

Evolution of technical-tactical match performance indicators according to age category in women's national football teams (World Cups 2004-2019)

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Abstract:

The aim of this study was to analyze the evolution of technical-tactical performance indicators of winning and losing teams according to age category in women's national teams (U-17, U-20, and senior). The sample consisted of 505 matches (141 senior-category matches, 210 U-20-category matches, and 154 U-17-category matches) played by 47 nations. The studied variables were ball possession, chances, shots not on goal, shots on goal, efficacy, corner kicks, goals, offsides, fouls committed, yellow cards, red cards, and second yellow cards. The values of the variables were obtained from the official match reports. The results showed that efficacy, shots, and shots on goal are the variables that discriminate the match winners. The evolution in the results of this research showed different trends for the different age groups. Chances, shots on goal and shooting efficacy were the variables that made it possible to discriminate the winning team of the match in all categories in more than 94% of the matches studied. Compared to the losing teams, the winning teams took more shots. The differences between winning and losing teams showed that efficacy, shots, and shots on goal are variables that correlate with winning the match. Among the different age groups, the results show in the U-17 category a greater creation of chances, shots on goal and goals. In the U-20 category, there was a decrease in fouls committed. In the senior category, there was a trend towards an increase in the control of the game. These results reflect a balance in ball possession, which is maintained in all categories. The evolution in the results throughout the different championships and age groups reflects a tendency towards a more balanced game with greater creation of opportunities and more effective playing actions.

Key Words: sport, performance, soccer, age, groups, match statistics

Introduction

Performance in football is determined by the technical, tactical, physical, psychological, and sociological interactions between the players of both teams. One approach to analyzing technical-tactical performance is to study performance indicators that affect the outcome of a match (Okholm et al., 2022). The technical-tactical performance indicators allow the identification of key aspects of performance related to match success in elite women's football (Kubayi & Larkin, 2020). Performance indicators depend on the players' sex, and their values change according to the level of each competition (Casal et al., 2019). By studying the evolution of performance indicators, it may be possible to identify values that can serve as a guide for the training of different age groups in elite football. The performance indicators in different age groups depend on the physical and technical-tactical abilities and experience of the players (Okholm et al., 2022). Knowing the technical-tactical indicators that are related to winning or losing a match in the female category and how they depend on the age groups could help understand how performance and its evolution contribute to the result of a match in international women's football.

In international elite women's football, studies on technical-tactical performance indicators are scarce (Harkness-Armstrong et al., 2020). In a review of performance indicators (Table 1), it was observed that, in senior women's national football teams, ball possession, shots and shots on goal, passing, passing accuracy, and corner kicks are variables positively associated with match success (Kubayi & Larkin, 2020; Mara et al., 2012). Fouls, yellow cards, and offsides are related to losing a match (Casal et al., 2019; Kubayi & Larkin, 2020). Less information is available about the evolution of the technical and tactical aspects in women's national football teams (Adán et al., 2020). At a lower level, in national development players, small differences were found in technical-tactical variables between teams of the U14 and U16 age groups (Harkness-Armstrong et al., 2020). Differences were found between specific playing positions (Harkness-Armstrong et al., 2020). The physical demands in women's football increase with age group in the players of international teams from U-17 to senior (Doyle et al., 2021; Villaseca-Vicuña et al., 2021). Studies show that throughout the training and maturation

process of a player, the levels of speed and power increase (Doyle et al., 2021; Villaseca-Vicuña et al., 2021). However, it is not known whether the increase in these levels has an impact on technical-tactical performance during competition.

Table 1. List of studies that analyzes technical-tactical performance indicators in senior women's international soccer teams.

	World Cup	Continental Cups	National leagues
Ball possession	3, 8, 9		12, 13
Shots	1, 3, 4, 5, 6, 7, 10	11	13, 14
Shots on goal	3, 4, 6, 10	11	12, 13, 14
Passes	1, 2, 3, 4, 5, 7, 8	11	13, 14
Faults	1, 3(-), 7		14(-)
Yellow cards	1, 3(-)		
Shooting efficacy		11	13
Passing accuracy	1, 3		13, 14
Free kicks	3, 5, 7		12
Corner kicks	3, 4, 5, 6, 7, 10	11	12
Assists		11	
Scoring the first goal	5	11	15
Offside	7(-), 10(-)	11(-)	14(-)

Note: Table 1 groups the variables studied by the reviewed bibliography in relation to the technical-tactical performance indicators in women's senior category. The value (-) indicates a negative correlation between the indicators and the success of the match. Goals scored are not included as a performance indicator of the match result.

*Studies of developmental age groups.

Legend: ¹(Garcia-Unanue et al., 2020) ²(Sainz de Baranda et al., 2019) ³(Kubayi & Larkin, 2020) ⁴(Lee & Mills, 2021) ⁵(Wang & Qin, 2020a) ⁶(Maneiro et al., 2019) ⁷(Pappalardo et al., 2021) ⁸(Maneiro et al., 2021) ⁹(Iván-Baragaño et al., 2021) ¹⁰(Baskaya & Senturk, 2017) ¹¹(de Jong et al., 2020) ¹²(Mara et al., 2012) ¹³(Wang & Qin, 2020b) ¹⁴(Casal et al., 2019) ¹⁵(Ibáñez et al., 2018).

