

Article

Differences in Physical Performance According to Contextual Variables in U21 Football Players

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Abstract

Understanding how contextual variables shape differences in match demands in youth football is essential for optimising performance and player development. Objective: This study aimed to compare physical and competitive performance according to playing position, match location, match result, and opponent quality in the physical and competitive performance of U21 football players from a professional Chilean club. Methods: Twenty male U21 players (19.2 ± 1.2 years) were monitored during 11 official matches using 10 Hz GPS devices (WIMU Pro™) and post-match Rating of Perceived Exertion (RPE). Variables included total distance (TD), high-speed running (HSR > 20 km/h), metres per minute (MM), accelerations/decelerations ($N^{\circ}AC/N^{\circ}DC > 3 \text{ m}\cdot\text{s}^{-2}$), player load (PL), and peak velocity (PV). Contextual variables were classified by playing position, home/away, win/loss, and opponent quality (higher vs. lower rank). Results: Significant between-group differences were found across all contextual factors ($p < 0.05$). Midfielders (MFs) covered greater TD and reported higher RPE, while full-backs (FBs) and wingers (WGs) reached higher HSR and PV. Away and lost matches showed greater RPE, PL, and $N^{\circ}AC/N^{\circ}DC$, alongside more goals conceded. Facing higher-ranked opponents increased RPE and HSR but reduced explosive actions. Conclusions: Physical performance in U21 football is strongly modulated by contextual factors. Coaches should adjust training load and tactical strategies according to match conditions and positional roles to optimise adaptation and competitive readiness in developmental categories.



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1. Introduction

The individual analysis of physical performance in football represents a constant challenge for elite strength and conditioning coaches. In this context, the incorporation of monitoring technologies such as global positioning systems (GPS) is considered a fundamental tool in these processes [1], as they allow for a more accurate assessment of the physical demands players are exposed to during competition [2]. For instance, Barrera et al. [1] reported that professional players typically cover between 10 and 11 km per match and accumulate 600–900 m of high-speed running ($>19.8 \text{ km}\cdot\text{h}^{-1}$), while Malone et al. [2] highlighted that repeated high-intensity bouts are closely linked with increased external load captured by GPS technology. These demands vary not only according to positional characteristics [3] but also in relation to contextual factors such as match location, result, and quality of the opposition [4]. Specifically, Sarmento et al. [3] showed that wide midfielders and fullbacks can perform 25–35% more high-speed distance than central defenders, and Bradley et al. [4] observed that home matches may elicit 8–12% greater high-speed running than away fixtures. However, these reference values are primarily derived from senior professional football and should be interpreted with caution when extrapolated to developmental categories, such as U21 squads, where players are still undergoing physiological, tactical, and competitive maturation processes. Understanding these variables has become a crucial aspect in the design of training tasks and planning in professional football, including developmental categories such as U21 teams, where preparation for high performance requires a detailed and context-specific approach [5].

Scientific literature has shown that contextual variables significantly influence the physical performance of football players during competition [6–8]. Several studies conducted with professional players have demonstrated that playing position, match location, result, and opponent quality all have a significant impact on physical load during competition [1,9], reinforcing the importance of analysing these factors collectively. Recent findings have shown that players increase their high-intensity distance by approximately 150–250 m when their team is losing compared with winning scenarios [10]. Similarly, Villaseca-Vicuña et al. [11] reported that female players from South America performed ~20% more sprints when facing higher-ranked opponents, illustrating the impact of contextual dynamics in youth competitions. However, most studies have focused on European leagues or adult categories, while evidence from Latin American contexts and from developmental squads remains scarce [5]. This limitation reduces the external validity of existing findings, as competition density, match dynamics, talent development pathways, and organisational structures may differ substantially between European and South American football environments. In this context, Gonçalves et al. [12] demonstrated that the type of competition phase (opening, closing, and playoffs) can modify total distance and high-speed efforts by up to 10%, underscoring the relevance of local competitive structures. This gap limits the ability to extrapolate findings to other competitive environments, where match dynamics, talent development pathways, and organisational structures may differ substantially [13].

