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Review

Analyses of Physical and Physiological Responses during Competition in Para-Footballers with Cerebral Palsy: A Systematic Review

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Abstract: Background: Classification of athletes in cerebral palsy (CP) football is a key action that aims to promote the participation of all players by minimizing the impact of their physical disabilities on the outcome of the competition by establishing sports classes. As such, a new research line has been included in the classification process at an international level; that is, the analysis of locomotor demands during competition helps classifiers to understand the para-footballers' profile. Therefore, the main aim of this systematic review was to summarize the physical and physiological responses of players with CP in different sport classes during competition. Methods: A bibliographic search was conducted using PubMed, SCOPUS, and Web Of Science databases following Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines using the PICOS strategy. Results: Six studies meeting inclusion criteria analyzing physical (i.e., total distances, distances at different speeds, high-intensity and short-term actions, change of directions, etc.) and physiological (heart rate (HR), time spent at different zones of maximum HR, etc.) responses. Findings revealed that para-footballers with CP and minimal impairment impact covered greater total and distance above 23.04 km·h^{-1} and achieved higher maximum speeds during match-play. Notably, no significant differences in physiological responses were observed based on classification. Conclusions: The research suggests that para-footballers with CP and lower physical impairment may exhibit enhanced performance in terms of distance covered and speed during gameplay, highlighting their potential competence in the sport. In addition, the limited number of studies examining the physiological response of para-footballers prevents conclusive results and differentiating between classification groups.

Keywords: para-sport; official matches; performance; exercise; impairment

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1. Introduction

Football (soccer) for people with cerebral palsy (CP) is a para-sport regulated globally by the International Federation of Cerebral Palsy Football (IFCPF). It is a discipline practiced by football players with central neurological injuries such as CP, head trauma, or stroke [1]. The institution which establishes the rules of the game is the Fédération Internationale de Football Association (FIFA), but the IFCPF has included some modifications such as, the match lasts two equal periods of 30 min separated by a half-time of 15 min, the field

dimensions are reduced to 70 m × 50 m with 2 × 5 m goals, the offside rule does not apply, and throw-ins are put into play by rolling the ball on the ground [1].

Classification of athletes in para-sports, particularly in CP football, is a key action that aims to promote the participation of all players by minimizing the impact of their physical disabilities on the outcome of the competition by establishing sports classes [2–4]. These sport classes were called C5, C6, C7, and C8 in the first classification system [5] and later FT5 (usually diplegic), FT6 (usually ataxia or athetosis), FT7 (usually hemiplegic), and FT8 (minimal impairment). The new classification system developed by IFCPF, based on scientific knowledge published to date [6,7], reduces the classes to three profiles (FT1, FT2, and FT3), providing a new setup for competition and including a new minimum disability criterion and new assessment methods. The new structure of sports classes for players with CP is organized as follows: (1) based on the level of the impairment impacting on sport-specific football skills (FT1 = severe impairment; FT2 = moderate impairment, or FT3 = minimal impairment), and (2) the type of disability and/or affected limbs, i.e., (A) bilateral spasticity (spastic diplegia), (B) athetosis/dystonia (dyskinesia or ataxia), or (C) unilateral spasticity (spastic hemiplegia) [1]. The goal of this system is to address the issue of "cut-off points", i.e., when the classifiers must decide if a para-footballer has a moderate or mild form of spastic diplegia, athetosis/ataxia or spastic hemiplegia, in contrast with mild forms of these types of disability [8]. During the classification process, medical professionals or physiotherapists carry out the physical evaluation through a battery test to determine the degree of spastic hypertonia, dyskinesia and/or ataxia. In addition, sport technical classifiers perform the technical evaluation through tests to assess basic physical skills (coordination, balance, agility, strength, power, speed) and football-related skills from the individual point of view (ball kicks, passes, and shots, dribbles and controls, and the goalkeeper's technique) and collective (in reduced games) to assign a sport class [1].

Over the last decade, there has been a considerable increase in the number of football players with CP, as well as the number of events organized at the regional, national, and international levels. Currently, 88 countries worldwide actively participate in CP football. Additionally, there are 93 male teams (compared to 84 in 2020) and 94 female teams (compared to 28 in 2020), according to data Worldwide Participation of IFCPF. The rise of this para-sport has also been reflected in the scientific context, with a large increase in publications on football with CP [8–10]. Research into CP football has extensively explored various aspects, including specifying the anthropometric and performance characteristics of the players [11], assessing physical performance through functional tests [10,12–15], and assessing the validity and reliability of different tests [6,16,17]. Specifically, it has been shown that football players with CP exhibit lower distances covered (total, high intensity, and sprint distance) than non-disability players [18] in match-play. However, they covered a greater total distance (4%), more distance walking (38%), and more distance in medium-intensity running (5%), and maintained a similar maximum velocity (0.4%) to conventional F7 players [19]. Additionally, significant differences have been found between match demands and small-sided game demands (2vs2+Goalkeeper, pitch size 27 × 19 m) in football players with CP [20]. Understanding both the profiles of para-footballers with CP and the specifics of relevant tests is essential. Additionally, knowledge of their responses during match-play is crucial for effective training planning. The availability of this information would not only aid classifiers in making informed decisions during the classification process but also assist coaches in optimizing training for competitions.

Based on the aforementioned information, the main aim of this systematic review was to summarize the physical and physiological responses encountered by para-footballers with CP during the competition according to sport classes.

2. Materials and Methods

This systematic review was carried out according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) adapted to the guidelines for conducting systematic reviews in Sports Sciences [21]. Due to the specific requirements in each area of knowledge, some modifications to the PRISMA declaration are necessary [22,23] to improve the quality of the main findings. In this study, a review of the scientific literature was carried out to analyze the physical and physiological responses of para-footballer players with CP during competition.

2.1. Search Strategy

The search and selection process for this systematic review was carried out through three specialized electronic databases in the field of Physical Activity and Sport Sciences: PubMed, SCOPUS, and Web Of Science. All records found were exported in a comma-separated values (CSV) format to a Microsoft® Excel document and in Research Information Systems (RIS) formats (PubMed and Web of Science), and directly (SCOPUS) to MENDELEY, the bibliographic manager used in this review. Keywords and their synonyms ("football", "soccer", "para-football", "football-7-a-side", "match", "competition", "performance", "activity", "cerebral palsy " and "cerebral paralysis") were entered in various combinations using boolean operators, selected using the PICOS search strategy (i.e., Population, Intervention, Comparator, Outcomes, Study design). Additionally, the bibliography (references) section of the selected articles was manually reviewed to detect potentially eligible articles not captured by the electronic searches. The final search strategy was carried out using the following combination of terms: ("football*" OR "soccer" OR "para-football*" OR "football-7-a-side") AND ("match" OR " competition" OR "performance" OR "activity") AND ("cerebral palsy" OR "cerebral paralysis").

