.1	9.84	4.51	5.33*	4.74	6.44	0.56†	1.63*	13.9	1.79	0.12†	0.05
		SD	10.7	5.02	2.89	2.89	2.51	7.82	0.63	2.08	5.20	1.34	0.39	0.21
		ES	-	-	-	3.70XL	-	-	1.16L	1.62XL	-	-	.276S	-
2015	W	M	52.5	13.0	6.36	6.64	5.00	21.9	2.71†	2.19	13.8*	1.57	0.07	0.02*
		SD	7.11	4.43	2.71	2.51	2.75	9.15	1.29	2.23	3.13	1.02	0.26	0.15
	L	M	47.4	9.36	5.57	3.79	5.64	7.18	0.60†	1.62	14.4*	1.76	0.05	0.07*
		SD	7.11	4.10	2.91	2.31	2.80	8.91	0.70	1.77	4.59	1.27	0.22	0.26
		ES	-	-	-	-	-	-	1.04L		3.92XL	-	-	.214S
2017	W	M	54.2	14.8	7.35	7.52*	5.33	23.7	3.13*	1.70	11.5	1.24	0.02*	0.00
		SD	10.1	5.21	3.50	3.15	3.18	14.7	1.31	1.79	3.90	1.04	0.15	0.00
	L	M	45.7	9.09	5.72	3.37*	4.61	8.77	0.63*	1.57	12.6	1.48	0.07*	0.00
		SD	10.1	4.81	3.46	2.31	2.85	11.3	0.64	1.53	5.16	1.11	0.25	0.00
		ES	-	-	-	2.76XL	-	-	1.03L	-	-	-	.205S	-
2019	W	M	51.4	14.2	6.85	7.36	5.34	21.1	2.89*	1.55*	11.8	1.21	0.02†	0.04
		SD	8.42	5.68	3.50	3.40	2.76	8.53	1.51	1.87	5.07	1.18	0.15	0.20
	L	M	48.5	8.91	4.77	4.15	4.70	11.1	0.74*	1.34*	12.6	1.85	0.11†	0.02
		SD	8.42	4.66	2.79	2.59	3.01	16.1	0.71	1.11	4.23	1.30	0.31	0.15
		ES	-	-	-	-	-	-	1.17L	1.54XL	-	-	.243S	-
Total	W	M	52.1†	15.8*	7.98	7.82†	5.51	19.0*	2.78*	2.01	13.8	1.53	.059†	.028*
		SD	8.50	5.85	3.90	3.43	3.07	10.3	1.37	1.92	5.13	1.20	.248	.166

	L	M	47.5†	10.9*	6.47	4.49†	4.81	7.22*	.669*	1.63	13.9	1.88	.147†	.045*
		SD	8.42	5.37	3.85	2.61	2.81	10.0	.750	1.85	5.14	1.36	.400	.208
		ES	1.10L	5.61XL	-	3.05XL	-	2.94XL	1.89XL	-	-	-	.333S	-
Evol.	W	R^2	.004	.033†	.031†	.012*	.021*	.037†	.002	.019*	.080†	.035†	.019*	.000
		Slope	.037	-.152	-.222	-.155	-.230	.091	.175	-.349	-.271	-.765	-2.765	-.066
	L	R^2	.000	.051†	.041†	.028*	.001	.014*	.001	.005	.036†	.019*	.028*	.003
		Slope	-.003	-.207	-.258	-.313	.048	.059	-.246	-.178	-.182	-.496	-2.075	-1.298

Legend: Match result: W = Win, & L = Loss. *Statistically significant differences between winning and losing teams p value = (< .05) †p value = (< .001); TE=Effect Size: N =No effect (< 0.20) S =Small (0.20 - 0.49) M =Medium (0.50 - 0.79) L =Large (0.80 - 1.19) XL =Extra Large (>1.2); R^2 = (>±.700)

The univariate analysis of the U-20 teams (Table 4) shows that total values for winning teams were significantly higher in ball possession, shots off target, shots on target, and goals. The magnitude of these differences was extra-large for chances, shots on target, effectiveness, and goals and was large for ball possession. Losing teams had significantly higher values for red cards and second yellow cards. The magnitude of these differences was small for red cards and second yellow cards. Regarding specific tournaments, winning teams had significantly higher values in some tournaments for shots on target (2005, 2011), corner kicks (2017), and effectiveness (2015). Losing teams received a significantly higher number of red cards in six out of nine tournaments and red cards for a second yellow card in four tournaments. Likewise, they received more yellow cards in the 2005 tournament.

Table 4. Descriptive and univariate statistical analysis of technical-tactical match performance indicators in the U-20 Men's World Cup (2003 - 2019).