In this regard, there is a clear need to examine the impact of contextual variables on physical performance in developmental categories approaching elite level, such as the U21 squads of professional teams in Chile. Evidence from advanced developmental stages suggests that U21 players may reach match demands close to first-team standards, typically covering 9.5–10.5 km per match and 400–700 m of high-speed distance depending on play-

ing style and competition [14,15]. Nevertheless, the extent to which contextual variables modulate physical performance in U21 players under real competitive conditions remains insufficiently explored, particularly within Latin American professional clubs. Understanding how these influences manifest in young footballers on the verge of professionalism not only enables the optimisation of training and competition processes but also facilitates their transition to the senior team [14]. Therefore, generating context-specific evidence in this population is essential to support evidence-informed decision-making during this critical transitional stage. This line of research is justified both by its practical relevance for coaching and support staff and by the limited literature describing physical performance in these categories under real competitive conditions and from a positional perspective [15].

Therefore, the aim of this study was to compare differences in the physical and competitive performance of U21 players from a professional Chilean football club according to contextual variables: playing position, match location, match result, and opponent quality. It was hypothesised that higher physical demands (e.g., greater total distance and high-speed running) would be observed in matches lost compared with won, and when facing higher-ranked opponents compared with lower-ranked opponents, and that these variations would be more pronounced in specific playing positions, particularly midfielders and wide players, reflecting position-specific competitive demands. By focusing on a Chilean U21 squad competing under real competitive conditions, this study aims to address an underrepresented population in the literature and provide applied, context-specific evidence to enhance decision-making processes among coaching and performance staff involved in competitive player development [1,16].

2. Materials and Methods

2.1. Design

A quantitative, observational, descriptive, and comparative study with a non-experimental design and repeated measures across official matches was conducted. The objective was to analyse the effect of different contextual variables (playing position, match location, match result, and opponent quality) on physical performance during official football matches over a competitive season. The analysis included a total of eleven official competitive matches, played across the season, allowing for repeated measurements under real competitive conditions. This design has been previously employed in similar research within professional football to describe physical behaviour in real competitive contexts [1,16].

2.2. Participants

A total of twenty U21 youth football players from a professional Chilean club (age: 19.2 ± 1.2 years; height: 175.9 ± 6.3 cm; body mass: 72.5 ± 8.5 kg) were monitored across eleven official matches of the “Fundación Collahuasi Youth Football Championship”, organised by the National Association of Professional Football (ANFP). Each match constituted a repeated observation for players meeting the inclusion criteria. The sample was classified into five playing positions: central defenders (CDs = 3), full-backs (FBs = 4), midfielders (MFs = 7), wingers (WGs = 3), and centre-forwards (CFs = 3). Inclusion criteria required players to have completed the full match duration in all analysed games and to be free from injury at the time of data collection. Based on their affiliation with a professional football club, regular participation in a national-level competition organised by the professional association, and inclusion in a structured high-performance development pathway, the players were classified as highly trained, developmental elite athletes.

2.3. Ethical Considerations

All participants held a valid federation licence and were fully informed about the objectives, procedures, potential risks, and benefits of the study. The research did not

interfere with football performance or involve any motor actions beyond those typical of competitive practice; therefore, it was not considered to pose any additional risk beyond that inherent to regular football participation. Moreover, all players had successfully completed a medical examination prior to the start of the season, and all matches were conducted in the absence of injury or physical discomfort. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki for research involving human subjects [17]. Each participant provided written informed consent, which was also authorised by the club’s management.

2.4. Procedures

Players who completed the full 90 min (including added time) during the 2024 season (from July to December) were included in the analysis. All matches were played in the morning (AM). On match days, all players performed a standardised warm-up supervised by the team’s strength and conditioning coach, lasting between 20 and 25 min. The warm-up included general joint mobility exercises, ball control and passing drills, small-sided games, and finishing work. To provide contextual clarity regarding the training process, the weekly microcycle implemented during the competitive period is illustrated in Table 1, which summarises the distribution and progression of physical, technical, and tactical tasks across each training day.

Table 1. Schematic representation of the microcycle structure according to the training tasks and contents implemented.

