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Comparison of the physical profile of male and female athletes of obstacle races

Comparación del perfil físico de atletas masculinos y femeninos de carreras de obstáculos

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Abstract: With the constant increase of the female population in obstacle races in sport it is important to consider possible comparisons with men in terms of physical capacities. Thus, the present study aims to compare the morphological and functional characteristics between male (n = 27) and female (n = 6) of obstacle course running (OCR). The results show that, comparing the runners of both sexes, men have a BMI (t = 0.135, d = 0.692) and body mass (t = 0.001, d = 1.905) slightly higher, with women having more fat mass t = 0.001, d = 2,541). In terms of functional aspects, male practitioners obtained significantly higher values of MRI in the back squat (t = 0.019; d = 1,120), pull-up (t = 0.001; d = 2,019) and throwing of the medicine ball (t = 0.001; d) = 3,469) compared to women. Concluding that in general men are more resistant, powerful, fast and agile, but with higher fatigue rates compared to women.
Keywords: Genders OCR, Power, Resistance, Agility, Strength.

Resumen: Con el constante aumento de la población femenina en el deporte, se hace importante la concienciación y caracterización de la modalidad en lo que se refiere a la diferencia entre géneros. En este seguimiento, el presente estudio tiene como objetivo comparar las características morfológicas y funcionales entre género masculino (n = 27) y femenino (n = 6) de practicantes de carreras de obstáculos (OCR). Los resultados muestran que, comparando los corredores de ambos sexos, los hombres presentan un IMC (t = 0,135, d = 0,692) y masa corporal (t = 0,001, d = 1,905) ligeramente superiores, siendo que las mujeres presentan más masa grasa t = 0,001, d = 2,541). En cuanto a los aspectos funcionales, los practicantes masculinos obtuvieron valores significativamente superiores de RM en el back squat (t = 0,019; d = 1,120), pull-up (t = 0,001; d = 2,019) y lanzamiento de la bola medicinal (t = 0,001; d) = 3,469) en comparación con las mujeres. Concluyendo que en general los hombres son más resistentes, potentes, rápidos y ágiles, pero con índices de fatiga superiores en comparación con las mujeres.
Palabras clave: Géneros OCR, Potencia, Resistencia, Agilidad, Fuerza.

Introduction

The *Obstacles course racing (OCR)* is a race that consists in the transposition of obstacles, in the shortest possible time, that appeals to different motor skills such as strength, resistance or speed as well as coordination (Stewart, 2012). The appearance of these events dates more than a decade of existence because in 1993, at Camp Pendleton (base of the California Marine Corps) the first and most famous race was organised, the *MUD RACE* which was, according to the existing records, the second race open to the public (Brett & McKay, 2015).

In order to rapidly control the state of an individual it is possible to, through anthropometric characteristics and regardless of gender, find their body mass index (BMI). Subsequently, it is possible to compare these values using a scale provided by the Normative Circular Nº03/DGCG where, in order to be considered within the healthy standards, individuals must have a BMI between 18.5 and 24.9. However, it is essential to take special care when assessing athletes since, sometimes, they may develop muscle levels that may possibly fit in the pre-obesity values (Maesta et al., 2000).

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When considering a sports modality, it is important to keep in mind that strength training is usually associated with a progressive increase in resistance and, consequently, associated with muscular strength gain and several types of training. Lewis, Kamon, & Hodgson (1986) found that, when comparing different types of training, there were no significant differences between the muscular gains in response to the type of training used. However, Gettman, Ward, & Hagan (1982) compared body composition according to gender and found that there was a higher significant increase in muscle mass in women compared to men, although this conclusion may be related to the fact that women were less well trained, thus achieving greater evolution. Regardless of gender, muscle structure is extremely important giving expression to the force during movement. In fact, there is an enormous correlation between muscle thickness and the individual's ability to produce force (Kawakami, Abe, & Fukunaga, 1993).

By analysing studies such as the one of Salvador and colleagues (Salvador, Cyrino, Luiz, & Gurjão, 2005) who investigated strength as a variable, it is possible to observe that men have been found to be slightly stronger and therefore their BMI is higher, which revalidates, to a certain extent, the author of the previous paragraph, also validating the existence of possible gender differences in strength.

