The scientific landscape regarding young padel players: a systematic review

El panorama científico sobre los jóvenes jugadores de pádel: una revisión sistemática

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Abstract

Introduction: this systematic review examines the literature on padel, focusing on young athletes. Despite the increasing number of practitioners, especially young ones, the quantity of scientific studies on the subject remains limited.
Objective: to identify the number and which aspects of the sport the studies in literature address regarding young padel players.
Methodology: A systematic search was conducted in the Scopus, PubMed, and Web of Science databases. The Inclusion criteria were original research articles published in scientific journals involving young padel athletes.
Results: out of the 39 studies identified eight were analyzed in detail. Of these eight articles, two report on the technical-tactical actions of players, one evaluates game materials, one investigates the timing and duration of points and matches, three report on the physical demands of padel play, and one studies mental aspects during the game.
Discussion: from the analyses, it is possible to highlight the need to adapt programs and training to the specific needs in the long-term development of athletes and the promotion of padel.
Conclusions: the diversity of approaches underscores the complexity of padel extending beyond physical aspects, incorporating psychological and technical-tactical elements for comprehensive athlete development.

Keywords

Padel; physical performance; sport; sports psychology; tactical performance.

Resumen

Introducción: esta revisión sistemática examina la literatura sobre pádel, centrándose en jóvenes atletas. A pesar del creciente número de practicantes, especialmente jóvenes, la cantidad de estudios científicos sobre el tema sigue siendo limitada.
Objetivo: es identificar el número y qué aspectos del deporte abordan los estudios en la literatura con respecto a los jóvenes jugadores de pádel.
Metodología: se realizó una búsqueda sistemática en las bases de datos de Scopus, PubMed y Web of Science. Los criterios de inclusión fueron artículos de investigación originales publicados en revistas científicas que involucraban a jóvenes atletas de pádel.
Resultados: de los 39 estudios identificados, ocho fueron analizados en detalle. De estos ocho artículos, dos informan sobre las acciones técnico-tácticas de los jugadores, uno evalúa los materiales de juego, uno investiga el tiempo y la duración de los puntos y partidos, tres informan sobre las demandas físicas del juego de pádel y uno estudia los aspectos mentales durante el juego.
Discusión: a partir de los análisis, es posible resaltar la necesidad de adaptar programas y entrenamientos a las necesidades específicas en el desarrollo a largo plazo de los atletas y la promoción del pádel.
Conclusiones: la diversidad de enfoques subraya la complejidad del pádel que se extiende más allá de los aspectos físicos, incorporando elementos psicológicos y técnico-tácticos para el desarrollo integral del atleta.

Palabras clave

Deporte; padel; rendimiento físico; rendimiento táctico; psicología deportiva.

Introduction

Padel is considered a recent sport in the performance sports scene compared to other racket sports (Barquin & García, 2008). The different movements condition the gameplay, making it a sport with constant interaction, characterized by a dynamic and unpredictable environment (Claver et al., 2021), intermittent and multidirectional (Bourara et al., 2023), consisting of repeated plays of high intensity (Mellado-Arbelo & Baiget, 2022). This set of activities is repeated throughout matches that can last more than an hour (Martínez et al., 2018).

Regarding gameplay tactics, it is worth noting that the duration of the match is not limited, causing the distance covered by players to vary according to the number of points, games, or sets played (Ramón-Llín et al., 2021), averaging between two and three thousand meters per match, which can vary according to the level of competition and the players' skill, demanding certain levels of physical condition of the players (Martínez et al., 2018). As for gameplay technique, studies focus on biomechanical analysis of movements, involving kinematic analysis of strokes (Vera et al., 2019). Other authors have investigated the physical demands related to capacities such as cardiorespiratory endurance and recovery capacity (Mendes et al., 2022), lower and upper limb power, speed, and agility (Ibáñes & Gálvez, 2020; Sánchez-Muñoz et al., 2020; Martínez et al., 2018). Based on these abilities and from a bioenergetic standpoint of the game, padel requires a balance between aerobic and anaerobic systems, making it a highly demanding sport in terms of energy expenditure (Mendes et al., 2022). The mental aspect of the game still has fewer studies, among which is research on mental fatigue, which is responsible for increasing the cognitive load or emotional processes of athletes after a padel match, also contributing to the motivation or demotivation of the athlete (Díaz-García et al., 2021).