MD + 2	MD-4	MD-3	MD-2	MD-1	MD	MD + 1
Recovery Day/Compensation	Strength	Duration	Velocity	Activation	Match Day	Off
Physical training Core training (10') dynamic and isometric contraction exercises Upper Body strength 3–5 sets/3–6 r 30–60%1RM Bench Press Pull-Ups TRX Pull-Ups Shoulder Push-Ups Recovery Work (>60 min players): —Aerobic continuous run or bike: 15–20' at 60–65% HRmax —Stretching and mobility (10–15'): assisted and with foam roller Complementary Work (<60 min players): —Small-sided games (3 × 4', 2' rec, 6v6–8v8) —Intermittent runs: 1–2 sets × 6–8 reps of 100 m (90–120% YYIRT-L1) Cool-down (10')	Physical training Core training (10') dynamic and isometric contraction exercises Lower Body strength 3–5 sets/3–6 r 30–60% 1RM Squat Deadlift Hip thrust TEC/TAC (~60') Duelling actions, few players in small spaces <60 m ² pp	Physical training Core training (10') dynamic and isometric contraction exercises Upper Body strength 3–5 sets/3–6 r 30–60% 1RM Bench Press Pull-Ups TRX Pull-Ups Shoulder Push-Ups Intermittent training 1–2 sets × 6–8 rep on 100 m 90–120% YYIRT-L1 TEC/TAC (~90') A greater number of players in larger playing spaces >90 m ² pp Cool-down (10')	Physical training Core training (10') dynamic and isometric contraction exercises Speed Block (20'): Unresisted sprints Linear sprints from 10 m to 30 m Change of direction and agility training from 10 m to 20 m TEC/TAC (~80') Fewer players in larger playing spaces >90 m ² pp Fixed tactic defensive Cool-down (10')	Physical training Coordination drills (15') Individual and collective techniques with the ball TEC/TAC (~50') Few players in small spaces <60 m ² pp Fixed tactic offensive Cool-down (10')	Football warm up (25') General exercises for joint mobility, control, and passing, games in reduced spaces, defensive block work, and offensive block work Competition Cool-down (10')	Recovery day

Abbreviations: TEC/TAC: technical and tactical training, YYIRT-L1: yo-yo intermittent fitness recovery test level one speed, 1RM: 1-repetition maximum, pp: per player.

2.5. Variables and Instruments

2.5.1. Rating of Perceived Exertion (RPE)

The players' internal load was quantified through the level of perceived exertion (RPE), recorded 30 min after each match using the Borg Category-Ratio 10 (CR10) scale. Players rated their perceived exertion on a 0–10 scale, where 0 represented rest and 10 represented maximal exertion, following the protocol described by Borg et al [18]. This method has been validated as a reliable tool for monitoring exercise intensity in football players [19,20].

2.5.2. Global Positioning System (GPS) Monitoring

The players' external load during each match was monitored using GPS devices operating at a sampling frequency of 10 Hz (WIMU Pro™, RealTrack Systems, Almería, Spain), which also include an integrated triaxial accelerometer functioning at 100 Hz. The devices were secured in a tight-fitting neoprene vest positioned between the shoulder blades to ensure accurate data collection. The variables analysed in this study included total distance (TD), high-speed running ($>20 \text{ km}\cdot\text{h}^{-1}$) (HSR), peak velocity (PV), metrage per minute (MM), player load (PL), calculated as the vector sum of the instantaneous changes in acceleration across the three orthogonal axes (anteroposterior, mediolateral, and vertical), expressed in arbitrary units, and the number of accelerations (N°AC) and decelerations (N°DC) greater than $3 \text{ m}\cdot\text{s}^{-2}$. These metrics are widely used to monitor training load and assess the physical performance of football players during official matches in men's football [21].

2.5.3. Competitive Performance Variables

To assess collective performance, the competitive performance variables considered were the number of goals scored and the number of goals conceded in each match. Goals scored were defined as the total number of goals achieved by the team during regular playing time, whereas goals conceded referred to the total number of goals allowed against. This information was obtained from the official match reports available on the National Association of Professional Football (ANFP), youth football championship website (<https://www.campeonatochileno.cl>, accessed on 12 December 2024). These variables provide contextual information to interpret physical performance and load demands in relation to the competitive success achieved in each match [22].

2.5.4. Contextual Variables

The contextual variables were classified as follows: playing position was defined according to the technical–tactical criteria established by the team's coaching staff and categorised as central defenders, full-backs, midfielders, wingers, and centre-forwards. Match location was classified as home or away, while match result was coded as win or loss. Opponent quality was determined based on the opponent's position in the overall league table at the time of the match and categorised into two levels: higher rank (positions 1–8) and lower rank (positions 9–15) [23]. All this information was obtained from the official website of the youth league tournament organised by the National Association of Professional Football: <https://www.campeonatochileno.cl> (accessed on 12 December 2024).

