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Características cineantropométricas y rendimiento físico específico en triatletas amateur de media distancia

Kinanthropometric characteristics and specific physical performance in amateur middle-distance triathletes

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Abstract
The evaluation of the different morphological characteristics in time-based sports such as triathlon has been continuously related to specific physical performance; however, the behavior of these variables in the amateur population is not clear. Therefore, the objective of this research was to characterize body composition and specific performance in amateur middle-distance triathletes. 72 triathletes of both sexes were evaluated: men, age: 36.8±7.3 years, weight: 72.0±9.5 kg, height: 172.1±6.7 cm and women, age: 34.8±6.2 years, weight: 59.2±7.6 kg, height: 159.6±5.0 cm. Body composition was assessed by anthropometric method and specific performance through three tests related to specific triathlon segments, using the functional power test (FTP) in cycling, 400m test in swimming and 3km test in athletics. In the fractionation by 5 components, it was found for men: skin percentage 4.97±0.40%, fat 21.64±3.18%, muscle 51.11±3.82%, bone 11.16±1.69%, residual 11.13±1.83%, and for women, skin 5.66±0.44%, fat 28.31±4.57%, muscle 45.33±4.13%, bone 10.74±0.64%, residual 9.96±0.94%. Regarding the specific performance for relative power in cycling 2.94±0.55 w/kg, total time in swimming 7.50±1.33 min and in running total time 12.51±1.53 min. From the above it could be concluded that the morphological characteristics of amateur triathletes are far from those of elite triathletes at an international level, with high percentages of fat mass and low percentages of muscle mass, therefore, the specific performance of the triathlon is affected by the characteristics of body composition in this population.

Keywords: anthropometric; average of fat; muscle mass; somatotype; triathlon.

Resumen
La evaluación de las diferentes características morfológicas en los deportes de tiempo y marca como el triatlón se ha relacionado continuamente con el rendimiento físico específico; sin embargo, el comportamiento de estas variables en la población amateur no es claro. Por lo tanto la investigación tuvo como objetivo caracterizar la composición corporal y el rendimiento específico en triatletas amateur de media distancia. Se evaluaron 72 triatletas de ambos sexos: hombres, edad: 36.8±7.3 años, peso: 72.0±9.5 kg, talla: 172.1±6.7 cm y mujeres, edad: 34.8±6.2 años, peso: 59.2±7.6 kg, talla: 159.6±5.0 cm. La composición corporal se valoró por medio del método antropométrico y el rendimiento específico a través de tres pruebas relacionadas con los segmentos específicos del triatlón, utilizando el test de potencia funcional (FTP) en ciclismo, test de 400m en natación y el test de 3km en atletismo. En el fraccionamiento por 5 componentes se halló para los hombres: porcentaje de piel 4.97±0.40%, grasa 21.64±3.18%, músculo 51.11±3.82%, óseo 11.16±1.69%, residual 11.13±1.83%, y para las mujeres, piel 5.66±0.44%, grasa 28,31±4.57%, músculo 45.33±4.13%, óseo 10.74±0.64%, residual 9.96±0.94%. En cuanto al rendimiento específico para la potencia relativa en ciclismo 2.94±0.55 w/kg, el tiempo total en natación 7.50±1.33 min y en carrera a pie tiempo total 12.51±1.53 min. De lo anterior se pudo concluir que Las características morfológicas de los triatletas amateur distan a las de triatletas elite a nivel internacional, con elevados porcentajes de masa grasa y bajos porcentajes de masa muscular, por lo tanto, el rendimiento específico del triatlón se ve afectado por las características de composición corporal en dicha población.

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Palabras clave: antropometría; porcentaje de grasa; masa muscular; somatotipo; triatlón.

Introduction

The study of body composition associated with the study of specific performance parameters allows us to know the qualities of an athlete according to the specific demands of his competition (Corredor-Serrano et al., 2022), hence the importance of analyzing the morphological characteristics, such as the fatty, muscular and bone components, which are fundamental in sports practice; as well as the general physical conditions and performance in situations specific to the competitive process. Similarly, it is important to observe and analyze how these variables relate to each other, to determine the characteristics of the population and conditions in the sports preparation process (Anjos et al., 2003). The above is important in the case of triathlon, where performance and efficiency in each of the segments take on great relevance, given the characteristics of endurance sports, since it could improve running economy, maximum power, as well as VO2max (Barbosa et al., 2023).