The growing popularity of padel since 2020 has driven a significant increase in the number of practitioners worldwide, encompassing both the professional scene and amateur and developmental categories (Ramón-Llín et al., 2021). In spite of its youth, in recent years there has been an interest in scientific growth to understand the specific technical-tactical, physical, biomechanical and psychological requirements of this sport (Cayetano et al., 2020; Martínez et al., 2018). This phenomenon not only underscores the importance of sports practice for the physical, motor, cognitive, emotional, and social development of children and adolescents but also highlights the urgent need for robust scientific production on the subject (Schirmer et al., 2023).

While the benefits of sports practice are recognized, it is crucial to understand more profoundly its specific impacts on different groups of practitioners. Professional padel has been the primary focus of scientific investigations, while studies on young athletes in the sport are still scarce (Courel-Ibáñez et al., 2017). In this context, it is essential to encourage and promote research that addresses not only sports performance but also the well-being and holistic development of practitioners of all ages, ensuring a solid knowledge base to guide both practitioners and health and education professionals involved in the realm of padel (Likkgaard et al., 2023).

Moreover, scientific attention should be given to long-term athlete development and the development of physical, cognitive, emotional, and social skills to cultivate a solid foundation of technical and tactical skills, providing a lasting competitive advantage (Wiersma, 2001). Furthermore, long-term development enables athletes to explore their maximum potential, developing mental and physical resilience to face challenges throughout their sports careers (Richards et al., 2012), as well as values such as discipline, teamwork, coping with pressure, managing success and defeat, and developing healthy interpersonal relationships and leadership, which will be useful in various situations (Camiré et al., 2011).

Padel deserves investigation not only due to its increasing popularity and number of practitioners but also because of its complexity and its potential to influence various aspects of individuals' physical, mental, and social health (Rodríguez-Cayetano et al., 2022). As a multifaceted sport, padel offers a unique platform to study a variety of phenomena, from the acute effects of physical exercise to the psychological and social aspects related to sports participation (Mellado-Arbelo & Baiget, 2022). The motivations for the practicing of padel appear to be dispersed at the beginning, considering the variety of concepts, otherwise at the maintenance the motivation is focused on competition, on the task and on effort (Cayote et al., 2020).

Investigating young padel athletes is essential for several reasons. Firstly, young athletes represent the

future of the sport, and understanding their needs and challenges is essential for promoting healthy and sustainable development of the discipline (Likkgaard et al., 2023). Additionally, formative years are critical for developing physical, technical, cognitive, and social skills, and researching how padel influences this development can provide valuable insights to optimize training programs and support for young athletes (Ibáñes & Gálvez, 2020).

Although research studies have been on padel, specific systematic reviews on the sport are still limited. Studies that aggregate and synthesize existing knowledge on different aspects of padel, such as technique, tactics, physiology, and psychology of the game, are essential to provide a comprehensive and updated view of the state of the art in this area. Systematic reviews can help identify knowledge gaps and guide future research. This review aims to identify the quantity and which aspects of the sport the studies in the literature are addressing concerning young padel players.

Method

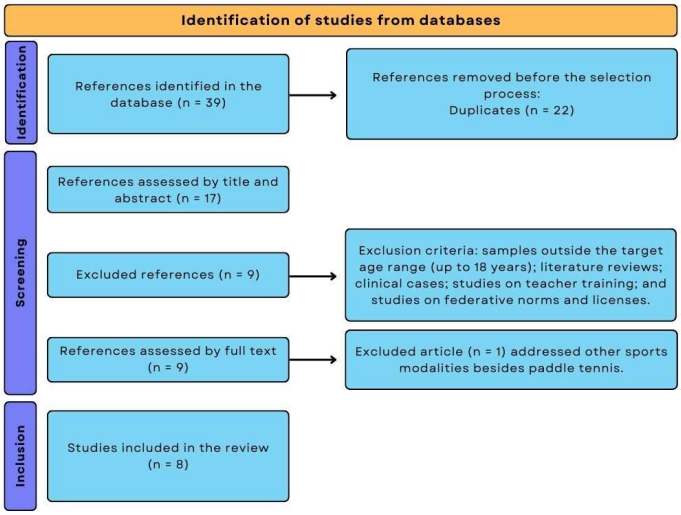
This systematic review was based on the methodology of Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020 abstract checklist. The structure for research of the articles used only the Patient and Intervention, included in the Patient/Population Intervention Comparison Outcome (PICO) strategy. In this case the patiente/population being child, young or adolescent and the intervention the practice of the sport of padel.