After analysing studies such as the ones of Entringer and colleagues (Entringer, Maciel, Machado, & Morales, 2011) with a sample of athletics, (Queiroga & Cavazzotto, 2013) on cyclists (Matos, 2017) or in the military, we verified that according to the modality, the power values in anaerobic tests vary widely in both genders.

Since agility is often recognized as the ability to change direction quickly and to stop and start also at high speed (Little & Williams, 2005)acceleration, or agility. Contradictory findings have been reported as to the extent of the relationship between the different speed components. This study comprised 106 professional soccer players who were assessed for 10-m sprint (acceleration it becomes a variable of extreme need for characterization. The same types of muscle fibres are used at maximum speed and agility suggesting that these qualities are closely related (Little & Williams, 2005)acceleration, or agility. Contradictory findings have been reported as to the extent of the relationship between the different speed components. This study comprised 106 professional soccer players who were assessed for 10-m sprint (acceleration. Thus, it was decided to be a factor of analysis during the course of the study. In previous studies that related these correlations of variables, (Sekulic, Spasic, Mirkov, Cavar, & Sattler, 2013) it is possible to verify that men are generally more agile than women. There are three neuromuscular variables: quick force, maximum strength and resistance. All of these variations are used in the most varied sports (Weineck, 1989).

It is necessary, to characterize a sports modality, to test all these variables, from aerobic resistance to anaerobic power. Although in different tests there are differences between men and women, there is no study dedicated to the characterization and differentiation of participants of Obstacle Races, which leads us to the execution of the present study. Therefore, with this study, we aim to understand the differences between the capacities and morphofunctional characteristics of both genders when evaluated in resistance tests, power tests, strength tests and agility tests.

Methods

Participants

Thirty-three recurring participants (3 minimum workouts per week) of obstacle races that attend gymnasiums of the modality were divided into two groups: Males (n=27) and Females (n=6), in order to carry out the respective physical and morphological characteristics. The total group presents a mean age of 34,15 years, with the mean age of the male group (n=27) 34,62 years and the mean age of the female group (n=6) with 32 years. All participants attend classes specific to the sports modality with a frequency exceeding two hours per week in addition to their normal workout, which varies weekly since they are not professional athletes. Participants were informed about the experimental protocol and the implications of the study. After becoming aware of the study, they signed an informed consent form. The intervention followed the recommendations of the Helsinki Declaration for the study in humans.

Experimental procedures

The tests were performed outdoors in March 2017 and were administered by Personal Trainer's properly accredited. The data collection was performed in two days, separated by seven days of interval, and introduced during OCR classes. Tests were performed after a warm-up protocol consisting of continuous low-intensity running (5 min) and specific dynamic stretches for the muscle groups participating in the tests (10 min).

The two test blocks were divided into a first group where all morphological characteristics were collected: age, height and BMI as well as *RAST* tests, *T-Test*, RM *Back Squat* tests and Hand Grip with Dynamometer. The second group had the following tests: *Squat Jump, Counter Movement Jump, Drop Jump, Cooper test, medicine ball throw and static resistance in a pull-up*.

The absence of moderate-to-intense practice was ensured in the two days prior to the tests. The tests were run in a controlled environment of about 23° C and relative humidity of 0 to 5%.

Jump squats

In the *Jump Squat* test, the participant climbed up the platform (Contact platform DIN-A3 – *chronojump Boscosytem*) and positioned himself with both hands resting on the waist, performing a squat until reaching an angle of 90 degrees, with the back of the tibiofemoral joint, where he stabilized the position for three seconds. In that position, it was possible for the researcher to start collecting data. Once the test started, the participant performed the full extension of the lower limbs with their maximum power, thus achieving a jump from the squat position. This test was repeated 3 times by each participant with a rest of 1 minute between each repetition, which allowed us to, "a posteriori" pick the best result for analysis.

Countermovement Jump

On the *Countermovement Jump*, the participant climbed up the platform (Contact platform DIN-A3 – *chronojump Boscosytem*) and put his hands on his hip. After the technician's permission, the participant performed a 90-degree squat with a jump in the final phase of the test. Thus, this is the only test in which the participant can gather force to jump through the countermovement. The participant should jump as high as possible and perform the reception with the toe of the foot first. The participant made 3 attempts with an interval of 1 minute. The best result was withdrawn for analysis.

