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Muscular strength and anthropometry in calisthenics athletes

For correspondence:
jesusleon.lm@gmail.com

Elías David Martelo-Sierra, Jesús León Lozada-Medina, Carlos Armando Hoyos-Espitia

Caribbean University Corporation, Colombia

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ABSTRACT

Introduction: Calisthenics has generated great popularity worldwide, being such an ancient sport discipline in which body weight is used and that its practice has been registered since ancient Greece, however, there is limitation in the number of scientific investigations related to muscular strength in upper limbs in regular athletes of such discipline. Objective: To analyze the muscular strength of the upper limbs and the anthropometric characteristics according to age in calisthenics athletes of the city of Sincelejo. Methodology: The study population consisted of twenty calisthenics athletes with a height of 171.4+-8 and a body mass of 65.1 +-

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Authors X @LozadaJesusPhD can be reached on Twitter.

11.3. The present research is of a quantitative type with a non-experimental design of transversal type with an exploratory approach of correlational descriptive level. An assessment of body composition and prehensile strength of Calisthenics practitioners was applied, after dividing the group between subjects older than 20 years and younger than 20 years. Results: the group older than 20 years presented better levels of strength proportional to body mass, although no significant differences were found for the prehensile strength in kilograms for the right and left hands when comparing the age groups (p.>.05), however, the BMI value did present differences between ages (p<.05), no correlations were found between strength and anthropometric characteristics (p.>.05). Conclusion: There is a probability that the differences in strength are not associated to age but to the experience of the athlete.

Key words: Calisthenics, Strength, Anthropometry, Street Workout, Athletes.

INTRODUCTION

Calisthenics is an emerging sport in which body weight is used for its execution among them we have isometric and isotonic exercises, the combination of this results in one of the modalities of calisthenics known as freestyle or "freestyle" which is similar to the branch of artistic gymnastics which in turn include variations that can modify the load and muscle recruitment.

Some works have addressed the study of strength in calisthenics by evaluating maximum repetitions to test the effectiveness of the intervention with means of deformation of structures (Calatayud et al. 2015;Doma et al. 2013), training with their own weight (Kotarsky et al. 2018), even addressing the benefits of its practice for elderly subjects (Farinatti et al. 2014), in children (Santos et al. 2015) and school physical education (Guerra et al., 2019), adult populations with clinical respiratory conditions (Basso-Vanelli et al. 2016), including Parkinson's (Ayán et al., 2013); military youth(Gist et al. 2015). However, in calisthenics there is a lack of knowledge and/or limitations of research studies related to calisthenics athletes resulting in a large number of trainings that are applied in a generalized way without taking into account training principles such as individualization of the sport and athletes.

In the work of Ngo et al. (2021), the high number of injuries in calisthenics practitioners due to overtraining in athletes is described, and tendinopathy is the most evident diagnosis in them due to repetitive execution of the exercises, It is clear that increased strength can improve sports performance and injury prevention (Behm et al., 2008; Faigenbaum & Myer, 2010; Lloyd et al., 2014; Stricker et al., 2020). In this sense, it is advisable to consider the analysis of

muscular strength in the upper limbs due to the possibility of affecting the elaboration of training plans and programs correctly adjusted to the needs of each athlete, considering the adherence to scientific principles including individuality and gradual progression of the load.
In this order of ideas it should be noted that the anthropometric characterization of the population is necessary in the sports field, in this case it can be evidenced the work of (Heir & Eide, 1996) which is entitled "age, body composition, in its they analyzed that body composition and age are key in the physical preparation of the recruits where you can see an increase in a high rate of musculoskeletal injuries according to this should take into account the characterization of calisthenics athletes to improve the effectiveness of methodological decision making, given the importance of this variable to determine the physical type of the athlete to determine the morphological optimization, where you can compare the physical type and performance (Norton et al. 1995). In the case of calisthenics athletes in Colombia, as well as in the department of Sucre, the limitation of precise information based on scientific results on their characterization is also clear.
In view of the above, it is evident that an analysis of muscle strength and anthropometric characteristics of calisthenics athletes, will allow to expand the scientific basis of the sport, and will also allow its foundation to optimize future training processes in Colombia and the Department of Sucre, therefore, the present work aims to analyze muscle strength and anthropometric characteristics according to age in calisthenics athletes in the city of Sincelejo.