Therefore, the keywords as descriptors: "padel" AND "sport" AND ("young*" OR "youth*" OR "child*" OR "adolescent*") were used to identified the studies through a systematic search in the Scopus, Web of Science, and PubMed databases. The initial search was conducted on July 26, 2023, and a follow-up search was performed on February 7, 2024. All peer-reviewed articles published until February 7, 2024, were considered.

Articles were selected based on title, keywords, and abstract, followed by the reading and reviewing of full texts. In the final stage, two researchers (T.R. and D.A.) ensured consensus on the studies. In case of disagreement, a third researcher (T.L.) was consulted for tie-breaking.

Inclusion criteria were: (a) the article should be about the sport of padel; (b) the study sample should consist of individuals up to eighteen years old. Exclusion criteria included: (a) literature reviews and clinical cases; (b) studies on teacher training; and (c) studies addressing federation licensing regulations.

Figure 1. Flowchart illustrating the article selection process.



An Excel spreadsheet was constructed for data extraction. The lead author extracted the following data from the selected articles: (a) author names, (b) year of publication; (c) article title; (d) journal; (e) publication location; (f) study objective; (g) study design; (h) sample size; (i) sample gender; (j) sample

mean age; (k) athletes' level; (l) sample experience time; (m) investigated variables; (n) applied tests; (o) study results; (p) study conclusion.

The initial systematic search yielded a total of 38 articles, with one additional article identified and added in the follow-up search as it was published after the initial systematic search date. After excluding duplicates, 17 articles remained, and upon reviewing the exclusion criteria, 8 original articles were identified as eligible, as highlighted in the process outlined in Figure 1.

Results

The table 1 summarizes the articles found and included in this systematic review, including their sections and characteristics.

Table 1. Characteristics of the eight reviewed articles studying young padel athletes.