A time restriction between 2000 and 2023 was established for the selection of studies. This search process was carried out independently by two authors (S.A.-H. and A.R.-F.), and in cases that generated discrepancies, a third author (D.C.) was consulted. The search was carried out on 31 January 2023.

The results obtained in the different databases were exported in a CSV sheet for later analysis in Microsoft® Excel (Microsoft Corporation, Readmon, WA, USA), where the articles were classified by title, author/s, date of publication, and database. This classification made it possible to detect duplicate/triplicate records (n = 45). A review of the title, abstract, and list of references for each of the studies was carried out to filter them and detect potentially relevant articles to include in the review. Subsequently, the complete versions of the included articles were reviewed to detect those that met the inclusion criteria established according to the PICOS strategy (Population: para-footballers with cerebral palsy; Intervention: data registered during an official match; Outcome: measures of physical and physiological responses; study design: an observational and descriptive design) (Table 1). Additionally, those studies that were not written in English, as well as conferences, abstracts, letters to the editor, errata, narrative reviews, systematic reviews, and meta-analyses, were excluded from our review.

Table 1. Description of the inclusion and exclusion criteria according to the PICOS search strategy.

PICOS	Inclusion Criteria	Exclusion Criteria
Population	Para-footballers with cerebral palsy	Footballers without cerebral palsy and para-athletes for other sports than soccer
Intervention	Data during an official match	Data during simulated match or small sided games
Comparator	-	-
Outcome	Measures of physical and physiological responses	Another nature responses
Study design	An observational and descriptive design	-

The following data was extracted from the selected studies: (a) author(s) and year of publication; (b) number of participants; (c) sex; (d) age; (e) number of observations; (f) competition; (g) sport class. In addition, the following variables were recorded for locomotor responses: total distance covered and distance covered at different intensity ranges in absolute and relative values, maximum speed reached, accelerations, decelerations, changes of direction, player load, and metabolic power. The following variables were used for physiological responses: average heart rate (HRm), maximum heart rate (HRmax), and time spent in different intensity ranges relative to HRmax.

2.2. Quality Assessment

The methodological quality assessment of the studies was determined following the indications of Palucci Vieira et al. [24] and was adapted from previous studies [25,26] on sport physical performance and data collection during soccer matches involving football players without disabilities (Table 2). The nine questions were: Q1 = Study objective(s) is/are clearly set out (Yes = 2; Maybe = 1; No = 0); Q2 = Demographic data (no information = 0 point; only age/age group was informed = 1 point; maturity offset also measured = 2 points); Q3 = Game rules (0–1 item described = 0 point; 2–3 items described = 1 point; 4–5 items described = 2 points; items: match duration, field size, players a-side, match type, whether rolling substitute policy was adopted); Q4 = Reliability/validity of the time-motion system/equipment is not stated, mentioned (i.e., a citation of previous studies) or measured under local conditions where data collections took place (Measured = 2; Mentioned = 1; No stated = 0); Q5 = Dependent variables defined (Yes = 2; Maybe = 1; No = 0); Q6 = Duration of players recordings/inclusion criteria is clearly indicated (Yes = 2; Maybe = 1; No = 0); Q7 = Statistics are appropriate (Yes = 2; Maybe = 1; No = 0); Q8 = Results are detailed (description of mean, standard deviation and null hypothesis significance test [*p*-value] = 1 point; also included effect size/magnitude-based inferences = 2 points); Q9 = Conclusions are insightful, clear, practical applications, and future directions (Yes = 2; Maybe = 1; No = 0). Subsequently, a sum of the points obtained in each question for each study was made, varying the rating between 0 (minimum points) and 18 (maximum points). Finally, the results obtained were converted into a percentage (0% minimum and 100% maximum). Studies were considered to have a high level of bias when they did not achieve a score > 75% [24].

Table 2. Sample information and scores assigned to each study for the nine quality (Q) questions.

Reference	*n*	Sex	Age	Sport Class	Observations		Q1 (0–2)	Q2 (0–2)	Q3 (0–2)	Q4 (0–2)	Q5 (0–2)	Q6 (0–2)	Q7 (0–2)	Q8 (0–2)	Q9 (0–2)	Total (Σ)	Score (%)
					n	T											
Boyd et al. [27]	40	M	22.0 (7.0)	C5/6, C7, and C8	47	I	2	1	1	0	2	2	2	1	2	13	72.2
Gamonales et al. [28]	12	N	29.6 (9.1)	FT1	65	N	2	1	2	0	2	0	2	2	2	13	72.2
			32.0 (3.8)	FT2													
			37.5 (7.7)	FT3													
Henríquez et al. [29]	87	M	25.3 (6.4)	FT1, FT2, and FT3	92 (46 [a], 46 [b])	I	2	1	0	0	2	2	2	2	2	13	72.2
Reina et al. (2021) [30]	259	N	25.46 (6.15)	FT1, FT2, and FT3	259	I	2	1	1	0	2	2	2	2	2	14	77.8
Reina et al. (2020) [31]	48	M	23.0 (7.0)	FT5/6, FT7, and FT8	N	I	2	1	0	1	2	2	2	2	2	14	77.8
Yanci et al. (2018) [32]	42	M	23.0 (6.0)	FT5/6, FT7, and FT8	62	I	2	1	0	0	2	2	2	2	2	13	72.2
Mean (SD)							2.0 (0.0)	1.0 (0.0)	0.7 (0.8)	0.3 (0.7)	2.0 (0.0)	1.2 (0.9)	2.0 (0.0)	1.8 (0.3)	2.0 (0.0)	13.2 (0.6)	73.5 (3.7)

Note: *n* = players; M = male; N = not specified; T = type; I = international tournament; N = national tournament; [a] = moderate altitude group; [b] = sea level group; SD = standard deviation.

3. Results

Figure 1 shows the study identification and selection process. A total of 167 studies were identified in an initial search of PubMed (n = 38), SCOPUS (n = 64), and Web of Science (n = 65) databases. It was found that there were 45 duplicate (or triplicate) records. Thus, the search decreased to 90 results. After reading abstracts, 71 records were excluded because they were articles in which footballers with CP did not participate, did not analyze match-play responses (physical or physiological), or did not fit the topic. Afterwards, a detailed reading of the 19 resulting studies was made, with 10 of them excluded because they were articles written in other languages (Portuguese and Korean). They did not analyze physical or physiological responses during match-play, or they analyzed these variables in training sessions or assessed functional tests. Therefore, a total of 81 records were excluded, and finally, 6 of these studies were included in the systematic review.