It has been established that the anthropometric profile is a significant selection factor in sports practice, as it provides valuable information about an individual's structure at a given time and allows for quantifying changes caused by training (García-Chaves et al., 2023). Each specialty, modality, test, or sport has a well-defined specific kinanthropometric pattern; however, in amateur populations, it is often unclear if these patterns are met (Yáñez-Sepúlveda et al., 2023).

Currently, there has been a surge in participation in amateur athletic events, including triathlons, which are categorized as long-duration events. The middle-distance triathlon consists of three disciplines conducted in the following order: swimming (1900m), cycling (90km), and running (21km), to complete the specific distances in the shortest possible time. For amateur athletes, these distances take an average of 5 hours according to age groups. Since around 2015, participation in middle-distance triathlons has significantly increased, along with the participation of amateur athletes, viewing it as a challenge to be met. Consequently, there has been an increased demand for trained

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professionals to guide these sports processes, often from low fitness levels to the optimal preparation for a middle-distance triathlon competition (Cunha et al., 2023).

Based on the above, it is important to consider that a triathlete's sports calendar includes not only triathlon competitions but also events from the individual disciplines. This results in a highly complex annual cycle, requiring strategies to improve athlete performance by training general and specific components according to the planning phase.

Moreover, middle-distance triathlons involve athletes competing in age categories divided into categories 5 years apart. The increasing popularity has invigorated its practice among the amateur population, leading to a significant number of events and demanding training processes. Even though these are not for high-performance athletes, it is also relevant to conduct a multidisciplinary intervention for appropriate and comprehensive monitoring and control of the triathletes. This involves establishing specific characteristics that need to be trained throughout the season to achieve proper physical, nutritional, metabolic, technical, and psychological adaptations, leading to a successful competition (Millet & Vleck, 2000). Evaluating the various factors influencing athlete performance is crucial in the sports preparation process for planning and controlling the training process (García-Chaves et al., 2021).

Thus, assessing specific performance for each triathlon segment is complex, since the performance of specific conditions must be simulated. For instance, the 100m and 400m freestyle tests in swimming can determine swimming paces specific to triathlon. For cycling, the Functional Threshold Power (FTP) test evaluates performance, requiring technologies like a roller and a heart rate monitor. In running, the tests to be used are specific to determine race pace; however, there are multiple options such as the mile, 3k, 5k, and 10k, among others, valid and appropriate to evaluate the triathlete (Ferriz-Valero et al., 2020).

Additionally, in recent years, research on variables determining triathlon performance has highlighted physical and physiological components, such as body composition, maximum oxygen volume (VO2 max), maximum aerobic speed (MAS), and others (Puccinelli et al., 2020). Similarly, literature reports the effects of age, sex, distance, and environmental factors on triathlon pace, i.e., energy expenditure

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distribution during events. However, most studies focus on the Olympic distance (Millet & Vleck, 2000), with less literature available on other distances, such as sprint or middle distance. With all the above, this study aimed to characterize body composition and specific performance in amateur middle-distance triathletes.

Materials and Methods

This research employed a quantitative, descriptive, and cross-sectional design. A total of 72 amateur middle-distance triathletes were evaluated, including 44 men (age: 36.8 ± 7.3 years, weight: 72.0 ± 9.5 kg, height: 172.1 ± 6.7 cm) and 28 women (age: 34.8 ± 6.2 years, weight: 59.2 ± 7.6 kg, height: 159.6 ± 5.0 cm), selected through non-probabilistic convenience sampling. The participants belonged to four triathlon clubs in the central-western region of Colombia, specifically in the cities of Cali, Armenia, Pereira, and Manizales. Participants were required to have no lower limb injuries in the past six months and be actively engaged in systematic training. All participants were informed about the study's objectives, procedures, risks, and benefits, and voluntarily agreed to participate by signing an informed consent form. The study adhered to ethical standards as outlined in the 2013 Declaration of Helsinki in Fortaleza, Brazil, and Colombian regulations (Resolution No. 008430 of 1993 of the Ministry of Health and Social Protection on health research and Law 1581 of 2012 on personal data protection). The Institutional Review Board of the Escuela Nacional del Deporte [National School of Sport], Cali-Colombia, approved the study under Act 40.07.269 on September 19, 2022.