AUTHORS	LOCATION	OBJECTIVE	SAMPLE, GENDER, AND MEAN AGE	LEVEL	YEARS OF EXPERIENCE	VARIÁBLES	TESTS AND MATERIALS	CONCLUSION
Bernadino J. Sánchez-Alcaraz Martínez (2014).	Spain	Analyze the temporal structure and gameplay actions of adolescent padel players and assess their heart rate levels.	16 M 14,24	Regional	Minimum 2 years	Total playing time (TT); actual playing time (TR); rest time (TD); average time per point (TPU); average time between points (TPA); average number of strokes per point (GP).	Video analysis	Identifying game parameters, including physiological ones, is essential for determining athlete effort, and their actions over time, and facilitating training planning by the coach.
Sergio García-Benítez (2017).	Spain	Evaluate the game activity profile and temporal structure in the under-16 and under-18 male and female categories in the Spanish Youth Championship in the year 2014.	32 M e F 15,49	National	The text does not contain this information.	Activity Profile: RD (rally duration), RT (rest time between rallies), WR (game-to-rest ratio), SR (strokes per rally), LR (lobs per rally).	Video analysis	The conclusive identification of the effects of situational variables, such as match status (win/loss), opponent level, and type of competition (final or semifinal), on players' performance was not achievable.
A. Sánches-Pay (2020).	Spain	Analyze the physical demands of initiation-level paddle competition and observe the influence of different ball types.	16 M e F 10,08	Iniciação	1 year	Heart rate and subjective perception of effort.	Video analysis, heart rate monitor, and Borg Scale	The type of ball does not influence the duration of the match, but the use of low-pressure balls appears to reduce the intensity of the game, with novice young players perceiving greater enjoyment, ease, and comfort, as well as longer rallies when playing with this type of ball.
Jesús Díaz-Garcia, Miguel Ángel López-Gajardo, José Carlos Ponce-Bordón e Juan José Pulido (2021).	Spain	Testing the effects of motivation on mental fatigue during paddle training.	36 M e F M = 17,4 F = 17,9	National	Minimum 3 years	Motivation, heart rate, mental workload, mental fatigue, reaction time.	*Situational Motivation Scale* (SIMS), Polar RS800CX (varaib FC),*Questionnaire to Quantify Mental Load* (QQML), *Visual Analogue Scale* (VAS), *Psychomotor Vigilance Task* (PVT)	The subjective feelings of mental load and fatigue measured with QQML and VAS were significantly increased in the presence of higher levels of motivation, as were the values of heart rate.
Francisco Pradas, Víctor Toro-Román, Miguel Ángel Ortega-Zayas, Duber Mary Montoya-Suárez, Bernardino Javier Sánchez-Alcaraz e Diego Muñoz (2022).	Spain	Assess the physical fitness and upper body asymmetries of young paddle practitioners aged between 13 and 16 years old, and determine potential differences between genders and categories.	60 M e F SUB 14 M e F = 13,75 SUB 16 M = 15,44 SUB 16 F = 15,46	National	Minimum 2 years	Physical fitness, BMI, grip strength, gestural speed of the dominant arm, flexibility, lower limb power, cardiorespiratory capacity, reaction time, and acceleration.	Scale and measuring tape; dynamometer; touch test; sit and reach test; SJ, CMJ, and Abalakov jump; Course Navette Test; Take-Off Reaction Time Measurement.	Male players demonstrated better performance in grip strength, vertical jump power, cardiorespiratory capacity, and lateral movement, while female players showed an advantage in reaction time and flexibility.
Javier Courel-Ibáñez e Javier Llorca-Miralles (2021).	Spain	To examine the physical fitness characteristics and identify the influence of gender and practice experience among	34 M e F 14,6	Regional	Minimum 2 years	Height, body composition, agility, upper and lower limb power.	Stadiometer; leg-to-leg impedance analyzer; 3 x 10 meters shuttle run test with 180-degree turn and Tapas 6R test (specifically	Padel players of both sexes exhibited similar performance in all tests, except for jumps. The practical experience appeared to influence upper limb throwing

		young amateur padel players.					designed paddle tests); medicine ball throw; CMJ and Abalakov jump.	strength; however, sub-analyses did not reveal conclusive results.
Marcos Andreu, Alejandro Sánches-Pay, Bernardino J. Sánchez-Alcaraz Martínez (2021).	Spain	To analyze the temporal structure and technical-tactical actions in padel matches of young players at the initiation stage and compare the differences according to the match outcome.	8 M 13,5	Initiation	Minimum 1 years	Temporal variables: average point duration and average rest duration between points. Game action variables: number of strokes; number of points; type of stroke; direction of stroke; stroke effectiveness; and court side.	Video analysis.	The most commonly used strokes are: serve, return of serve, forehand drive, and forehand wall shot. In the initiation categories, players make a higher percentage of errors than winners.
Carlos Espino Palma, Vicente Luis del Campo e Diego Mñoz Marín (2023).	Spain	Addressing the visual behaviors of eight young paddle tennis specialist athletes during paddle tennis matches.	8 M 14,5	National	Mean 5,75 years	Fixation time, number of fixations.	SMI *Eye Tracking Glasses* 2 *Wireless* (SMI ETG 2w).	Experienced padel players utilized visual information of the ball and the upper body kinematics of their opponents to perform various interceptive actions in situ when playing against them.

Through the adopted criteria, eight studies were included, resulting in the analysis of the following factors present in padel gameplay: a) analysis of players' tactical-technical actions; b) influence of aspects involving game materials; c) duration of points and match time; d) physical aspects; and e) psychological aspects.

Analysis of players tactical-technical actions

This section will present studies that address information on types of technical fundamentals and player behavior in observing opponents during the game.

