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Could football be a valid tool to combat adolescents' physical inactivity? A Descriptive Study

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Abstract: Football is considered the most popular sport among adolescents, but most do not meet the World Health Organization's recommendation of 60 minutes of moderate to vigorous physical activity (MVPA) per day. Can regular football practice help to meet this recommendation? This research aimed to assess the physical activity levels of players in a high-performance football academy, both in training and in matches, using accelerometry. In addition, the study aimed to analyze the coaching style of the participants' coaches using the researcher's diary. A total of 130 players from a Spanish professional La Liga team agreed to participate: Under 18 (U18), Under 15 (U15) and Under 13 (U13). In addition, the subjective perception of total quality of recovery (TQR) and perceived exertion (RPE) before and after each training session/match, as well as their coaches, were analysed. The results showed that the average minutes of MVPA per training session and match with more than 60 minutes played were respectively: U18: 61.46 ± 2.45 and 77.78 ± 5.93, U15: 50.84 ± 3.78 and 79.63 ± 14.84, and U13: 53.35 ± 4.96 and 74.04 ± 14.73. Players were consistently considered "very well recovered" (TQR). The RPE values of coaches and players were similar during training, but higher for coaches in competition. The U18 coaches showed a coaching style of autonomy support, while the U15 and U13 categories showed a controlling style. In conclusion, weekly football practice in a high-performance academy may enable adolescent players to meet international MVPA recommendations for health benefits by encouraging an active lifestyle.

Keywords: Football; Accelerometry; training; competition; health

1. Introduction

Physical activity and sports have been linked to the concept of science since the dawn of culture. In the last two decades, scientific production has been more closely related to the improvement of sporting performance than to the health of its participants. The relationship between physical activity and health has already been extensively studied (Cairney et al., 2019; Ramírez et al., 2021), although there are indeed many factors that determine whether an individual obtains more or fewer benefits from physical activity (Arazi et al., 2022; Santina et al., 2021). The foundations for future adult health are laid in childhood and adolescence (5-17 years). Therefore, the

World Health Organization (2020) recommends "at least an average of 60 minutes of daily physical activity, mainly aerobic, of moderate to vigorous intensity (MVPA)" (World Health Organization [WHO], 2020). However, around 81% of adolescents do not meet this recommendation. Even so, some young people choose to maintain their health by playing sports like football.

The sport is a mass phenomenon that is becoming increasingly popular. According to the Federation of International Football Associations (FIFA), approximately 270 million people actively play the sport in its 211 member nations, which would represent up to 4% of the total population. The Union of European Football Associations (UEFA) has more than 23 million members in 55 countries. For its part, the Royal Spanish Football Federation (RFEF) has around 1 million registered players, of which only 2,400 are involved in professional football. Related to this, a statistic produced by the Association of Spanish Football Players (AFE) highlights that only 0.4% of the youth players currently registered in Spain will fulfill their dream of becoming professional players. There are different studies carried out in England that tell us that of the 1.5 million children playing football, only 180 will sign professional contracts for a Premier League club, i.e. a success rate of 0.012% (Calvin, 2017). In 2011, 13,612 children made up the professional football academy system in England. Unfortunately, 50% left the system before the age of 16 (Premier League, 2012). Furthermore, 98% of players who get a scholarship in these academies at the age of 16 do not play in any of the top five English divisions by the age of 18 (Calvin, 2017). This is why the practice of football should go further, seeking the adherence of its practitioners to the sport and, as a consequence, the improvement in their health, as indicated by the WHO (Bull et al., 2020).

Studies on the health benefits of physical activity have focused on aerobic exercise, such as treadmill and outdoor running (Adarve et al., 2019). Despite their advantages, adherence to these activities, especially among adolescents, is relatively low because they are perceived as boring and monotonous (Aznar-Ballesta & Santana, 2023). Therefore, it is crucial to find more engaging training approaches that offer comparable health benefits to those mentioned above (Hammami et al., 2018). In this regard, football emerges as a popular alternative for those who wish to improve their cardiovascular, metabolic and musculoskeletal fitness (Krustrup, Dvorak, et al., 2010; Krustrup & Parnell, 2019).

The concept of football as medicine is well established in the literature (Krustrup & Parnell, 2019). Football is a broad-spectrum exercise that improves cardiovascular and musculoskeletal fitness and reduces the risk of cardiovascular disease, falls and fractures (Bangsbo et al., 2015; Krustrup, Aagaard, et al., 2010; Lee et al., 2012). Importantly, at the grassroots level it represents an attractive opportunity to engage the population in regular physical activity, due to its low cost and the availability of facilities. In fact, it has been found that the impact of its practice on players' health is as positive as that of other sports such as running, swimming or cycling, except that football, being a team sport with a sense of social belonging, has a lower dropout rate (Aparicio-Ugarriza et al., 2015;

Hammami et al., 2016). In order to be able to quantify the physical activity performed in it, portable devices such as accelerometers have become very useful as they can provide data on exercise intensity, frequency and duration without disturbing people (Sanders et al., 2014).