Drop jump

Researchers put a box with a height of 30 cm in front of the platform of impact (Contact platform DIN-A3 – *chronojump Boscosytem*). The box was the starting point of the test for the participant. The participant begins on top of the box and, when he receives the permission to start, he places the hands on the waist (as previously mentioned) and makes a step forward. He then dropped on the platform. As soon as he reached with the toe of the foot he reacts to the fall with an opposite movement. Three attempts are made, with intervals of 30 seconds between each attempt. The researcher records the best result obtained by the participant.

12-min Cooper's test

The researcher places the elements in an outdoor track previously marked and gauged through GPS (Garmin eTrex 10). After the warm-up, the participant ran for twelve minutes without interruption. In the end, everyone marked on the floor their final position so that they can immediately carry out an active recovery (Cooper & Storer, 2004).

Back squat

This test was used to evaluate the Strength of the lower limbs, that is, by maximal repetition (MR) in *Back Squat* and following (Haff & Triplett, 2016) through the suggested protocol. The participant warmed up and performed some sets of exercises with submaximal loads, starting with a light load. After the participant has rested enough to feel recovered from the previous attempt (1-5 minutes, depending on the difficulty of the attempt) he increases slightly the weight, based on the ease of performing on the previous test and in order to achieve only one repetition of the exercise, thus achieving MR (Inez, Pereira, & Chagas, 2003).

Pull-up

In order to perform the test, an element responsible for the evaluation of the exercise and timing was placed in the lateral of the participant. The participant had to raise an arm up to his shoulders and elbows obtaining an angular position of 90 degrees. The test applicator finished the timing as soon as the participant lost the evaluation position, and recorded the variable (time) obtained (Montalvão, César, Salum, Dantas, & Meireles, 2008).

Medicine ball throw

In order to perform this test, the protocol suggested by the Federal University of Rio Grande do Sul was followed. This University prepared a manual suggesting the application of tests and physical evaluations (Gaya & Gaya, 2016). The test started with the participant sitting with his knees extended, the legs joined and the back completely supported on the wall from which a metric tape attached perpendicularly should measure the throwing distance of the medicine ball (3kg). The ball was thrown frontally, leaving from an anterior position of the body. The distance from the pitch was recorded from the ground zero to the place where the ball touched the ground for the first time. Participants had two attempts each. Only the best attempt was recorded.

Repeated ability sprint test

After the participants had already performed some sprints for warm-up, the data was collected. Each participant performed 6 complete races of 35 meters, previously measured with a tape measure (Tape measure with crank 50MX13MM DEXTER) at maximum speed with only 10 seconds of rest between each sprint (Queiroga & Cavazzotto, 2013). The researcher recorded all times (seconds) of each running track. The fatigue index (Maximum Power [W]) - Minimum Power [W] / Total time of the 6 races [sec]) was calculated afterwards by calculating the power of each path (Peso [Kg] x Distância [m²]/ Tempo [seg ²]). This test was preceded by a weighing in order to record the weight of the participant when performing the test.

Handgrip test

In accordance with Bertuzzi, Franchini and Kiss (2005) the participants through a manual gripper dynamometer (Jamar dynamometer) and try to find their maximum hold load. The participant with his dominant hand held the device in an orthostatic position performing 3 attempts with a 1-minute rest interval between each repetition. After, the variable (weight kg) with the highest value was recorded in the device.

T-test

We performed the T-Test according to the protocols suggested by Haff & Triplett (2016) with A-B distances of 9,1 meters and B-C of 4,6 meters. Each element performed two tests with a rest interval always exceeding 5 minutes. The variable obtained (time) with the best mark was recorded.

Statistical procedures

The descriptive statistics (mean and 90% confidence interval) were calculated for all dependent variables. The assumption of normality was assured considering the Central Limit Theorem (n > 30) (Marôco, 2010). The Levene statistical test was used to verify the assumption of homogeneity. For the comparison between male and female participants, independent t-tests were used followed by the calculation of the effect size from D Cohen. The effect size classification was performed according to the following intervals (Ferguson, 2009): no effect (d <0.41), minimal effect (0.41 <d <1.15), moderate effect (1.15 <d <2.70), and large effect (d> 2.70). Statistical processing was performed using SPSS software (version 23.0, IBM, USA) at p <0.05.