Year			Ball possession	Chances	Shots off target	Shots on target	Corner Kick	Efficacy	Goals	Offside	Fouls committed	Yellow card	Red cards	2nd yellow card
2003	W	M	51.7	12.2	6.09	6.16	5.18	17.6	1.93	2.39	17.8	2.14	0.11*	0.00
		SD	7.61	5.05	2.73	3.26	2.85	9.43	0.95	2.39	6.23	1.44	0.32	0.00
	L	M	48.3	9.95	5.73	4.23	5.23	5.69	0.55	1.68	18.4	2.39	0.23*	0.00
		SD	7.61	4.60	3.28	2.65	3.06	6.80	0.63	1.51	5.83	1.33	0.42	0.00
		ES	-	-	-	-	-	-	-	-	-	-	.376S	-
2005	W	M	54.0	15.0	7.16	7.84*	5.88	17.1	2.35†	1.88	18.3	2.21*	0.12	0.00
		SD	7.84	5.95	3.28	3.50	3.16	11.2	1.45	1.76	4.85	1.17	0.32	0.00
	L	M	45.2	9.05	5.50	3.55*	4.98	4.76	0.45†	2.05	16.8	2.66*	0.16	0.00
		SD	8.02	4.37	2.95	2.15	3.40	6.85	0.63	2.03	4.94	1.54	0.48	0.00
		ES	-	-	-	2.89XL	-	-	1.11L	-	-	1.36XL	-	-
2007	W	M	53.5	16.2	8.13	8.07	5.90	15.6	2.30*	2.32	17.1	2.12	0.13†	0.00
		SD	5.75	5.31	3.28	3.32	2.82	9.04	1.22	1.94	5.98	1.57	0.33	0.00
	L	M	46.4	12.4	7.80	4.68	5.38	4.64	0.53*	1.63	16.5	3.07	0.37†	0.00
		SD	5.75	4.87	3.35	3.05	2.89	6.13	0.64	1.48	6.28	1.90	0.59	0.00
		ES	-	-	-	-	-	-	.976L	-	-	-	.477S	-
2009	W	M	51.1	17.9	9.53	8.40	5.80	17.5	3.00	2.60†	16.9	2.48	0.05†	0.10*
		SD	8.45	6.03	3.92	3.33	2.90	7.59	1.52	2.37	5.30	1.68	0.22	0.30
	L	M	48.8	13.4	8.70	4.72	4.97	4.18	0.58	1.60†	17.3	2.60	0.23†	0.23*
		SD	8.45	5.85	4.23	2.50	2.86	5.87	0.75	1.35	5.95	1.53	0.42	0.53
		ES	-	-	-	-	-	-	-	1.93XL	-	-	.337S	.432S
2011	W	M	53.4	15.6	8.87	6.79*	5.47	16.9	2.58†	2.68	12.7	1.61	0.00*	0.00†
		SD	6.80	4.97	3.73	3.14	2.42	8.30	1.35	1.93	4.00	1.31	0.00	0.00
	L	M	46.5	13.1	9.37	3.82*	4.68	4.09	0.39†	1.92	13.4	2.37	0.03*	0.11†
		SD	6.80	4.75	4.27	1.86	3.02	11.3	0.68	1.46	3.87	1.51	0.16	0.31
		ES	-	-	-	2.57XL	-	-	1.06L	-	-	-	.115N	.220S
2013	W	M	52.4	16.1	7.05	9.10	5.74	16.5	2.46*	2.00	13.5	1.54	0.03	0.05
		SD	7.94	6.82	3.83	4.09	2.98	8.37	1.10	1.62	4.62	1.07	0.16	0.22

	L	M	47.5	12.0	5.59	6.41	5.44	5.33	0.64*	1.38	14.6	1.82	0.05	0.05
		SD	7.94	5.63	2.91	3.44	2.95	5.73	0.71	1.31	3.69	1.19	0.22	0.22
		ES	-	-	-	-	-	-	.922L	-	-	-	-	-
2015	W	M	53.7	13.0	6.44	6.56	5.22	23.8*	2.88*	1.90	13.8	1.27	0.00†	0.07†
		SD	8.95	4.72	3.07	2.78	2.90	13.4	1.52	1.48	4.51	0.92	0.00	0.26
	L	M	46.2	7.90	4.76	3.15	3.66	6.46*	0.54*	1.90	15.6	1.78	0.07†	0.20†
		SD	8.95	4.52	2.89	2.42	2.84	7.99	0.71	1.62	5.71	1.27	0.26	0.40
		ES	-	-	-	-	-	11.0XL	1.18L	-	-	-	.186N	.339S
2017	W	M	52.1	12.3	6.55	5.82	5.15*	20.8	2.40*	1.77	13.6	1.45	0.03	0.03
		SD	8.21	4.52	2.80	2.58	2.56	11.7	1.39	1.87	5.92	1.22	0.16	0.16
	L	M	47.9	9.88	6.40	3.47	5.18*	6.70	0.55*	1.35	14.0	1.80	0.03	0.05
		SD	8.21	4.95	3.56	2.45	3.39	10.9	0.78	1.25	5.41	1.26	0.16	0.22
		ES	-	-	-	-	3.00XL	-	1.12L	-	-	-	-	-
2019	W	M	51.4	12.7	6.32	6.41	5.41	20.9	2.59*	1.23	14.0	1.59	0.00†	0.02*
		SD	9.27	5.66	2.59	3.96	2.70	10.6	1.94	1.22	4.12	1.34	0.00	0.15
	L	M	48.5	8.09	4.61	3.48	4.11	5.72	0.50*	1.18	13.5	1.70	0.18†	0.07*
		SD	9.27	3.94	2.52	2.28	2.85	10.8	0.76	1.19	4.55	1.32	0.39	0.25
		ES	-	-	-	-	-	-	1.47XL	-	-	-	.276S	.209S
Total	W	M	52.6†	14.5	7.31†	7.22†	5.52	18.6	2.49*	2.07	15.4	1.82	.051†	.030†
		SD	7.93	5.76	3.42	3.94	2.80	10.3	1.43	1.90	5.46	1.36	.221	.170
	L	M	47.2†	10.5	6.43†	4.14†	4.84	5.29	.524*	1.63	15.6	2.24	.151†	.076†
		SD	7.97	5.20	6.33	2.70	3.05	8.29	.695	1.50	5.43	1.50	.388	.285
		ES	1,12L	-	9,39XL	3,12XL	-	-	1,71XL	-	-	-	,316S	,235S
Evol.	W	R^2	.001	.010	.006	.008	.002	.027*	.012*	.022*	.099†	.050†	.039†	.005
		Slope	-.020	-.093	-.124	-.133	-.075	.084	.396	-.408	-.303	-.868	-4.726	2.106
	L	R^2	.002	.016*	.016*	.005	.010	.003	.000	.012*	.068†	.062†	.021*	.010
		Slope	.027	-.128	-.178	-.143	-.171	.035	.087	-.390	-.253	-.875	-1.993	1.863