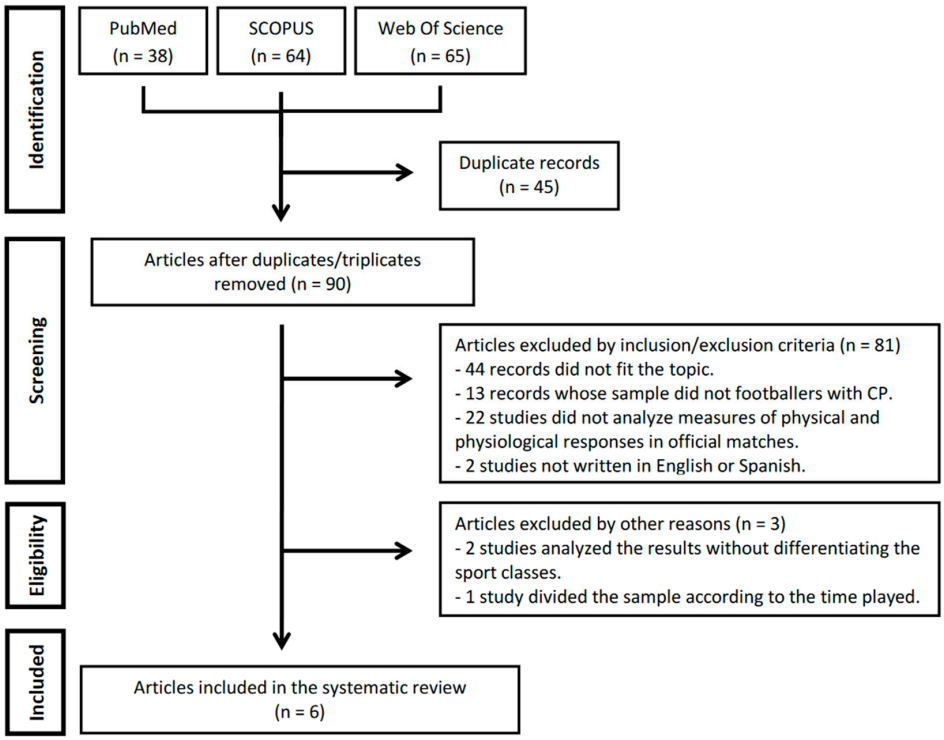

Figure 1. Diagram flow of the review.

The results of methodological quality and risk of bias in the studies included in the review are shown in Table 1; the mean score is 73.5 ± 3.7%. The highest value, 77.8%, was reported in two studies [30,31], while 66.6% of the studies reached a methodological quality of 72.2% (n = 4) [27–29,32].

All the studies fit the inclusion and exclusion criterion analyzing physical responses [27–32], but only one the physiological responses [27]. Three studies attended to the new classification FT1 to FT3 [28–30] and three to the old classifications C5/6, C7 to C8 [27], and FT5/6 to FT8 [29,31]. The number of participants in the studies analyzed was 488, of whom 4 belonged to C5/6, 29 to C7, 7 to C8, 9 to FT5/6, 32 to FT7, 7 to FT8, 64 to FT1, 238 to FT2, and 56 to FT3; of the remaining 42, it is not known how many correspond to each FT, since the authors determine and quantify the sample (8 from FT5, 3 from FT6, 42 from FT7, and 9 from FT8) by the total number of individual observations, n = 62 [32]. Four studies determined the sex of the sample (all male) and only two did not determine it [27,28,30,31], but they were men observing the city and the year of the competitions.

Tables 3 and 4 shows the total and distance covered at different speed ranges by players with PC during match-play, expressed in absolute and relative terms, respectively. The speed ranges to classify the distance covered were diverse: between 17.64–23.04 km·h^{-1},

above 23.04 km·h^{-1} [27], between 0.6–6 km·h^{-1}, 6–12 km·h^{-1}, 12–18 km·h^{-1}, 18–21 km·h^{-1}, 21–24 km·h^{-1}, above 24 km·h^{-1} [28], below 0.4 km/h, between 0.4–3 km·h^{-1}, 3–9 km·h^{-1}, 9–13 km·h^{-1} [29,30,32], 13–18 km·h^{-1}, and above 18 km·h^{-1} [29,30,32].

Table 3. Results for measures of total and distance covered at different speed ranges extracted from literature research of studies on para-footballers with cerebral palsy.

Variables	SC	Boyd et al. [27]
Total distance (m)	C5/6	5642 ± 674
	C7	5532 ± 814
	C8	6343 ± 551
	TOTAL	5839 ± 668
Distance between 17.64–23.04 km/h (m)	C5/6	13 ± 2
	C7	13 ± 2
	C8	12 ± 2
	TOTAL	13 ± 2
Distance >23.04 km/h (m)	C5/6	12 ± 4
	C7	12 ± 4
	C8	15 ± 4
	TOTAL	13 ± 4
$p < 0.05$ between sport classes for CP-Football		C8 > C7 and C5/6. - Total distance. - Distance covered > 23.04 km/h. No differences were observed between FT5/6 and FT7 classes.

Note: SC = sport class.

Table 4. Results for measures of total and distance covered at different speed ranges extracted from the literature research of studies on para-footballers with cerebral palsy.

Variables	SC	Gamonales et al. [28]	Henríquez et al. [29]	Reina et al. [30]	Reina et al. [31]	Yanci et al. [32]
Total distance (m/min)	FT5/6	-	-	-	-	93.12 ± 18.02
	FT7	-	-	-	-	92.88 ± 12.49
	FT8	-	-	-	-	91.57 ± 14.48
	TOTAL	-	76.81 ± 11.55 [a] 92.06 ± 12.47 [b] 84.43 ± 14.20 [c]	84.51 ± 16.50	-	92.63 ± 13.54
	FT1	60.55 ± 23.62	74.06 ± 11.36 [a] 84.36 ± 12.16 [b]	81.26 ± 15.35	-	-
	FT2	84.24 ± 17.27	79.30 ± 11.19 [a] 95.56 ± 11.05 [b]	85.23 ± 17.05	-	-
	FT3	106.42 ± 9.59	70.21 ± 11.21 [a] 88.01 ± 14.04 [b]	84.75 ± 5.13	-	-
Distance <0.4 km/h (m/min)	FT5/6	-	-	-	-	1.17 ± 0.64
	FT7	-	-	-	-	1.10 ± 0.76
	FT8	-	-	-	-	1.08 ± 0.19
	TOTAL	-	2.56 ± 1.05 [a] 1.23 ± 0.58 [b] 1.89 ± 1.08 [c]	2.68 ± 1.21	-	1.11 ± 0.68
	FT1	-	2.47 ± 1.04 [a] 1.43 ± 0.69 [b]	2.03 ± 0.85	-	-
	FT2	-	2.54 ± 1.11 [a] 1.09 ± 0.43 [b]	1.69 ± 0.99	-	-
	FT3	-	2.70 ± 0.96 [a] 1.51 ± 0.82 [b]	1.78 ± 1.11	-	-