To our knowledge, there are no published studies that have used accelerometers to assess the impact of football practice on the physical demands of young performance academy players. We are only aware of one published study, but it was conducted with senior football players (Fernandez-Rio et al., 2020). Furthermore, no comparisons have been made between objective measures and subjective perceptions of the same programme (ratings of perceived exertion) to fully understand football training from the physical, mental and social perspective of health and well-being.

In addition to assessing players' physical activity levels, this study aims to analyze the coaching style of the participants' coaches. Given that the coach-athlete relationship can significantly influence performance outcomes, understanding these dynamics can provide valuable insights to enhance the effectiveness of training programs and player development in elite environments.

Based on the above, the main objective of the study was to assess, using accelerometry, the physical activity levels of players (U18, U15 and U13) belonging to a performance football academy, both in training and in match play. The second objective was to obtain, from both coaches and players, their subjective perception levels of recovery/fatigue before and after the aforementioned scenarios. The third objective focused on analysing the interpersonal style of the participating coaches.

The first hypothesis was that the levels of physical activity would be different in the different categories of players. The second hypothesis was that these levels would be different in training and matches. The third hypothesis was that the subjective perceptions of effort of players and coaches would be similar in matches and in training. The fourth and final hypothesis was that different coach profiles would be observed among the participants.

2. Materials and Methods

Participans — A total of 130 male football players enrolled in different grassroots categories belonging to a professional team of the Spanish league in the north of Spain agreed to participate. They had a mean age of 14.71 ± 1.83 years and a previous competitive experience of 8.76 ± 2.08 years. They were grouped by the club into three categories: U18 (n=47, 16-18 years), U15 (n=45, 14-15 years) and U13 (n=38, 12-13 years). Therefore, fixed groups were used in the study. For further analysis, participants in each category were grouped according to their specific playing position: goalkeepers (n=14), defenders (n=47), midfielders (n=29) and forwards (n=40). Based on the previously described characteristics of performance football in young athletes (professional governing organisations, official divisions, long-term leagues, demanding training schedules, etc.), the inclusion criteria for inclusion in the study were as follows: a) competing in a performance school of a professional Spanish league team in

competitions organised by the Regional Football Federation (RFFPA) and under the supervision of the Royal Spanish Football Federation (RFEF); b) having a minimum experience of 4 years of systematic training in football activity; c) regular attendance at training sessions and matches (<90%) and d) willingness to be monitored.

On the other hand, the exclusion criteria were: a) having been injured at the time of the study or during the last year; b) missing two or more training sessions out of the 12 scheduled in the study (<90%); and c) taking any type of medication that could alter the results. Prior to enrolment in the study, all participants underwent a medical examination to validate their health status. The club's medical services determined an average body mass of 60.74 ± 4.84 kg, an average height of 171.10 ± 4.67 centimetres, an average body mass index (BMI) of 21.81 ± 2.12 kg/m2 and an average fat percentage of 11.03 ± 1.37. For fat percentage, the sum of 6 folds from the equations proposed by Faulkner and Carter (Stewart et al., 2011) tricipital, subscapular, suprascapular, abdominal, thigh and calf were used (Table 1)

Procedure — The present study followed a mixed quantitative-qualitative, longitudinal, quantitative-qualitative research design and the sampling selection was non-probabilistic, by convenience (Thomas et al., 2022). First, approval was obtained from the researchers' University Ethics Committee (12/2022). Subsequently, the project was presented to the administration of the participating football club and, once their approval was obtained, to the players' families, from whom written informed consent to participate in the research project was obtained. This respected key ethical values: the right to information about all procedures, protection of anonymised personal data, guarantees of confidentiality, non-discrimination in terms of general or socio-economic status, and the possibility to leave the study at any time.

After obtaining the above-mentioned permissions, the participants followed a similar weekly training programme, under the guidelines of the club: three training sessions per week of 90 minutes each, for 4 weeks for a total of 12 sessions, and 3 matches of 105 minutes, including 15-minute breaks, held on weekends. All training sessions included work on physical condition and technical and tactical skills under an integrated methodology, characterised by the joint appearance of physical, technical, tactical and psychological factors, as Albert (2008, p.8) explains: "This methodology involves an integration and combination of different types of load, but the common denominator of this methodology is always technique and tactics. Through it, the remaining qualities involved in performance are developed. Depending on individual characteristics, the training is organised by.

Table 1. Anthropometric analysis.