Legend: Match result: W = Win, & L = Loss. *Statistically significant differences between winning and losing teams p value = (< .05) †p value = (< .001); TE=Effect Size: N =No effect (< 0.20) S =Small (0.20 - 0.49) M =Medium (0.50 - 0.79) L =Large (0.80 - 1.19) XL =Extra Large (>1.2); R^2 = (>±.700)

For senior men (Table 5), the results of the univariate analysis do not show a common trend in the different tournaments. Winning teams had significantly higher total values for ball possession, chances, shots off target, shots on target, and effectiveness. The magnitude of these differences was extra-large for shots on target, effectiveness, and goals, and it was large for ball possession and chances. Losing teams had significantly higher values for goals, red cards, and second yellow cards. The magnitude of these differences was small for red cards and minimal for second yellow cards. Regarding specific tournaments, winning teams had significantly higher values in corner kicks and effectiveness in two of the four tournaments. Winning teams had significantly higher values in one championship in shots on target (2014) and offsides (2006). In 2006, 2010, and 2014, losing teams obtained a significantly higher number of red cards. In two of the four tournaments (2010, 2014), losing teams had a significantly higher number of red cards after a second yellow card.

Table 5. Descriptive and univariate statistical analysis of technical-tactical match performance indicators in the senior men's World Cup (2003 - 2019).

Year			Ball possession	Chances	Shots off target	Shots on target	Corner Kick	Efficacy	Goals	Offside	Fouls committed	Yellow card	Red cards	2nd yellow card
2006	W	M	51.4	13.8	6.36	7.51	5.64*	17.1	2.19†	3.55*	17.3	2.51	0.06†	0.00
		SD	6.89	4.66	3.17	2.62	2.97	9.85	1.10	2.73	5.49	1.68	0.32	0.00
	L	M	48.5	9.85	6.11	3.74	4.28*	3.77	0.30†	2.77*	19.2	2.91	0.26†	0.00
		SD	6.89	3.88	2.71	2.25	2.20	8.49	0.51	1.75	5.12	1.49	0.49	0.00

		ES	-	-	-	-	2.61^{XL}	-	.854^{L}	2.29^{XL}	-	-	.414^{S}	-
2010	W	M	52.4	16.0	9.00	7.06	5.27	13.9*	2.10*	2.50	14.3	1.81	0.00†	0.02†
		SD	5.90	5.35	3.68	2.70	2.93	7.12	1.19	2.06	4.81	1.47	0.00	0.14
	L	M	47.5	12.8	8.90	3.98	4.44	3.30*	0.46*	2.38	16.2	1.90	0.15†	0.13†
		SD	5.90	4.70	3.38	2.04	2.44	4.60	0.62	1.77	6.01	1.29	0.36	0.33
		ES	-	-	-	-	-	5.99^{XL}	.948^{L}	-	-	-	.252^{S}	.257^{S}
2014	W	M	51.3	14.9	4.88	10.0*	5.63†	17.6*	2.39	2.24	15.0	1.12	0.02†	0.00*
		SD	7.80	6.04	2.52	4.72	3.75	9.82	1.29	1.85	5.79	0.88	0.14	0.00
	L	M	48.6	12.0	5.43	6.59*	4.98†	5.52*	0.59	2.06	14.6	1.53	0.10†	0.02*
		SD	7.80	4.44	2.42	3.04	2.08	7.14	0.64	2.20	4.31	0.82	0.31	0.14
		ES	-	-	-	3.96^{XL}	3.03^{XL}	8.58^{XL}	-	-	-	-	.239^{S}	.101^{N}
2018	W	M	51.1	10.3	5.37	4.94	5.00	22.6	2.12	1.33	13.3	1.41	0.02	0.02
		SD	9.55	4.02	2.25	2.47	2.32	13.0	1.13	1.28	4.57	1.08	0.14	0.14
	L	M	48.8	8.20	5.00	3.20	4.51	6.91	0.49	1.49	14.2	1.92	0.02	0.02
		SD	9.55	3.81	2.36	2.28	2.67	11.4	0.70	1.22	4.11	1.25	0.14	0.14
		ES	-	-	-	-	-	-	-	-	-	-	-	-
Total	W	M	51.5†	13.7*	6.37*	7.36*	5.37	17.8*	2.20*	2.38	14.9	1.70	.026†	.010†
		SD	7.64	5.48	3.32	3.72	3.01	10.6	1.17	2.16	5.35	1.39	.188	.101
	L	M	48.4†	10.7*	6.33*	4.37*	4.55	4.91*	.462*	2.15	16.0	2.05	.128†	.041†
		SD	7.64	4.57	3.11	2.75	2.36	8.42	.628	1.81	5.27	1.32	.350	.199
		ES	,941^{L}	1,17^{L}	9,57^{XL}	3,27^{XL}		2,70^{XL}	1,99^{XL}				,281^{S}	,158^{N}
Evol.	W	R^2	.001	.062†	.059†	.023*	.003	.047*	.000	.128†	.056†	.100†	.004	.002
		Slope	-.018	-.204	-.327	-.182	-.087	.092	.018	-.741	-.199	-1.015	-1.552	1.886
	L	R^2	.001	.023*	.062†	.001	.003	.024*	.015	.066†	.126†	.077†	.058†	.001
		Slope	.018	-.149	-.360	.049	.109	.083	.889	-.637	-.303	-.939	-3.082	-.660