2.6. Observational Structure

To enhance methodological transparency, Table 2 presents the distribution of observations derived from the analysis of 20 U21 players monitored across 11 official matches, where each observation corresponds to a player $\times$ match record ($n = 82$). The table summarises the number of observations for each contextual variable analysed, including playing position, match location, match result, and opponent quality.

Table 2. Distribution of player–match observations across contextual variables in 20 U21 players monitored over 11 official matches.

Category	Observation (n)
Playing position	
Central defenders (CDs)	19
Full-backs (FBs)	17
Midfielders (MFs)	29
Wingers (WGs)	11
Centre-forwards (CFs)	6
Match location	
Home	42
Away	40
Match result	
Win	32
Loss	50
Total observations	82

2.7. Statistical Analysis

Normality of the distributions was first verified using the Shapiro–Wilk test. Subsequently, descriptive analyses (mean and standard deviation) were performed, and group comparisons were conducted using one-way ANOVA for the variable playing position, and independent samples *t*-tests for the variables match location, match result, and opponent quality. When appropriate, post hoc tests with Bonferroni correction were applied. Effect size was calculated using partial eta squared (η^2) for ANOVA and Cohen's *d* for *t*-test comparisons. Statistical significance was set at $\alpha = 0.05$. For ANOVA results, the magnitude of the effect size (η^2) was interpreted as small (~ 0.01), medium (~ 0.06), and large (~ 0.14). For *t*-test comparisons, Cohen's *d* was interpreted as small (< 0.2), moderate (0.2 – 0.5), and large (> 0.8) [24,25]. The primary unit of analysis was the player–match observation. For the analysis by playing position, individual player–match data were grouped according to positional role and summarised using mean and standard deviation. For contextual variables related to match conditions (match location, match result, and opponent quality), player–match observations were aggregated at the match level by calculating team mean values for each variable, in order to avoid over-representation of matches with a higher number of individual observations. Data were processed using IBM SPSS Statistics version 26.0.

3. Results

Table 3 shows significant differences in several physical variables according to playing position, with large global effects observed for RPE ($\eta^2 = 0.624$). Post hoc analyses indicated that midfielders (MFs) presented higher RPE values than central defenders (CDs), full-backs (FBs), and centre-forwards (CFs) ($p < 0.05$). MFs also covered a greater total distance (TD) than CDs, FBs, and WGs (overall ANOVA $p = 0.044$; $\eta^2 = 0.126$) and displayed higher metres per minute (MM) than CDs and WGs ($p = 0.015$; $\eta^2 = 0.164$). Regarding high-speed running (HSR), FBs and wingers (WGs) achieved higher values than CDs ($p < 0.001$; $\eta^2 = 0.311$). In peak velocity (PV), FBs and WGs outperformed MFs ($p = 0.005$; $\eta^2 = 0.192$). Additionally, FBs and MFs executed a greater number of accelerations (N°AC) and decelerations (N°DC) than CDs ($p = 0.038$; $\eta^2 = 0.137$ and $p = 0.001$; $\eta^2 = 0.225$, respectively). Finally, player load (PL) values were higher in MFs compared with CDs ($p = 0.049$; $\eta^2 = 0.119$), reflecting greater external demands in that position.

Table 3. Comparisons of physical performance in official competitions by playing positions.

Variables	Central Defenders (n = 3)		Fullbacks (n = 4)		Midfielder (n = 7)		Wingers (n = 3)		Centre Forwards (n = 3)		ANOVA	
	M	SD	M	SD	M	SD	M	SD	M	SD	p	η^2
RPE (0–10)	6.69 ^b	1.03	7.00	1.54	9.46 ^{ad}	0.87	8.25	0.50	7.00	0.67	<0.001	0.624
TD (m)	9440 ^{ab}	521	10,004	1223	10,125 ^{ac}	892	9199	799	9198	2233	0.044	0.126
MM	97.6 ^a	2.88	105	6.28	106 ^c	6.98	97.1 ^a	5.26	101	26.1	0.015	0.164
HSR (m)	518 ^{ac}	201	941	245	651 ^a	196	846	248	939	486	<0.001	0.311
PV (km/h)	30.18	2.06	30.8	1.07	28.9 ^{ac}	1.90	31.2	1.81	29.5	2.88	0.005	0.192
N° AC (#)	49.9 ^a	20.86	71.8	17.9	61.4	20.7	49.6 ^a	24.9	69.7	39.1	0.038	0.137
N° DC (#)	48.6 ^{ab}	20.64	88.4	23.7	72.8	29.4	55.6 ^a	27.2	78.8	19.1	0.001	0.225
PL (au)	119 ^b	10.30	131	23.5	139	21.4	128	14.6	126	33.3	0.049	0.119