Category	Position	N	Weight (kg)	Height (cm)	BMI (kg/m²)	% Body Fat
			M ± SD	M ± SD	M ± SD	M ± SD
U18	Goalkeepers	5	66.32 ± 2.65	185.40 ± 2.70	19.31 ± 1.17	10.32 ± 0.74
	Defenders	15	65.71 ± 6.09	175.27 ± 6.05	21.33 ± 1.72	10.88 ± 3.66
	Midfielders	11	64.09 ± 7.52	174.27 ± 4.52	21.04 ± 1.61	10.64 ± 0.94
	Forwards	16	66.54 ± 6.26	176.18 ± 5.43	21.59 ± 1.31	10.30 ± 1.08
	Total	47	65.66 ± 5.63	177.78 ± 4.67	22.27 ± 1.51	10.53 ± 1.60
U15	Goalkeepers	4	65.25 ± 5.58	179.00 ± 7.08	20.39 ± 0.38	10.49 ± 0.27
	Defenders	17	60.86 ± 5.79	170.67 ± 5.64	20.86 ± 1.19	12.13 ± 4.68
	Midfielders	9	61.54 ± 3.52	172.78 ± 3.16	20.63 ± 0.85	10.44 ± 0.48
	Forwards	15	57.58 ± 6.29	169.04 ± 5.52	20.13 ± 1.23	10.31 ± 0.39
	Total	45	61.31 ± 5.29	172.87 ± 5.35	20.50 ± 0.91	10.84 ± 1.45
U13	Goalkeepers	5	59.28 ± 3.08	164.30 ± 2.68	22.45 ± 6.50	12.29 ± 0.77
	Defenders	15	53.64 ± 2.94	162.50 ± 3.86	20.29 ± 0.55	11.98 ± 1.89
	Midfielders	8	52.06 ± 2.46	160.12 ± 4.08	20.30 ± 0.53	11.02 ± 0.64
	Forwards	10	56.06 ± 5.97	163.72 ± 5.41	20.87 ± 1.17	11.61 ± 0.99
	Total	38	55.26 ± 3.61	162.66 ± 4.01	20.97 ± 2.18	11.72 ± 1.07
	Total	130	60.74 ± 4.84	171.10 ± 4.67	21.81 ± 2.12	11.03 ± 1.37

Note: M = Mean; SD = Standard Deviation; BMI = Body Mass Index.

Table 2. Physical Activity and Health Variables by age Categories.

ANOVA: Analysis of variance; MVPA: Moderate-to-Vigorous Physical Activity. M = Mean; SD = Standard Deviation. Note: Different superscripts on the same

Physical Activity		U18 (n=47)	U15 (n=45)	U13 (n=38)
		M ± SD	M ± SD	M ± SD
TRAINING	Sedentary	21.68 ± 2.77[a]	16.27 ± 2.80[b]	13.06 ± 4.56[c]
	Light	6.75 ± 1.28[b]	22.88 ± 3.85[a]	21.82 ± 4.22[a]
	Moderate	29.69 ± 5.08[b]	30.88 ± 4.58[ab]	33.70 ± 6.33[a]
	Vigorous	20.09 ± 3.77	17.92 ± 5.03	17.86 ± 6.35
	Very Vigorous	11.61 ± 6.28[a]	2.04 ± 1.83[b]	1.42 ± 1.62[b]
	MVPA	61.46 ± 2.45[a]	50.84 ± 3.78[b]	53.35 ± 4.96[b]
	Steps	5872.93 ± 648.65[b]	6000.06 ± 665.89[ab]	6309.67 ± 899.39[a]
MATCH (+ 60 min)	Sedentary	11.39 ± 3.41	13.27 ± 7.65	11.12 ± 6.28
	Light	18.25 ± 2.57	20.06 ± 10.68	20.50 ± 11.01
	Moderate	38.97 ± 10.92[b]	49.80 ± 11.48[a]	41.78 ± 9.56[b]
	Vigorous	34.77 ± 9.26	28.65 ± 12.89	30.24 ± 15.66
	Very Vigorous	4.79 ± 5.29[a]	1.14 ± 1.67[b]	2.01 ± 3.37[b]
	MVPA	77.78 ± 5.93	79.63 ± 14.84	74.04 ± 14.73
	Steps	9851.96 ± 1096.91	10154.07 ± 1839.56	9795.10 ± 2202.86
MATCH (- 60 min)	Sedentary	1.96 ± 2.22	2.03 ± 2.35	3.65 ± 3.78
	Light	7.38 ± 3.83	8.88 ± 6.92	6.48 ± 3.14
	Moderate	17.04 ± 4.59	15.58 ± 5.09	19.14 ± 4.82
	Vigorous	17.16 ± 5.71	14.13 ± 6.09	14.39 ± 5.93
	Very Vigorous	2.64 ± 4.26	1.38 ± 1.41	0.91 ± 1.05
	MVPA	36.91 ± 5.22[a]	31.09 ± 9.17[b]	34.84 ± 6.63[ab]
	Steps	4830.5 ± 832.83[a]	4111.98 ± 1115.75[b]	4423.37 ± 901.87[ab]

item indicate statistically significant differences at the level p ≤.05:

emphasising a physical, psychological or visual quality in order to obtain a performance in an interrelated way". The practices included individual, pair and/or group exercises with/without defence, always with the ball, in which there was a specific training protocol/workload for the teams, always guided by the director responsible for grassroots football. The objective was to evaluate intact training and match contexts.