Table 4. *Cont.*

Variables	SC	Gamonales et al. [28]	Henríquez et al. [29]	Reina et al. [30]	Reina et al. [31]	Yanci et al. [32]
Distance between 0.4–3 km/h (m/min)	FT5/6	-	-	-	-	9.47 ± 3.10
	FT7	-	-	-	-	8.32 ± 5.66
	FT8	-	-	-	-	6.73 ± 2.33
	TOTAL	-	11.74 ± 3.73 [a] 7.89 ± 2.72 [b] 9.81 ± 3.78 [c]	10.16 ± 5.03	-	8.30 ± 4.93
	FT1	-	11.75 ± 2.80 [a] 9.65 ± 2.97 [b]	12.21 ± 8.32	-	-
	FT2	-	11.96 ± 4.21 [a] 7.19 ± 1.90 [b]	9.92 ± 4.11	-	-
	FT3	-	10.87 ± 2.66 [a] 8.43 ± 4.09 [b]	9.10 ± 3.54	-	-
Distance between 0.6–6 km/h (m/min)	FT1	38.06 ± 8.72	-	-	-	-
	FT2	41.97 ± 3.21	-	-	-	-
	FT3	39.80 ± 5.08	-	-	-	-
Distance between 3–9 km/h (m/min)	FT5/6	-	-	-	-	40.26 ± 4.39
	FT7	-	-	-	-	40.15 ± 5.15
	FT8	-	-	-	-	39.23 ± 4.45
	TOTAL	-	38.30 ± 6.74 [a] 44.11 ± 5.67 [b] 41.20 ± 6.84 [c]	42.33 ± 8.52	-	40.02 ± 4.84
	FT1	-	36.91 ± 6.48 [a] 42.13 ± 6.20 [b]	39.45 ± 9.14	-	-
	FT2	-	38.66 ± 5.70 [a] 44.95 ± 5.09 [b]	42.54 ± 8.17	-	-
	FT3	-	38.35 ± 10.59 [a] 43.28 ± 7.07 [b]	44.40 ± 8.78	-	-
Distance between 6–12 km/h (m/min)	FT1	16.72 ± 12.90	-	-	-	-
	FT2	29.54 ± 10.28	-	-	-	-
	FT3	36.50 ± 4.43	-	-	-	-
Distance between 9–13 km/h (m/min)	FT5/6	-	-	-	-	27.28 ± 11.59
	FT7	-	-	-	-	28.40 ± 9.08
	FT8	-	-	-	-	26.30 ± 7.28
	TOTAL	-	14.68 ± 5.36 [a] 22.11 ± 6.90 [b] 18.39 ± 7.19 [c]	19.38 ± 25.45	-	27.87 ± 9.18
	FT1	-	15.03 ± 6.29 [a] 18.14 ± 5.43 [b]	17.21 ± 7.32	-	-
	FT2	-	15.28 ± 5.46 [a] 23.80 ± 6.65 [b]	20.33 ± 30.42	-	-
	FT3	-	12.07 ± 3.47 [a] 20.43 ± 7.74 [b]	17.47 ± 6.26	-	-
Distance between 12–18 km/h (m/min)	FT1	5.40 ± 5.95	-	-	-	-
	FT2	10.38 ± 6.58	-	-	-	-
	FT3	23.49 ± 6.26	-	-	-	-

Table 4. *Cont.*

Variables	SC	Gamonales et al. [28]	Henríquez et al. [29]	Reina et al. [30]	Reina et al. [31]	Yanci et al. [32]
Distance between 13–18 km/h (m/min)	FT5/6	-	-	-	11.34 ± 5.07	12.21 ± 5.76
	FT7	-	-	-	11.62 ± 4.53	11.64 ± 4.18
	FT8	-	-	-	13.70 ± 5.35	13.71 ± 4.95
	TOTAL	-	7.28 ± 4.11 [a] 12.89 ± 5.10 [b] 10.23 ± 5.32 [c]	9.47 ± 5.46	11.87 ± 4.71	12.00 ± 4.52
	FT1	-	6.42 ± 3.79 [a] 9.37 ± 4.74 [b]	8.08 ± 4.97	-	-
	FT2	-	8.52 ± 4.23 [a] 14.55 ± 4.74 [b]	9.81 ± 5.59	-	-
	FT3	-	5.24 ± 2.97 [a] 10.82 ± 4.38 [b]	9.45 ± 5.30	-	-
Distance >18 km/h (m/min)	FT5/6	-	-	-	2.65 ± 2.09	2.73 ± 2.09
	FT7	-	-	-	3.23 ± 1.60	3.20 ± 1.63
	FT8	-	-	-	4.97 ± 2.97	4.53 ± 3.01
	TOTAL	-	2.05 ± 1.62 [a] 3.96 ± 2.69 [b] 3.01 ± 2.41 [c]	3.05 ± 2.79	3.38 ± 2.01	3.27 ± 1.96
	FT1	-	1.42 ± 0.95 [a] 2.44 ± 1.94 [b]	2.04 ± 2.09	-	-
	FT2	-	2.40 ± 1.68 [a] 4.54 ± 2.87 [b]	3.18 ± 2.82	-	-
	FT3	-	1.39 ± 1.67 [a] 3.55 ± 2.17 [b]	3.56 ± 3.11	-	-
Distance between 18–21 km/h (m/min)	FT1	0.96 ± 1.76	-	-	-	-
	FT2	3.85 ± 3.60	-	-	-	-
	FT3	9.87 ± 3.65	-	-	-	-
Distance between 21–24 km/h (m/min)	FT1	0.06 ± 0.18	-	-	-	-
	FT2	0.54 ± 0.76	-	-	-	-
	FT3	1.79 ± 1.14	-	-	-	-
Distance >24 km/h (m/min)	FT1	0.00 ± 0.00	-	-	-	-
	FT2	0.11 ± 0.25	-	-	-	-
	FT3	0.32 ± 0.23	-	-	-	-
$p < 0.05$ between sport classes for CP-Football		FT3 > FT2 > FT1. - Total distance. - Distance covered between 12–18, 18–21, and 21–24 km/h. FT3 = FT2 > FT1 in distance covered >24 km/h. FT3 > FT2 in distance covered bet-ween 6–12 km/h. FT2 > FT1 in distance covered bet-ween 6–12 km/h.	Does not analyze the significant differences between CP-Football classes without taking into account the place of the competition.	FT1 > FT3 = FT2 in distance covered between 0.4–3 km/h. FT3 = FT2 > FT1 in distance covered >18 km/h. FT3 > FT1 in distance covered between 3–9 km/h. No differences were observed between FT2 and FT3 classes.	FT8 > FT5/6 in distance covered >18 km/h. No differences were observed between FT8 and FT7 classes.	No differences were observed between sport classes.

Note: SC = sport class; [a] = moderate altitude group; [b] = sea level group; [c] = overall sample.

Maximum speed variables are shown in Tables 5 and 6, respectively. Table 6 also shows accelerations, decelerations, impacts, and change directions (COD) values (total and

in different ranges of intensity), as well as player load and metabolic power, all expressed in relative terms.

Table 5. Results for measures of maximal speed extracted from literature research of studies on para-footballers with cerebral palsy.