The study by Andreu et al. (2021) analyzes the temporal structure and tactical-technical actions in matches of young padel players at the initiation level and compares them according to the match outcome. For this purpose, 8 male players with an average age of 13.5 years were considered. The results show differences in actions between the winning pair (WP) and the losing pair (LP) of the match. The most used strokes by both pairs were the first serve (18.4%), drive the return of serve (rebound executed on the dominant side of the body) (18.2%), drive shot (17.8%), and drive wall exit (8.9%). When comparing WP and LP, the drive shot (WP = 71; LP = 56), drive volley (WP = 24; LP = 18), backhand volley (WP = 3; LP = 8), and drive wall exit (WP = 28; LP = 36) presented statistically significant differences. Additionally, both pairs had a higher frequency of shots directed diagonally (WP = 65.2%; LP = 61.3%) compared to parallel (WP = 34.8%; LP = 38.7%). In both pairs, the player on the right side of the court hit more balls (WP = 193; LP = 210) than the player on the left side (WP = 158; LP = 151). Regarding the effectiveness of the action, continuity actions (WP = 77.2%; LP = 74.4%) had a higher frequency, followed by actions resulting in errors (WP = 15.4; and LP = 19.1%) and winning points (WP = 7.3%; LP = 6.50%). The authors conclude that the direction of the plays was not determinant of the match outcome and that in initiation categories, players make a higher percentage of errors than winning points.

The study by Palma et al. (2023) addresses tactical-technical actions through the visual behaviors of padel athletes, through an in-situ approach while technical fundamentals of padel were performed by their opponents. For this purpose, 8 male players with an average age of 14.5 years were considered. The results show that among the possible eye fixation points were: 1st) the ball, 2nd) the upper body, 3rd) the lower body, and 4th) other points, which do not correspond to either the ball or the opponent's body that is hitting. The eye fixation point of the athletes on the ball presented values close to 80% about the number of fixations and 90% regarding the total number of fixation times. The upper and lower body, with values close to 5% of the total number and time of fixations. This high result regarding the percentage of time and number of fixations for the ball occurred in all categories of analysis of the opponent's technical fundamentals: serve, volley, bandeja/smash. These were chosen because they impose high time pressure and, therefore, require quick reactions due to the high speed of the ball. The authors conclude that the visual patterns of padel players were characterized by a long fixation on the ball in its

flight trajectory, together with fixations on the opponent's trunk, shoulders, and arm-hand-racket at the moment of hitting during the match points.

Influence of aspects involving game materials

The following section will focus on analyzing one of the main materials that influence the game, the ball. Regarding this theme, only one study was found.

The study by Pay et al. (2020) aimed to analyze the influence of different types of balls during the game on the physical demands of padel competition at the initiation level. For this purpose, 16 players, 10 male, and 6 female, with an average age of 10.0 years were considered. The results reveal that there were no statistically significant differences between the use of the official ball (OB) and the use of the low-pressure ball (LPB) in terms of set duration (OB = 24.03 min; LPB = 23.38 min), a number of points (OB = 51.75; LPB = 48.25), and strokes per set (OB = 223.25; LPB = 209.00). There were no significant differences in the number and type of technical fundamentals per point. The use of LPB showed higher average values in the variables "number of strokes per point" (OB = 4.31; LPB = 4.33) and "wall exits" (OB = 3.81; LPB = 3.86), and lower values about the use of OB in the variables "strokes without using the wall" (OB = 1.64; LPB = 1.49) and "point duration" (OB = 8.07; LPB = 7.99). Regarding the average heart rate (HR) of the athletes, it was higher in games with the use of OB (145.43 beats per minute (bpm)) compared to LPB (140.19 bpm). The use of OB also recorded higher averages in the variables of the percentage of maximum heart rate (HRmax) (OB = 72.47% HRmax; LPB = 69.85% HRmax) and subjective effort perception using the Borg 6-20 scale (OB = 13.81; LPB = 13.75). Regarding the players' satisfaction when playing with different types of balls, a greater enjoyment during the game was observed with the use of LPB (62.5% of the players) compared to the use of OB (37.5% of the players). The authors conclude that the different ball pressures appear to affect the temporal structure of a padel match; based on the average HR results, padel can be considered a healthy cardiovascular activity; and young players who start practicing padel have a greater perception of fun, ease, and comfort in the game when practicing with LPB.

Duration of points and match time

Despite these variables being present in other articles as well, the study that specifically analyzes these variables of point duration and match time will be included in this category of observation, rather than those that present it as a complementary characteristic of information provided by the author(s).