Participants underwent body composition assessment and specific performance tests in swimming, cycling, and running. For body composition, the International Society for the Advancement of Kinanthropometry (ISAK) protocol was followed, with measurements taken by a Level II certified evaluator, who maintained an intra-observer technical measurement error of 5.0% for skinfolds and 1.0% for circumferences and diameters (Stewart et al., 2011). The measurements recorded included (height, weight, seated height, arm span, eight skinfolds (triceps, subscapular, biceps, iliac crest, suprailiac, abdominal, thigh, calf), ten body perimeters (head, relaxed arm, contracted arm, forearm, chest, waist, hip, mid-thigh, maximum thigh, calf), seven bone diameters

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(biacromial, biiliocrestal, anteroposterior thorax, transverse thorax, humerus, femur, bistyloid) and five lengths (arm, forearm, hand, thigh, and leg).

For height and seated height, a portable Seca 213 stadiometer (60-200 cm; accuracy 1 mm) was used; weight was measured with a Terraillon Fitness Coach Premium scale (0-160 kg; accuracy 100 g); perimeters were measured with a Lufkin W606PM tape measure (0-200 cm; accuracy 1 mm); skinfolds were measured with a Slim Guide caliper (0-75 mm; accuracy 0.5 mm); bone diameters were measured with a 16 cm Cescorf short anthropometer (0-164 mm; accuracy 1 mm); and lengths were measured with a 60 cm Cescorf long anthropometer (0-600 mm; accuracy 1 mm). The body composition study used the Ross & Kerr method (1991) to calculate five components: skin, fat, muscle, bone, and residual. Subcutaneous fat was assessed by the sum of skinfolds and fat percentage using the Faulkner (1958) and Carter & Yuhazs equations (Alvero et al., 2009). The three components of somatotype were calculated using the Heath-Carter method, based on the simple average of the endomorphy, mesomorphy, and ectomorphy components. These body composition tests were conducted without any prior physical activity that could cause sweating.

Specific physical performance tests were conducted in separate sessions, ensuring no prior physical activity that could cause fatigue. Evaluators encouraged participants with verbal stimuli to promote the greatest display of their physical capabilities.

The swimming test consisted of a 400m freestyle test at maximum speed in a 25m pool, recording the performance time and calculating the pace per 100m. Warm-up included three sets of 100m freestyle at low intensity, two sets of 50m kicking at medium intensity, and four sets of 25m at high intensity (Ferriz-Valero et al., 2020).

The cycling test consisted of performing the Functional Threshold Power (FTP) test (Niño & Leguizamo, 2020). A Tacx NEO 2T Smart simulator, adaptable to each triathlete's personal bicycle, was used for evaluation. The simulator was synchronized with a Polar Vantage V2 watch and a Polar H10 heart rate monitor to record the watts generated. The FTP test included a warm-up of 5 minutes of free pedaling, two sets of 2 minutes at medium intensity with 1-minute recovery, two sets of

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2 minutes at high intensity with 1-minute recovery, and 2 minutes of low-intensity pedaling. The main test required the triathlete to pedal for 20 minutes at maximum effort, followed by 5 minutes of recovery with gentle pedaling.

The running test consisted of a 3 km run at maximum speed on a 400m synthetic track, recording performance time and calculating the pace per km. The warm-up included three minutes of joint mobility, three minutes of low-intensity running, and ten minutes of running drills with progressive intensity increases.

Data processing and analysis were performed using Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corporation, USA) for MacBook Air. Descriptive statistics were used, with variables presented as mean and standard deviation. The assumption of data normality was verified with the Shapiro-Wilk test and, based on its results, comparisons between sexes were made using the Mann-Whitney U test. For body composition and specific performance variables, percentiles (3, 10, 25, 50, 75, 90, and 97) were calculated by sex. All analyses were conducted with a significance level of $p<0.05$.

Results

The objective of this research was to characterize body composition and specific performance in amateur middle-distance triathletes. The results show the mean, standard deviation, and data normality. Additionally, the comparison between men and women using the Mann-Whitney U test revealed significant differences in most variables, except for height, thigh length, ectomorphy, fat mass, bone percentage, sum of four skinfolds, and fat percentage according to Faulkner.

Table n.◦ 1. Kinanthropometric characteristics.