Variables	SC	Boyd et al. [27]	Henríquez et al. [29]	Reina et al. [30]	Reina et al. [31]	Yanci et al. [32]
Maximal speed ($km \cdot h^{-1}$)	FT5/6	24.23 ± 1.58	-	-	21.86 ± 2.04	21.79 ± 1.92
	FT7	25.09 ± 2.02	-	-	22.94 ± 1.90	22.81 ± 2.41
	FT8	27.86 ± 1.22	-	-	24.41 ± 1.83	23.96 ± 2.12
	TOTAL	25.74 ± 1.62	21.96 ± 2.62 [a] 23.22 ± 2.41 [b] 22.59 ± 2.58 [c]	22.58 ± 3.18	22.95 ± 2.01	22.81 ± 2.34
	FT1	-	20.89 ± 2.37 [a] 22.36 ± 2.66 [b]	21.28 ± 2.86	-	-
	FT2	-	22.52 ± 2.06 [a] 23.46 ± 2.33 [b]	22.74 ± 3.05	-	-
	FT3	-	20.94 ± 4.16 [a] 23.36 ± 2.51 [b]	23.22 ± 3.75	-	-
$p < 0.05$ between sport classes for CP-Football		FT8 > FT5/6 and FT7 in maximal speed. No differences were observed between FT5/6 and FT7 classes.	Does not analyze the significant differences between CP-Football classes without taking into account the place of the competition.	FT3 = FT2 > FT1 in maximal speed. No differences were observed between FT2 and FT3 classes.	FT8 > FT7 and FT5/6 in maximal speed. No differences were observed between FT7 and FT5/6 classes.	No differences were observed between sport classes.

Note: SC = sport class; [a] = moderate altitude group; [b] = sea level group; [c] = overall sample.

Table 6. Results for measures of accelerations, decelerations, player load, metabolic power, change of directions (COD), and impacts per minute, extracted from literature research of studies on para-footballers with cerebral palsy.

Variables	SC	Gamonales et al. [28]	Henríquez et al. [29]	Reina et al. [30]	Reina et al. [31]	Yanci et al. [32]
Mean speed ($km \cdot h^{-1}$)	TOTAL	-	-	5.07 ± 0.99	-	-
	FT1	-	-	4.87 ± 0.93	-	-
	FT2	-	-	5.12 ± 1.02	-	-
	FT3	-	-	5.09 ± 0.91	-	-
Total accelerations (n/min)	FT1	11.75 ± 5.26	-	-	-	-
	FT2	13.91 ± 2.93	-	-	-	-
	FT3	14.93 ± 2.29	-	-	-	-
Accelerations 1 to 2 $m \cdot seg^{-2}$ (n/min)	FT1	9.63 ± 4.20	-	-	-	-
	FT2	10.47 ± 2.08	-	-	-	-
	FT3	10.77 ± 1.74	-	-	-	-
Accelerations 1 to 2.78 $m \cdot seg^{-2}$ (n/min)	FT5/6	-	-	-	1.08 ± 0.60	1.15 ± 0.64
	FT7	-	-	-	0.88 ± 0.33	0.98 ± 0.52
	FT8	-	-	-	1.29 ± 0.83	1.34 ± 0.79
	TOTAL	-	5.43 ± 1.57 [a] 7.21 ± 1.42 [b] 6.32 ± 1.74 [c]	5.55 ± 3.81	0.98 ± 0.50	1.06 ± 0.58
	FT1	-	5.46 ± 1.24 [a] 6.38 ± 1.37 [b]	4.82 ± 2.78	-	-
	FT2	-	5.63 ± 1.72 [a] 7.54 ± 1.42 [b]	5.78 ± 4.14	-	-
	FT3	-	4.64 ± 1.13 [a] 6.93 ± 1.16 [b]	5.29 ± 3.11	-	-

Table 6. *Cont.*

Variables	SC	Gamonales et al. [28]	Henríquez et al. [29]	Reina et al. [30]	Reina et al. [31]	Yanci et al. [32]
Accelerations 2 to 3 m·seg^{-2} (n/min)	FT1	1.67 ± 0.97	-	-	-	-
	FT2	2.46 ± 0.85	-	-	-	-
	FT3	2.67 ± 0.80	-	-	-	-
Accelerations >2.78 m·seg^{-2} (n/min)	FT5/6	-	-	-	0.03 ± 0.03	0.03 ± 0.04
	FT7	-	-	-	0.06 ± 0.05	0.07 ± 0.06
	FT8	-	-	-	0.15 ± 0.11	0.14 ± 0.10
	TOTAL	-	1.09 ± 0.38 [a] 1.32 ± 0.39 [b] 1.20 ± 0.40 [c]	1.08 ± 0.66	0.07 ± 0.07	0.07 ± 0.07
	FT1	-	0.96 ± 0.40 [a] 1.22 ± 0.50 [b]	0.87 ± 0.64	-	-
	FT2	-	1.12 ± 0.40 [a] 1.37 ± 0.33 [b]	1.09 ± 0.59	-	-
	FT3	-	1.08 ± 0.30 [a] 1.25 ± 0.45 [b]	1.26 ± 0.90	-	-
Accelerations 3 to 4 m·seg^{-2} (n/min)	FT1	0.36 ± 0.29	-	-	-	-
	FT2	0.77 ± 0.43	-	-	-	-
	FT3	1.12 ± 0.36	-	-	-	-
Accelerations 4 to 100 m·seg^{-2} (n/min)	FT1	0.08 ± 0.11	-	-	-	-
	FT2	0.21 ± 0.15	-	-	-	-
	FT3	0.38 ± 0.10	-	-	-	-
Total decelerations (n/min)	TOTAL	-	-	-	-	-
	FT1	10.28 ± 5.29	-	-	-	-
	FT2	12.14 ± 2.83	-	-	-	-
	FT3	11.97 ± 2.13	-	-	-	-
Decelerations −1 to −2 m·seg^{-2} (n/min)	FT1	8.58 ± 4.35	-	-	-	-
	FT2	9.39 ± 2.01	-	-	-	-
	FT3	8.44 ± 1.50	-	-	-	-
Decelerations −1 to −2.78 m·seg^{-2} (n/min)	FT5/6	-	-	-	0.86 ± 0.28	0.95 ± 0.36
	FT7	-	-	-	0.89 ± 0.32	0.99 ± 0.44
	FT8	-	-	-	1.37 ± 0.71	1.36 ± 0.65
	TOTAL	-	4.20 ± 1.26 [a] 5.77 ± 1.22 [b] 4.99 ± 1.46 [c]	4.49 ± 3.15	0.95 ± 0.42	1.03 ± 0.47
	FT1	-	4.03 ± 0.98 [a] 5.44 ± 1.65 [b]	3.89 ± 2.38	-	-
	FT2	-	4.43 ± 1.37 [a] 6.00 ± 1.05 [b]	4.69 ± 3.44	-	-
	FT3	-	3.49 ± 0.78 [a] 5.34 ± 1.21 [b]	4.24 ± 2.33	-	-
Decelerations −2 to −3 m·seg^{-2} (n/min)	FT1	1.30 ± 0.80	-	-	-	-
	FT2	1.91 ± 0.75	-	-	-	-
	FT3	2.36 ± 0.62	-	-	-	-
Decelerations >−2.78 m·seg^{-2} (n/min)	FT5/6	-	-	-	0.05 ± 0.03	0.08 ± 0.11
	FT7	-	-	-	0.12 ± 0.08	0.13 ± 0.09
	FT8	-	-	-	0.14 ± 0.09	0.15 ± 0.09
	TOTAL	-	0.74 ± 0.30 [a] 0.96 ± 0.35 [b] 0.85 ± 0.35 [c]	0.76 ± 0.72	0.11 ± 0.08	0.12 ± 0.09
	FT1	-	0.68 ± 0.26 [a] 0.77 ± 0.41 [b]	0.55 ± 0.42	-	-
	FT2	-	0.76 ± 0.31 [a] 1.03 ± 0.33 [b]	0.80 ± 0.81	-	-
	FT3	-	0.74 ± 0.35 [a] 0.93 ± 0.34 [b]	0.79 ± 0.54	-	-

