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Effect of a Padel Match on Biochemical and Haematological Parameters in Professional Players with Regard to Gender-Related Differences

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Abstract: Haematological and biochemical parameters have not yet been analysed in professional padel players. The aim of this study was to determine the basal values of these parameters and to observe the effect of a simulated competition on them, including gender-related differences. A total of 14 male professional players (age: 28.2 ± 7.9 years), and 16 female professional players (age: 29.7 ± 3.7 years) participated in this study. Players were allowed to hydrate ad libitum during the matches. Haematological and biochemical values were obtained before and after a simulated competitive padel match. The men's group showed higher baseline values in red blood cells, haematocrit, haemoglobin, urea, creatinine, uric acid, albumin, glutamic oxaloacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), lactate dehydrogenase (LDH) and creatine kinase (CK) ($p < 0.01$) than the women's group. Attending to match effect, significant differences were obtained in urea, creatinine, CK and glucose ($p < 0.05$). Finally, the group x match interaction revealed significant differences in serum concentrations of sodium and chloride ($p < 0.05$). In conclusion, high-level padel matches provoke several changes in biochemical parameters related to muscle damage and protein catabolism. Recovery and fluid intake strategies could be added regarding gender. The results obtained could be due to the differences in the intensity and volume of the simulated competition.

Keywords: racket-sport; performance; men; female; blood

1. Introduction

Padel is a popular sports activity that has become a mass phenomenon in some countries such as Spain, in the last decade. This sport is practised by populations of any age, gender or physical condition [1]. Padel is an intermittent, racket sport played in pairs (two vs. two) on a small-sized grass court (20 × 10 m) surrounded by glass and mesh walls on which the ball can bounce [2]. These different characteristics with respect to other racket sports have increased interest among researchers. Therefore, it seems essential to know its acute effects on the organism.

Physiologically, padel can be considered a predominantly aerobic sport, with short periods of high and very high intensity actions [3]. Like tennis, padel requires the complex interaction of several physical components (i.e., strength, agility and speed) and metabolic pathways (i.e., aerobic and anaerobic) [4]. Players have to develop fast movements and continuous changes of direction in very short periods, using mainly the phosphagen system (ATP-Pc) to obtain energy. On the other hand, anaerobic glycolysis could be less important. In this sense, maximal lactate values obtained during the game (2.4 mmol/L) confirm this fact [3]. Previous studies have reported low intensity and rest periods about 60.3% of the total time of the game, showing the relevance of the aerobic system [5].

In addition, several authors have analysed the physiological demands in padel competition. During the game, the mean of oxygen consumption (VO_2) is about 40–50% of VO_2 max measured in a laboratory test [6,7]. Similar results have been observed in other racket sports such as tennis [8]. Maximal VO_2 obtained in men and women padel players have been about 50–55 mL/kg/min [3,7], similar values to other racket sports like tennis [9].

Heart rate (HR) is considered an important parameter to determine the physiological demands in padel. The maximal HR obtained in a woman padel player (measured in a laboratory test) was about 177 ± 9.2 bpm [3]. These authors reported a mean HR of 151 ± 8.1 bpm (76.3% of maximal HR) during the game. Maximal HR observed in young men padel players (laboratory incremental test until exhaustion) was 170 ± 18.4 bpm, with a mean HR of 148.3 ± 13.6 ppm (84.9% respect to maximal HR) during the game [6].

Traditionally, studies in padel have been focused on physiological responses [3,6,10], game pattern analysis [11–13] or technical and tactical descriptions [14–17]. Regarding gender differences, a higher total time, in play time and rallies per match are observed in women's padel matches compared to men players [11,18]. However, greater score equality has been found in men's than women's matches [19], which could also indicate a higher intensity in men's padel match play. However, few studies have focused on high level padel players and the gender-related differences.

Previous studies analysed haematological and biochemical values in similar racket sports like tennis [20,21] or badminton [22,23]. However, no studies have evaluated the haematological and biochemical changes in high-level padel players after a padel match. The knowledge of these values could be very interesting to control the training load and program future training. No previous studies have been found on this topic [24,25]. Thus, the main objective of this study was to observe the effects of a simulated padel competition on haematological and biochemical parameters in professional padel players and to evaluate the gender differences.