Bold values mean $p < 0.05$; #: counts, au: arbitrary unit, RPE: Rating of Perceived Exertion, TD: total distance, MM: metres per minute, HSR: high-speed running, PV: peak velocity, N° AC: number of accelerations, N° DC: number of decelerations, PL: player load. Post hoc: a = difference with Full-backs, b = difference with Midfielders, c = difference with Wingers, d = difference with Centre-forwards. “n” indicates the number of players per playing position. Values are presented as mean $\pm$ standard deviation based on player–match observations aggregated by playing position.

Table 4 shows significant differences in various physical and performance variables according to match location. Compared with home matches, away matches were associated with higher RPE ($p = 0.049$, $d = 0.657$), a greater number of accelerations (N° AC; $p = 0.005$, $d = 0.680$) and decelerations (N° DC; $p = 0.003$, $d = 0.722$), as well as higher player load (PL; $p = 0.008$, $d = 0.640$). Moreover, away matches were linked to a greater number of goals conceded ($p < 0.001$, $d = 0.947$). These results indicate that playing away from home entails greater physical demands and a negative impact on competitive performance.

Table 4. Comparisons of physical performance in official competitions when playing at home or away.

Variables	Home (n = 6)		Away (n = 5)		Comparison Between Groups		
	M	$\pm$ SD	M	$\pm$ SD	$\Delta\%$	p	TE Cohen’s d
RPE (0–10)	7.50	1.47	8.50	1.60	−11.8	0.049	−0.657
TD (m)	9571	1156	9856	1075	−2.9	0.285	−0.254
MM	102	11.9	101	7.25	1.1	0.848	0.045
HSR (m)	757	311	727	285	4.1	0.672	0.100
PV (km/h)	30.2	2.19	29.8	1.86	1.3	0.343	0.225
N° AC (#)	52.8	26.4	68.5	31.1	−22.9	0.005	−0.680
N° DC (#)	58.9	31.5	80.1	26.3	−26.1	0.003	−0.722
PL (au)	124	19.8	137	20.7	−9.5	0.008	−0.640
# Goals scored	2.29	2.13	1.68	0.82	36.3	0.134	0.358
# Goals conceded	0.95	0.97	2.06	1.39	−53.9	<0.001	−0.947

Bold values mean $p < 0.05$; #: counts, au: arbitrary unit, RPE: Rating of Perceived Exertion, TD: total distance, MM: metres per minute, HSR: high-speed running, PV: peak velocity, N° AC: number of accelerations, N° DC: number of decelerations, PL: player load. “n” indicates the number of matches under each condition. Values are presented as team mean $\pm$ standard deviation, obtained by aggregating individual player–match GPS data at the match level. Positive values of Cohen’s d indicate higher values in the first group listed.

Table 5 shows significant differences in physical and performance variables according to match result. Compared with defeats, victories were associated with a higher number of accelerations ($N^{\circ}AC$; $p = 0.007$, $d = 0.663$), indicating greater engagement in explosive actions during successful matches. In contrast, players reported lower RPE values in wins ($p = 0.043$, $d = 0.629$), suggesting that matches won were perceived as less physically demanding despite the increased acceleration load. These results represent statistical differences between winning and losing matches, rather than an intrinsic characterisation of match success. Additionally, significant differences were observed in goals scored and conceded between match outcomes ($p < 0.001$), which should be interpreted as contrasts between conditions rather than as descriptive features of winning matches per se. Overall, these findings indicate that successful performances were characterised by more frequent high-intensity actions and a more favourable scoring balance when compared with losing matches.

Table 5. Comparisons of physical performance in official competitions based on the results of the game.