Results

Morphological

The descriptive statistics (mean ± 90% confidence interval) for age, body mass, height, BMI and fat mass of male and female practitioners can be observed in figure 1. The independent t-test (t) followed by the effect dimension calculation from Cohen's D (d) analysed the variance of the morphological variables between male and female practitioners. Body mass (*t* = 0.001, *d* = 1.905, *moderate effect*) and height (*t* = 0.001, *d* = 3.772, *large effect*) were found to be significantly higher in male practitioners.

On the other hand, fat mass was significantly higher in female athletes (*t* = 0.001, *d* = 2.541, *large effect*). There were no significant differences between male and female practitioners in BMI (*t* = 0.135, *d* = 0.692, *minimal effect*) and age (*t* = 0.447, *d* = 0.348, *no effect*).

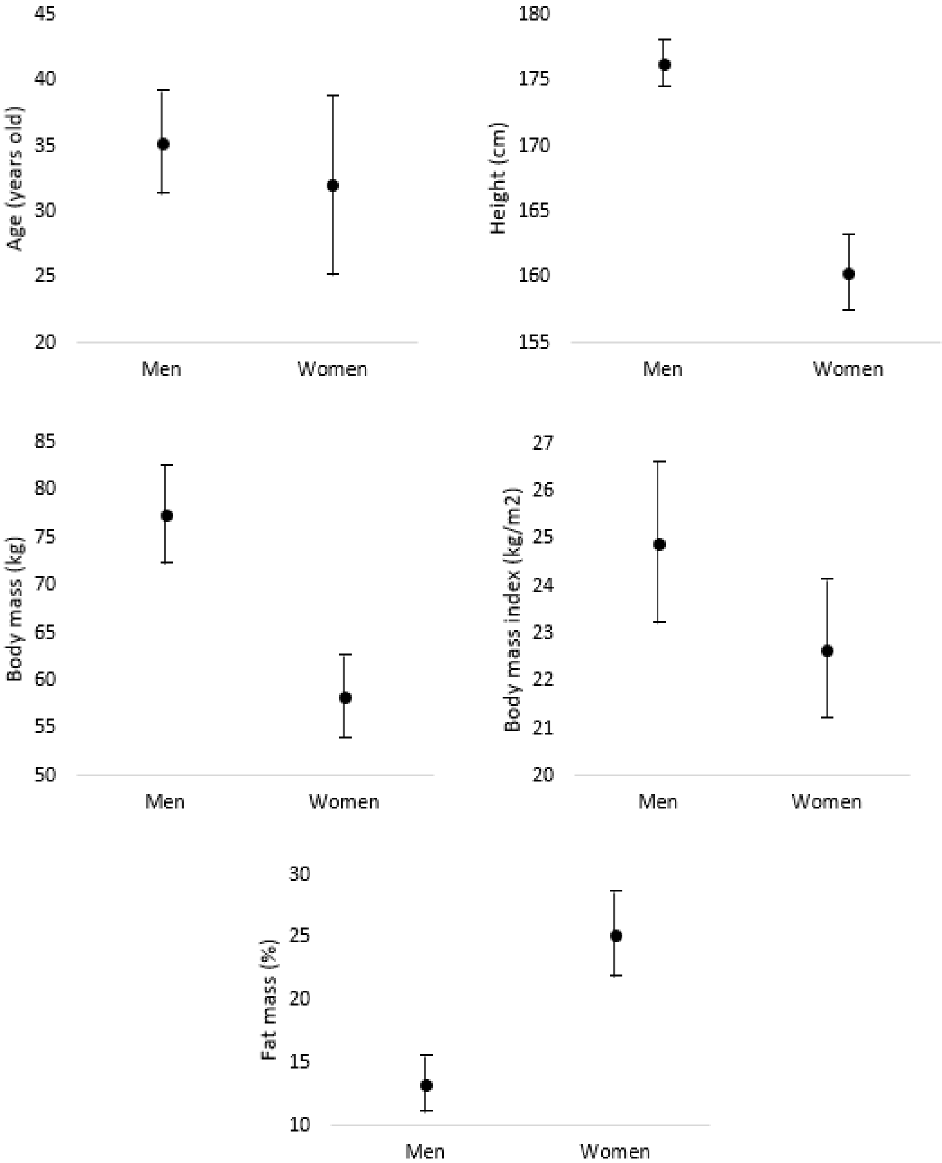

Figure 1. Mean ± 90% Confidence Interval of age, body mass, height, BMI and fat mass of male (n = 27) and female (n = 6) practitioners.