	Men (n=44)		Women (n=28)		U
	Mean (S.D.)	Shapiro Wilk (Sig.)	Mean (SD)	Shapiro Wilk (Sig.)	(Sig.)
Age (years)	36.84 (7,32)	0.178	34.82 (6.23)	0.010	0.234
Weight (kg)	72.00 (9.54)	0.041	59.19 (7.62)	0.063	0.000
Seize (cm)	172.09 (6.72)	0.997	159.56 (5.01)	0.062	0.000
BMI (kg/m²)	24.27 (2.52)	0.001	23.22 (2.57)	0.008	0.017

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Seated height (cm)	90.38 (4.50)	0.000	85.95 (3.15)	0.258	0.000
LENGTHS (CM)					
Arm span	175.60 (8.08)	0.987	158.37 (5.71)	0.754	0.000
Arm length	33.58 (2.82)	0.000	29.69 (1.75)	0.878	0.000
Forearm length	27.26 (4.95)	0.000	23.61 (1.46)	0.878	0.000
Hand length	19.30 (1.87)	0.000	17.23 (2.77)	0.000	0.000
Thigh length	42.39 (3.40)	0.671	41.18 (2.62)	0.882	0.950
Leg length	46.58 (2.89)	0.153	42.94 (1.98)	0.230	0.000
SOMATOTYPE					
Endomorphy	2.77 (1.04)	0.000	4.06 (1.22)	0.535	0.000
Mesomorphy	5.81 (2.35)	0.000	4.46 (1.24)	0.428	0.001
Ectomorphy	1.86 (0.91)	0.184	1.61 (0.83)	0.921	0.180
5 COMPONENT FRACTIONATION (KERR AND ROSS, 1991)					
Skin (kg)	3.55 (0.36)	0.007	3.33 (0.26)	0.662	0.000
Skin (%)	4.97 (0.40)	0.001	5.66 (0.44)	0.437	0.000
Fat (kg)	15.63 (3.55)	0.000	16.82 (3.93)	0.009	0.106
Fat (%)	21.64 (3.18)	0.382	28.31 (4.57)	0.503	0.000
Muscle (kg)	36.79 (5.47)	0.659	26.79 (3.91)	0.079	0.000
Muscle (%)	51.11 (3.82)	0.015	45.33 (4.13)	0.484	0.000
Bone (kg)	8.02 (1.51)	0.000	6.35 (0.82)	0.120	0.000
Bone (%)	11.16 (1.69)	0.000	10.74 (0.64)	0.632	0.054
Residual (kg)	8.00 (1.71)	0.108	5.91 (1.05)	0.442	0.000
Residual (%)	11.13 (1.83)	0.000	9.96 (0.94)	0.504	0.000
Estimated body weight	72.00 (9.54)	0.041	59.19 (7.62)	0.063	0.000
FAT COMPONENT					
Summation 4 folds	45.73 (16.62)	0.000	52.43 (16.71)	0.110	0.061
Summation 6 folds	61.34 (20.25)	0.000	82.61 (26.46)	0.054	0.000
Summation 8 folds	79.68 (26.21)	0.000	102.39 (32.69)	0.113	0.001
Fat % (Faulkner)	12.78 (2.54)	0.000	13.80 (2.56)	0.110	0.061
Fat % (Carter)	9.03 (2.13)	0.000	11.26 (2.78)	0.054	0.000

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Fat % (Yuhasz)	13.08 (3.13)	0.000	16.37 (4.10)	0.54	0.00 0

SD: Standard deviation; U: Mann-Whitney U significance.

The first table presents the characterization of the body composition of amateur middle-distance triathletes.

Table n.◦ 2. Specific physical performance.

	Men (n=44)		Women (n=28)		*U* (Sig.)
	Mean (S.D.)	(Sig.)	Mean (S.D.)	(Sig.)	
FPT Power (watts)	208.45 (33.36)	0.328	173.48 (44.77)	0.505	0.000
Relative Power FTP (w/kg)	2.94 (554.08)	0.486	2.95 (0.78)	0.307	0.872
TT 400m Swimming (min)	7.50 (1.33)	0.001	8.01 (1.44)	0.012	0.052
AS 400m Swimming (m/s)	0.89 (1.33)	0.001	0.83 (1.44)	0.012	0.052
Pace 100m Swimming (min)	1.87 (0.33)	0.001	2.00 (0.36)	0.012	0.052
TT 3km Running (min)	12.51 (1.53)	0.000	14.68 (2.66)	0.001	0.000
AS 3 km Running (km/h)	14.39 (0.51)	0.000	12.26 (0.89)	0.001	0.000
Pace 1km Running (min)	4.17 (0.51)	0.000	4.89 (0.89)	0.001	0.000

TT: Total time; AS: Average speed

Table two presents the data obtained on specific performance, which shows the results of the tests carried out to evaluate performance in each segment of the triathlon.