2. Materials and Methods

2.1. Subjects

A total of 30 professional padel players, divided into two groups depending on their gender, participated in this study: 14 male players (age: 28.2 ± 7.9 years; height: 178.3 ± 4.4 cm; weight: 78.2 ± 8.5 kg), and 16 female players (age: 29.7 ± 3.7 years; height: 166.7 ± 5.1 cm; weight: 60.3 ± 4.4 kg). All of them had participated in the professional circuit World Padel Tour during the previous seven years. Anthropometric parameters are presented in Table 1.

Table 1. Anthropometric parameters of the participants (mean ± standard deviation).

Parameters	Men (n = 14)	Women (n = 16)
Age (years)	28.2 ± 7.9	29.7 ± 3.7
Weight (kg)	78.2 ± 8.5	60.3 ± 4.4
Height (cm)	178.3 ± 4.4	166.7 ± 5.1
Fat mass (%)	10.6 ± 2.5	17.6 ± 2.7
Muscle mass (%)	43.4 ± 2.4	36.6 ± 2.8
VO_{2max} (mL/kg/min)	55.4 ± 7.0	46.8 ± 4.6
Maximum heart rate (bpm)	179 ± 7.5	175 ± 6.4
Training per week (h)	23.5 ± 3.9	24.1 ± 3.3

All participants were informed about the aim of the study and gave their informed consent. A code was assigned to each participant for the collection and treatment of the samples in order to maintain their anonymity. This research was carried out according to the Helsinki Declaration ethic guidelines, updated at the World Medical Assembly in Fortaleza (Brazil) in 2013 for research with human subjects. The Clinical Research Ethics Committee of the Department of Health and Consumption of the Government of Aragon (Spain) approved the research project.

2.2. Procedures

The sample was selected by convenience due to the difficulty of finding these types of athletes. Padel players, included in the world ranking, compete around the world. Therefore, a specific moment was selected to evaluate the maximum number of players when they competed in Spain. The volume of training per week was determined by asking the player. In order to record the biochemical and haematological response produced during a competition and considering the difficulties to perform it during a World Padel Tour (WPT) test, a simulated competition (SC) was designed. SC characteristic are presented in Table 2. The SC consisted in the organisation of a padel match where a competitive situation similar to one of an official nature was reproduced, following the rules of the International Padel Federation [26]. The matches were held on an outdoor court with environmental humidity conditions of 43 ± 4.2% and temperature of 22.5 ± 0.8 degrees Celsius. Training intensity and volume were reduced on the two previous days of SC.

Table 2. Simulated competition (SC) characteristics (mean ± standard deviation).

Parameters	Men (n = 14)	Women (n = 16)
Total Time (min)	79.4 ± 16.6	69.7 ± 17.9
Real Time (min)	31.2 ± 7.6	25.2 ± 17.9
Real Time (%)	40.7 ± 9.8	43.5 ± 11.8
Rest Time (min)	47.1 ± 9.9	33.7 ± 10.6
Rest Time (%)	59.3 ± 10.2	56.5 ± 12.3
Water Intake (mL)	861.4 ± 369.8	737.5 ± 326.1

The development of the SC was according to the official regulations applied in professional tournaments playing all the matches to the best of three sets. If the situation of six equal games was reached, a tie break was played. Before starting the SC, the players performed a standardised warm-up of a duration of 15 min, divided into 5 min of generic physical activity and 10 min of a technical specific warm-up on the court. Total time is the full time of the match, from the beginning to the end, considering the periods of game and rest. Real time is the time that passes since a point begins (at the moment it hits the ball the player serving) until the end. Rest time means the time that passes from the end of one point to the beginning of the next point [16].

2.3. Determination of Maximum Oxygen Consumption and Maximum Heart Rate

A maximum incremental test was used to evaluate the physical performance variables. The test consisted of running on a treadmill (Pulsar HP. Cosmos, Nussdorf, Germany) until exhaustion. The treadmill was equipped with a gas analyser (Oxycon Pro. Jaegger, Germany) and pulsometer (Cosmos. Nussdorf, Germany). To guarantee a warm-up phase before the test, all participants ran for 5 min at 6 km/h. The protocol consisted in running in incremental stages, until voluntary exhaustion (no possibility of continuing running) starting at an initial speed of 8 km/h and increasing it by 1 km/h every minute, with a stable slope of 1%.