Legend: Match result: W = Win, & L = Loss. *Statistically significant differences between winning and losing teams p value = (< .05) †p value = (< .001); TE=Effect Size:^{N} =No effect (< 0.20) ^{S} =Small (0.20 - 0.49) ^{M} =Medium (0.50 - 0.79) ^{L} =Large (0.80 - 1.19) ^{XL} =Extra Large (>1.2); R^2 = (>±.700)

In the multivariate analysis (Table 6), chances, shots on target, and effectiveness were the variables that best predicted the match result in all tournaments and age groups. For U-20, the inclusion of the ball possession variable in the predictive model improves the predictive capacity to significantly identify the winning team in six tournaments and in the totals. The reclassification level of the discriminant analysis was higher in U-17 (91.7%) than in U-20 (88.8%) and seniors (87.5%).

Table 6. Multivariate discriminant analysis of match performance indicators according to age group and championship in the Men's World Cup (2003-2019).

Year	Ball possession	Chances	Shots off target	Shots on target	Corner Kick	Efficacy	Offside	Fouls committed	Yellow card	Red card	2nd yellow card	Eigenvalue	Lambda de Wilks'	Canonical correlation	Chi-squared	Sig.	Reclassification
U-17																	
2003	.232	.381*	.235	.402*	.397*	.449*	.218	-.068	-.112	-.114	-.117	1.579	.388	.782	38.84	<.001	91.7%
2005	.164	.338*	.177	.427*	.051	.551*	.174	-.033	-.187	-.238	.000	.961	.510	.700	30.30	<.001	86.5%
2007	.209	.441*	.174	.597*	.127	.465*	.012	.267	-.017	.000		2.151	.317	.826	88.94	<.001	95.2%
2009	.268	.285	.077	.452*	.318*	.698*	.000	-.130	-.150	-.142	-.134	.941	.515	.696	51.08	<.001	84.5%
2011	.063	.241	.083	.380*	.000	.699*	.327*	-.082	-.136	-.192	-.056	1.323	.430	.755	64.90	<.001	84.5%
2013	.291	.469*	.350*	.449*	-.004	.559*	-.035	.070	-.143	-.173	.000	1.514	.398	.776	72.81	<.001	83.7%
2015	.286	.341*	.112	.473*	-.092	.652*	.113	-.068	-.066	.040	-.089	1.608	.383	.785	73.80	<.001	89.3%
2017	.350*	.486*	.197	.633*	.100	.480*	.033	-.100	-.094	-.089		1.440	.410	.768	76.24	<.001	89.1%
2019	.195	.587*	.379*	.612*	.127	.448*	.079	-.100	-.296	-.201	.069	.772	.564	.660	49.75	<.001	85.1%
U-20																	
2003	.243	.257	.065	.352*	-.008	.788*	.191	-.047	-.097	-.164		.874	.534	.683	51.17	<.001	80.7%