The literature review showed that in women's football the available results limit the objective information that can guide the player's training process (Doyle, Browne, & Horan, 2021). The analysis of performance indicators for different age groups will provide information that can be used as a reference for the training of players in training. Analyzing the outcome of matches (win/lose) allows the identification of differences in the technical-tactical performance of winning and losing teams. The study of match reports allows the analysis of technical-tactical variables and their evolution in women's football. There is currently insufficient evidence to establish a hypothesis regarding the evolution of women's football in relation to technical-tactical performance indicators between age groups. The aim of the study was to analyze the evolution of technical-tactical performance indicators between winning and losing teams according to age category in women's national teams (U-17, U-20 and senior).

Method

Sample: The sample was the matches between the women's national teams that played the World Cup in the age categories (U-17, U-20 and senior), during the championships (2004 to 2019). The matches were played by 47 nations. From the total of 610 matches, matches that ended in a draw in regulation time (96) were excluded. Table 2 contains the 505 matches included in the study by championship and age group. The sample was discriminated into 141 senior category matches, 210 U-20 category matches, and 154 U-17 category matches. The studied variables used in this study 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).

Table 2. Number of matches by championship and age group included in the study (Women's World Cup between 2004 - 2019).

Competition	2004	2006	2007	2008	2010	2011	2012	2014	2015	2016	2018	2019	Total
Senior			26(6)			26(6)			41(11)			48(4)	141
U-20	17(3)*	27(5)		29(3)	27(5)		28(4)	27(5)		28(4)	27(5)		210
U-17				24(8)	31(1)		25(7)	27(5)		27(5)	20(9)*		154

Legend: *Statistics for 9 match reports (6 in 2004 and 3 in 2018) were not available on the website. "(n)" Number of matches tied by championship and age group. These matches were not included in the analysis performed.

Design: A non-experimental retrospective observational design was used. The studied variables were ball possession, chances, shots no on goal, shots on goal, corner kicks, efficacy, goals scored, offside, fouls committed, yellow card, red card and red card for second yellow card. The variables chances and efficacy were calculated using other variables. The variable "chances" was obtained from the sum of shots no on goal and shots on goal. The variable "efficacy" was calculated by multiplying the goals by 100, divided by the total number of chances (Lago-Peñas et al., 2011). The unit of analysis was the match per team. The information from the match

reports was transferred to a spreadsheet. A process of debugging and verification of the data was carried out by performing a descriptive analysis of the results, visual representation and random review of the data entered. To establish the reliability of the match report, the researchers 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 (Soto et al., 2022). The rater reliability was calculated using Cohen's Kappa for the categorical variables and an Interclass Correlation Coefficient (ICC) for the continuous variables. All the variables studied had a value of 1, except the possession time which has an ICC of 0.959.

Statistical analysis: For the study of the differences between winners and losers, a T-test and a discriminant analysis were performed. The analysis of the evolution between the championships of the decades 2003 - 2009 and 2010 - 2019 was carried out through a T-test. To analyze the change between the different championships, a linear regression and its slope were used. An ANOVA with post-hoc comparison (Tukey) was performed to study the differences between age groups. The structural coefficients (SC) were used to discriminate winning from losing teams (SC above 0.30, Tabachnick and Fidell, 2007). Significance level was set at $p < 0.05$. The effect size was established with the Cohen 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) (Sawilowsky, 2009). All analyses were conducted using the Statistical Package for the Social Sciences (SPSS, version 28.0.0.0., IBM, Boston, IL, USA).

Results

In the U-17 female category (Table 3), the total values show that the winning teams had significantly higher numbers of occasions, shots no on goal, shots on goal, corner kick and goals. Losing teams had significantly higher values for 2nd yellow card. Within the exceptions, winning teams had significantly higher values for shots on goal during three championships (2008, 2012, 2018); shots no on goal during two championships (2010, 2012) and occasions (2012), corner kick (2014), efficacy (2018), and offside during one championship (2012). Losing teams received significantly more red cards in two championships (2012, 2014) and 2nd yellow cards in three of six championships (2008, 2010, 2018).

Table 3. Descriptive and univariate statistical analysis of technical-tactical match performance indicators in the U-17 women's world cup (2008-2018).