2.4. Blood Samples

Two extractions of 5 mL of venous blood were drawn from the antecubital vein of each participant. Venous blood samples were collected in Vacutainer tubes containing ethylenediaminetetraacetic acid (EDTA) as anticoagulant. The first sample was extracted 90 min before the matches after a fasting period of 8 h and the second, just after the matches (10 min after). After the first blood extraction, the participants ingested a similar breakfast, which consisted of a bottle of a 5% glucose solution drink. Once extracted, the samples were collected into a metal-free polypropylene tube (previously washed with diluted nitric acid).

Once collected, the blood samples were centrifuged at 2500 revolutions per minute for 10 min at room temperature to isolate the serum. The samples were coagulated for 25–30 min. The serum was aliquoted into an Eppendorf tube (previously washed with diluted nitric acid) and conserved at −80 °C until biochemical analysis. During the matches, the drink ingested was controlled and consisted of bottled mineral water. Players were allowed to hydrate freely during the matches (ad libitum). Body weight was measured before and after the SC.

2.5. Determination of Haematological and Biochemical Parameters

Haematological parameters (red blood cells, haematocrit, haemoglobin and mean corpuscular volume) were determined through an analyser model Coulter model A^{c}T diff. Urea, creatinine, uric acid, glutamic-oxaloacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), albumin, lactate dehydrogenase (LDH), creatine kinase (CK), glucose, triglycerides and electrolytes (sodium (Na), potassium (K), chloride (Cl^-) and magnesium (Mg)) were determined by spectrophotometric techniques. Complete biochemistry was processed at the laboratory of San Jorge University Hospital, with a Chemistry Analyzer model Advia 1650 (Bayer, Germany).

2.6. Statistical Analysis

A descriptive analysis was performed to show means and standard deviations. The normality of the distribution of the variables was analysed using the Shapiro-Wilk test and the homogeneity of the variances using the Levene test. A two-way ANOVA (Group effect and Match effect) was used to show differences between study variables. The differences between after and before (delta values = Δ) were determined. $p < 0.05$ differences were considered statistically significant. Data were processed in IBM SPSS 25.0 Statistics for Macintosh (IBM Corp., Armonk, NY, USA).

3. Results

The results obtained in the body weight and haematological parameters before and after the matches are presented in Figure 1.