2005	.509*	.523*	.244	.678*	.126	.615*	-.039	.135	-.151	-.048		1.221	.450	.741	64.22	<.001	86.2%
2007	.530*	.311*	.042	.454*	.078	.607*	.173	.043	-.232	-.223		1.415	.414	.765	64.79	<.001	88.8%
2009	.107	.291	.078	.479*	.110	.757*	.199	-.026	-.030	-.199	-.111	1.742	.365	.797	73.63	<.001	88.8%
2011	.454*	.228	-.056	.516*	.129	.580*	.199	-.072	-.242	-.103	-.214	1.282	.438	.750	56.93	<.001	90.8%
2013	.305*	.326*	.211	.350*	.051	.770*	.205	-.130	-.122	-.065	.000	1.063	.485	.718	51.40	<.001	84.6%
2015	.372*	.496*	.254	.588*	.244	.706*	.000	-.158	-.207	-.176	-.162	1.268	.441	.748	61.40	<.001	89.0%
2017	.306*	.315*	.028	.558*	-.005	.743*	.159	-.040	-.168	.000	-.078	.718	.582	.647	39.51	<.001	75.0%
2019	.156	.473*	.332*	.452*	.232	.706*	.019	.047	-.043	-.328	-.108	1.033	.492	.713	57.48	<.001	88.6%
Senior																	
2006	.177	.396*	.037	.651*	.220	.614*	.145	-.154	-.108	-.195		1.434	.411	.768	77.82	<.001	86.2%
2010	.347*	.268	.012	.546*	.131	.750*	.028	-.152	-.026	-.245	-.171	1.425	.412	.767	78.83	<.001	87.5%
2014	.170	.275	-.111	.437*	.108	.705*	.045	.036	-.240	-.171	-.101	1.021	.495	.711	64.04	<.001	86.7%
2018	.135	.312*	.093	.424*	.113	.738*	-.072	-.117	-.252	.000	.000	.765	.567	.658	53.98	<.001	78.4%
Totals																	
U-17	.298	.470*	.213	.595*	.129	.637*	.109	-.016	-.151	-.144	-.049	.840	.544	.676	427.31	<.001	84.5%
U-20	.355*	.381*	.130	.521*	.124	.751*	.137	-.024	-.154	-.167	-.104	.894	.528	.687	467.38	<.001	84.0%
Senior	.222	.325*	.008	.494*	.165	.732*	.061	-.111	-.140	-.197	-.105	.861	.537	.680	237.88	<.001	82.8%

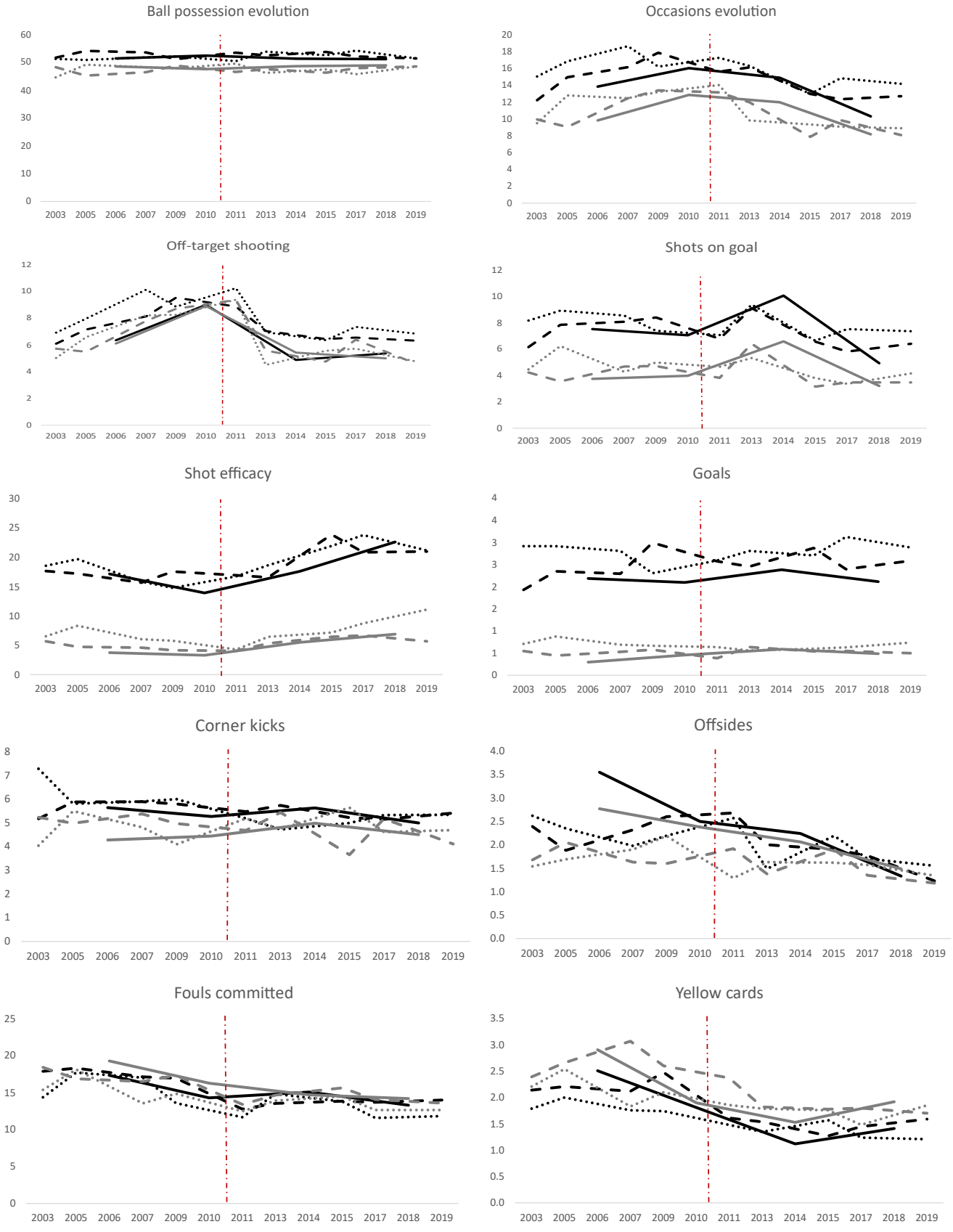
Legend: * EC values ≥ |,300 | difference between winning and losing teams.