Functional performance

The descriptive statistics (mean ± 90% confidence interval) of back squat MR, suspension seconds (s) in the pull-up, medicine ball throw and hand grip with dynamometer of male and female practitioners can be observed in figure 2. The independent t-test (*t*) followed by the calculation of the effect size with Cohen's D (*d*) analysed the variance of the functional variables between male and female practitioners. It was found that male practitioners obtained significantly higher MR values in the back squat (*t* = 0.019, *d* = 1.120, *minimal effect*), pull-up (*t* = 0.001, *d* = 2.019, *moderate effect*), and medicine ball throw (*t* = 0.001, *d* = 3.499, *large effect*) compared to female practitioners. There were no significant differences in hand grip with the dynamometer (*t* = 0.055, *d* = 0.900, *minimal effect*).

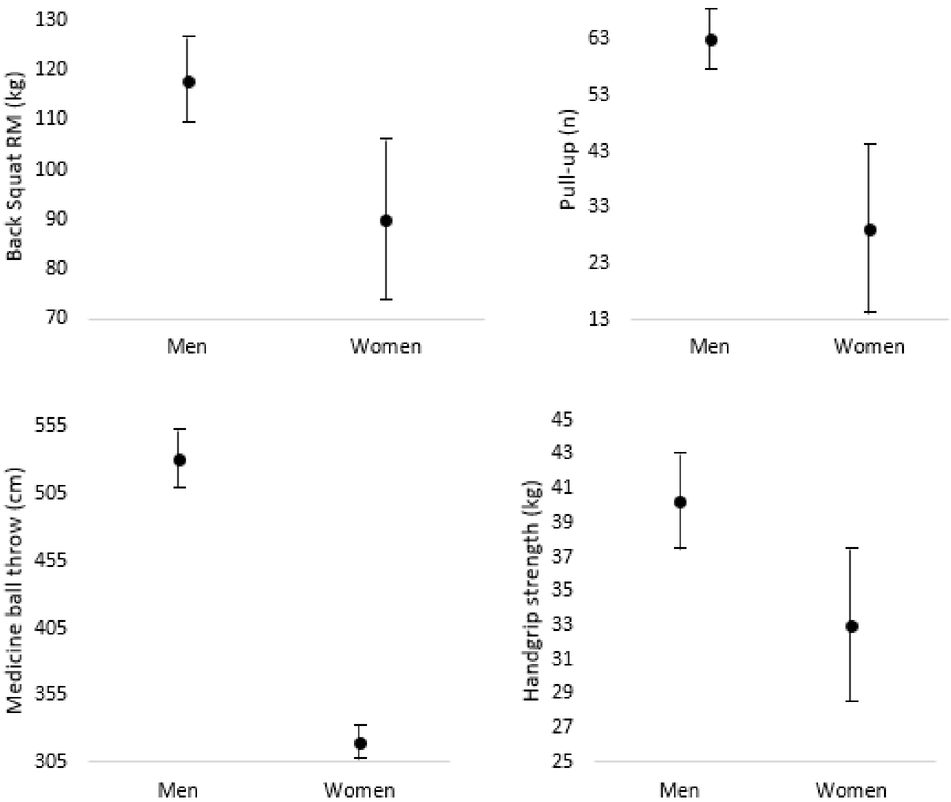

Figure 2. Mean ± 90% MR Confidence Interval in the back squat, pull-up suspension time, medicine ball throw and manual grip with the dynamometer of male (n = 27) and female (n = 6) practitioners.

The descriptive statistics (mean ± 90% confidence interval) of the RAST test and the agility t-test of male and female practitioners can be observed in figure 3. The analysis of the variance showed that male practitioners, in the RAST test, were significantly faster (*t* = 0,001; *d* = 1,630, *moderate effect*), powerful (*t* = 0.001, *d* = 2.539, *large effect*) and with a higher fatigue index (*t* = 0.006, *d* = 1.341, *moderate effect*). It was also found that males were significantly faster in the agility test (*t* = 0.001; *d* = 2.924, *large effect*).