Year		Ball possession	Occasions	Shots no on goal	Shots on goal	Corner Kick	Efficacy	Goals	Offside	Fouls committed	Yellow card	Red cards	2 nd yellow card
2008	W M	50.6	17.1	7.46	9.71*	5.08	19.8	3.08*	1.54	9.92	0.58	0.08	0.00*
	SD	5.62	6.54	3.90	4.26	3.24	10.7	1.69	1.72	3.88	0.78	0.28	0.00
	L M	49.3	9.63	5.17	4.46*	3.54	10.5	0.87*	1.21	9.17	0.63	0.08	0.08*
	SD	5.62	4.22	3.36	2.45	2.43	11.0	0.74	1.50	3.73	0.58	0.28	0.28
	TE				3.47 ^X _L			1.30 ^X _L					
2010	W M	52.7	17.8	9.19*	8.61	5.29	18.3	3.16*	1.52	9.42	1.03	0.00	0.00
	SD	9.18	7.68	4.90	4.15	2.97	9.67	2.25	1.50	4.03	1.08	0.00	0.00
	L M	47.2	11.2	6.13*	5.16	3.23	5.54	0.68*	2.00	9.42	0.65	0.00	0.03
	SD	9.18	5.64	2.92	3.59	2.14	6.70	0.98	2.05	3.36	0.71	0.00	0.18
	TE			4.03 ^X _L				1.73 ^X _L					
2012	W M	56.9	22.1*	11.8*	10.2*	8.08	16.4	3.92 [†]	3.76*	10.2	0.32	0.00*	0.04
	SD	8.11	7.91	4.31	5.47	3.80	8.74	3.20	3.15	6.08	0.63	0.00	0.20
	L M	43.0	6.96*	3.84*	3.12*	2.84	5.00	0.44 [†]	1.16*	8.84	0.84	0.04*	0.04
	SD	8.11	3.98	2.64	2.26	2.95	9.59	0.82	1.34	4.04	1.07	0.20	0.20
	TE		6.26 ^X _L	3.57 ^X _L	4.18 ^X _L			2.33 ^X _L	2.42 ^X _L				
2014	W M	54.7	18.7	7.85	10.9	6.07*	15.8	2.93*	2.44	10.8	1.04	0.04*	0.00
	SD	8.85	6.28	2.67	4.72	3.20	7.08	1.92	1.97	3.84	0.94	0.19	0.00
	L M	45.3	9.44	3.93	5.52	3.56*	4.04	0.41*	2.15	10.6	1.00	0.00*	0.00
	SD	8.85	4.65	2.62	2.89	2.03	6.73	0.75	2.09	3.82	0.88	0.00	0.00
	TE					2.67 ^X _L		1.45 ^X _L					
2016	W M	57.1	16.1	8.52	7.63	5.89	19.6	3.00*	1.81	12.0	1.30	0.00	0.04
	SD	8.58	6.07	4.26	2.65	2.86	10.0	1.49	1.55	5.17	1.23	0.00	0.19

	L	M	42.8	7.96	4.78	3.19	2.78	6.70	0.48	1.85	13.7	1.22	0.00	0.04
		SD	8.58	4.14	2.99	2.34	1.97	9.99	0.64*	1.46	5.47	1.25	0.00	0.19
		TE							1.15 ^L					
2018	W	M	53.3	15.7	9.25	6.45*	5.35	18.8*	2.75 [†]	2.15	11.7	1.40	0.05	0.00*
		SD	10.6	6.68	5.22	3.26	3.36	9.42	1.48	1.42	5.36	1.09	0.22	0.00
	L	M	46.7	11.2	7.85	3.35*	3.75	2.67*	0.30 [†]	1.65	10.0	0.90	0.05	0.10*
		SD	10.6	5.51	4.92	1.56	3.05	4.63	0.47	1.04	4.86	1.11	0.22	0.30
		TE				2.56 ^X _L		7.42 ^X _L		1.10 ^L				
Total	W	M	54.2	18.0 [†]	9.01*	9.01 [†]	5.96 [†]	18.1	3.15 [†]	2.18	10.6 [†]	.94	.03	.01 [†]
		SD	8.77	7.11	4.42	4.39	3.33	9.32	2.10	2.08	4.77	1.03	.160	.114
	L	M	45.7	9.41 [†]	5.21*	4.20 [†]	3.26 [†]	5.79	.54 [†]	1.69	10.3 [†]	.87	.03	.05 [†]
		SD	8.77	4.92	3.44	2.80	2.40	8.63	.777	1.68	4.49	.961	.160	.209
		TE		6.12 ^X _L	3.96 ^X _L	3.68 ^X _L	2.90 ^X _L		1.58 ^X _L					.168 ^X _L
Evol	W	R ²	.001	.025*	.001	.051*	.001	.004	.005	.001	.011	.044*	.002	.001
		Slope	-.008	-.071	-.027	-.167	-.022	-.023	-.114	.059	.071	.675	-.928	1.11
	L	R ²	.059*	.007	.001	.038*	.002	.040*	.045*	.002	.021	.021	.005	.000
		Slope	-.076	-.056	.036	-.231	-.057	-.078	-.924	.086	.104	.507	-1.44	-.050
		TE												

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); R2 = (± > .700)

The univariate analysis of the U-20 female teams (Table 4) shows that the total values in winning teams had significantly higher numbers of occasions, shots no on goal, shots on goal, corner kick, goals and offside. Losing teams had no significant values. The analysis of the different championships showed that winning teams had significantly higher values for occasions (2008, 2012), shots no on goal (2004, 2008) and shots on goal (2012, 2018) during two championships and offside in four championships (2008, 2012, 2016, 2018). Losing teams received significantly more fouls committed in one championship (2014); 2nd yellow card in three championships (2010, 2012, 2018) and red card in four out of eight championships (2004, 2010, 2012, 2016).

Table 4. Descriptive and univariate statistical analysis of technical-tactical match performance indicators in the U-20 women's world cup (2004-2018).