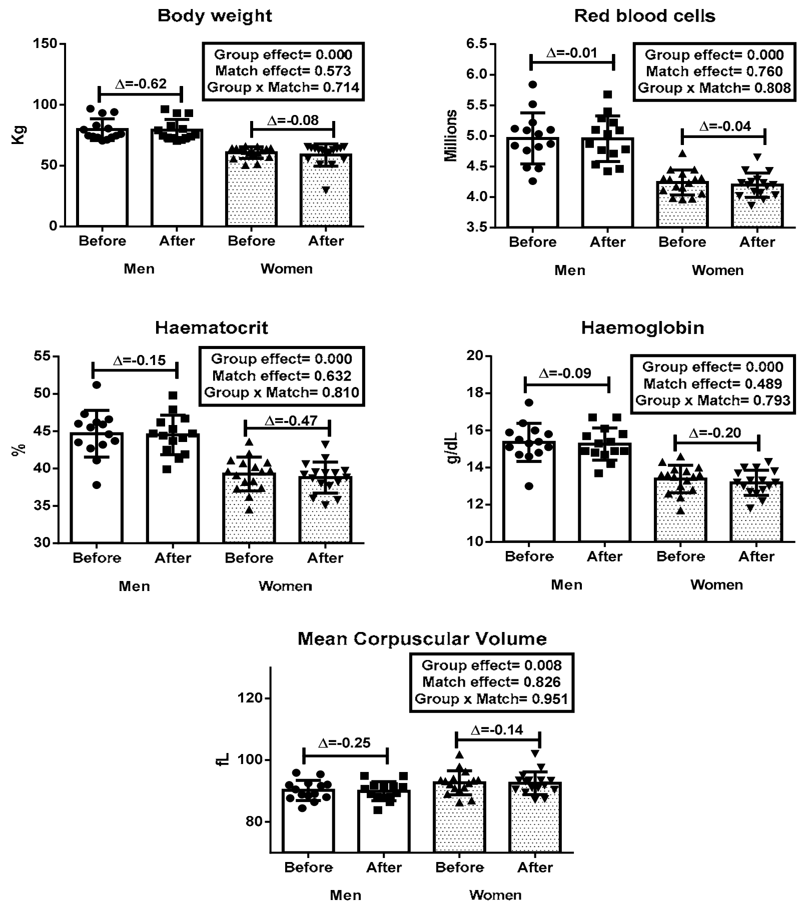

Figure 1. Body weight and serum concentrations of the haematological parameters before and after the match in both groups. Δ = delta.

When examining the group effect, significant differences were observed in all parameters ($p < 0.01$). No differences in match effect or group x match interaction were observed.

Biochemical parameters are shown in Figures 2 and 3.