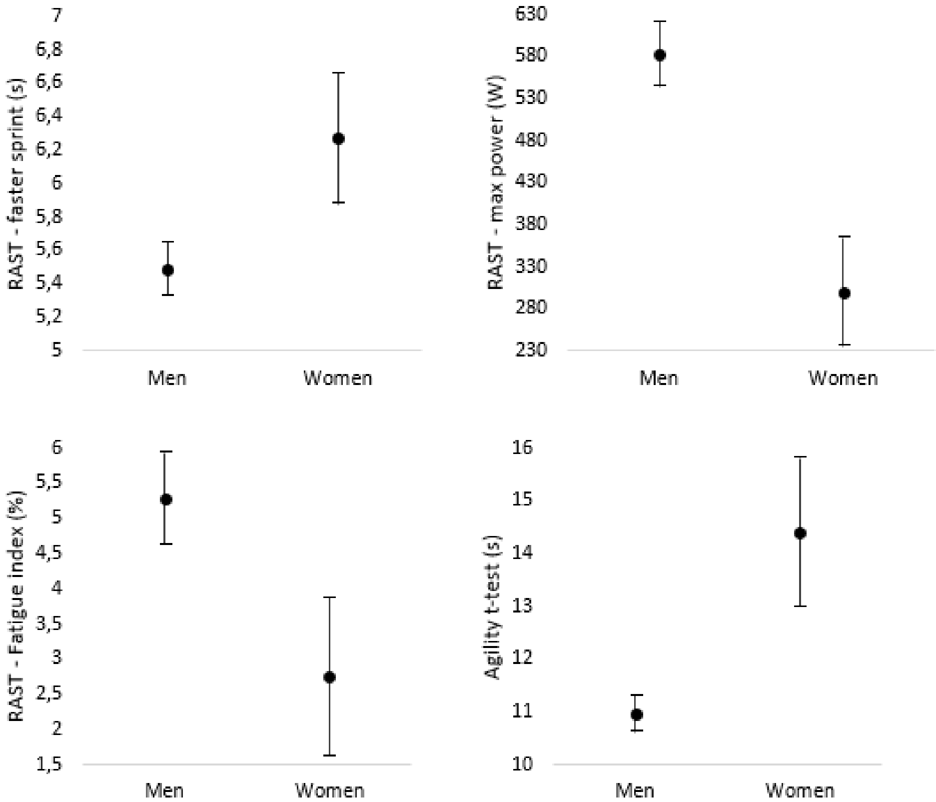

Figure 3. Mean ± 90% RAST Confidence Interval - best time, maximum power and fatigue index, as well as agility t-test of male (n = 27) and female (n = 6) practitioners.

The descriptive statistics (mean ± 90% confidence interval) of the jump squat, countermovement jump and drop jump tests of male and female practitioners are presented in figure 4. The analysis of variance showed that male practitioners jumped significantly higher in the jump squat test (t = 0.035, d = 0.998, *minimal effect*) and countermovement jump (t = 0.005, d = 1.351, *moderate effect*). There were no significant differences in the drop jump (t = 0.109; d = 0.743, *minimal effect*).