The comparison in the evolution (Table 7 and Figure 1) shows that in all age groups, winning teams have a significantly higher number of shots off target and goals. When comparing U-17 vs. U-20 and U-17 vs. senior, winners had more chances and fouls committed. In U-17 vs. U-20, the number of yellow cards increased. Losing teams showed significantly higher correlation values in effectiveness, goals, and fouls committed in U-17 vs U-20 and U-17 vs Senior, yellow cards in U-17 vs U-20, and offsides in U-20 vs Senior. These differences had a small effect size.

Table 7. Comparison of age groups for winning and losing teams in the Men's World Cups (2003-2019).

Variable		Eta square	Effect size	*p* value	U17 vs U20	U17 vs Senior	U20 vs Senior
					p value	*p* value	*p* value
Ball	W	.002	-	.335	.726	.689	.306
possession	L	.003	-	.277	.905	.444	.253
Chances	W	.019	Small	<.001†	.008*	<.001†	.273
	L	.001	-	.586	.563	.830	.960
Shots off	W	.027	Small	<.001†	.032*	<.001†	.010*
goal	L	.000	-	.905	.988	.897	.944
Shots on	W	.006	-	.063	.056	.320	.881
goal	L	.003	-	.205	.183	.865	.601
Corner Kick	W	.000	-	.837	.999	.861	.842
	L	.002	-	.478	.994	.544	.486
Efficacy	W	.002	-	.436	.811	.403	.717
	L	.012	Small	.003*	.012*	.012*	.881
Goals	W	.026	Small	<.001†	.012*	<.001†	.039*
	L	.014	Small	.001*	.015*	.003*	.571
Offside	W	.005	-	.098	.915	.092	.181
	L	.015	Small	<.001†	.999	.002*	.002*
Fouls	W	.018	Small	<.001†	<.001†	.037*	.629
committed	L	.029	Small	<.001†	<.001†	<.001†	.655
Yellow card	W	.010	Small	.010*	.007*	.307	.534
	L	.012	Small	.003*	.002*	.371	.294
Red card	W	.003	-	.238	.887	.216	.399
	L	.001	-	.787	.987	.849	.775
2nd yellow	W	.002	-	.327	.990	.401	.335
card	L	.004	-	.139	.203	.979	.233

Legend: Statistically significant differences between winning and losing teams: * p value = (< .05) †p value = (< .001); Match result: W = Win, & L = Loss. Effect Size: No effect (< 0.01), Small (0.01 - 0.059), Medium (0.60 - 0.139), Large (>0.140).


Ball possession evolution
Occasions evolution
Off-target shooting
Shots on goal
Shot efficacy
Goals
Corner kicks
Offsides
Fouls committed
Yellow cards

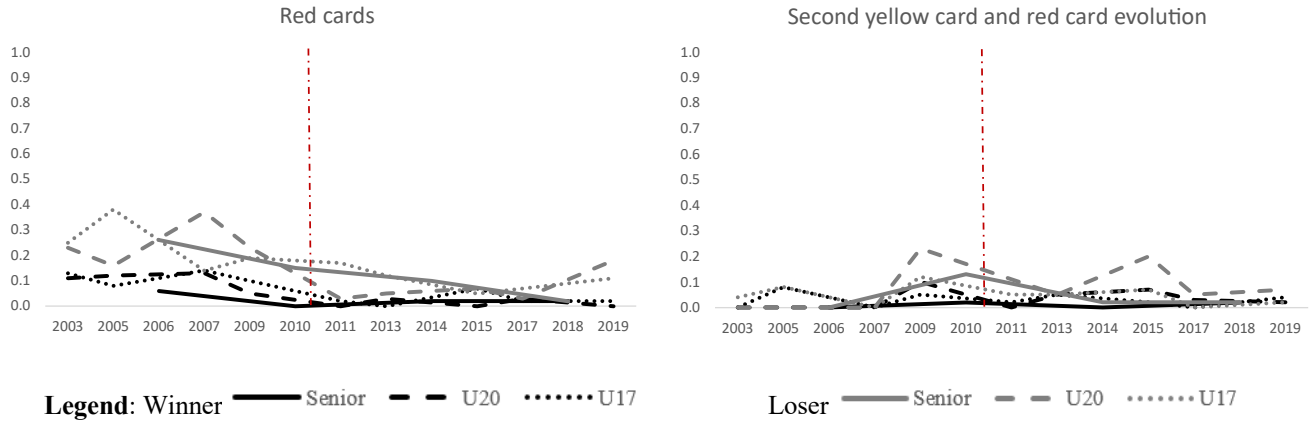


Figure 1. Evolution of the performance indicators of the winning and losing teams by age group in the Men's World Cups (2003-2010 period vs 2011-2019 period).

Table 8. Evolution of performance indicators by decade for winning and losing teams by age group in Men's World Cups (2003-2019).

