



EFFECTS ON STRENGTH, JUMP, REACTION TIME AND PERCEPTION OF EFFORT AND STRESS IN MEN'S TOP-20 WORLD PADEL COMPETITIONS

EFFECTOS EN LA FUERZA, SALTO, TIEMPO DE REACCIÓN Y PERCEPCIÓN DE ESFUERZO Y ESTRÉS EN COMPETICIÓN MASCULINA DE PÁDEL TOP-20 MUNDIAL

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ABSTRACT

Padel has experienced significant growth in recent years, becoming one of the most popular and globally expanding sports. This study aims to examine the physiological performance and subjective perception of stress and fatigue in top-20 padel players during matches. Seven elite players participated in the study. Various variables were evaluated, such as subjective perception of effort and stress, isometric grip strength, reaction time, and jump performance, both before and after the matches. The results showed significant increases in subjective perception of effort ($p=0.02$), and performance in Abalakov vertical jump ($p=0.05$), as well as in horizontal jump ($p=0.03$) after the matches. However, no significant changes were observed in reaction time, free-arm jumps, and grip strength. These findings suggest that the physical conditioning of high-level padel players allows them to endure the fatigue of matches. The differences between the dominant and non-dominant hand indicate asymmetries due to the one-sided nature of this sport. Reaction time did not decrease, suggesting that the level of fatigue was not sufficient to limit the information processing of these athletes. Perceived stress, with widely dispersed values far from the maximum, was consistent with the reaction and adaptation times of the players. The repeated decelerations and accelerations from the backcourt to the net (and vice versa) did not produce excessive fatigue but rather muscular activation, which was evident in horizontal jumps. These findings contribute to understanding the physical fitness aspects of padel and can be used for the development of training programs that optimize performance and minimize the perception of fatigue in players.

Keywords: Padel, male players, psychophysiology, competitive, elite.

RESUMEN

El pádel ha experimentado un crecimiento notable en los últimos años, convirtiéndose en uno de los deportes más populares y de mayor expansión a nivel mundial. Este estudio tiene como objetivo examinar el rendimiento fisiológico y la percepción subjetiva de estrés y fatiga en jugadores de pádel top-20 durante los partidos. Participaron en el estudio siete jugadores de élite. Se evaluaron diversas variables, como la percepción subjetiva del esfuerzo y el estrés, la fuerza de agarre isométrica, el tiempo de reacción y el rendimiento en saltos, antes y después de los partidos. Los resultados mostraron aumentos significativos después de los partidos en la percepción subjetiva del esfuerzo ($p=0.02$), y en el rendimiento en salto vertical Abalakov ($p=0.05$), así como en el salto horizontal ($p=0.03$). Sin embargo, no se observaron cambios significativos en el tiempo de reacción, el salto con brazos libres y en la fuerza de agarre. Estos hallazgos sugieren que la preparación física de los jugadores de pádel de alto nivel permite soportar la fatiga de los partidos. Las

diferencias entre mano dominante y no dominante indica asimetrías debidas a la unilateralidad de este deporte. El tiempo de reacción no disminuyó, lo que sugiere que el nivel de fatiga no fue suficiente para limitar el procesamiento de información de estos deportistas. El estrés percibido, con valores muy dispersos y lejanos al máximo, coherentes con los tiempos de reacción y adaptación de los jugadores. Las repetidas frenadas y arrancadas desde el fondo a la red (y viceversa), no produjeron un exceso de fatiga, sino una activación muscular que se puso de manifiesto en el salto horizontal. Estos hallazgos contribuyen a comprender los aspectos de condición física del pádel y pueden servir para el desarrollo de programas de entrenamiento que optimicen el rendimiento y minimicen la percepción de fatiga en los jugadores.

Palabras clave: Pádel, jugadores masculinos, competición, psicofisiología, élite.