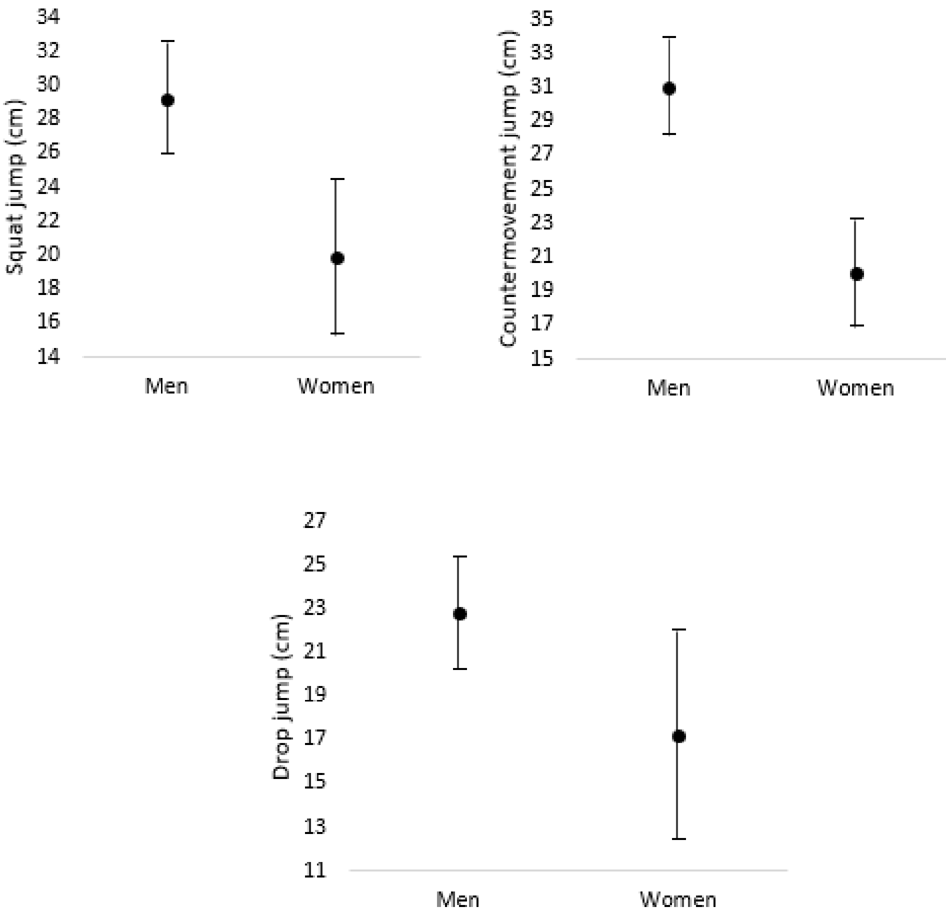

Figure 4. Mean ± 90% confidence interval of the jump squat test, countermovement jump and drop jump of male (n = 27) and female (n = 6) practitioners.

The descriptive statistics (mean ± 90% confidence interval) of the results obtained in the Cooper test of 12 minutes of male and female practitioners can be observed in figure 5. The analysis of variance did not identify significant differences between gender in the 12-minute Cooper test (t = 0.426; d = 0.364, *no effect*).

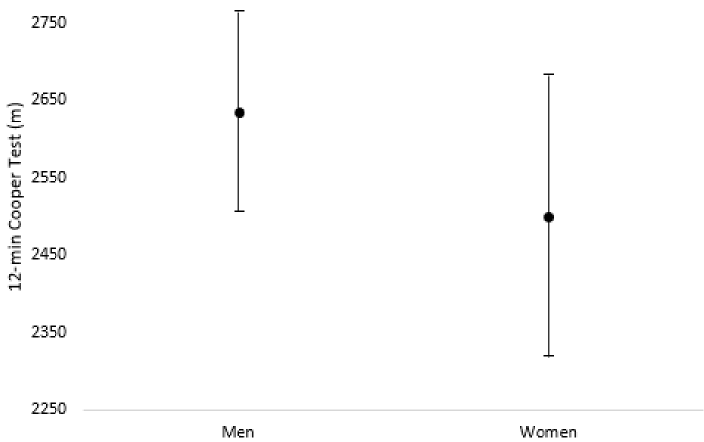

Figure 5. Mean ± 90% confidence interval of the 12-minute Cooper test of male (n = 27) and female (n = 6) practitioners.

Discussion

For data analysis, it is possible to combine the studied variables into two large groups of tests: race tests that ate referring to lower limb muscle groups and other tests directed to the upper train. In the lower train, and in accordance to a study carried out by the University of Lisbon that correlated the motor development with gender, it was expected that the majority of the tests revealed significant differences at the motor level between the genders (Barreiros & Neto, 2015). In the Cooper test, the distance travelled in the 12 minutes was studied and, after analysing the variance, no significant differences between genders were found (t = 0.426; d = 0.364, *no effect*), which is not in accordance to the previous author. It is possible that the fact that the entire female sample belongs to the elite group may have influenced the results obtained. In fact, the male sample did not belong to the elite group.