Instruments — Accelerometers: ActiGraph GT3X accelerometers (ActiGraphTM, Fort Walton Beach, FL, USA) were used to objectively quantify the participants' physical activity levels. These devices collect data every 10 seconds of acceleration in the three orthogonal axes: vertical (y), horizontal left and right (x) and horizontal forward and backward (z), as well as including the magnitude vector in each of the three indicated axes (Baptista et al., 2012) Data were collected every 10 seconds (1 epoch), measuring acceleration in three axes. Cut-off points were adjusted for children/adolescents (Freedson et al., 1998) to categorise physical activity intensity as sedentary (0-149 counts per minute [rpm cpm]), light (150-499 rpm cpm), moderate (500-3999 rpm cpm), vigorous (4000-7599 rpm cpm) and very vigorous (<7600 rpm cpm). The accelerometer also provided data on MVPA and step data, but no information was delivered on how it was calculated. Before the start of each training session or competition match, the researchers attached the accelerometers to the children's bodies with an elastic strap above the right hip.

Total quality recovery level (TQR) and *perceived level of effort* (RPE): Kenttä & Hassmén, (1998) developed a model that focuses on the individual's subjective perception of recovery. Borg & Kaijser, (2006) found a linear relationship between perceptual factors and physiological or physical parameters. Both models of subjective perception were based on a scale of 6-20. In the present project, the subjective perception of the level of total recovery (before) training (TQR) and the subjective perception of effort (after) each training session were asked to the participating players (RPE). In addition, coaches were also asked before and after each session about their assessment of the level of intensity that would be elicited by the prepared training (RPE-pre) and that actually observed (RPE-post). The aim was to compare the RPE expected by the coach with the RPE observed afterwards by the coach, as well as with the RPE experienced by the players.

Researcher's diary: The use of a research diary is an ideal tool for recording information in qualitative research and, according to Hernandez, (2014) it is widely used by researchers for those events that are susceptible to interpretation. It can be used from the very beginning of the study, taking notes in an organisational manner: dates and places of meetings, names of activities and people involved, descriptions or reflections, among other aspects that are considered relevant. It is important to highlight that the participant observer who keeps this record is an expert with a solid background in sports science and holds a degree as a senior sports technician in football. Participant observation is a technique characteristic of ethnographic approaches that seek to understand both concrete actions and the meanings associated with those actions from

the perspective of those who carry them out (Restrepo and Acevedo-Merlano, 2016).

Data Collection — Actilife 6.7.1. (ActiGraphTM, LLC, Fort Walton Beach, FL, USA) was used to handle all accelerometer data, which were then exported and analysed using Statistical Package for Social Science 24.0 (SPSS; IBM, Chicago, IL, USA). Kolomogorov-Smirnov normality tests showed that the parameters obtained did not follow a normal distribution. However, the F-test remains a valid statistical procedure under non-normal conditions when skewness and kurtosis range between -1 and 1. In the present study these were -.849 and .745. Therefore, several one-factor analyses of variance (ANOVA) were carried out to assess differences between groups of participants on all recorded variables (activity levels, steps, MVPA) and as a function of different grouping changes (playing position, age, years of experience, etc.). One-factor analyses of variance (ANOVA) were also conducted to assess the differences between the TQR and RPE variables and the correlation between these variables and the MVPA. This means that descriptive, inferential and correlational analyses were performed.

The data obtained from the researcher's diary were used to create a descriptive profile of each of the coaches in order to better interpret the qualitative results. Notes were taken on four relevant aspects during the training sessions: previous information, typology of the tasks, organisation of the training and feedback provided (Sánchez et al., 2021).

3. Results

Quantitative: Table 2 shows the results of the physical activity variables by category, recorded during training and matches. Regarding training, significant differences ($p<.001$) can be seen in different variables comparing the different categories. U18 present significantly greater differences in sedentary physical activity: $F(2, 128) = 70.59$, $p=.001$; very vigorous: $F(2, 128) = 89.88$, $p=.001$ and MVPA: $F(2, 128) = 98.52$, $p=.001$. Furthermore, U15 show significantly greater differences in light activity: $F(2, 128) = 337.61$, $p=.001$ with U18, but not with U13. Finally, U13 show significantly greater differences in moderate activity: $F(2, 128) = 6.16$, $p=.003$ and steps: $F(2, 128) = 3.82$, $p=.024$ with U18, but not with U15.

Regarding matches (Table 2), significant differences in physical activity levels appear in players playing more than 60 minutes of matches. U15 in moderate activity: $F(2, 57) = 4.94$, $p=.011$ with U18 and U13, while U18 in very vigorous activity: $F(2, 57) = 4.08$, $p=.022$. Finally, significant differences also appear when players play less than 60 minutes of match time. MVPA U18: $F(2, 66) = 4.25$, $p=.019$ and step players: $F(2, 66) = 3.58$, $p=.033$ with U15, but not with U13

Table 3 shows the results by positions during training and matches, showing significant differences ($p<.001$) in different variables: moderately active goalkeepers: $F(3, 127) = 3.04$, $p=.031$ with midfielders, but not with defenders and forwards, and vigorously active midfielders: $F(3, 127) = 7.46$, $p=.001$ and passing: $F(3, 127) = 56.42$, $p=.001$ with goalkeepers, but not with defenders and forwards.