Variables	Win (n = 6)		Lose (n = 5)		Comparison Between Groups		
	M	$\pm SD$	M	$\pm SD$	$\Delta\%$	p	TE Cohen's d
RPE (0–10)	7.31	1.66	8.27	1.42	−11.6	0.043	−0.629
TD (m)	9803	848	9626	1276	1.8	0.514	0.157
MM	102	7.04	101	11.7	1.2	0.628	0.116
HSR (m)	712	55.5	765	299	−6.9	0.459	−0.178
PV (km/h)	30.0	2.10	30.0	2.04	0.0	0.957	0.013
$N^{\circ}AC$ (#)	69.0	19.7	53.6	25.2	28.7	0.007	0.663
$N^{\circ}DC$ (#)	74.0	26.2	64.5	33.5	14.7	0.203	0.307
PL (au)	127	15.7	132	23.8	−3.8	0.265	−0.268
Goals scored (#)	3.55	1.59	1.02	0.79	247.1	<0.001	0.331
Goals conceded (#)	0.27	0.45	2.20	1.06	−87.7	<0.001	−2.192

Bold values mean $p < 0.05$; #: counts, au: arbitrary unit, RPE: Rating of Perceived Exertion, TD: total distance, MM: metres per minute, HSR: high-speed running, PV: peak velocity, $N^{\circ}AC$: number of accelerations, $N^{\circ}DC$: number of decelerations, PL: player load. “n” indicates the number of matches under each condition. Values are presented as team mean $\pm$ standard deviation, obtained by aggregating individual player–match GPS data at the match level. Positive values of Cohen's d indicate higher values in the first group listed.

Table 6 shows significant differences in various physical and performance variables according to the competitive level of the opponent. Against higher-ranked teams, players reported higher RPE ($p = 0.032$, $d = 0.777$) and performed greater high-speed running (HSR; $p = 0.022$, $d = 0.597$). In contrast, when facing lower-ranked opponents, higher values were observed for the number of accelerations ($N^{\circ}AC$; $p < 0.001$, $d = 1.025$) and decelerations ($N^{\circ}DC$; $p = 0.037$, $d = 0.516$), as well as a greater number of goals scored ($p < 0.001$, $d = 1.033$). Additionally, more goals were conceded against higher-ranked opponents ($p = 0.040$, $d = 0.534$). These findings suggest that matches against stronger rivals demanded greater high-intensity efforts, whereas matches against lower-ranked opponents involved more explosive actions and higher offensive effectiveness.

Table 6. Comparisons of physical performance in official competitions with a quality opponent.

Variables	Higher Ranked (n = 5)		Lower Ranked (n = 6)		Comparison Between Groups		
	M	±SD	M	±SD	Δ%	p	Cohen's d
RPE (0–10)	8.66	1.43	7.50	1.53	15.5	0.032	0.777
TD (m)	9456	1431	9800	959	−3.5	0.233	−0.307
MM	102	15.4	102	6.87	0.0	0.952	0.015
HSR (m)	865	315	692	278	25.1	0.022	0.597
PV (km/h)	30.1	2.23	30.0	1.99	0.3	0.815	0.060
N°AC (#)	43.9	29.2	66.5	18.3	−34.6	<0.001	−1.025
N°DC (#)	57.3	37.6	73.0	26.7	−21.5	0.037	−0.516
PL (au)	130	26.0	130	18.8	0.0	0.955	−0.014
# Goals scored	0.90	0.81	2.51	1.77	−64.1	<0.001	−1.033
# Goals conceded	1.90	0.81	1.23	1.40	54.5	0.040	0.534

Bold values mean $p < 0.05$; #: counts, au: arbitrary unit, RPE: Rating of Perceived Exertion, TD: total distance, MM: metres per minute, HSR: high-speed running, PV: peak velocity, N°AC: number of accelerations, N°DC: number of decelerations, PL: player load. “n” indicates the number of matches under each condition. Values are presented as team mean $\pm$ standard deviation, obtained by aggregating individual player–match GPS data at the match level. Positive values of Cohen's d indicate higher values in the first group listed.

4. Discussion

The present study aimed to compare differences in the physical and competitive performance of U21 players from a professional Chilean football club according to key contextual variables: playing position, match location, match result, and opponent quality. The main findings indicate that midfielders (MFs) and wingers (WGs) were associated with higher physical demands, particularly in total distance (TD), high-speed running (HSR), and RPE. Regarding contextual factors, lost matches were associated with higher RPE, whereas winning matches showed a higher number of accelerations (N°AC), reflecting increased engagement in explosive actions during successful performances. Additionally, matches played away from home and those against higher-ranked opponents were associated with increased physical demands across several variables [6–9]. Overall, these results highlight how competitive context is closely associated with both physical and performance demands, even at developmental levels approaching elite football [6,12]. These findings should be interpreted not only as isolated match-related outcomes, but also within the broader organisational context of weekly training and competitive preparation in elite youth football.