		U-17				U-20				Senior			
		2003-2010		2011-2019		2003-2010		2011-2019		2003-2010		2011-2019	
Variables	**Result**	**Av**	**SD**	**Av**	**SD**	**Av**	**SD**	**Av**	**SD**	**Av**	**SD**	**Av**	**SD**
Ball	Win	51.6	7.92	52.5	8.83	52.6	7.52	52.6	8.28	51.9	6.39	51.2	8.69
possession	Lose	47.6	7.73	47.4	8.83	47.1	7.60	47.3	8.28	48.0	6.39	48.7	8.69
Chances	Win	16.9*	5.96	15.1*	5.68	15.2*	5.92	13.9*	5.57	14.9*	5.11	12.5*	5.58
	Lose	12.2†	5.31	10.2†	5.26	11.1	5.20	10.1	5.16	11.3*	4.55	10.0*	4.53
Shots off	Win	8.74*	4.10	7.53*	3.71	7.68	3.52	7.01	3.32	7.69†	3.66	5.13†	2.39
goal	Lose	7.34†	3.86	5.95†	3.76	6.87*	3.69	6.08*	3.65	7.52†	3.36	5.21†	2.38
Shots on	Win	8.19	3.39	7.60	3.45	7.59	3.43	6.92	3.52	7.28	2.65	7.45	4.52
goal	Lose	4.91*	2.61	4.25*	2.59	4.27	2.61	4.04	2.77	3.86	2.13	4.86	3.16
Corner Kick	Win	6.16*	3.30	5.12*	2.85	5.68	2.92	5.40	2.70	5.45	2.93	5.31	3.10
	Lose	4.58	2.93	4.96	2.74	5.14	3.04	4.59	3.05	4.36	2.31	4.74	2.39
Efficacy	Win	16.7†	8.87	20.5†	10.8	17.0*	9.38	19.9*	10.9	15.5*	8.68	20.1*	11.7
	Lose	6.50	8.38	7.65	10.9	4.83	6.41	5.68	9.57	3.53*	6.77	6.22*	9.57
Goals	Win	2.69	1.37	2.84	1.36	2.38	1.34	2.58	1.49	2.15	1.13	2.25	1.20
	Lose	.72	.826	.64	.699	.52	.656	.52	.727	.38	.568	.54	.673
Offside	Win	2.23	2.00	1.89	1.86	2.29*	2.13	1.90*	1.68	3.02†	2.46	1.78†	1.64
	Lose	1.89*	2.23	1.49*	1.57	1.74	1.61	1.54	1.39	2.57*	1.76	1.77*	1.78
Fouls	Win	15.6†	5.62	12.7†	4.47	17.5†	5.59	13.5†	4.64	15.8*	5.35	14.1*	5.25
committed	Lose	15.1†	5.34	13.2†	4.88	17.3†	5.75	14.2†	4.75	17.7†	5.75	14.4†	4.19
Yellow card	Win	1.81†	1.29	1.36†	1.10	2.23†	1.46	1.49†	1.17	2.16†	1.60	1.27†	.993
	Lose	2.12*	1.49	1.75*	1.26	2.67†	1.58	1.89†	1.32	2.40†	1.47	1.73†	1.07
Red card	Win	.11*	.339	.03*	.163	.10†	.303	.01†	.099	.03	.228	.02	.141
	Lose	.22*	.485	.10*	.330	.24†	.483	.07†	.263	.20*	.428	.06*	.239
2nd yellow	Win	.03	.171	.03	.163	.02	.153	.03	.183	.01	.103	.01	.100
card	Lose	.06	.238	.04	.188	.05	.274	.09	.293	.06	.245	.02	.141

Legend: Match result: W = Win, & L = Loss. *Statistically significant differences between winning and losing teams p value = (< .05) † *p* value = (< .001).

Regarding the evolution of the game (Table 8 and Figure 1), between 2003-2010 and 2011-2019, winning teams had significantly fewer fouls committed and yellow cards in all categories (medium effect size). For U-17, there was a significant decrease in shots off goal and corner kicks (small effect size). For U-17 and U-20, there was a significant increase in effectiveness, while

chances and red cards decreased (small effect size). For U-20 and senior categories, offsides significantly decreased (small effect size). Losing teams in all categories showed a significant decrease in fouls committed, yellow cards, and red cards (small effect size). For U-17, chances and shots on target decreased significantly, while for the U-17 and senior categories, the number of offsides was lower (small effect size).

Discussion

For all age categories, the number of chances, shots on target, and shot effectiveness were the variables that best discriminated the winner of the match. These results indicate that winning teams play a more offensive game which allows them to take more shots. Winning teams were able to direct a greater proportion of these shots at the target and were more effective (converting more goals). The univariate analysis indicates that winning teams had more ball possession. This demonstrates that possession of the ball may imply greater control of the game and therefore a greater probability of winning the match. However, it was not one of the variables that best allows us to predict the outcome of the match. These results for the offensive variables are similar to the findings of previous studies carried out in the senior category. Regarding ball possession, there are studies that indicate the importance of this variable in winning a match[7] and others that indicate the opposite.[19] This may be due to sample size, the sample selected, and whether or not the sample includes tied matches. The results of this study confirm the importance of ball possession in all three categories in winning the match, although it does not discriminate the match winner. In younger age groups (U-17 and U-20), winning teams also had greater offensive effectiveness than losing teams. These results corroborate the trend found in senior national teams, in U-17, and U-20 national teams. The results show similar technical-tactical performance indicators at the different age categories. These results suggest game aspects that should be considered in the establishment of long-term athletic development in male football players at the technical-tactical level.