Table 6. *Cont.*

Variables	SC	Gamonales et al. [28]	Henríquez et al. [29]	Reina et al. [30]	Reina et al. [31]	Yanci et al. [32]
Decelerations −3 to −4 m·seg^{-2} (n/min)	FT1	0.30 ± 0.22	-	-	-	-
	FT2	0.60 ± 0.33	-	-	-	-
	FT3	0.85 ± 0.18	-	-	-	-
Decelerations −4 to −100 m·seg^{-2} (n/min)	FT1	0.11 ± 0.10	-	-	-	-
	FT2	0.25 ± 0.14	-	-	-	-
	FT3	0.32 ± 0.15	-	-	-	-
Player load (A.U./min)	FT5/6	-	-	-	10.86 ± 1.83	10.76 ± 2.02
	FT7	-	-	-	10.39 ± 2.57	10.55 ± 2.39
	FT8	-	-	-	10.46 ± 1.43	10.55 ± 1.35
	TOTAL	-	-	9.85 ± 2.26	10.49 ± 2.28	10.56 ± 2.19
	FT1	-	-	10.05 ± 1.77	-	-
	FT2	-	-	9.87 ± 2.40	-	-
	FT3	-	-	9.53 ± 2.10	-	-
Metabolic Power (W/min)	FT5/6	-	-	-	106.91 ± 47.25	106.74 ± 42.43
	FT7	-	-	-	117.84 ± 36.31	114.64 ± 35.75
	FT8	-	-	-	113.51 ± 37.48	108.57 ± 37.41
	TOTAL	-	-	-	115.16 ± 38.04	113.21 ± 36.94
Low-intensity COD forward (n/min)	FT5/6	-	-	-	-	0.50 ± 0.14
	FT7	-	-	-	-	0.69 ± 0.43
	FT8	-	-	-	-	0.46 ± 0.13
	TOTAL	-	-	-	-	0.62 ± 0.38
Low-intensity COD backward (n/min)	FT5/6	-	-	-	-	0.77 ± 0.39
	FT7	-	-	-	-	1.03 ± 0.41
	FT8	-	-	-	-	0.67 ± 0.29
	TOTAL	-	-	-	-	0.94 ± 0.41
Low-intensity COD left (n/min)	FT5/6	-	-	-	-	3.87 ± 3.84
	FT7	-	-	-	-	2.38 ± 0.83
	FT8	-	-	-	-	2.08 ± 0.55
	TOTAL	-	-	-	-	2.64 ± 1.82
Low-intensity COD right (n/min)	FT5/6	-	-	-	-	3.35 ± 3.14
	FT7	-	-	-	-	3.35 ± 1.37
	FT8	-	-	-	-	2.81 ± 0.77
	TOTAL	-	-	-	-	3.27 ± 1.73
Medium-intensity COD forward (n/min)	FT5/6	-	-	-	-	0.11 ± 0.09
	FT7	-	-	-	-	0.18 ± 0.11
	FT8	-	-	-	-	0.18 ± 0.07
	TOTAL	-	-	-	-	0.17 ± 0.10
Medium-intensity COD backward (n/min)	FT5/6	-	-	-	-	0.26 ± 0.16
	FT7	-	-	-	-	0.35 ± 0.17
	FT8	-	-	-	-	0.37 ± 0.13
	TOTAL	-	-	-	-	0.34 ± 0.17
Medium-intensity COD left (n/min)	FT5/6	-	-	-	-	0.48 ± 0.30
	FT7	-	-	-	-	0.40 ± 0.23
	FT8	-	-	-	-	0.39 ± 0.15
	TOTAL	-	-	-	-	0.42 ± 0.24
Medium-intensity COD right (n/min)	FT5/6	-	-	-	-	0.48 ± 0.35
	FT7	-	-	-	-	0.53 ± 0.24
	FT8	-	-	-	-	0.52 ± 0.21
	TOTAL	-	-	-	-	0.52 ± 0.26
High-intensity COD forward (n/min)	FT5/6	-	-	-	-	0.08 ± 0.09
	FT7	-	-	-	-	0.08 ± 0.06
	FT8	-	-	-	-	0.11 ± 0.06
	TOTAL	-	-	-	-	0.09 ± 0.07

Table 6. *Cont.*

Variables	SC	Gamonales et al. [28]	Henríquez et al. [29]	Reina et al. [30]	Reina et al. [31]	Yanci et al. [32]
High-intensity COD backward (n/min)	FT5/6	-	-	-	-	0.17 ± 0.17
	FT7	-	-	-	-	0.13 ± 0.09
	FT8	-	-	-	-	0.17 ± 0.14
	TOTAL	-	-	-	-	0.14 ± 0.11
High-intensity COD left (n/min)	FT5/6	-	-	-	-	0.11 ± 0.09
	FT7	-	-	-	-	0.12 ± 0.12
	FT8	-	-	-	-	0.08 ± 0.07
	TOTAL	-	-	-	-	0.11 ± 0.11
High-intensity COD right (n/min)	FT5/6	-	-	-	-	0.11 ± 0.10
	FT7	-	-	-	-	0.13 ± 0.09
	FT8	-	-	-	-	0.17 ± 0.08
	TOTAL	-	-	-	-	0.13 ± 0.09
Total impacts (n/min)	FT1	45.45 ± 40.24	-	-	-	-
	FT2	76.75 ± 39.22	-	-	-	-
	FT3	94.95 ± 45.77	-	-	-	-
Impacts 2 to 5 G (n/min)	FT1	38.97 ± 34.81	-	-	-	-
	FT2	69.35 ± 34.21	-	-	-	-
	FT3	83.10 ± 42.36	-	-	-	-
Impacts 5 to 7 G (n/min)	FT1	5.34 ± 5.37	-	-	-	-
	FT2	6.29 ± 5.91	-	-	-	-
	FT3	10.15 ± 3.68	-	-	-	-
Impacts 7 to 8 G (n/min)	FT1	0.67 ± 0.58	-	-	-	-
	FT2	0.65 ± 0.58	-	-	-	-
	FT3	1.06 ± 0.12	-	-	-	-
Impacts 8 to 9 G (n/min)	FT1	0.22 ± 0.19	-	-	-	-
	FT2	0.25 ± 0.27	-	-	-	-
	FT3	0.35 ± 0.11	-	-	-	-
Impacts 9 to 10 G (n/min)	FT1	0.11 ± 0.12	-	-	-	-
	FT2	0.11 ± 0.12	-	-	-	-
	FT3	0.12 ± 0.04	-	-	-	-
Impacts 10 to 100 G (n/min)	FT1	0.13 ± 0.12	-	-	-	-
	FT2	0.11 ± 0.09	-	-	-	-
	FT3	0.17 ± 0.09	-	-	-	-
$p < 0.05$ between sport classes for CP-Football		FT3 > FT2 > FT1. -Accelerations 2 to 3 and 3 to 4 m·seg^{-2}. -Decelerations between −2 to −3 and −3 to −4 m·seg^{-2}. FT3 = FT2 > FT1. -Accelerations 1 to 100 m·seg^{-2}. -Decelerations −1 to −100 m·seg^{-2}. -Total impacts. -Impacts 2 to 5 G.	Does not analyze the significant differences between CP-Football classes without taking into account the place of the competition.	FT3 > FT1 in accelerations >2.78 m·seg^{-2}. No differences were observed between FT2 and FT3 classes.	FT8 > FT7 and FT5/6. - Accelerations >2.78 m·seg^{-2}. - Decelerations −1 to −2.78 m·seg^{-2}. No differences were observed between FT7 and FT5/6 classes.	FT8 > FT7 and FT5/6 in accelerations >2.78 m·seg^{-2}. FT5/6 > FT8 and FT7 in low-intensity COD to the left. FT7 > FT8 in low-intensity COD backward.