The study by García-Benítez et al. (2017) evaluates the activity profile, influenced by the players' sex, age, and specific training or competition requirements, thus assisting coaches in designing and structuring training sessions to strengthen the response to situational variables present in the game, and temporal structure in male and female padel players of the under-16 and under-18 categories in the Spanish National Youth Championship of 2014. Thirty-two players from the Spanish Youth National Team, 16 male (M) and 16 female (F), with an average age of 15.49 years were considered. The results reveal that games had a longer duration per point for under-18 boys compared to under-16 boys (Under-18 = 12.0 s; under-16 = 8.9 s). When comparing genders, the under-16 female category also had longer points (11.3 s) compared to under-16 males (8,9 s). This result can be explained by the fact that the under-16 female category had a higher number of lobs per point compared to under-16 males (under-16 F = 1.92; under-16 M = 1.03). Additionally, this female category was the one that used this stroke the most among all analyzed (under-16 F = 275 lobs per game; Under-16 M = 169; under-18 F = 161; under-18 M = 259). Regarding the duration of games in matches, it can be observed that male categories have a shorter duration compared to female categories (under-16 F = 167 s; under-18 F = 168 s; under-16 M = 142 s; and under-18 M = 163 s). The authors concluded that they were unable to conclusively identify the effects of situational variables, such as match status, opposition quality, or type of competition, on player performance. This knowledge may have implications for padel training to ensure that volume and intensity demands are adequately addressed.

Physical aspects

One of the most addressed aspects in the studies of this review was about the physical fitness of the players and its influence on game actions, relating to time, positioning, and the number of plays.

Martínez's study in 2014 analyzed the temporal structure and game actions in young padel players and related them to their heart rate levels. The author addresses the scarcity of studies on the physiological,

temporal, and game action demands in competition in young Padel athletes. For this purpose, 16 male players with an average age of 14.24 years were considered. The results reveal that padel is characterized by intermittent efforts, influenced by specific rules due to the sport allowing a 20-second rest interval between each point, with rapid fluctuations in heart rate (average of 141.23 bpm), presenting an average of 6.73 actions per point for youth players, compared to professionals (between 9.10 and 9.40 actions per point). The authors conclude that padel involves intermittent efforts of varying intensity, providing valuable data for coaches to adapt training to the sport's specific demands, and recommending broader studies to fully understand its requirements.

The study by Ibáñez and Miralles in 2021 examined the physical demands and the influence of sex and practice experience among young padel players. For this purpose, 34 players, 19 male and 15 female, with an average age of 14.60 years, were considered. The results show that players have healthy body composition, similar results in all physical valences tested: agility, tested from the Padel Agility Test (Male (M) = 18.2 s; Female (F) = 19.4 s); upper limb power tested from the Medicine Ball throw, through: a) overhead throw (H = 6.0 m; M = 5.2 m); b) throw with the dominant arm (H = 5.0 m; M = 4.7 m); and c) throw with the non-dominant arm (H = 4.8 m; M = 4.8 m). To assess speed, the Shuttle Run 3x10 test was performed (H = 8.3 s; M = 8.8 s). The only physical valence that did not show similarity in the results was lower limb power when comparing boys and girls in both tests: Countermovement Jump (CMJ) (M = 23.2 cm; F = 9.9 cm) and the Abalakov Vertical Jump (M = 27.0 cm; F = 11.7 cm). The authors conclude that athletes of both sexes present similar results in the tests used, except for jumps, showing that the physical capacity with the greatest discrepancy between genders is lower limb power. The results also contribute to providing new data on the fitness status of young Padel players aged 13 to 17 and open a window for future interventions using padel as a tool for promoting health among young people.