Year		Ball possession	Occasions	Shots no on goal	Shots on goal	Corner Kick	Efficacy	Goals	Offside	Fouls committed	Yellow card	Red cards	2 nd yellow card	
2004	W	M	52.3	13.8	6.41	7.41	5.41	31.4	3.06*	2.59	14.5	1.41	0.00*	0.00
		SD	7.64	7.40	4.24	3.92	3.84	28.1	1.56	2.71	7.95	1.50	0.00	0.00
	L	M	47.6	8.18	3.53	4.65	4.41	19.4	0.71*	1.82	10.7	1.59	0.12*	0.00
		SD	7.64	6.54	3.52	3.57	3.79	31.5	0.68	2.06	5.05	1.77	0.33	0.00
		TE							1.20 ^X _L					.235 ^S
2006	W	M	53.4	16.5	7.43	9.11	5.79	20.3	3.25 [†]	2.54	14.9	1.43	0.04	0.04
		SD	5.39	6.35	3.76	4.12	2.79	10.6	2.07	1.57	4.59	1.00	0.19	0.19
	L	M	46.3	8.35	3.92	4.42	3.08	6.84	0.50 [†]	2.54	13.8	1.38	0.08	0.00
		SD	5.03	5.12	3.02	3.07	2.04	9.56	0.71	1.98	3.33	1.06	0.27	0.00
		TE							1.56 ^X _L					
2008	W	M	51.5	16.2*	7.69*	8.52	6.52	23.5	2.90	2.10*	9.97	1.03	0.45	0.03
		SD	5.64	7.73	6.27	3.28	5.67	19.3	1.08	2.73	5.41	0.87	1.12	0.19
	L	M	48.4	10.5*	5.66*	4.90	5.38	8.71	0.86	0.93*	10.3	0.83	0.48	0.03
		SD	5.64	5.00	4.13	2.51	5.49	10.3	0.95	1.41	5.69	1.04	1.30	0.19
		TE		6.51 ^X _L	5.31 ^X _L					2.17 ^X _L				
2010	W	M	51.8	16.6	9.20	7.44	5.20	16.7	2.64	2.08	10.0	0.64	0.04*	0.00*
		SD	4.32	5.51	3.48	2.84	2.86	8.73	1.25	1.68	3.73	0.86	0.20	0.00
	L	M	48.1	12.4	7.92	4.48	3.84	4.93	0.60	1.40	10.1	0.88	0.00*	0.04*

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		SD	4.32	4.33	3.37	2.33	2.29	6.69	0.71	1.55	4.10	1.13	0.00	0.20
		TE							1.01 ^L				.141 ^N	.141 ^N
201 2	W	M	52.4	16.5*	8.79	7.71*	5.25	19.4	3.00 [†]	2.64*	10.1	0.75	0.00*	0.00*
		SD	6.85	6.19	4.52	3.02	2.96	10.3	1.72	3.03	5.08	0.80	0.00	0.00
	L	M	47.5	9.29*	6.21	3.07*	3.86	4.32	0.36 [†]	1.79*	10.7	1.07	0.07*	0.04*
		SD	6.85	4.28	3.71	1.92	3.10	7.18	0.56	1.75	5.51	1.09	0.26	0.19
		TE		5.31 ^X _L		2.53 ^X _L			1.28 ^X _L	2.47 ^X _L			.185 ^N	.134 ^N
201 4	W	M	51.7	15.5	6.12	9.40	4.92	19.1	2.64*	2.24	9.92*	0.68	0.00	0.00
		SD	6.94	6.97	4.03	4.07	2.78	9.73	1.32	1.85	3.11	0.95	0.00	0.00
	L	M	48.2	11.4	5.24	6.16	4.00	6.50	0.64*	2.64	10.8*	1.08	0.00	0.00
		SD	6.94	5.03	3.22	3.04	2.20	9.09	0.70	2.34	5.61	0.95	0.00	0.00
		TE						1.05 ^L		4.53 ^X _L				
201 6	W	M	56.9	13.0	6.25	6.75	6.11	23.6	3.18*	3.46*	12.4	1.18	0.29*	0.54
		SD	8.32	6.09	2.95	4.20	3.73	10.8	1.94	4.02	6.34	1.70	1.51	2.46
	L	M	43.0	6.68	3.75	2.93	3.64	9.20	0.57*	1.93*	10.5	0.71	0.00*	0.14
		SD	8.32	3.87	2.44	2.19	3.01	12.6	0.69	1.84	5.87	0.94	0.00	0.59
		TE						1.45 ^X _L	3.12 ^X _L				1.06 ^L	
201 8	W	M	53.0	12.5	5.04	7.52*	3.89	22.2	2.67 [†]	2.44*	10.9	0.96	0.00	0.04*
		SD	7.32	5.69	2.70	3.98	2.91	9.37	1.57	2.99	4.59	1.02	0.00	0.19
	L	M	46.9	9.33	5.22	4.11*	3.59	7.56	0.59 [†]	1.15*	10.0	1.19	0.00	0.00*
		SD	7.32	4.31	2.45	2.50	1.93	9.96	0.64	1.17	3.81	1.04	0.00	0.00
		TE			3.32 ^X _L				1.19 ^L	2.27 ^X _L				.136 ^N
Tota l	W	M	52.9	15.1 [†]	7.15*	8.00 [†]	5.41*	21.7	2.92 [†]	2.52 [†]	11.5	1.00	.11	.09
		SD	6.73	6.59	4.29	3.74	3.61	14.1	1.59	2.69	5.42	1.12	.712	.915
	L	M	47.0	9.54 [†]	5.24*	4.30 [†]	3.97*	7.95	.60 [†]	1.76 [†]	10.8	1.06	.10	.03
		SD	6.71	5.00	3.48	2.76	3.21	13.2	.718	1.84	5.02	1.12	.533	.250
		TE		5.85 ^X _L	3.91 ^X _L	3.29 ^X _L	3.41 ^X _L		1.23 ^X _L	2.31 ^X _L				
Evol .	W	R ²	.074 [†]	.001	.005	.000	.002	.000	.003	.009	.003	.005	.000	.007
		Slop e	.112	-.024	-.074	.017	-.051	.001	-.150	.159	-.047	-.274	-.067	.420
	L	R ²	.021*	.003	.008	.000	.000	.006	.000	.000	.000	.003	.018	.005
		Slop e	.064	.046	.118	-.031	-.002	-.027	-.122	.032	-.009	-.219	-.114	1.25