Introduction

In recent years, padel has experienced unprecedented growth, becoming one of the most popular and rapidly expanding sports around the world (Courel-Ibáñez et al., 2017). Since 2000 it has been in continuous growth, with an estimated number of practitioners above 4 million and placing it among the ten most practiced sports in Spain (Sanchez-Alcaraz, 2013). Some of the main reasons for this massive growth of padel practitioners are (i) its recreational and social character as it is practiced by 4 players, (ii) its ease of technical learning due to the proximity of the point of impact to the hand, (iii) the longer duration of the points that allows a high enjoyment of the participants, (iv) the easy accessibility to all sectors of the population due to its low economic cost and (v) the proximity to the place of residence of facilities for practice (Casper et al., 2007; Ministerio de Educacion Cultura y Deportes, 2015; Muñoz Marín et al., 2016; Sanderson, 2002). Besides, this sport promotes health benefits and positive physiological effects in collective physical activity programs (Burke et al., 2006; Zapico et al., 2012).

Previous research on competitive padel defines it as a high-intensity intermittent sport that combines high and low speed actions executed in points of short duration (Castillo-Rodríguez et al., 2014; Torres-Luque et al., 2015). Therefore, physical fitness performance determines sporting success in both professional and non-professional players (Courel-Ibáñez & Herrera-Gálvez, 2020). Typically, The strength and conditioning profile in padel involves short-distance sprints, changes in direction, upper-body strength and power, intermittent recovery endurance, and assessments of body balance (Courel-Ibáñez & Herrera-

Gálvez, 2020). In another study it was reported that elite padel players present similar values to subelite players in manual isometric strength (51.3 kg vs 49.4 kg), and jumping power (CMJ: 44.6 vs 42.3 cm) (Sánchez-Muñoz et al., 2020). Similarly, a later investigation (Courel-Ibáñez & Herrera-Gálvez, 2020) published average grip strength values of 47.4 kg in both groups of players, as well as in aerobic performance, measured with the Yo-Yo test, or flexibility. Regarding the subjective perception of effort and stress, the existing literature indicates that padel players present significant subjective stress perception (RPE) values in terms of post-match fatigue level. Previous studies have found RPE values of 4.9 out of 10 in padel players of the national ranking of Spain (Castillo-Rodríguez et al., 2014). When detailing this variable by categories, they showed higher RPE values the lower the category in the ranking (C1: 3.2; C2: 5.8 and C3 5.1 out of 10 on the Borg10 scale). In other studies, RPE values of 16 on the Borg20 scale have been found in players of the Spanish national padel championship after analyzing 60 sets and 24 players (Roldán-Márquez et al., 2022).

There are few studies that analyze physical performance in padel players. This may be due to the fact that it is a young sport, recently created and whose professionalization is in a growing process (Ruiz-Barquín & Lorenzo-García, 2008). In addition, the information reported in the research is not clear as to which physiological performance parameters are most important in the performance of padel players. However, recently, several studies that have analyzed padel players performance and they have confirmed that the professionalization of padel is growing in the sense that the values of the performance variables are reaching high values, similar to other more established sports disciplines (Courel-Ibáñez & Llorca-Miralles, 2021; Pradas, García-Giménez, et al., 2021; Pradas, Sánchez-Pay, et al., 2021; Pradas et al., 2022).

The aim of the present study was to observe the physical fitness performance in an official match of world top-20 padel players. As a secondary aim, the subjective perception of stress and fatigue of the padel players was studied.

The following hypotheses were defined: (i) Strength and jumping capacity will be reduced. (ii) Subjective perception of stress and effort will increase. (iii) Reaction time will increase.

Method

Participants

The padel matches of 7 world top-20 right-handed players (age = 27.2 ± 3.6 years, height = 180.6 ± 3.8 cm) were analyzed. Before starting the study, the participants and their coaching staff were informed of the research aims and procedures, and gave their voluntary consent according to the Declaration of Helsinki. The procedures performed in the present study were approved by the ethics committee of the Universidad Europea de Madrid (CIPI/22.303).

Study variables and measurement instruments

Rate of perceived exertion

Subjective perception of effort, using the Borg 6-20 scale (Borg, 1982). The assessments were made before and right after the matches. Participants were given detailed instructions on how to rate the experience in terms of perceived exertion. Each participant rated the perception of physical effort on a scale from “absolutely nothing” (score 6) to “extremely strong” (score 20).

Rate of stress level perception

The subjective perception of stress, using the 0-100 scale (Clemente-Suárez et al., 2018). Stress scale was shown to players before and after the matches, asking the about the level of stress they felt at these moments on a scale ranging from 0 (no stress at all) to 100 (very stressed).