Univariate analysis shows that losing teams have more red cards and second yellow cards. These variables do not allow us to predict the outcome of the match as they occur in one of four matches. The results show that the loss of one or more players affects the possibility of scoring goals by increasing the chance of losing the match. These results are consistent with previous studies demonstrating a relationship between a red card, goal scoring, and match outcome.[7] Considering the implications of these variables on the match outcome, it seems necessary to control aggressiveness in ball recovery actions and reduce risky situations (e.g., controlling the position of the hands by the defender when a cross occurs). On the other hand, the corner kick and offsides variables are significant in the univariate analysis of some tournaments, but with more matches, the trend is not reflected at a global level. Therefore, there is not enough evidence to support that these variables give teams a greater chance of winning. The values found in the analysis of winners and losers can serve as a reference to establish normative profiles for the different age groups. These values can allow us to evaluate the evolution of teams during the training process, the match analysis, and the establishment of collective technical-tactical objectives.

The U-17 national teams had more chances, shots, and goals than the U-20 and senior teams. These results show a better balance between offensive and defensive actions in U-20 and senior teams. This may be due to greater maturity, experience, and training of players in these categories. This idea is supported by the higher number of fouls committed and yellow cards in U-20 and senior categories. This strategy seems to be used by teams in defense to counteract the opponent's offensive capacity. Another possible cause is greater knowledge of the opponent, which could lead to improved defensive actions. Different authors[14,31] indicate that fouls demonstrate aggressive play, in some cases causing the cautioning and conditioning of a player's defensive performance. This reflects the importance of developing skills and strategies to balance the offense/defense as performance increases.

The evolution of technical-tactical performance indicators between 2003-2009 and 2010-2019 showed a decrease in fouls committed and yellow cards for all categories, although the reasons are not clear. One possible reason could be a change in individual and collective playing styles that are more oriented to game control. It is also possible that it is related to the performance of referees and their application of the laws of the game. Increased professionalization, improved training, or technological aids, among others, may be some of the aspects behind this change.[32] The reduction of fouls and yellow cards is continuous since the 2000s, so it is not possible that it is caused by a particular event such as the recent implementation of technological systems to support refereeing.[33] The Video Assistant Referee (VAR) was used in the 2018 FIFA Men's World Cup, 2019 U-17 FIFA Men's World Cup, and 2019 U-20 FIFA Men's World Cup. The VAR supports the referee and allows him or her to review actions that could impact the results of the match (e.g., offsides or goals). More studies are needed to confirm this hypothesis. The U-17 and U-20 categories also showed a decrease in red cards. Red cards affect the team's chance of scoring goals by being disadvantaged by the loss of one or more players.[7] In all categories, there is a trend towards a reduction in the number of offences, which makes the game less aggressive and with fewer interruptions.

The evolution between the U-17 and U-20 categories shows fewer chances and higher effectiveness. These results indicate that the number of attempts was lower, but with higher accuracy to score the goal. In line with these results, previous studies found that what determines the outcome of the match is the quality and not the quantity of shots.[3,4] In U-17, there is a decrease in shots off target and corner kicks. This may be due to the fact that, in this category, more chances and goals are generated. This may be because the attack/defense balance in U-17 is shifted towards attack. The decrease in offsides in U-20 and senior categories may indicate that in these categories the attack is more organized than defense or there is more attention during the training process/competition to avoid offside.

Several aspects should be considered when interpreting and applying the results of this work: a) This study only analyzed match variables and did not study individual actions, physical actions, styles of play, etc. b) Only matches won and lost were considered, and c) The population under study were elite national teams. Future studies should consider a greater number of aspects of the game and study training categories at local, regional, and national levels to establish performance indicators and analyze the evolution of game actions. Further, it must be

considered that there is a lack of reference values to analyze the match statistics in the different stages of player development and their connection with the game styles. A possible solution to this problem could be the generation of large databases of players and team performance with the data from official tournaments. This approach is possible to find in other sports, such as baseball (e.g., Lahman Baseball Database). This type of database can allow for the study of the evolution of the sport and provide normative values to analyze the performance of players through the different stages of development. This type of resource will allow for a better understanding of the impact of changes in the laws of the game, factors that affect performance, and their evolution.

In general, the results show an evolution in the game towards strategies that seek to generate more effective situations with a greater chance of scoring. There is a tendency in the game to increase quality over quantity. There is an increase in effectiveness, despite the decrease in shots and chances. In terms of offences, the loss of a player due to a red card or second yellow card alters the attack/defense balance between the teams and correlates with losing the game. The decrease in fouls and red cards throughout the different tournaments shows a reduction in aggressiveness and offences, possibly due to the evolution of playing styles and refereeing. This paper shows the evolution of men's football at the national team level.

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