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); R² = (± > .700)

In the senior women's category (Table 5), the results of the univariate analysis do not show a common trend in the different championships analyzed. The total values show that the winning teams had significantly higher values in occasions, shots no on goal, shots on goal, efficacy, and goals. Losing teams had significantly higher values for fouls committed, red cards and 2nd yellow card. The analysis of the different championships showed that in three of the four championships the winning teams had a significantly higher frequency of shots on goal. In one championship, the winning teams had significantly higher values for occasions (2011), corner kick (2019), efficacy (2015) and offside (2015). Losing teams received significantly more red cards in one championship (2015) and red cards for second yellow in three of the four championships (2007, 2011, 2019).

Table 5. Descriptive and univariate statistical analysis of technical-tactical match performance indicators in the senior men's world cup (2007 - 2019).

Year		Ball possession	Occasions	Shots no on goal	Shots on goal	Comer Kick	Efficacy	Goals	Offside	Fouls committed	Yellow card	Red cards	2 nd yellow card	
2007	W	M	53.5	19.1	9.35	9.81*	6.00	16.0	3.23*	2.23	11.1	1.08	0.00	0.00*
		SD	7.54	4.71	3.17	4.53	2.59	7.52	2.20	1.95	4.73	1.06	0.00	0.00
	L	M	46.4	10.4	6.27	4.19*	3.08	5.00	0.42*	1.50	11.4	1.42	0.00	0.08*

			SD	7.54	4.62	3.42	2.55	2.54	10.7	0.70	1.58	3.92	1.03	0.00	0.27
		TE				3.67 ^{XL}				1.63 ^{XL}					.192 ^N
2011	W	M	52.2	14.4 [*]	8.38	6.04	6.00	15.8	2.19 [*]	2.62	10.8	0.96	0.04	0.00	
		SD	5.23	4.02	3.10	2.13	2.26	7.64	1.02	1.65	4.66	1.00	0.20	0.00	
	L	M	47.7	11.3 [*]	7.88	3.50	4.58	5.76	0.50 [*]	2.12	9.65	0.81	0.04	0.00	
		SD	5.23	5.69	4.06	2.37	2.58	8.65	0.65	2.05	5.16	1.10	0.20	0.00	
		TE		4.92 ^{XL}					.855 ^L						
2015	W	M	54.6	12.1	6.17	5.93 [†]	5.51	24.0 [*]	2.51 [†]	2.49 [†]	10.8	0.80	0.00 [*]	0.00 [*]	
		SD	6.80	6.24	3.19	3.93	3.24	19.1	2.13	1.87	4.63	0.95	0.00	0.00	
	L	M	45.3	8.41	5.29	3.12 [†]	4.05	4.37 [*]	0.41 [†]	1.24 [†]	11.4	1.29	0.05 [*]	0.02 [*]	
		SD	6.80	4.70	3.45	1.96	2.50	6.84	0.59	1.02	4.44	1.19	0.22	0.16	
		TE				3.10 ^{XL}		14.3 ^{XL}	1.56 ^{XL}	1.50 ^{XL}			.154 ^N	.110 ^N	
2019	W	M	55.4	22.3	16.2	6.08 [*]	5.85 [*]	11.8	2.46 [*]	2.21	10.1	0.77	0.00	0.00 [†]	
		SD	9.05	9.88	6.94	3.49	3.51	6.55	1.84	1.60	3.55	0.81	0.00	0.00	
	L	M	44.5	12.0	9.27	2.75 [*]	3.33 [*]	3.40	0.42 [*]	1.73	10.2	1.58	0.00	0.06 [†]	
		SD	9.05	6.68	5.11	1.87	2.50	5.03	0.54	1.47	4.67	1.07	0.00	0.24	
		TE				2.80 ^{XL}	3.05 ^{XL}		1.35 ^{XL}				.173 ^N		
Total	W	M	54.2	17.3 [*]	10.6 [*]	6.71 [†]	5.80	16.9 [*]	2.56 [†]	2.36	10.6 [†]	.872	.007 [*]	.000 [*]	
		SD	7.55	8.34	6.37	3.89	3.04	12.7	1.89	1.74	4.28	.932	.084	.000	
	L	M	45.7	10.5 [*]	7.30 [*]	3.26 [†]	3.72	4.41 [*]	.433 [†]	1.61	10.7 [†]	1.32	.021 [*]	.043 [*]	
		SD	7.55	5.75	4.47	2.17	2.55	7.51	.601	1.52	4.58	1.12	.145	.203	
		TE		7.16 ^{XL}	5.50 ^{XL}	3.15 ^{XL}		10.4 ^{XL}	1.40 ^{XL}		.143 ^N		1.03 ^L	.118 ^N	
Evol.	W	R ²	.015	.030 [*]	.161 [†]	.083 [†]	.001	.008	.010	.001	.007	.015	.004	-	
		Slop e	.073	.091	.279	-.327	-.039	-.030	-.238	-.065	-.086	-.586	-3.17	-	
	L	R ²	.015	.004	.037 [*]	.055 [*]	.000	.010	.000	.000	.002	.014	.000	.000	
		Slop e	-.073	.047	.190	-.480	-.032	-.058	-.160	-.018	-.043	.470	-.493	.193	