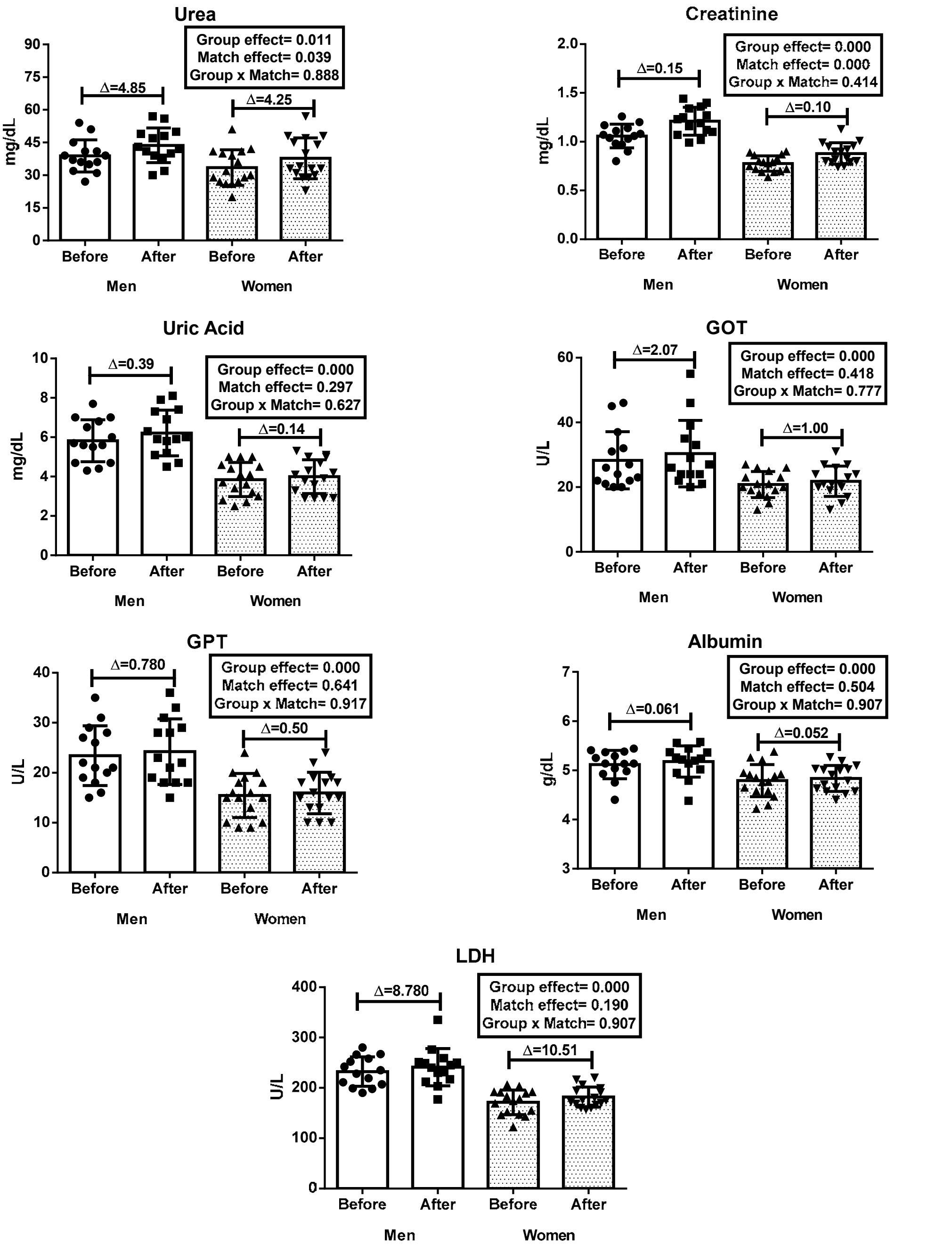

Figure 2. Serum concentrations of urea, creatinine, uric acid, GOT, GPT, albumin and LDH before and after the matches in both groups. GOT = Glutamic-Oxaloacetic Transaminase; GPT = Glutamic-Pyruvic Transaminase; LDH = Lactate Dehydrogenase; Δ = delta.