METHOD

The study population consisted of 20 male calisthenics athletes of different levels of experience, located in the city of Sincelejo, and representing the universe, the sample will be made up of all the units of analysis that make up the population. For the analysis of the sample and the treatment of its data, the SPSS 25© statistical package was used, performing the descriptive analysis with the measures of central tendency and dispersion, as well as the comparison of means and correlations for the inferential analysis, this type of analysis being usual in studies related to sports science (Lozada-Medina et al., 2023).

Inclusion Criteria

- To be a Calisthenics practitioner with a minimum experience of 1 year.

- Present a negative evaluation in the PAR-Q test (pre-participation questionnaire).

Exclusion Criteria

- People who present musculoskeletal injuries in the last two months, illnesses, cognitive alterations, and others.

Data collection procedure

For the execution of the work, some tools of scientific rigor and scientific validation at a worldwide level were taken into account, applying the Par-Q questionnaire previously validated at an international level for the evaluation of the risk of coronary events during the participation in the tests (Rodríguez, 2011), as well as the completion of the informed consent, thus taking care of the ethical principles in the treatment of data and health care of the participants, as established in the Helsinki protocol. Next, the anthropometric assessment was applied considering the restricted profile established by ISAK (Esparza-Ros et al., 2019): for body mass a Seca © weight accurate to 0.1kg, for height a seca stadiometer accurate to 0.1mm, diameters with a Rosscraft © Tommy anthropometer, perimeters using a metallic Lufkin © tape) and skinfolds using a Slim Guide © model caliper.to identify the body composition of Calisthenics practitioners, based on the consensus of the Spanish group of Cineanthropometry of the Spanish Federation of Sports Medicine (Ramón Alvero Cruz et al., 2011), taking as reference the (% fat mass, (kg) fat mass and (kg) muscle mass), in addition to the body mass index (BMI) and the waist hip index (WHI). For the physical tests, valid tests were selected (López, 2002), of isometric prehensile strength and elbow flexion and extension.

Results

Table 1 shows the descriptive statistics and normality for the basic variables and those including the study objectives, showing that all of them are normal (p>.05) according to the significance for Shapiro Wilk.

Table 2 shows that there are no significant differences between the age groups discriminated by those under 20 years of age and those over 20 years of age, except for the BMI, which, however, is in the normal weight range for both groups; this heterogeneity can be seen in the following figure of the box plot.

Table 3 shows that there is no correlation between basic anthropometric variables and muscle strength for the group under study.

Table 1. Descriptive statistics and normality by Shapiro Wilk for anthropometric variables and upper limb muscle strength in calisthenics athletes from the city of Sincelejo.

Variable	n	Mean	Deviación	mínimum	maximum	Shapiro Wilk (sig.)
Height (cm)	20	171,4	8,0	152,0	183,8	0,491
Body Mass (kg)	20	65,1	11,3	42,5	88,3	0,964
IMC	20	22,0	2,4	18,1	26,4	0,630
waist to hip ratio	20	0,8	0,0	0,8	0,9	0,119
fat mass (%)	20	13,0	2,4	9,5	17,0	0,191
muscle mass (kg)	20	29,9	4,6	20,8	37,8	0,786
left hand strength (kg)	20	38,9	6,2	23,6	50,8	0,879
right hand strength (kg)	20	37,8	6,4	19,6	50,5	0,108
elbow flexions and extensions (rep)	20	39,0	5,7	25,0	50,0	0,789

Table 2. Comparison of means by age groups for anthropometric variables and muscle strength in calisthenics athletes from the city of Sincelejo.

Variables	Age group	n	mean	Deviation	minimun	maximum	t-test (sig.)
Height (cm)	Under 20 year of age	9	170,1	8,4	152,0	180,0	0,523
	Over 20 year of age	11	172,5	7,8	160,0	183,8	
Body Mass (kg)	Under 20 year of age	9	59,7	11,6	42,5	83,7	0,055
	Over 20 year of age	11	69,4	9,5	56,8	88,3	
IMC	Under 20 year of age	9	20,5	2,3	18,1	25,8	0,006
	Over 20 year of age	11	23,2	1,7	21,1	26,4	
waist to hip ratio	Under 20 year of age	9	0,8	0,0	0,8	0,9	0,392
	Over 20 year of age	11	0,8	0,0	0,8	0,9	
fat mass (%)	Under 20 year of age	9	12,1	2,1	9,8	17,0	0,132
	Over 20 year of age	11	13,7	2,5	9,5	17,0	
muscle mass (kg)	Under 20 year of age	9	28,4	5,1	20,8	37,8	0,173
	Over 20 year of age	11	31,2	3,9	24,3	37,4	
left hand strength (kg)	Under 20 year of age	9	36,7	7,6	23,6	47,7	0,156
	Over 20 year of age	11	40,8	4,5	33,2	50,8	
right hand strength (kg)	Under 20 year of age	9	36,2	9,2	19,6	50,5	0,332
	Over 20 year of age	11	39,1	2,7	35,6	44,9	