Handgrip Strength

Handgrip strength test was performed as an indicator of overall strength (Cronin et al., 2017). This test was performed using a hydraulic hand-held dynamometer (Takei 5001, Japan) with an accuracy of 0.1 kg. Before and after the test, the subjects held a standardized position (standing, with the elbow in full extension) for 2–3 s at maximum pressure. All participants repeated the test twice, alternating between each hand. The researchers recorded the best score from the two trials.

Jump tests

Vertical jumps were evaluated using the jumping platform Chronojump Boscosystem version 1.6.2 (Barcelona, Spain). Countermovement jump, squat jump and Abalakov jump were evaluated according to standard methodology (Bosco et al., 1983). Each participant performed three maximal jumps of each type, interspersed with 60 s of passive recovery. The highest height out of the three jumps was recorded for each type.

Horizontal jump was used to measure strength (Wakai & Linthorne, 2005). Participants were instructed to perform a standing long jump from a position behind a designated starting line, with the aim of achieving the maximum distance forward using both legs. The distance covered during the jump was quantified in centimeters, determined by measuring from the front edge of the starting line to the point of initial heel contact with the ground.

Reaction time

Reaction time was measured using a mobile application. The phone screen would be completely white, it would randomly change to a color and the subject would have to react immediately to the change and touch the screen. The participants were previously familiarized with the application and made 3 attempts from which the average value was obtained (Tornero-Aguilera & Clemente-Suárez, 2021).

Data analysis

The statistical package IBM SPSS version 21.0 for Windows (IBM Corp., Armonk, NY) was used for data analysis. Assumptions of normality were verified with the Shapiro-Wilk test. Descriptive statistics are presented as mean plus-minus standard deviation. A repeated-measures t-test was used to assess differences in variables before and after playing the match. The significance level for all comparisons was set at $p < 0.05$. The effect size was evaluated using Cohen's *d* value (Cárdenas-Castro & Arancibia-Martini, 2014; Rhea, 2004). The results were based on the following criteria: trivial (0–0.19), small (0.20–0.49), medium (0.50–0.79), and large (0.80 and greater) (Cohen, 1992).

Results

Table 1 shows the results obtained before and after the match.

Table 1: Physical fitness response pre and post match.

<i>Variables</i>	<i>Pre match</i>	<i>Post match</i>	<i>T</i>	<i>p</i>	<i>Cohen's d</i>
GS Dominant hand (kg)	47.0±8.8	45.0±5.6	0.650	0.551	-0.227
GS Non-dominant hand (kg)	37.8±5.0	38.2±7.1	-0.232	0.828	0.080
Reaction time (ms)	286.9±26.7	269.2±16.8	-1.262	0.161	-0.663
Stress (0-100)	12.0±21.6	34.0±29.6	-1.262	0.276	1.019
RPE (6-20)	9.6±2.1	14.2±3.0	-3.683	0.021	2.190
SJ (cm)	20.3±2.8	24.5±4.6	-1.798	0.147	1.500
CMJ (cm)	23.0±2.7	27.6±5.8	-2.100	0.104	1.704
ABK (cm)	26.6±5.8	30.5±6.2	-2.759	0.050	0.672
Horizontal jump (cm)	220.6±15.8	231.2±11.0	-3.309	0.030	0.671

Note: GS: grip strength. RPE: Rate of Perceived Exertion. SJ: Squat Jump. CMJ: Countermovement Jump. ABK. Abalakov Jump.

Significant differences ($p < 0.05$) were found in the subjective perception of effort and horizontal jump. Both variables were higher after the match than before the match. In addition, a large effect size was obtained in perceived stress and SJ and CMJ jumps (Cárdenas-Castro & Arancibia-Martini, 2014).

Discussion

The aim of the present study was to analyze the physical fitness performance of top-20 world padel players before and after playing an official match. The first hypothesis was not fulfilled, since the grip strength values were maintained, and the jump values increased. The second hypothesis was fulfilled, as the values of subjective perception of effort and stress increased. The third hypothesis was also not fulfilled, as information processing time was not affected by match fatigue.