Regarding playing positions, midfielders (MFs) showed the highest values in total distance (TD), metres per minute (MM), high-speed running (HSR), and RPE, which is consistent with previous research describing this position as the most physically demanding due to its continuous involvement in both offensive and defensive actions [3]. However, these differences should be interpreted in light of positional tactical responsibilities and match-specific role constraints, rather than as a direct reflection of superior physical capacity. Wingers (WGs) also stood out in variables such as peak velocity (PV) and player load (PL), which aligns with their offensive and defensive roles within tactical width, requiring repeated explosive efforts with limited recovery time [26]. Conversely, central defenders (CDs) and centre-forwards (CFs) recorded significantly lower values, in line with studies indicating that these positions involve more specific actions and lower participation in high-intensity movements [3,27]. Such positional differences are likely modulated by team formations, match strategies, and role-specific tactical instructions adopted across matches, rather than by isolated physiological characteristics.

Regarding match location, away matches were associated with higher RPE, number of accelerations (N°AC), number of decelerations (N°DC), and player load (PL). These results support the well-documented phenomenon of competitive disadvantage when playing away from home, which has been explained by factors such as travel demands, unfamiliarity with the environment, and reduced psychological support [28,29]. From a physical perspective, the increase in external load and deceleration actions may be attributed to the need to respond to more demanding tactical contexts, such as greater opposition pressure or reduced ball possession [30]. Importantly, these findings do not imply a causal effect of match location on physical performance, but rather reflect the interaction between environmental, tactical, and psychological constraints. Furthermore, away teams conceded more goals and scored fewer, confirming a disadvantage not only in physical demands but also in collective performance [31]. Variations in weekly microcycle load distribution may partially modulate these away-match demands.

Regarding the match result, significant differences were observed in RPE and the number of accelerations (N°AC). RPE was higher in lost matches, whereas N°AC was significantly lower in these games. These findings should be interpreted as statistical contrasts between winning and losing matches, rather than as an intrinsic characterisation of match success or failure. This indicates that, when facing an unfavourable scoreline, players perceive greater physical effort—possibly due to increased tactical and psychological demands—yet perform fewer explosive actions [11]. The reduction in N°AC may reflect accumulated fatigue, tactical limitations imposed by the opponent, or reduced effectiveness in offensive and defensive transitions [32]. Thus, match outcome should be understood as a contextual condition shaping physical responses, rather than as a direct determinant of physical performance. Despite the absence of differences in total distance (TD) and high-speed running (HSR), the observed variations in RPE and N°AC suggest that match outcome influences how physical demands are experienced and expressed, with players potentially redistributing their effort by prioritising positional adjustments, defensive organisation, or recovery behaviours over high-speed movements [11,32].

Regarding opponent quality, significant differences were found—players exhibited higher RPE and HSR values when facing higher-ranked opponents (8.66 vs. 7.50 and 865 vs. 692 m, respectively), although paradoxically they performed fewer accelerations (N°AC) and decelerations (N°DC). This mixed pattern may be interpreted as an adaptation to the style of play imposed by the opponent [32], involving more prolonged and sustained running (HSR) but fewer explosive actions due to the dominance of the opposing team [3,4]. These responses likely reflect contextual and tactical adaptations rather than inherent limitations in physical capacity. Likewise, fewer goals were scored, and more were conceded against stronger rivals, reflecting a genuine competitive challenge that may condition the team's physical behaviour [28]. Opponent quality is closely linked to tactical dominance and game control, which may partly explain these physical responses.