Variables	Age group	n	mean	Deviation	minimun	maximum	t-test (sig.)
elbow flexions and extensions (rep)	Under 20 year of age	9	36,6	5,9	25,0	43,0	0,081
	Over 20 year of age	11	41,0	4,8	33,0	50,0	

Figure 1. *Average and 95% confidence zone for anthropometric variables and muscle strength in calisthenics athletes in the city of Sincelejo.*

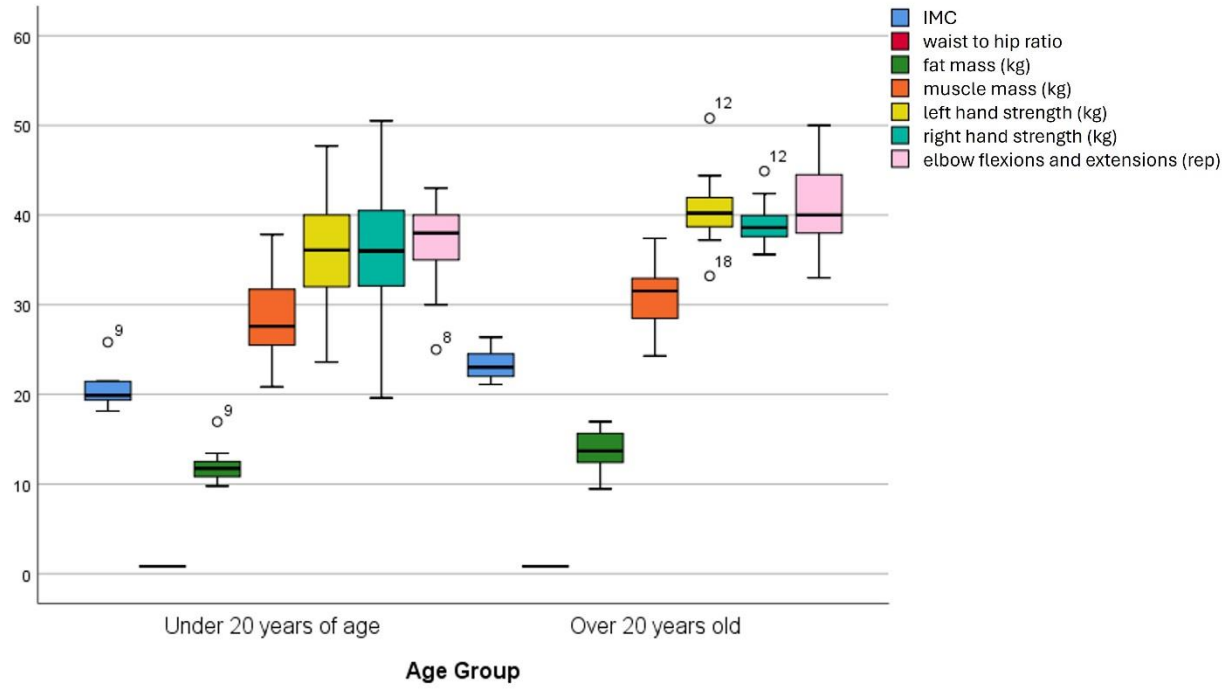

Table 3. Correlation of anthropometric variables and muscle strength in calisthenics athletes of the municipality of Sincelejo