Regarding the RAST tests and in accordance with results obtained in similar tests (e.g., Salvador, Cyrino, Luiz & Gurjão, 2005) men were faster considering the Power generated, (t = 0,001; d = 1,630, *moderate effect*) and were also powerful (t = 0,001; d = 2,539, *large effect*). However, their fatigue index was higher than the fatigue index of females (t = 0,006; d = 1,341, *moderate effect*). These results are in line with some studies that have used contractions with the use of electromyography (Häkkinen, 1993), or through voluntary contractions (Misner, Massey, Going, Bembem, 1990) which indicate a greater tolerance to the effort for women, thus supporting our results.

Regarding the specific muscular aspects, it was verified that male practitioners obtained significantly higher MR values in the back squat (t = 0.019; d = 1.120, *minimal effect*), which is in line with previous studies that obtained results indirectly using MRIs obtained by different genders (Chagas, Barbosa, & Lima, 2005).

In order to revalidate the results that could be obtained in these power tests, Jump Squat tests were also performed (t = 0.035, d = 0.998, *minimal effect*) as well as countermovement jump (t = 0.005, d = 1.351, *moderate effect*) in both genders. Results revealed a prevalence of power in men when compared to women through the jump height analysis. The same results were found in Carvalho's (2008) study, with the results being in line with the ones found in this study as regards to gender comparison.

This data can also be compared with the declarations of Brett and Kate, (2015) who state that power is fundamental to a good performance in an OCR, and can be a justification for the best results obtained in the events by the men.

In the Drop Jump, although the results obtained (t = 0.109, d = 0.743, *minimal effect*) were linear to the results obtained by Komi and Bosco (1978), they are not relevant in our characterization, because they do not have high representativity in an OCR. However, it was important to carry out the data collection because it will be interesting to perfume comparative studies in the future, specifically with other modalities such as the trail.

Regarding the variable that evaluated the agility, this study found that men were significantly faster in the T-Test (t = 0,001; d = 2,924, *large effect*) compared to women. By comparing between our test that was organized according to Haff & Triplett (2016) with the three agility tests performed by the study (Mendes & Paulo, 2015), it is possible to conclude that the results obtained attest to the study of 2015, therefore there is a verification of the expectable regarding to the agility of the athletes.

In the group of tests concerning the physical capacities of the upper limbs, as regards to the variable static resistance, we obtained the values of pull-up (t = 0,001; d = 2,019, *moderate effect*) which indicates that it is a relevant factor, because after analysis of results of the Cooper test (t = 0,426; d = 0,364, *no effect*) it was found that the resistance force a determinant factor for the transposition speed of about 60% of the obstacles of OCR's. The analysis suggests that this may be a result that supports the general classifications of the different genders with males usually obtaining better times than females (COTW, 2017).

Although both values obtained in the hand grip with dynamometer are higher in the male group, which is in line with other studies (e.g., Sampaio, Mancini, Caetano, & Silva, 2006), this data (t = 0,055; d = 0,900, *minimal effect*) and the results found are not expected. In fact, this test was performed to verify if there was a correlation between the grip strength and the static resistance of the upper limbs due to the fact that they work together in the OCR. Although the values are higher, they do not follow the expected variance.

In the study of Gorgatti, (2002), where the results obtained are in the medicine ball throw in wheelchair basketball players, it is possible to verify that the values obtained resemble ours in the male group. Although our results (t = 0.001, d = 3.499, *large effect*) show a high difference of results between genders, this comparison with the Gorgatti study allows us to compare the potency of the upper limbs of our participants to a group of highly targeted athletes for upper limb training.

The present study has some limitations. First of all, the size of the female sample was a limitation in the study, as well as the fact that all the female elements present in the sample usually compete in the elite category, which indicates a greater preparation at the start of the modality. Despite these limitations, this study may prove to be a starting point for the future analysis of motivations for participation in events of this nature, which would give a complete profile of the characteristics of participants in obstacle courses, as well as the optimization of training planning.

Conclusions

It was verified in the present study that men presented a slightly higher BMI and body mass, with women presenting more fat mass. Regarding functional aspects, it was concluded that male practitioners were more resistant and more powerful considering the upper limbs. With regards to the lower limbs, men were faster, more powerful and agile than women, but they had lower rates of fatigue.

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