In the development of the matches, significant differences also appear in the players who play more than 60 minutes in some variables: goalkeepers show significantly greater differences in sedentary activity: $F(3, 57) = 3.44$, $p=.023$ and light activity: $F(3, 57) = 30.55$, $p=.001$. In contrast, it

is the forwards who show significantly greater differences in moderate activity: F (3, 57) =4.58, p=.006 with the goalkeepers, but not with defenders and midfielders. In addition, midfielders show significantly greater differences in vigorous activity: F (3,57) = 9.37, p=.001, MVPA: F (3,57) =27.40, p=.001 and steps: F (3,57) =26.40, p=.001 with goalkeepers, but not with defenders and forwards. Finally, when players play less than 60 minutes, goalkeepers show significantly greater differences in sedentary activity: F (3, 66) =3.33, p=.025 with midfielders, but not with defenders and forwards and light: F (3,66) =67.33, p=.001 with defenders, midfielders and forwards. In contrast, midfielders show significantly greater differences in vigorous activity: F (2, 66) =23.24, p=.001, MVPA: F (2,66) =27.98, p=.001 and steps: F (2,66) =34.39, p=.001 with goalkeepers, but not with defenders and forwards (table 3) .

In Table 4 we can observe the results concerning the levels of total quality recovery (TQR) and the level of perceived exertion (RPE) of both players and coaches, in training and in matches. In the latter, significant differences (p<.001) can be seen between the coach's perception before RPE-pre (18.29 ± 1.77), and after the matches RPE-post (14.83 ± 3.93); furthermore, significant post-test differences have been observed between the coaches' and players' RPE-post (11.50 ± 1.63)

Finally, Table 5 shows the correlations between the levels of total quality recovery (TQR), the levels of perceived exertion (RPE) and the MVPA. In this table, we can see that there is a negative correlation (-.308) between the TQR variables and the MVPA, but a very high positive correlation (0.618) between the RPE variables and the MVPA.

Qualitative: The analysis of the data extracted from the researcher's diary allowed us to identify two coach profiles (Pulido et al., 2019): Autonomy supportive (facilitator) and controlling (constraining). Each of these is presented below with text excerpts (in inverted commas) that reflect them.

The coaches belonging to the U18 category showed a coaching style of autonomy support, as they were facilitators in the development of the four relevant aspects observed during the training sessions: a) prior information: "in each and every one of the training sessions carried out during the research, coach 1 (U18 category), held a previous meeting in which they informed the players of the objectives, content/tasks and the order of these" (training 12); b) typology of the tasks: "the exercises performed have an open character and pose a challenge for the group of players, for example: coach 1 (U18 category), proposed a positional game of 6 vs 6 + 4 jokers and explained where the spaces should appear and then let the players express themselves through the game" (training 3); c) Organisation of the training: "transmits the functioning of the task and, from there, gives the initiative to the players, for example: coach 1 (U18 category), proposed a positional game of 6 vs. 6 + 4 jokers and explained where the spaces should appear and then let the players express themselves through the game" (training 3); c) Organisation of the training: "transmits the functioning of the task and, from there, gives the initiative to the players, for example: coach 1 (U18 category) presented the task, which was a reduced game of football in the form of a competition and allowed them to decide which player would perform the task of the inside joker (training session 10); and d) feedback provided: "was always positive, either individually or globally, with very defined guidelines; for example: coach 1 (U18 category), asked the right back defender, in an attack/defence situation, what profile he should condition the opposing winger if he was left-footed" (training session 8).

Table 3. Physical Activity and Health Variables by Positions on the pitch.