Pradas et al. study in 2022 evaluated the physical fitness and asymmetries of the upper body of young padel players. For this, 60 athletes were divided into four groups with 15 players each: 1) under-14 male (average age 13.75 years); 2) under-14 female (average age 13.75 years); 3) under-16 male (average age 15.44); and 4) under-16 female (average age 15.46 years). The results revealed that male players had better average results in hand grip strength with the dominant arm (under-14 M = 35.40 Kg; under-14 F = 26.31 Kg; under-16 M = 35.03 Kg; under-16 F = 27.77 Kg) and non-dominant arm (under-14 M = 30.52 Kg; under-14 F = 21.75 Kg; under-16 M = 30.59 Kg; under-16 F = 24.12 Kg), vertical jump power Squat Jump (SJ) (under-14 M = 1765 W; under-14 F = 1565 W; under-16 M = 2388 W; under-16 F = 1724 W), vertical jump power Countermovement Jump (CMJ) (under-14 M = 2002 W; under-14 F = 1741 W; under-16 M = 2555 W; under-16 F = 1894 W), cardiorespiratory capacity (under-14 M = 47.21 mL·kg·min−1; under-14 F = 41.29 mL·kg·min−1; under-16 M = 45.70 mL·kg·min−1; under-16 F = 39.85 mL·kg·min−1), and lateral movement (under-14 M = 2.23 s; under-14 F = 2.28 s; under-16 M = 2.14 s; under-16 F = 2.23 s). Female players showed better flexibility (under-14 M = 18.91 cm; under-14 F = 29.31 cm; under-16 M = 25.46 cm; under-16 F = 32.42 cm). The authors conclude that these results can be used as reference values for coaches and physical trainers of youth categories to improve the health control and physical planning of athletes.

Psychological Aspects

In this analysis session, the main theme of the study will be the influence of psychological aspects on the athletic performance of paddle athletes.

Díaz-García et al., 2021 study tested the effects of motivation on mental fatigue during paddle training sessions. For this purpose, 36 elite Spanish paddle players (22 male and 14 female) with a mean age of 17.40 years were considered. They would play two matches: one with conditions (the doubles teams that win more sets in the two matches played to win a free class with a professional paddle player) and another without conditions. The results reveal that both intrinsic and extrinsic motivation were significantly higher before matches with restrictions compared to matches without restrictions. These two variables, along with identified regulation, which is explained as the internalization of values or importance of a specific activity, and therefore, the athlete engages in it voluntarily because they recognize its importance or value its intrinsic benefits. Specifically, athletes showed higher average scores in matches where they knew about the restriction compared to matches without restrictions: a) intrinsic motivation: without restriction = 5.17; with restriction = 6.31; b) upon identifying the restriction: without restriction = 4.36; with restriction = 4.55; c) external motivation: without restriction = 3.86; with

restriction = 4.45; d) amotivation (absence of intrinsic or extrinsic motivation to perform a certain activity): without restriction = 2.67; with restriction = 2.21. The authors conclude that variation in motivation can influence athletes' efforts. These results contribute to informing paddle coaches that by manipulating intrinsic and extrinsic motivation, they can also manipulate athletes' workload and mental fatigue, thus altering their performance in training sessions.

Discussion

Few systematic reviews exist on the paddle. Searching for the terms "padel" AND "systematic review" in the Scopus database yielded eight review studies (Mellado-Arbelo; Baiget, 2016; Villena-Serrano et al., 2016; Martínez et al., 2018; Gallardo et al., 2023; Dahmen et al., 2023; Martín-Miguel et al., 2023; Giustino et al., 2023; Starzak et al., 2024). Of these eight, one is a scoping review and not systematic (Giustino et al., 2023), six studies exclusively address paddle (Mellado-Arbelo; Baiget, 2016; Villena-Serrano et al., 2016; Martínez et al., 2018; Dahmen et al., 2023; Martín-Miguel et al., 2023; Giustino et al., 2023), and the other two investigate paddle and other racket sports (Gallardo et al., 2023; Starzak et al., 2024), with none of the eight focusing on young athletes. These results, still scarce in terms of the number of reviews and even more so regarding the youth age group, demonstrate the importance of this review. Therefore, this article aimed to conduct a systematic review of studies regarding the aspects involving the development of young paddle athletes.

It is noted that many factors interrelate, such as technical-tactical issues, physical aspects, and the duration of points and match time. Because paddle is a dynamic and unpredictable sport (Claver et al., 2021), it is understood that tactical aspects and game actions contribute to and are influenced by longer point durations, which impact performance and match duration (Palma et al., 2023; García-Benítez et al., 2017; Martínez, 2014; Pradas et al., 2022; Díaz-García et al., 2021). Results of this technical-tactical influence are also found in other studies such as those by Priego et al. (2013) and Marín et al. (2017), which highlight the importance of lobbing during points and how paddle play is tactically designed around this movement, dynamically shaping points in various ways, such as slowing down points with defensive lobs or speeding them up with counter-attacking lobs.