Note: SC = sport class; n = number; COD = change of direction; A.U. = Arbitrary units; [a] = moderate altitude group; [b] = sea level group; [c] = overall sample.

Finally, Table 7 shows the physiological responses recorded by the players with CP during the competition.

Table 7. Results for measures of physiological responses extracted from literature research of studies on para-footballers with cerebral palsy.

Variables	SC	Boyd et al. [27]
Maximum heart rate (bpm)	C5/6	196 ± 18
	C7	194 ± 11
	C8	200 ± 6
	TOTAL	197 ± 12
Average heart rate (bpm)	C5/6	161 ± 20 [a] | 157 ± 19 [b] | 153 ± 19 [c] | 158 ± 18 [d]
	C7	164 ± 14 [a] | 166 ± 13 [b] | 159 ± 14 [c] | 160 ± 13 [d]
	C8	170 ± 5 [a] | 171 ± 7 [b] | 168 ± 7 [c] | 169 ± 10 [d]
	TOTAL	165 ± 13 [a] | 165 ± 13 [b] | 160 ± 13 [c] | 162 ± 14 [d]
Time < 75% Maximum HR (min)	C5/6	3.5 [a] | 4.5 [b] | 5.6 [c] | 8.0 [d]
	C7	2.3 [a] | 1.8 [b] | 3.6 [c] | 2.7 [d]
	C8	1.0 [a] | 1.6 [b] | 1.9 [c] | 2.9 [d]
Time between 75–85% Maximum HR (min)	C5/6	4.4 [a] | 4.7 [b] | 5.0 [c] | 3.9 [d]
	C7	6.0 [a] | 6.0 [b] | 6.8 [c] | 7.4 [d]
	C8	3.9 [a] | 4.0 [b] | 5.0 [c] | 3.7 [d]
Time > 85% Maximum HR (min)	C5/6	7.1 [a] | 5.8 [b] | 4.4 [c] | 3.3 [d]
	C7	6.6 [a] | 7.1 [b] | 4.4 [c] | 4.8 [d]
	C8	10.4 [a] | 9.4 [b] | 8.0 [c] | 9.0 [d]
$p < 0.05$ between sport classes for CP-Football		No differences were observed between sport classes for maximum or mean HR. C8 > C7 and C5/6 in time spent > 85% Max HR. No differences were observed between C5/6 and C7 classes.

Note: SC = sport class; [a] = between 0–15 min of the match; [b] = between 16–30 min of the match; [c] = between 31–45 min of the match; [d] = between 46–60 min of the match.

4. Discussion

Analyzing match responses in footballers with CP has a two-fold purpose. On the one hand, coaches and strength and conditional coaches can design training drills that allow replicable competitive situations, under-stimulated or over-stimulated; and on the other hand, help classifiers to make decisions when assigning a player to a certain sport class. Therefore, the aim of this systematic review was to summarize the physical and physiological responses encountered by para-footballers with CP during the competition according to sport classes. To our knowledge, this is the first review that analyzes these locomotor and physiological responses in CP players during official matches. The main results showed that players with less physical impairment cover greater total and distance at high speeds, perform greater high-intensity acceleration and deceleration per minute, and achieve greater maximal speed. However, the physiological responses do not seem to be influenced by the sport class assigned.

To gain a comprehensive understanding of the responses of football PC and to optimize performance, it is necessary to consider not only locomotor responses but also the physiological responses of players during match-play [33]. Only one study included in this review analyzes the HR, dividing the sample by sport classes [27]. In the selected study, maximum HR values range from 200 ± 6 to 196 ± 18 bpm, and average heart rate values range from 153 ± 19 to 171 ± 7 bpm. These values were obtained by the sport classes with the least impairment (C8) and the maximum values obtained by other studies which the sample is not divided are similar [34,35]: the values of maximum and average heart rate have been shown 194 ± 13 and 154.4 ± 22 bpm, respectively. This similar physiological response during matches can be attributed to several factors. On one hand, it may be due to the

great variability existing among players in terms of muscle glycogen, free fatty acid levels, insulin levels, and so forth, during a game [36]. On the other hand, it could be because CP players with less physical impairment have higher levels of physical fitness [37]. Therefore, despite demonstrating higher physical performance (i.e., covering greater total distance and distance at high speeds), their physiological response during matches is similar, as occurs in non-disabled soccer players [38]. However, the relationship between physical fitness and match running performance was shown to be playing position-dependent [39] and, therefore, more studies with CP players are necessary to analyze this aspect.

Only one study included in the review analyzes the total distance covered in absolute terms dividing the sample by sport classes [27]. This study indicates that total distance covered was 6343 ± 551 m, 5642 ± 674 m, and 5532 ± 814 m for classes C8, C7, and C5/6, respectively [27]. The highest values of total distance covered in relative terms in para-footballers were 106.42 ± 9.59 m·min^{-1}, 95.56 ± 11.05 m·min^{-1}, and 60.55 ± 23.62 m·min^{-1} for FT3, FT2, and FT1, respectively [28,29]. Therefore, the total distance covered seems to be related to the degree of physical impairment of footballers with CP [27–29], as the para-footballers with minimal impairment are the ones who complete the greatest total distance in absolute terms and per minute of play. Among the players classified according to the previous classification system (C5/6-C8) there are significant differences between sport classes regarding the total distance covered in absolute terms, the same as occurs with the players classified according to the current system (FT1-FT3) with respect to the total distance covered in relative terms. These differences between sport classes could occur because C5/6, FT5/6, and FT1, regardless of the classification system used, are the sport classes with the greatest physical impairments to move due to diplegic, hemiplegia, ataxia, athetosis, dyskinesia or dystonia, unlike C8, FT8, and FT3, which are the sport classes with the least physical impairment and the greatest locomotion capacity.