This study presents several limitations that should be considered when interpreting the results. First, the limited number of matches analysed ($n = 11$) may restrict the generalisability of the findings, as it does not fully represent competitive behaviour across an entire season. Second, the limited number of players included in the analysis, particularly when subdivided by playing position (e.g., $n = 3$ in some positions), constitutes a critical methodological limitation, as it may have reduced statistical power and constrained the detection of true differences between specific playing roles. Third, technical-tactical and psychological indicators were not included, which would have provided a more comprehensive understanding of performance in real competitive contexts. Finally, although physical performance was monitored through external load metrics obtained via GPS, the study did not incorporate internal load indicators such as session-RPE, which could

have offered valuable insight into individual physiological responses to match demands. Additionally, inter-unit reliability of the GPS devices was not formally assessed, which may have introduced additional variability in external load measures across matches. Furthermore, although players were monitored across multiple matches during the competitive season, the statistical analyses did not explicitly account for the hierarchical structure of the data, with repeated observations nested within players. Therefore, the results should be interpreted with caution, and future studies with larger samples and a greater number of matches should consider the use of mixed-effects or multilevel models to appropriately address within-player dependency.

Future studies should explore the longitudinal effects of contextual variables across an entire competitive season, including internal load indicators (e.g., RPE, HRV, or biochemical markers) and tactical variables derived from positional data. Integrating these multidimensional metrics would enable a more comprehensive understanding of how physical and contextual factors interact to influence performance and recovery. Moreover, future research should consider the combined use of absolute and relative (e.g., per-minute) external load variables, particularly when analysing players with variable playing time, to improve comparability across competitive contexts. Additionally, expanding the analysis to other developmental categories and female football could provide valuable comparative insights to guide individualised training and talent development strategies.

Nevertheless, the results provide relevant practical insights: strength and conditioning coaches can use this information to design training loads that are more specifically aligned with positional demands, match context, and opponent level. In U21 developmental football, such evidence not only enables a more precise optimisation of physical preparation but also supports the integration of tactical and strategic components that facilitate better adaptation to the demands of competitive play.

5. Conclusions

The present study demonstrates that factors such as playing position, match location, match result, and opponent quality influence physical and competitive demands in developmental football. Midfielders (MFs) and wingers (WGs) exhibited the highest high-intensity demands. Greater external loads, fewer goals scored, and more goals conceded were observed in away matches. Defeats were associated with higher RPE, lower accelerations ($N^{\circ}AC$), fewer goals scored, and more goals conceded. When facing higher-ranked opponents, players showed higher RPE and HSR, together with reduced accelerations ($N^{\circ}AC$) and decelerations ($N^{\circ}DC$), fewer goals scored, and more goals conceded. Collectively, these findings underscore the importance of implementing individualised, context-specific load management strategies to optimise performance, enhance recovery, and minimise fatigue in youth players transitioning toward professional football.

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Institutional Review Board Statement: All participants held a valid federation licence and were fully informed about the objectives, procedures, potential risks, and benefits of the study. The research did not interfere with football performance or involve any motor actions beyond those

typical of competitive practice; therefore, it was not considered to pose any additional risk beyond that inherent to regular football participation. Moreover, all players had successfully completed a medical examination prior to the start of the season, and all matches were conducted in the absence of injury or physical discomfort. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki for research involving human subjects. Each participant provided written informed consent, which was additionally authorised by the management of Club Universidad de Chile.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent was also obtained from all participants for the use of their anonymized data in scientific publications.

Data Availability Statement: The data used in this study originate from internal club records and contain sensitive information from youth players. Due to privacy considerations, personal data protection, and ethical restrictions established by Club Universidad de Chile, the datasets are not publicly available. However, the authors may provide aggregated or non-identifiable data upon reasonable request to the corresponding author and pending institutional approval.

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Abbreviations

The following abbreviations are used in this manuscript:

RPE	Rating of Perceived Exertion
TD	Total Distance
MM	Metres per Minute
HSR	High-Speed Running
PV	Peak Velocity
N° AC	Number of Accelerations
N° DC	Number of Decelerations
PL	Player Load
GPS	Global Positioning System
TEC/TAC	Technical and Tactical Training
YYIRT-L1	Yo-Yo Intermittent Recovery Test Level 1
1RM	One-Repetition Maximum
pp	Per Player
CDs	Central Defenders
FBs	Full-backs
MFs	Midfielders
WGs	Wingers
CF	Centre-Forwards
ANOVA	Analysis of Variance
ηp^2	Partial Eta Squared
SD	Standard Deviation
M	Mean
au	Arbitrary Units
HRmax	Heart Rate Maximum
ANFP	Asociación Nacional de Fútbol Profesional
AM	Morning
MD	Match Day
MD-1/MD-2/...	Match Day minus 1/2
MD + 1/MD + 2	Match Day plus 1/2

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