Table n.◦ 3. Body composition percentiles.

	P3	P10	P25	P50	P75	P90	P97
Variables				**WOMEN (n=28)**			
% SM	5.0	5.1	5.4	5.7	5.9	6.1	6.6
% FM	35.2	34.6	31.8	28.9	24.7	22.8	19.7
% MM	38.7	39.9	41.8	46.0	47.9	50.1	52.7
% BM	9.6	10.1	10.3	10.6	11.2	11.5	11.8
% RM	8.4	8.7	9.2	10.1	10.6	11.2	11.4
Variables				**MEN (n=44)**			
% SM	4.1	4.7	4.8	5.0	5.2	5.3	5.5
% FM	27.5	26.0	24.0	21.5	19.1	17.8	17.0
% MM	45.8	46.6	48.3	51.0	53.4	54.7	58.2
% BM	8.0	10.2	10.6	11.1	11.7	12.4	12.7
% RM	7.8	9.8	10.4	11.5	12.1	12.5	13.7

SM: Skin mass; FM: Fat mass; MM: Muscle mass; BM: Bone mass; RM: Residual mass

Table three presents body composition percentile data to provide input to this population and type of sport.

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Table n.◦ 4. Specific physical performance percentiles.

	P3	P10	P25	P50	P75	P90	P97
Variables				**WOMEN (n=28)**			
RPC - FTP (w/kg)	1.8	2.0	2.5	2.9	3.4	3.9	4.7
P100S (min)	1.5	1.7	1.8	1.9	2.2	2.3	2.6
P1R(min)	3.9	4.1	4.3	4.6	5.3	6.1	6.7
Variables				**MEN (n=44)**			
RPC - FTP (w/kg)	2.0	2.2	2.6	2.8	3.4	3.6	3.9
P100S (min)	1.4	1.5	1.7	1.8	2.0	2.3	2.7
P1R(min)	3.5	3.6	3.9	4.1	4.2	4.9	5.5

RPC: Relative power cycling; P100S: Pace in 100 meters swimming; P1R: Pace in 1 kilometer running.

Table 4 presents the data on specific physical performance percentiles to have a reference for triathlon control tests for the amateur population.

Discussion

Understanding the characteristics of body composition in different types of sports allows for identifying some requirements in preparation. Based on the data obtained, specific data about the evaluated population are presented, which are compared with studies of amateur triathletes by age group in the male category in Chile (Sanhueza et al., 2017). These data show similarities in weight and height, providing a clear reference to the state of amateur triathlon in South America. However, compared to elite populations of different ages, both male and female (Canda et al., 2014; Ferriz-Valero et al., 2020), the latter shows greater height and lower weight than those found in this study, which may be important for optimal performance in the swimming segment. These results could be due to differences in age, level of competition, and performance, as well as the dominance of countries like Spain in the development of this sport. Regarding BMI in men and women, according to WHO parameters, the values are in the normal or healthy weight range, similar to what was reported by Sanhueza et al. (2017).

As for the lengths, these are measurements of great importance in triathlon practice because they can influence the specific performance of the different segments

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of the competition. For instance, leg length can optimize pedaling technique in cycling or stride in running, leading to reduced energy expenditure. Additionally, arm span and height are measurements that can affect swimming performance, as a greater reach per stroke can result in less time for the race (Canda et al., 2014). When comparing the lengths obtained in our study with references such as Canda et al. (2014), who evaluated elite male and female triathletes, they found much higher values for arm span and thigh length in their study compared to our research, reflecting the characteristics of that elite population. However, similarities were found in lengths such as leg, hand, and forearm.