In relation to upper body performance, the analysis of isometric grip strength showed that the strength of both dominant and non-dominant hands

did not change after the matches (Table 1). Usually, in racquet sports, the dominant hand is the one used more frequently, using the non-dominant hand as support for the backhand stroke in only a few cases (García-Giménez et al., 2022) and therefore, it is the hand susceptible to fatigue. The non-loss of performance is associated with the level of the players being higher than the load of the matches played (Muñoz et al., 2018). On the other hand, the reported dominant hand strength values are similar to those found in previous studies. Previous studies reported data of 47.5 kg and 47.3 kg for the dominant hand in elite and subelite players, respectively (Courel-Ibáñez & Herrera-Gálvez, 2020). However, the reported values for non-dominant hand strength were 43.9 kg and 43.5 kg for elite and subelite. These values are higher than those reported by the top-20 players in our study, who presented a strength difference of 10 kg between both hands before playing the match. Similarly, isometric grip strength data of 51.3 kg in the dominant hand and 43.6 kg in the non-dominant hand were reported in elite players (Sánchez-Muñoz et al., 2020). Although the values reported by Sánchez-Muñoz et al. were higher than those shown in the present study, the difference between one hand and the other was similar to that of top-20 players. A possible explanation for this difference between dominant and non-dominant hands is the unilateral nature of padel, which is characteristic of racquet sports and which may promote this type of difference (Sanchis-Moysi et al., 2013).

Reaction time to a visual stimulus is a measurement related to the level of information processing by the Central Nervous System, and which in turn is related to muscle fatigue (Clemente-Suárez, 2017). In the present study, reaction time did not decrease, suggesting that the level of muscle fatigue was not sufficient to limit information processing, something similar observed after performing a Wingate test (Clemente-Suarez, 2015) and in university students during lectures (Tornero-Aguilera & Clemente-Suárez, 2021). On the contrary, other work did find an increase in mental fatigue and reaction time in players after matches belonging to the World Padel Tour competition (Díaz-García et al., 2021). In this line, our reaction time data are in accordance with the level of stress perceived by the top-20 players, which was low both before and after the matches, indicating a high level of self-confidence in these players regarding their physiological performance (Conde-Ripoll et al., 2023; Parraca et al., 2022). However, the RPE indicated by the players after the matches was significantly higher. This was not in accordance with the results of the performance tests performed, indicating that the subjective perception of fatigue was not in accordance with physiological behavior. A previous study analyzing the subjective perception of effort in padel players of the Spanish national ranking

indicated an RPE of 4.96 on the Borg10 scale after the games (Castillo-Rodríguez et al., 2014). The results of the present study, although reported on the Borg20 scale, present similarities with respect to these previous results. Similar to the present study, they reported an RPE after the Spanish national championship matches of 16 on the Borg20 scale (Roldán-Márquez et al., 2022).

Regarding the jumping tests analyzed, as a sample of the performance of the lower body musculature, the data reported by the top-20 players showed that not only was there no loss of performance, but that in the long jump test there was a significant increase in the test result. This indicates that the match load did not involve excessive fatigue for the lower body musculature of the athletes, but an activation probably related to the numerous starts that occur from the back of the court to the net (Muñoz et al., 2018). The data reported in the present study are well below the results obtained in CMJ by other researchers (Sánchez-Muñoz et al., 2020) where elite players obtained an average of 44.6 cm, and subelite players 42.3 cm. These differences may be due to a lack of familiarity with jumping technique or the inability to perform a truly maximal jump before a competition. Future studies should consider and measure the inter-point lapses (Torres-Luque et al., 2015), as well as the breaks between games and sets because they may influence the recovery process in the lower extremities of the players.

The major limitation of the present study is the sample analyzed, although they represent an important part of the total population of elite padel players. Another limitation was the lack of recording of the competitive nature of the matches according to the result, which may influence the accumulated load and fatigue.

Conclusions and practical applications

In conclusion, based on our data, it could be observed that the physical fitness performance of top-20 padel players was affected by match play in terms of subjective perception of effort and stress. Playing a competitive match also helped to activate the horizontal and vertical jumping capacity, probably due to the continuous accelerations and decelerations from the back wall to the net (and vice versa). Upper body strength and information processing capacity were not compromised by the matches, showing adequate physical preparation of the elite players, although asymmetries in strength between dominant and non-dominant hands were detected.

The results of the present investigation can be taken into account to design

adequate training programs to improve physical fitness performance and reduce the perception of fatigue in padel tennis players. The data provided by the present study will serve as a reference for physical trainers to work on the basis of the performance capabilities of elite players of this sport.

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