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); R² = (± > .700)

In the multivariate analysis (Table 6), chances, shots on goal and efficacy were the variables that allowed us to discriminate the result of the match in all the championships and age groups analyzed. In the U-17 and senior categories and in the total values, the inclusion of the ball possession variable in the predictive model increases the ability to discriminate the winning team. In the U-17 category, the variables shots no on goal and corner kick are also variables of the predictive model in four championships and in the total values. The reclassification level of the discriminant analysis was higher in U-17 (96.0%) than in U-20 (94.2%) and senior (94.6%) categories.

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

Year	Ball possession	Occurrences	Shots no on goal	Shots on goal	Corner Kick	Efficacy	Offside	Fouls committed	Yellow card	Red card	2 nd yellow card	Edgevalue	Wilks' Lambda	Canonical correlation	Chi-squared	Sig.	Reclassification
U-17																	
2008	.101	.586*	.269	.646*	.230	.365*	.088	.084	-.026	.000	-.178	1.428	.412	.767	36.376	<.001	91.7%
2010	.246	.398*	.313*	.366*	.328*	.635*	-.111	.000	.174		-.105	1.524	.396	.777	51.384	<.001	91.9%
2012	.517*	.735*	.681*	.518*	.467*	.377*	.325*	.084	-.180	-.086	.000	2.840	.260	.860	57.851	<.001	96.0%
2014	.400*	.636*	.559*	.520*	.354*	.640*	.055	.015	.015	.102		1.834	.353	.804	49.474	<.001	92.6%
2016	.665*	.628*	.405*	.710*	.506*	.517*	-.010	-.125	.024		.000	1.631	.380	.787	45.942	<.001	88.9%
2018	.129	.237	.098	.406*	.184	.755*	.146	.109	.176	.000	-.191	1.308	.433	.753	32.623	<.001	87.0%
U-20																	
2004	.110	.395*	.390*	.358*	.139	.234	.183	.263	-.062	-.317		.475	.678	.567	15.342	.082	69.6%
2006	.488*	.506*	.367*	.459*	.394*	.476*	-.001	.099	.015	-.063	.094	2.023	.331	.818	51.999	<.001	88.9%
2008	.257	.415*	.183	.592*	.097	.459*	.257	-.033	.103	-.014	.000	1.136	.468	.729	38.717	<.001	86.2%
2010	.385*	.379*	.166	.504*	.233	.674*	.186	-.009	-.106	.125	-.125	1.329	.429	.755	36.350	<.001	86.0%
2012	.264	.498*	.228	.673*	.168	.623*	.127	-.044	-.124	-.141	-.098	1.928	.342	.811	52.634	<.001	94.6%
2014	.253	.346*	.123	.460*	.187	.684*	-.097	-.099	-.215			1.002	.500	.707	30.536	<.001	90.0%
2016	.694*	.516*	.385*	.475*	.303*	.514*	.205	.129	.141	.111	.092	1.492	.401	.774	44.744	<.001	91.1%
2018	.385*	.292	-.033	.469*	.055	.694*	.261	.104	-.099		.125	1.238	.447	.744	38.255	<.001	87.0%
Senior																	
2007	.396*	.787*	.394*	.646*	.481*	.505*	.174	-.030	-.140		-.169	1.458	.407	.770	40.925	<.001	94.2%
2011	.428*	.304*	.068	.556*	.290	.611*	.133	.116	.072	.000		1.067	.484	.719	33.042	<.001	86.5%
2015	.601*	.292	.116	.395*	.222	.600*	.362*	-.061	-.198	-.139	-.097	1.334	.428	.756	63.573	<.001	89.0%
2019	.513*	.526*	.494*	.510*	.354*	.619*	.134	-.015	-.368		-.155	1.389	.419	.763	77.955	<.001	90.6%
Totals																	
U-17	.383*	.670*	.465*	.631*	.453*	.672*	.127	.031	.035	.000	-.097	.985	.504	.704	210.46	<.001	88.5%
U-20	.339*	.550*	.287	.653*	.250	.601*	.199	.069	-.034	.013	.048	.655	.604	.629	209.96	<.001	81.1%
Senior	.581*	.485*	.309*	.563*	.381*	.613*	.236	-.009	-.226	-.062	-.153	.952	.512	.698	183.95	<.001	85.5%

Legend: * EC values > .300 difference between winning and losing teams.