Physical Activity		Goalkeepers (14)	Defenders (47)	Midfielders (29)	Forwards (40)
		M ± SD	M ± SD	M ± SD	M ± SD
TRAINING	Sedentary	16.03 ± 5.19	16.89 ± 4.88	18.23 ± 4.92	17.50 ± 4.85
	Light	21.71 ± 10.83	16.76 ± 7.48	15.05 ± 7.41	16.20 ± 8.28
	Moderate	34.82 ± 3.86^{a}	31.09 ± 5.78^{a}	29.54 ± 5.35^{b}	31.51 ± 5.42^{a}
	Vigorous	13.14 ± 3.32^{b}	19.22 ± 4.68^{a}	20.23 ± 4.46^{a}	18.88 ± 5.51^{a}
	Very Vigorous	3.66 ± 2.89	5.29 ± 5.89	5.93 ± 7.29	5.49 ± 6.67
	MVPA	51.47 ± 8.65	55.74 ± 5.18	55.92 ± 5.14	56.03 ± 6.08
	Steps	4426.96 ± 412.18^{b}	6188.18 ± 537.92^{a}	6379.61 ± 528.58^{a}	6199.18 ± 446.71^{a}
MATCH (+ 60 min)	Sedentary	19.67 ± 11.67^{a}	11.25 ± 5.75^{b}	12.62 ± 7.00^{ab}	10.31 ± 3.02^{b}
	Light	42.58 ± 9.15^{a}	19.20 ± 7.06^{b}	13.46 ± 2.79^{b}	17.11 ± 5.32^{b}
	Moderate	35.01 ± 9.58^{b}	45.11 ± 10.26^{ab}	41.65 ± 9.87^{ab}	52.45 ± 11.45^{a}
	Vigorous	9.25 ± 6.06^{b}	31.18 ± 10.90^{a}	39.67 ± 9.18^{a}	29.19 ± 14.97^{a}
	Very Vigorous	1.40 ± 1.86	2.60 ± 3.88	2.13 ± 3.53	0.76 ± 0.83
	MVPA	45.67 ± 15.43^{b}	78.72 ± 8.77^{a}	83.46 ± 5.77^{a}	82.40 ± 8.64^{a}
	Steps	5847.08 ± 1862.33^{b}	10039.93 ± 1395.67^{a}	11118.86 ± 722.95^{a}	10695.57 ± 933.69^{a}
MATCH (- 60 min)	Sedentary	4.48 ± 3.01^{a}	2.73 ± 3.46^{ab}	1.14 ± 0.63^{b}	2.14 ± 2.39^{ab}
	Light	18.23 ± 4.37^{a}	6.60 ± 2.46^{b}	5.25 ± 1.15^{b}	6.26 ± 1.72^{b}
	Moderate	15.98 ± 3.96	17.01 ± 4.53	17.04 ± 5.36	17.74 ± 5.14
	Vigorous	4.93 ± 2.23^{b}	16.19 ± 5.04^{a}	19.67 ± 4.40^{a}	16.69 ± 3.96^{a}
	Very Vigorous	0.87 ± 1.09	1.58 ± 1.67	2.63 ± 5.36	2.26 ± 3.11
	MVPA	21.78 ± 6.27^{b}	35.16 ± 5.33^{a}	39.30 ± 1.91^{a}	36.79 ± 4.73^{a}
	Steps	2723.12 ± 455.87^{b}	4538.57 ± 769.77^{a}	5301.44 ± 404.99^{a}	4740.15 ± 598.49^{a}

ANOVA: Analysis of variance; MVPA: Moderate-to-Vigorous Physical Activity. M = Mean; SD = Standard Deviation. Note: Different superscripts on the same item indicate statistically significant differences at the level p ≯.05

Table 4 . TQR and RPE assessment of players and coaches.

Positions	TRAINING		MATCH	
	TQR / RPE_{pre}	RPE_{post}	TQR / RPE_{pre}	RPE_{post}
	M ± SD	M ± SD	M ± SD	M ± SD
Coaches	14.68 ± 1.86	14.30 ± 1.46	18.29 ± 1.77*	14.83 ± 3.93^{a}
Players	16.79 ± 0.77	14.54 ± 1.42	17.36 ± 0.83	11.50 ± 1.63^{b}

*M = Mean; SD = Standard Deviation; * Significant pre-post differences at the p <.05; Different superscripts in the same column denote statistically significant post-test differences at the level p <.05.*

Table 5. *Correlation between the variables TQR, RPE and MVPA.*

		1	2	3
1.	TQR	1	-.104	-.308**
2.	RPE	-,104	1	.618**
3.	MVPA	-.308**	.618**	1

Significant differences at the p<.001.

On the contrary, the coaches belonging to the U15 and U13 categories showed a controlling style, as they imposed their opinions on the development of the four relevant aspects observed during the training sessions: a) Prior information: "For example: coach 2 (U15 category), proposed several rounds of 4 against 1, with the previously organised location (Player 1 inside and Players 2, 3, 4 outside), maximum two contacts and no repeated passes" (training 5); b) Typology of tasks: "they have a more closed, directed and even analytical character, for example: coach 3 (U13 category), proposed an activity of finishing to goal by means of lateral crosses by pairs as a competition (wall on the flank to put the cross and a pair entered to finish), maximum 2 contacts and mandatory crossing before finishing" (training 7); c) Organisation of the training: "reports the functioning of the task and demonstrates absolute control of all the details, coach 2 (U15 category), indicated the task, which consisted of a passing wheel to work the third man (the first player started with a drive to fix the opponent, the second player separated from the cone to receive and return the pass facing the opponent, the third player separated in the same way but to the opposite side and received the pass from the first player, to play facing the second player who had to appear in a defined space), transmitting to them each of the movements they had to do" (training 9); and d) Feedback given: was negative and was transmitted in a public way, for example: coach 3 (U13 category), during one of the tasks shouted to one of his players: "Do you have Dori's memory? I just explained it to you 5 minutes ago" (training 6).

4. Discussion

The main objective of the study was to evaluate, by means of accelerometry, the physical activity levels of players (U18, U15 and U13) belonging to a performance football academy in training and matches and the results showed different values in some categories. The second objective was to obtain, from both coaches and players, their subjective perception levels of fatigue before and after the above mentioned scenarios and the results showed that they were different in matches. The last objective was to analyse the interpersonal style of the participating coaches and the results showed two coach profiles: autonomy supportive (facilitating) and controlling (constraining).