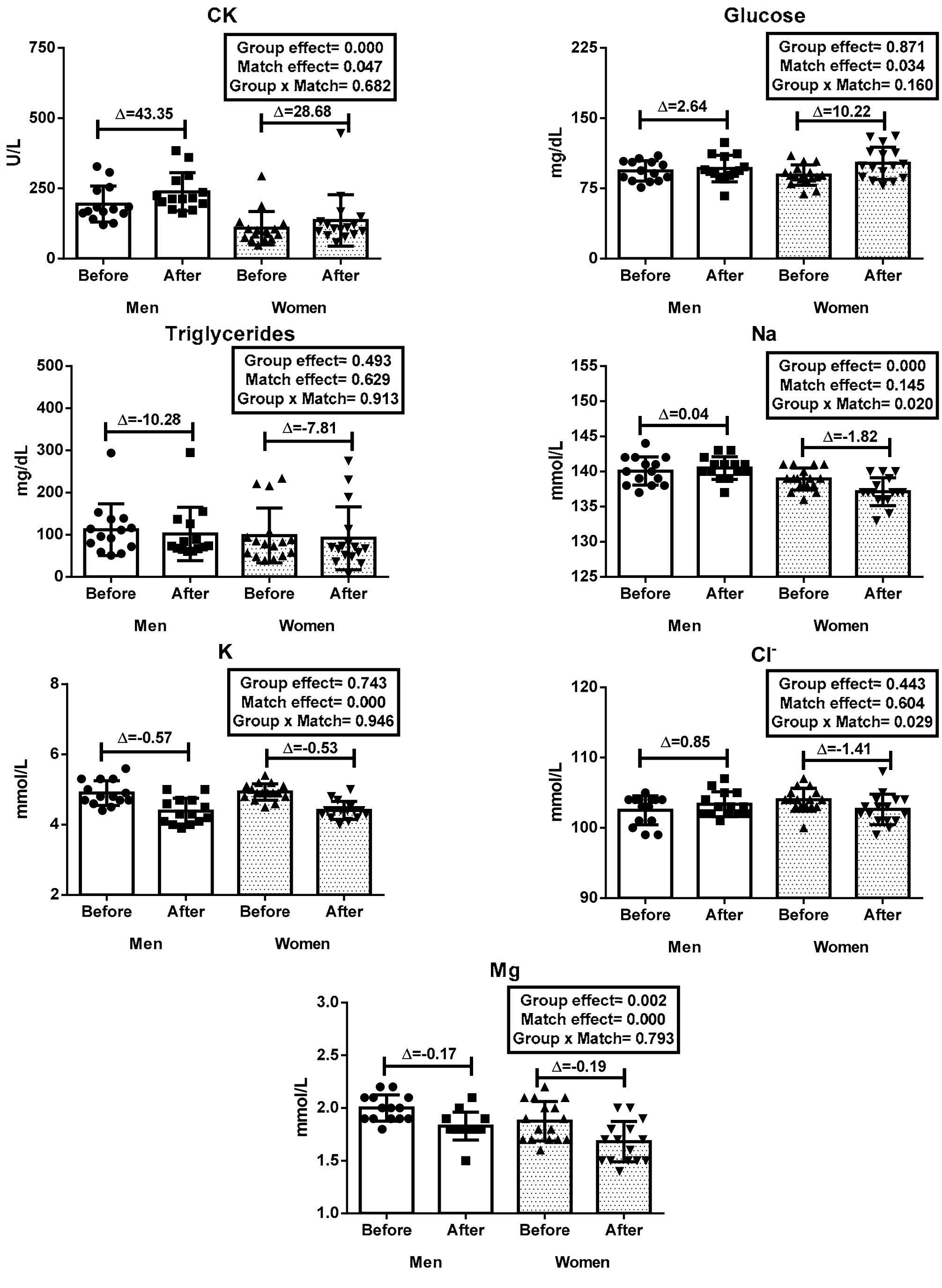

Figure 3. Serum concentrations of CK, glucose, triglycerides, Na, K, Cl^- and Mg before and after the matches in both groups. CK = Creatine Kinase; Na = Sodium; K = Potassium; Cl^- = Chloride; Mg = Magnesium; Δ = delta.

Significant differences were observed between groups in all parameters ($p < 0.05$). Higher values were observed in men compared to women. Attending to match effect, significant differences were observed in urea and creatinine ($p < 0.05$).

When examining the group effect, significant differences were observed in CK, Na and Mg ($p < 0.05$). According to match effect, significant differences were obtained in CK, glucose, K and Mg ($p < 0.05$). Finally, in the group x match interaction significant differences were observed in Na and Cl^-.

4. Discussion

The main objective of this study was to determine the effects of a padel match (simulated competition) on haematological and biochemical parameters in professional padel players, and to observe the gender-related differences. No previous studies have been found in the literature about this topic in padel.

Other racket sports, such as tennis or badminton, have similar physiological characteristics to padel. Badminton is a combination of high-intensity short rallies and longer or moderate-intensity rallies with recovery periods between rallies. Approximately 80% of rallies last less than 10 s and competitive matches last 40 min to 1 h [27]. On the other hand, tennis has average points that last <10 s, but competitions can last >5 h. Tennis is a predominant anaerobic activity requiring high levels of aerobic conditioning to avoid fatigue and recover between points [28].

Firstly, a high-level padel match produced changes in several parameters (especially in biochemical ones), in both the men's and women's groups. All of the haematological [29] and biochemical results [30,31] were in normal ranges.

Regarding haematological parameters, no changes were observed after the matches in any group. In contrast to our study, Abián et al. observed significant changes in men players after a simulated badminton match in haemoglobin and haematocrit [23]. Attending to group effect, significant differences were observed in all parameters. Higher values were observed in men compared to women. These gender-related differences have been previously observed in other sports [32,33]. The difference in testosterone values between genders could explain the higher values observed in the men's group [34], not only related to protein synthesis and tissue growth, but also to erythropoiesis [35,36]. Also, the different muscle mass values and fitness levels of each group may explain gender-related differences in haematological values [37].

Urea, creatinine and uric acid concentrations increased after the SC in both groups. Higher values were observed in men's group. Creatinine and uric acid levels are associated with increased strength and muscle mass [38,39]. Similar results were obtained by Majumdar et al. after a simulated badminton match [22]. In the same way, other authors observed uric acid, urea and creatinine increases after strength training [40]. Uric acid is a final product of purine metabolism, and it has been suggested to be an important antioxidant molecule [40–43]. Antioxidant properties of uric acid have been attributed to the capacity of reacting with biological oxidants [40]. Thus, the increases observed in this parameter after the padel matches could be a mechanism to face the greater production of reactive oxygen species (ROS) cause by the physical exercise [44]. On the other hand, the increases observed in urea after the SC could be associated with an enhanced protein catabolism due to the game intensity. Similar results were observed in previous studies in tennis [45].