The comparison in the evolution of the different age groups (Table 7) shows that the winning teams presented significantly higher correlation values in shots no on goal in all age groups. Occasions and efficacy in U-17 vs U-20 and U-17 vs Senior; goals in U-17 vs Senior and ball possession in U-20 vs Senior. Losing teams had significantly higher correlation values for shots on goal and yellow card in U-17 vs Senior and U-20 vs Senior and occasions and efficacy in U-20 vs Senior.

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

Variable	Eta square	Interpretation	p valor	U-17 vs U-20	U-17 vs U-20	U-17 vs U-20
				p valor	p valor	p valor
Ball possession	W	.013	N	.037	.236	.670
	L	.002	N	.662	.705	.711
Occasions	W	.033	S	<.001	<.001	.916
	L	.012	N	.044	.997	.077
Shots no on goal	W	.082	L	<.001	.001	.008
	L	.063	M	<.001	.999	<.001
Shots on goal	W	.037	S	<.001	.040	<.001
	L	.022	S	.003	.979	.015
Corner Kick	W	.007	N	.174	.227	.995
	L	.010	N	.075	.069	.244
Efficacy	W	.022	S	.004	.034	.826
	L	.017	N	.012	.153	.548
Goals	W	.014	N	.027	.478	.021
	L	.008	N	.129	.758	.422
Offside	W	.003	N	.433	.410	.663
	L	.000	N	.890	.968	.971
Fouls committed	W	.004	N	.332	.338	.944
	L	.002	N	.562	.666	.578
Yellow card	W	.002	N	.679	.900	.907
	L	.028	S	<.001	.253	<.001
Red card	W	.010	N	.087	.210	.938
	L	.010	N	.087	.159	.994
2 nd yellow card	W	.004	N	.330	.475	.981
	L	.001	N	.871	.878	.997

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 (< 0.20), Small (0.20 - 0.49), Medium (0.50 - 0.79), Large (0.80 - 1.19), Extra Large (>1.2).

In relation to the evolution of the game (table 8 and graph 1), between the period 2003 - 2009 and 2010-2019, the winning U-17 teams did not show significant differences. In U-20, yellow cards decreased significantly, and ball possession increased significantly. In the senior category, shots on goal and goals decreased significantly. Losing teams in U-17 showed a significant decrease in ball possession, efficacy, and goals. In the U-20 category, ball possession and shots no on goal increased significantly. In U-20 category, the red card and in senior category the shots on goal decreased significantly.

Table 8. Evolution of performance indicators by decades of winning and losing teams by age groups in women's World Cups (2003-2019).

Variables	Result	U-17		U-20		Senior	
		2003-2009	2010-2019	2003-2009	2010-2019	2003-2009	2010-2019
Ball possession	W	50.6	53.7	48.5*	53.2*	7.09	53.5
	L	49.3*	44.0*	43.8*	46.7*	7.09	46.4
Occasions	W	17.1	17.7	14.6	14.8	6.26	19.1
	L	9.63	9.16	8.49	9.73	4.73	10.4
Shots no on goal	W	7.46	9.09	6.75	5.13	3.89	9.35
	L	5.17	5.10	4.18*	3.74	3.32	6.27
Shots on goal	W	9.71	8.68	7.85	7.74	3.72	9.81†
	L	4.46	4.06	3.10	4.10	2.64	4.19*
Corner Kick	W	5.08	5.98	5.54	5.08	3.11	6.00
	L	3.54	3.14	3.99	3.78	2.53	3.08
Efficacy	W	19.8	17.3	22.3	20.3	10.0	16.0
	L	10.4*	4.81*	7.79	9.76	6.53	9.43

Goals	W	3.08	1.69	3.15	2.16	3.05	1.59	2.83	.158	3.23*	2.19	2.42*	1.80
	L	.88*	.741	.47*	.765	.65	.803	.55	.657	.42	.703	.43	.579
Offside	W	1.54	1.71	2.25	2.13	2.20	2.33	2.59	2.88	2.23	1.94	2.40	1.70
	L	1.21	1.50	1.74	1.70	1.59	1.88	1.77	1.81	1.50	1.58	1.64	1.51
Fouls committed	W	9.92	3.87	10.5	5.12	11.9	6.87	10.7	4.78	11.1	4.72	10.5	4.19
	L	9.17	3.72	10.3	4.80	10.7	5.73	10.4	4.99	11.4	3.92	10.5	4.71
Yellow card	W	.58	.776	.98	1.06	1.18*	1.10	.85*	1.12	1.08	1.05	.83	.901
	L	.63	.576	.89	1.01	1.12	1.26	.98	1.03	1.42	1.02	1.30	1.14
Red card	W	.08	.282	.02	.122	.18	.708	.07	.698	.00	.000	.01	.093
	L	.08	.282	.02	.122	.23*	.836	.02*	.122	.00	.000	.03	.160
2nd yellow card	W	.00	.000	.02	.122	.03	.157	.12	1.13	.00	.000	.00	.000
	L	.08	.282	.04	.191	.01	.113	.05	.298	.08	.272	.03	.184

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

Discussion

The aim of this study was to analyze the evolution of technical-tactical performance indicators between winning and losing teams according to age category in women's national teams (U-17, U-20 and senior). Chances, shots on goal and shooting efficacy were the variables that made it possible to discriminate the winning team of the match in all categories in more than 94% of the matches studied. Compared to the losing teams, the winning teams took more shots. Of these shots, the winning teams managed to get more shots on goal, and these were more effective (convert more goals). These results show that the winning teams play a more offensive and effective game, by having more offensive actions that end in a shot and having a higher efficacy than the losing teams. These results can be considered as normal as it was found that the variables that are related to goal scoring (shots and their effectiveness) are the ones that best predict the outcome of the match.