Furthermore, the pace dictated by point duration is also associated with the technical-tactical, physical, and mental aspects of the game. This is evident during the play of professional athletes of both genders, as they engage in longer points and are better physically and mentally prepared for match competition (Courel-Ibánez; Herrera-Gálvez, 2019). However, there is a particularity regarding male professional athletes who present a higher frequency of shorter points made from force-based defining shots compared to professional female players and young players of both genders, a fact explained by the production of male body power compared to female body power (Ramón-Llin et al., 2020).

Regarding physical and psychological aspects and technical-tactical issues, it is already known, according to Miller et al. (2020), that athletes with good emotional control perform better in their technical skills, perceive the game better for tactical choices, show better leadership behaviors, and experience freer body movement with less tension and pressure during games. Another important topic within the psychological aspect category is motivation, a subject that is one of the most researched in the psychological analysis of paddle sports. Studies like Smith et al. (2016) consider motivation as an influencing factor for athlete performance, wherein the higher the player's motivation, the better their performance.

Studies on paddle materials are still scarce, with themes on the manufacturing of game materials, such as the study by Ruiz et al. (2022), which addresses the manufacturing process of paddle rackets. Regarding different materials during the game, only the study by Pay et al. (2020) was found. When expanding the search to other racket sports, additional results are found regarding the play and stay pedagogical method, a Canadian methodology for tennis teaching that varies court size and ball type to facilitate learning for children, which can be partially adapted to paddle, as shown by Pay et al. (2020).

When discussing beginner athletes, such as the study by Pay et al. (2020) mentioned earlier, it is observed that the duration of points played is shorter than that of points played by athletes who already have a regular training routine. These results agree with those of Torres-Luque et al. (2017), who affirm longer point durations in professional games and emphasize the importance of young athletes training in the sport rather than just playing it. This discussion arises when discussing young athletes because

we often encounter early specialization in the lives and training routines of potential future champions. Parents, athletes, and even some coaches believe that early specialization is important for athlete development because reaching elite status is faster by training in a single sport as much as possible. However, it is worth remembering that only a small percentage of young athletes reach professional status, and early specialization can compromise the holistic development of individuals in terms of physical, social, and mental aspects (Valverde et al., 2024; Güllich et al., 2022).

The studies included in this review, in addition to the categories into which the articles were divided, at least mention the importance of physical activity in the lives of children and adolescents, as seen in the studies by Schirmer et al. (2023) and Likkegaard et al. (2023), which emphasize the importance of children and adolescents having the opportunity to exercise during their routines, both during school hours and in after-school periods. Knowing that most young athletes will not become professional athletes, coaches, and teachers should invest in early diversity in the child's initial years, allowing the athlete later to choose a sport of their preference for specialization once their physical conditioning, neuromuscular training, and psychomotor maturation are not compromised and have already been achieved, so that the athlete does not suffer medium or long-term losses (Valverde et al., 2024).

Conclusions

Detailed information on competitive demands, the temporal structure of the game, and physical and behavioral variables provide a solid foundation for personalized training strategies, emphasizing the need to adapt training programs to the specific needs of players. The ability to adapt training based on specific data can result in significant improvements in the performance and long-term development of young paddle players.

Collectively, the studies highlighted here not only enrich the scientific understanding of paddle sports but also offer valuable practical guidance for coaches, athletes, and professionals involved in long-term athlete development and sports promotion. The diversity of approaches underscores the complexity of paddle sports, going beyond physical aspects to incorporate psychological, technical, and tactical elements for a multidisciplinary and holistic formation of athletes.

The main limitation of this study is that the search was conducted in only three databases, despite the importance of the selected databases in the scientific context. Future studies should attempt to update the contents and studies presented here and continue to focus on young athletes to further investigate the categories presented in this review, such as physical, technical-tactical, and mental aspects, in addition to improving research on future professional paddle athletes worldwide. This will help establish a more robust database for this rapidly growing sport.

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