The first hypothesis was that the levels of physical activity would be different in the different categories and scenarios (training and match), and the results showed that this was partially fulfilled. Specifically, U18 players stand out for having the highest levels of very vigorous activity in training and in match (when they played more than 60 minutes), as well as having the highest MVPA than the rest of the categories when they played less than 60 minutes. In contrast, players in the U15 and U13 categories stood out for having higher levels of light and moderate activity in training and match (when they played more than 60 minutes). We are not aware of similar research in performance academies, so we have to look at studies with other populations. In a sample of senior amateur football players, they averaged 46.70 min of MVPA on average per training session (Fernandez-Rio et al., 2020), much lower than U18, U15 and U13 players in the performance academy. Therefore, adolescent football players reach higher MVPA levels. This may be due to the fact that the training was performed under a methodology that involved an integration and combination between different types of load, and with a more exhaustive control of all the details (Albert, 2008). The WHO recommends that adolescents perform an average of 60 minutes of MVPA per day (Bull et al., 2020) and the concept of football as medicine is well established in the literature (Krustrup and & Parnell, 2019). In this case, we can point out that U18-aged players more

than comply with such advice, both in training and in matches, whereas U15 and U13 players would do so when their participation in matches is longer than 60 minutes. In order to increase this value, it would be interesting to alter the training/match density with rest: as stated by (M. Brink et al., 2010) a higher training load (external and internal) combined with good recovery would lead to better performance. In the same way, it is necessary to point out that any player of any category who participates less than 60 minutes in competition should complete with another activity until reaching the aforementioned recommendations. A possible explanation for the differences obtained could lie in the "style" of the coaches of each team, which characterises the way they train (Balaguer et al., 2012a). Style can have an impact on the performance of players (Deci & & Ryan, 1985) and the environment created can be relevant to lead to consequences related to the integral development of young athletes (Cecchini & Méndez-Giménez, 2014).

The second hypothesis stated that the levels of physical activity would be different in the different positions and scenarios (training and match) and the results showed that, again, this was partially fulfilled. As expected, goalkeepers are the players who were more moderately active in training, but not in matches, where they showed more sedentary and light activity. On the other hand, midfielders are the players who carried out more vigorous activity and covered more steps (distance), both in training and in matches. On the other hand, defenders and forwards did not excel in almost any type of activity, except for the latter in moderate activity and only in matches where they played more than 60 minutes. It is necessary to highlight the levels of MVPA in the different positions, as no significant differences were observed in training, but in competition. This seems to indicate that, with the aim of prioritising the training aspect, practices in training sessions involved all players equally through global tasks and exercises, not as in professional football where training is highly specialised depending on the position of the players (Clemente et al., 2017). Unfortunately, there are no similar publications to date, so again we have to turn to related studies. In a sample of senior amateur and professional football players, the positions in which the level of vigorous intensity lasted the longest were midfielder, winger and striker, while the position in which the lowest percentage was recorded was full-back (Castillo-Rodríguez et al., 2020; Di Salvo et al., 2007; Parra Rojas et al., 2019). These results only confirm that the position of midfielder is a dominant position in the game and the one that works most intensively. With the above results, we conclude that none of the specific positions that have been analysed comply with the aforementioned WHO recommendations (Bull et al., 2020) in the case of training, but in the matches in which they exceeded 60 minutes of play, with the exception of the goalkeeper position. Therefore, again, it should be emphasised that in such cases of non-compliance it would be necessary to supplement with other physical activity to achieve the goal of maintaining an active and healthy lifestyle.

The third hypothesis of the study indicated that the players' perceptions of total quality recovery (TQR) for training and matches would be similar in both cases and the results supported this. This indicates that the training sessions were well structured, both in intensity and duration, by the responsible academy manager and performance area manager with a view to matches. In contrast, in the subjective perception of effort (RPE) there were significant differences between that of the coach and that of the players. These results indicate that watching the game from the "outside" is not the same as participating in it (Brink et al., 2013; Dalen et al., 2018).

Moreover, it is noteworthy that for coaches the RPE-pre was always higher than the RPE-post, which corroborates the difficulty in predicting the variability, behaviour and development of team sports in competition. Finally, it should also be noted that the correlation between TQR and MVPA was negative: the higher the perception of full recovery, the lower the level of MVPA achieved. This is very important because it indicates that TQR can be a tool available to any coach to adjust the training load to the level of exhaustion perceived by the players at the beginning of the training. Recent studies have shown that information about the recovery status of athletes can help to plan the training load and prevent overtraining (Coutts et al., 2009; Kenttä & Hassmén, 1998; Sato et al., 2006). In contrast, the correlation between RPE and MVPA was positive: the higher the level of perceived exertion, the higher the level of work intensity. As in the previous case, RPE is shown to be a cheap, non-invasive and easily applicable method within the reach of coaches to monitor and plan training (Lorente et al., 2016; Osiecki et al., 2015; Váquez & Belanda, 2018). It should be noted that no previous published research is known to have related TQR/RPE parameters to MVPA, but MVPA and energy expenditure, and RPE and enjoyment of a U12 boys' football team have been compared (McNally, 2017).