When analyzing the trend of each variable specifically (univariate analysis), differences were observed between different age categories in the different variables analyzed. The winning teams of all categories presented significant values in shots and shots on goal, although the values of shooting efficacy were not significant in any category. The winning teams in U-17 and U-20 categories presented a significant increase in corner kicks in total values. This could be due to the increase in shots (attempt to finish the play with a shot on goal). These results are consistent with previous studies showing that corner kicks generated by the defense facilitate scoring opportunities (Wang & Qin, 2020a). The results seem to indicate that winning senior teams have more control and initiative in the game and this may allow them to be more effective in attack. In this line, previous work has proposed that ball possession can increase the probability of winning the match by generating more chances and shots on goal (Kubayi & Larkin, 2020; Maneiro et al., 2021). This study confirms the importance of avoiding offside in offensive play when exploiting the opponent's defensive weaknesses.

In terms of fouls, in the U-17 and senior categories, the losing teams had a higher number of fouls committed. This may be due to the fact that in these categories the losing teams use more fouls as a strategy to counter the attacker. Another possible cause could be that losing teams use a riskier defensive style due to the need to even the score (Ibáñez et al., 2018). This tendency was not observed in the U-20 category. This may be due to the process of sport maturation of the player in training and competition conditions, which allows them to minimize fouls and increase the number of shots and the effectiveness of the shots. The red card and 2nd yellow card variables were significant in the total values of some championships for the U-17 and U-20 training categories and in all the senior category championships. However, given the low occurrence and small differences between winners and losers with respect to the number of fouls, cards and offsides, it is not clear that this aspect has a practical impact on the game (e.g., differences of less than 0.7 fouls and offside per match between winners and losers). This is a different with studies in men's football which red cards correlate negatively with goals scored and match outcome (Mao et al., 2016). In this regard, it should be noted that the number of fouls and cards found in the female category is lower than in the male category.

In U-17 category winning teams, the results reflected a higher number of shots, shots on goal and goals than U-20 teams. The higher number of offensive actions in the U-17 category may be due to a greater imbalance between attack and defense of the younger teams. In the U-20 category, teams have fewer offensive options, but increase the efficacy of their offensive actions. The development of the game through the different age groups shows an evolution in the quantity and quality of offensive actions. In the senior category, teams had a more balanced game with more ball possession to control the game than in previous categories. This may be the result of the process of adaptation and training of the players, who evolve towards a more organized game, with more control and effectiveness in attack. Previous studies in senior teams indicate that success in women's football is largely associated with ball possession (Wang & Qin, 2020b).

The evolution in the results of this research showed different trends for the different age groups. The evolution of technical-tactical performance indicators showed between 2010-2019 in U-17 losing teams, a significant decrease in ball possession, efficacy and number of goals scored. These results show an increase

between the differences between the attack of losing teams and the defense of winning teams. In winning U-20 teams, control of the game increased with ball possession, and fouls committed, and cards received decreased. A possible cause could be the progress in the training process and the experience of the players to have a better control over the game and the execution of the actions. In the senior category, there was a better balance between winning and losing teams in shots on goal and goals scored. In senior categories, the evolution in sport performance is reflected in winning and losing teams, possibly due to the improvement of game actions (Maneiro et al., 2021). These results reflect in U-20 and senior categories a tendency to keep possession of the ball to generate chances and create goal-scoring opportunities.

Conclusions

The differences between winning and losing teams showed that efficacy, shots and shots on goal are variables that correlate with winning the match. Among the different age groups, the results show in the U-17 category a greater creation of chances, shots on goal and goals. In the U-20 category, there was a decrease in fouls committed. In the senior category, there was a trend towards an increase in the control of the game. These results reflect a balance in ball possession, which is maintained in all categories. The evolution in the results through the different championships and age groups reflects a tendency towards a more balanced game with greater creation of opportunities and more effective playing actions. The interpretation and application of these results requires considering the following limitations: a) match variables were analyzed and not individual actions, physical actions or styles of play. b) the sample was made up of matches won and lost and c) the studied age groups correspond to elite national women's national teams. From these findings it is possible to establish normative profiles in winning teams of different age groups in this level of competition. During the training process, these values provide a starting point to analyze the game, evaluate the evolution and establish technical-tactical objectives at a collective level. Future studies should analyze the evolution and age group differences at local, regional and national level, which will allow the establishment of performance indicators and facilitate the analysis of the evolution of game actions for these populations.

Conflicts of interest - the authors have no conflicts of interest.

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