An increase in glucose concentration was observed after the match. Similar results were obtained by Akşit et al. in well trained tennis players after a performance test [46]. These changes in glucose values are facilitated by a diminution of insulin hormone concentration and an increase in glucagon and catecholamine plasma levels [47]. During exercise, endogenous glucose production is higher in order to minimise the possible hypoglycaemia risks [48].

Regarding exercise-induced muscle damage, basal values of CK and LDH were higher in the men's than the women's group. A significant increase of CK was observed after the match and this change was higher in the men's group. Previous studies obtained similar results in national badminton players, with increased CK and LDH concentrations after a SC [22,23]. However, Abián et al. observed higher changes in men players after a simulated badminton match compared to our study [23]. In the same way, similar results were obtained by Ojala & Häkkinen after some tennis matches in a tournament [20]. The presence of CK and LDH in blood is a cell-membrane damage indicator [49]. Exercise-induced muscle damage is related to eccentric activities and to highly repeated muscle contractions [50,51]. It has been observed that CK and LDH increases could provoke a loss of strength, reduced range of motion and an increase in muscle soreness [52]. Padel players have to develop fast movements and continuous changes of direction in very short periods, with eccentric and high intensity muscle contractions, which could explain the increases in serum CK and LDH concentrations [53]. Differences in muscle mass between the genders could explain the higher values of CK and LDH in men.

The results showed increases in transaminases (GOT and GPT) and albumin after a padel match in both groups. Basal concentrations of these parameters were higher in the men than the women. Other studies obtained the same results in bodybuilders [54] and marathon runners [55]. GOT and GPT have been reported as liver status markers. However, they are also present in muscles, heart, kidney, red blood cells, brain and the small intestine [56], and their increase could be more related to muscle damage [57] than to a hepatic disorder. As happened with CK and LDH, the high-intensity actions, changes of direction and powerful hits required in padel could provoke this response.

Finally, electrolyte concentrations (Na, K, Cl^- and Mg) suffered a decrease after the matches; these differences were significant in K and Mg ($p < 0.01$). Attending to group effect, significant differences were observed in Na and Mg ($p < 0.01$). Abián et al. observed the same results after a badminton match [23]. However, no changes in plasma electrolyte values were reported after an indoor tennis match [58], where participants drank fluids ad libitum. The intensity of game [59], dehydration, or distribution of electrolytes in other compartments may affect serum concentrations of electrolytes [60,61]. Also, the weight loss observed in the present study, higher in the men's than the women's group, could be related with an increment in sweat excretion caused by the exercise. Sweat is comprised of several electrolytes, including Na, Cl^- and K [59], and a high sweating is related to an electrolyte deficit, especially Cl^- and Na [62]. On the other hand, other authors suggest that exercise intensity has an impact on sweat K losses in practice [59]. In addition, electrolyte losses observed in other studies demonstrate the large variability among individuals [58]. Thus, these diminished mineral concentrations in serum after the match could be related to a sweat increase in order to reduce metabolic heat production. Great losses could negatively affect performance or provoke some injuries [63]. Our results suggest that different fluid/electrolyte intake strategies may be needed depending upon variations in exercise intensity between training sessions/competitions and gender.

Some limitations of the study should be noted. First, a simulated competition is different from a real competition, so that could affect the results. Second, an indoor surface could be different from outdoor matches. Temperature and humidity conditions and sweat vary according to the conditions. Third, changes in plasma volume after SC were not evaluated. Future research should examine the haematological and biochemical parameters in more detail and consider the conditions under which the matches are played. Monitoring of training load and control of nutritional intake is necessary for future studies.

5. Conclusions

This is the first research observing the effects of a high-level padel match on haematological and biochemical parameters and the differences between genders representing a preliminary approach. In addition, these results could be used as a reference for padel players, as they let us know the impact of a padel match on the players. Recovery and fluid intake strategies could be added regarding gender.

In conclusion, with respect to the gender differences, all values analysed were higher in the men's group than the women's group, probably due to the intensity of training and anthropometric characteristics of male padel players. High-level padel matches provoke several changes in parameters related to muscle damage, protein catabolism and electrolytes due to the game intensity. More research is needed in order to clarify these facts.

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