The fourth and last hypothesis indicated that different coach profiles would be observed among the participants and the results confirmed this, as two profiles were found: autonomy supportive (facilitating) and controlling (constraining). The former establishes strategies to take into account the innate character of the players, encouraging their participation and facilitating their interactions with the group; implements routines and involves the group of players in the session, which benefits their development and commitment; poses problems by providing the necessary information and allowing the group of players to solve them by themselves, giving them the opportunity to satisfy their sense of competence; supports the autonomy of the group of players, giving them the opportunity to develop skills that they can then apply in competitive contexts; and provides feedback at the right time to improve participation in the exercises and contribute to players developing their skills, increasing their competence and maintaining autonomous motivation (Balaguer et al. , 2012b; Gurrola et al., 2016a; Pulido et al., 2019).

In the second profile found, controlling (dominant), the coach makes all decisions unilaterally, considering sport practice as a purely competitive tool and not a learning tool for the player; uses imposition and excessive control in all aspects of the exercises, which negatively affects the players' attention and pre-competition cognitive affectivity; the activity approach limits the players' ability to express themselves freely and hinders their need to express their creativity; absolute control over movements and details creates a reliance on movement patterns that are not needed in competition, which limits players' decision-making and autonomy; and coaches being overly critical and harsh and employing tactics that embarrass players negatively affects their need for competition and makes them feel incompetent (Llanos-Muñoz et al. , 2023; Pulido et al., 2019). U15 and U13 coaches, who displayed a controlling style, may provoke an environment in which players perceive that they are under constant control. This perception of excessive control can lead to frustration of basic psychological needs and include decreased sense of achievement, physical and emotional exhaustion, and devaluation of their participation (Gurrola et al., 2016b).

The current study has several limitations. Firstly, the results are from a single performance academy. It is necessary to collect data from other academies to compare results and generalise conclusions. Secondly, variables related to physical activity levels have been measured. Future studies should assess other variables such as heart rate or lactate and connect them with the data obtained in this study to have a broader picture of the health parameters of performance football players. Third, fixed groups selected by the club were used and players' maturation information was not available. Therefore, the researchers did not have the option to group the players based on this information. Future research should take into account this type of data. Finally, this study focused on male football players. Future studies should include female football players in order to be able to compare results based on gender.

5. Practical Applications.

The results of this study have important practical implications for promoting physical activity among adolescents through regular football practice in high-performance academies. Given that football is the most popular sport among adolescents, harnessing its potential to meet the physical activity recommendations of the World Health Organization (WHO) can have a significant impact on the health and well-being of this population.

First, it was observed that U18, U15 and U13 players from the high performance football academy achieved significant levels of moderate to vigorous physical activity (MVPA) during training sessions and matches exceeding 60 minutes. These findings suggest that regular football practice in this setting can effectively contribute to adolescents meeting the international MVPA recommendations for health benefits.

In addition, it was found that players consistently reported a "very well recovered" perception of total quality of recovery (TQR), suggesting that training sessions and matches were well structured and allowed for adequate recovery between sessions. This highlights the importance of designing training programmes that not only promote physical activity, but also take into account the recovery and well-being of the players.

In terms of perceived exertion (RPE), there was agreement between players' and coaches' values during training, but the values were higher for coaches during competition. This indicates the importance of coaches being aware of the physical demands of the players and adjusting the training load accordingly to ensure a proper balance between effort and recovery. The difference in perspective between players experiencing the game from within and coaches observing from the sidelines may further contribute to variations in perceived exertion. Players directly engage in physical and mental demands, whereas coaches, viewing from outside, may interpret exertion levels differently, underscoring the importance of effective communication to bridge this gap (Foster et al., 2001; Coutts et al., 2009).

In summary, the results of this study suggest that regular football practice in a high-performance academy may be an effective strategy to promote an active lifestyle among adolescents and help them meet physical activity recommendations for health. However, it is important to keep in mind that these findings are based on a specific sample of football players in a particular academy, so further research is needed to confirm these results and generalise them to other populations and contexts.

6. Conclusions

The aim of this research was to assess, using accelerometry, the physical activity

levels of players belonging to a performance football academy, both in training and in match play, and the results showed that these athletes almost fully met the WHO international recommendations of MVPA for health benefits. Football practice was considered to be "somewhat hard" to "hard" and could therefore be considered a suitable sport to help adolescents maintain an active and healthy lifestyle. It would also be beneficial for both clubs and families to be aware of these results and take advantage of the adherence and impact of the sport, so that even if young people do not achieve their dream of becoming professionals, they can at least use it as a tool to improve their health. Finally, both the TQR and the RPE have been shown to be tools within the reach of any coach to adjust the training load.

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