In relation to the distance covered in different speed ranges in absolute terms, only one study included in this review analyzes these variables dividing the sample by sport class [28]. The results showed that C8 players covered more distance above 23.04 km·h^{-1}. Considering the correlation between the distance covered at high speeds and the effectiveness of attacking moves during the match [40], it appears that being able to go a greater distance at these speeds helps players become more competent in-game. On the other hand, an analysis of the distances covered at different speeds shows a disparity in the results obtained in relative terms [41]. While some studies show a relationship between the distance covered at high speeds and the degree of physical impairment of para-footballers [28], others show no such results [29,31,32]. The establishment of arbitrary values for the speed ranges may have influenced the results obtained by the different studies [42]. More studies are needed using individualized ranges in CP footballers, which allow us to obtain a clearer vision of the activity levels of the players in all-time motion analysis studies using GPS devices as occurs in conventional football [43]. To our knowledge, only the study of Goh et al. [35] analyzed match responses in para-footballers using individualized thresholds, i.e., below 25%, between 25 and 50%, between 50 and 70%, between 70 and 90%, and above 90% of maximum speed.

In addition to the relevance of recording the distance covered at high speeds, it is also necessary to pay attention to the maximum speed achieved by the players, since one of the most frequent actions preceded by goal situations in soccer is the sprint [44]. In the studies included in this review, the maximum speed values were 27.86 ± 1.22 km·h^{-1}. Previous studies have indicated that as the level of physical impairment decrease (i.e., C8, FT8, or FT3, depending on the classification system in force at the time of each investigation), maximum speed values tend to be higher [27,30,31]. This variable in football is closely associated with physical and locomotor performance [43,45]. Therefore, players with less motor impairment are likely to generate force more efficiently and move at faster speeds.

The intermittent nature of PC football underscores the importance of short-term high-intensity actions, such as accelerations, decelerations and change of direction [46,47]. The intensity zones for the accelerations and decelerations are arbitrary and vary de-

pending on the authors. Different ranges have been proposed, including 1–2 $m \cdot s^{-2}$ [28], 1–2.78 $m \cdot s^{-2}$ [29–32], 2–3 $m \cdot s^{-2}$ [28], >2.78 $m \cdot s^{-2}$ [29–32], 3–4 and >4 $m \cdot s^{-2}$ [28]. Like the distance covered in different speed zones, there should be unanimity in the scientific community for the presentation of the results in the research studies that analyze the intensity zones of the external load variables collected by GPS devices and facilitate the understanding and comparison of the activity levels of athletes, as pointed out by Malone et al. [48].

In the reviewed studies, it is observed that sports classes with lesser impairment (FT3-FT2 and FT8-FT7) exhibit higher values of accelerations and decelerations compared to FT1 and FT5/6 classes [28,30–32]. This trend can be attributed to greater neuromuscular impairment, poorer coordination, and reduced functional capacity resulting from spasticity, ataxia, athetosis, dyskinesia, or dystonia [6]. In addition, this difference is conditioned by playing time, which significantly affects the external load of PC players since those who play more minute's (i.e., <20, 20–40, and <40 min) experience a higher match load [18]. Additionally, regarding Metabolic Power, Player Load, and change of direction, no significant differences were observed between sport classes [30–32].

While the present review provides novel outcomes in physical and physiological match-play load in CP footballers, the limitations of our findings should be acknowledged, therefore, the results should be interpreted with caution. Firstly, studies included in this systematic review are subject to different classification systems for para-footballers, which has made it impossible to relate the variation in physical and physiological responses during official matches from all the studies, according to the same sport classes. This limitation can likely persist over time, considering that the classification process is dynamic and subject to continuous and necessary changes to ensure competitive equality. Secondly, it is difficult to establish a consensus regarding physical and physiological responses during match-play, as the competitive levels included in this review are different. In this sense, while some studies have reported data from national championships, others have focused on international championships. Thirdly, only one study has analyzed the physiological responses according to the sport classes of different classification systems. As such, it is impossible to compare the results obtained. Fourth, the speed ranges and thresholds for accelerations and decelerations vary among studies, making it challenging to compare them. Lastly, given that all the studies are carried out in male competitions, and considering that gender determines the physical responses of competition in conventional soccer [49], and the participation of women football players with CP and the organization of different events is becoming relevant, it would be necessary to analyze this aspect in future studies. We acknowledge that subsequent to the completion of our review process, additional relevant studies have been published. While our review was conducted up to 31 January 2023, we are aware of the inclusion of one additional study that was not part of our original review [50] (online, ahead of print). Despite our efforts to capture all relevant literature available at the time of our review, the dynamic nature of research in this field may result in the emergence of new studies post-review.

Strength and conditions coaches, along with performance staff, working across para-footballers with CP must know what the physical and physiological demands of match-play are. Previous studies have analyzed competition demands based on different contextual variables, such as moderate altitude [29], sport classes [32], simulated games [29], or even in a 3-day national tournament [35]. However, to our knowledge, this is the first systematic review to analyze the physical and physiological responses encountered by para-footballers with CP during the competition, according to sport classes. This knowledge is essential for adequately preparing athletes for competition and simulating competition situations during training tasks.

5. Conclusions

The main conclusions of this systematic review suggest that para-footballers with CP and less physical impairment (i.e., current FT3 or FT8 in the previous classification system)

tend to cover a greater total distance, achieve higher maximum speeds, and cover more distance above 23.04 $km \cdot h^{-1}$ during match-play, indicating potentially greater competence during a game. However, it is essential to interpret these findings with caution due to the limited number of studies examining the physiological response of para-footballers. Furthermore, players with an intermediate degree of impairment (i.e., current FT2 or FT7 in the previous classification system) demonstrate the highest relative values in specific performance metrics such as accelerations from 1 to 2.78 $m \cdot s^{-2}$ and above 2.78 $m \cdot s^{-2}$, decelerations from -1 to -2.78 $m \cdot s^{-2}$ and above 2.78 $m \cdot s^{-2}$, as well as greater peak metabolic power suggesting unique strengths in certain aspects of play. Conversely, players with severe physical impairment (FT1 or FT5/6 in the previous classification system) exhibit higher player load, which may reflect different physical demands. Despite these insights, the conclusions are constrained by the scarcity of studies directly comparing physical and physiological demands across classification groups. Therefore, while the findings provide valuable insights into the performance characteristics of para-footballers with CP, further research is needed to draw definitive conclusions and inform training and classification strategies.

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