In terms of somatotype, both men and women showed a prevalence of mesomorphy. However, according to the behavior of the three components, women were classified as mesomorphic-endomorphic, and men as endo-mesomorphic, similar somatotype characteristics to those found by Sanhueza et al. (2017), again showing a similar behavior in the practice of this sport among the amateur population in South America. However, elite international references in this sport (Barbosa et al., 2023; Canda et al., 2014; Ferriz-Valero et al., 2020) identify a dominance of mesomorphy followed by ectomorphy in both men and women, indicating a predominance of muscle to meet competitive needs such as overcoming water resistance in swimming or the force exerted in cycling and running (Hotfiel et al., 2019). This is followed by a fundamental linearity component to assume the swimming segment, and finally, the endomorphism that relates the amount of adiposity that can negatively affect physical performance in the three segments. According to these arguments, the amateur population should present better nutritional conditions and adaptations in their training processes, allowing them to reduce the endomorphic component and increase the mesomorphic component, as these conditions can be modified according to need, unlike the ectomorphic component, which due to its bone lengths, cannot be modified through training.

Another important variable in this sport is the behavior of the fat component. Compared to Sanhueza et al. (2017), this study presented lower values of body fat percentage obtained by the Ross & Kerr method (1991) of the 5 components. Nevertheless, regarding the sum of six and eight skinfolds in both men and women, the

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values obtained by Canda et al. (2014) and Ferriz-Valero et al. (2020) were much lower than those found in this study, indicating that the elite level is characterized by having a lower fat component. Additionally, high levels of this fat component could affect performance times in each triathlon segment, regardless of the distance covered, which aligns with Ferriz-Valero et al. (2020) in their study correlating anthropometric measures with performance in tests for each segment. In their study, the body fat percentage showed significant inverse correlations with swim cycle length, average swimming speed, critical power in cycling, and average running speed, concluding that a high body fat percentage affects performance in the three triathlon segments.

In terms of muscle mass percentage, as found by Sanhueza et al. (2017), it was lower compared to the population in this study, despite being two populations with similar characteristics, highlighting that, according to different studies (Bentley et al., 2002; Niyazova & Raximova, 2021), this sport requires greater muscle development. In the population studied by Ferriz-Valero et al. (2020), there was a better muscle percentage despite being younger than this population, similar to what was reported by Canda et al. (2014) in a population of the same age but higher athletic level. In the latter case, higher percentages of muscle mass were presented, positively affecting critical power in the pedaling test, confirming that optimal muscle development is required for the application of force in the specific cycling segment (Ferriz-Valero et al., 2020).

Regarding specific performance data, they allow for associating general performance with the performance in each segment that makes up the competition. Therefore, comparisons were made for each segment. For swimming and running performance, the times obtained were compared with the results reported by Isaza-Gómez et al. (2022), who reported lower times in these tests due to their population being of elite competitive level in the junior and U23 categories in Colombia, as well as what was reported by Niyazova & Raximova (2021) in elite junior triathletes in Uzbekistan. On the other hand, compared to what was found by Ferriz-Valero et al. (2020), who obtained the average speed in swimming tests in elite child triathletes, both male and female, reported higher average speed values than those recorded in this study, indicating greater distance covered in less time. This behavior could be due to differences in the population, in aspects such as age and competition level.

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For other segment-specific tests, it was required to compare with studies in their respective sports, such as swimming and cycling, as no references were found in triathlon. Thus, for the swimming test, the data were compared with those obtained by Zacca et al. (2016), who measured elite Brazilian swimmers aged 15, of both sexes, presenting better results in 400m in both men and women. Similarly, the study by Véliz et al. (2020) reported similar data for the same test in elite Chilean swimmers aged 15, showing better performance in this specific test compared to the triathletes evaluated in the present study. In summary, these differences in execution time are demonstrated and presented by significant aspects such as the specificity of the swimmers' training, as well as their preparation level.

In the case of the FTP test, Niño & Leguizamo (2020) and Casas et al. (2017) reported higher relative power values in professional road cyclists in Colombia compared to what was found in this study, which is due to the characteristics of their population, such as specificity and competition level, similar to what had been described in the case of swimming.

Additionally, to contribute to the development of amateur triathlon, Table 3 presents body composition percentiles, which are reference data for the percentage of skin, adipose, muscle, bone, and residual mass in men and women. Finally, Table 4 shows the percentiles of specific physical performance as reference data and comparison for the 20-minute FTP test, the pace per 100m in the 400m swimming test, and the pace per 1km in the 3km running test, specific to the preparation process for a competition of an amateur male or female triathlete.

Conclusions

The morphological characteristics of the amateur triathletes in this study differ from those of international elite triathletes. Therefore, the specific performance of triathlon is affected by the body composition characteristics of this population, making it necessary to adapt training processes to improve variables related to body composition and performance in each segment, as well as to conduct nutritional controls to optimize this process.

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