Variables		IMC	waist to hip ratio	fat mass (%)	muscle mass (kg)	left hand strength (kg)	right hand strength (kg)	elbow flexions and extensions (rep)
IMC	Correlation de Pearson	1	0,393	,722**	,707**	0,154	0,050	0,404
	Sig. (bilateral)		0,086	0,000	0,000	0,516	0,835	0,077
waist to hip ratio	Correlation de Pearson	0,393	1	0,246	-0,048	-0,075	0,045	0,029
	Sig. (bilateral)	0,086		0,295	0,842	0,754	0,851	0,902
fat mass (%)	Correlation de Pearson	,722**	0,246	1	0,357	0,381	0,250	0,239
	Sig. (bilateral)	0,000	0,295		0,123	0,097	0,287	0,309
muscle mass (kg)	Correlation de Pearson	,707**	-0,048	0,357	1	-0,002	-0,044	0,395
	Sig. (bilateral)	0,000	0,842	0,123		0,994	0,854	0,085
left hand strength (kg)	Correlation de Pearson	0,154	-0,075	0,381	-0,002	1	,793**	0,142
	Sig. (bilateral)	0,516	0,754	0,097	0,994		0,000	0,551
right hand strength (kg)	Correlation de Pearson	0,050	0,045	0,250	-0,044	,793**	1	-0,020
	Sig. (bilateral)	0,835	0,851	0,287	0,854	0,000		0,932
elbow flexions and extensions (rep)	Correlation de Pearson	0,404	0,029	0,239	0,395	0,142	-0,020	1
	Sig. (bilateral)	0,077	0,902	0,309	0,085	0,551	0,932	

**. Correlation is significant at the 0.01 level (bilateral).

Discussion

The present work was proposed to analyze the muscular strength and anthropometric characteristics according to the age of calisthenics athletes in the city of Sincelejo. Where the manual grip strength of the practitioners were 40.8kg for the left hand and 39.1kg for the right hand for those older than 20 years and 36.7 kg for the left hand and 36.2kg for the right hand,

whose results in that sense we have that according to the average body mass of the group the subjects older than 20 years present a strength index of 59% for the left hand and 56% for the right, on the other hand 62% and 61% for the left and right hand respectively are observed in the group of those younger than 20 years, which indicates that proportionally they present more strength without such difference being significant, thus obtaining similar results when comparing these results with Ukrainian calisthenics athletes with 1.5 years of experience in the practice of the sport who reached 60% of prehensile strength according to their body mass, while Ukrainian athletes with more than 2.5 years of experience reached 70% of prehensile strength (Podrihalo Olha et al. 2021)

No significant differences were found between the age groups discriminated by under 20 years or over 20 years, which corresponds with the findings of a study where age groups specifically 21.8 ±6.5 years with 2 months and 24 months of experience were equally compared. The results show that these differences are mainly associated with the athlete's experience, not age (Sanchez-Martinez et al., 2017).

For nutritional status, significant differences were seen ($p>0.05$), specifically in BMI, over 20 years of age 23.2 and under 20.5; however, both groups are in the normal weight classification, presenting a low cardiovascular risk. This measure has been used to reference the health status of the person in reference to obesity. In this way it is evident that it is probable that the strength as the anthropometric characteristics for calisthenics athletes is more conditioned to the experience of the athlete than to the chronological age.

Assuming the representative data of the dynamometry test in terms of results, we can recognize that muscular strength is a determining factor in the health of a person, without leaving aside, as we have evidenced above, body composition and cardiovascular capacity. Recognizing this, we can sustain that as age advances, a functional retrospective process is added, resulting in the involution of physical condition in the loss of strength, decrease of cardiovascular capacity and decrease of muscle mass as referred to in their study (Carbonell Baeza et al., 2009). The practice of calisthenics from an early age could be very useful to improve the physical condition of any population, from different potential health aspects such as improved strength, cardiovascular endurance, psychological improvement, motor improvement in young children and all without low cost and without external implementation.

Considering the above, we can mention some limitations that were presented in the research, it is necessary to take them into account for future research. At the methodological level, we can mention firstly that in future works the sample size should be increased and the discrimination by competition modalities should be considered; a limitation in previous similar

studies, although it limits to a certain extent the interpretation of the same, it is also an opportunity to open the field for future related works. On the other hand, it is declared that the present work does not present a conflict of interest and that it was not financed by any organization.

Conclusion

Considering the results, we present the following conclusions for the group under study, considering the proposed aims:

1. No significant differences in strength according to age group are showed, it is likely that the differences in strength are not associated with age but with the experience of the athlete. Taking this into account, the subjects older than 20 years present a strength index of 59% for the left hand and 56% for the right hand, while 62% and 61% are observed for the left and right hand respectively in the group younger than 20 years; in relation to body composition both groups are located in normal weight.
2.The analysis of muscle strength shows no correlation with the anthropometric variables.

Contributions

Contributed to conception and design: EM, JL
Contributed to acquisition of data: EM, JL
Contributed to analysis and interpretation of data: EM, JL and CH
Drafted and/or revised the article: EM, JL and CH
Approved the submitted version for publication: EM, JL and CH

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