Research Article

Handgrip strength in university students in Bogotá Colombia

Fuerza Prensil en estudiantes universitarios en Bogotá Colombia

Força de preensão em estudantes universitários de Bogotá Colômbia

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ABSTRACT

Manual prehensile grasp (MPF) has been widely used as a test to evaluate muscle function, as an indicator of nutrition, metabolic risk, and mortality in young adults. Objective: To assess prehensile grasp in university students of physical education in Bogota, Colombia. Methodology: Cross-sectional descriptive study, 334 students of physical education courses in Bogota, Colombia, during their first semester in 2022 were evaluated. The variables evaluated were weight (kg), height (cm), BMI (kg/m²), and prehensile grasp (kg) in both sexes. Results: Physical education university students in Bogota, Colombia, have the following average weight: men (67.62 ± 10.23) kg, women (61.32 ± 10.18) kg; for height: (1.72 ± 0.08) cm in men, (1.62 ± 0.07) cm in women; a body mass index (BMI) of (22.72 ± 2.96) kg/m² in men, (23.20 ± 3.34) kg/m² in women; and a prehensile grasp of (38.36 ± 7.86) kg in men and (25.44 ± 5.24) kg in women. Conclusions: The low value of prehensile grasp is an important health indicator, being a strong independent predictor of metabolic syndrome. It occurs in both women and men, with women presenting lower values of prehensile grasp when compared to men.

Keywords: University; Dynamometry; Physical condition; Nutrition.

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RESUMEN

La fuerza de prensión manual (FPM) se ha utilizado ampliamente como una prueba para evaluar la función muscular, siendo un indicador de nutrición, riesgo metabólico y mortalidad en personas adultas jóvenes. Objetivo: Valorar la fuerza prensil en estudiantes universitarios de educación física de Bogotá, Colombia. Metodología: Estudio descriptivo transversal en el que se evaluaron 334 estudiantes de cursos de educación física de Bogotá, Colombia, durante el primer semestre de 2022. Las variables evaluadas fueron: peso (kg), estatura (cm), IMC (kg/cm²) y fuerza prensil (kg) en ambos sexos. Resultados: Los estudiantes universitarios de educación física de Bogotá, Colombia, presentan un peso promedio de hombres (67,62 ± 10,23) kg y mujeres (61,32 ± 10,18) kg; estatura de hombres (1,72 ± 0,08) cm y mujeres (1,62 ± 0,07) cm; índice de masa corporal (IMC) de hombres (22,72 ± 2,96) kg/cm² y mujeres (23,20 ± 3,34) kg/cm²; y fuerza prensil de hombres (38,36 ± 7,86) kg y mujeres (25,44 ± 5,24) kg. Conclusiones: El bajo valor de la fuerza prensil es un importante indicador de salud, siendo un fuerte predictor independiente del síndrome metabólico. Este valor es incidente tanto en mujeres como en hombres, presentando las mujeres menores valores de fuerza prensil en comparación con los hombres.

Palabras clave: Universitarios; Dinamometría; Condición física; Nutrición.

RESUMO

A força de preensão manual (FPM) tem sido amplamente utilizada como um teste para avaliar a função muscular, como um indicador de nutrição, risco metabólico e mortalidade em adultos jovens. Objetivo: Avaliar a força preênsil em estudantes universitários de educação física em Bogotá, Colômbia. Metodologia: Estudo descritivo transversal, no qual foram avaliados 334 estudantes de cursos de educação física em Bogotá, Colômbia, no primeiro semestre de 2022. As variáveis avaliadas foram: peso (kg), altura (cm), IMC (kg/cm²) e força preênsil (kg) em ambos os sexos. Resultados: Os graduandos de educação física de Bogotá, Colômbia, apresentam um peso médio de homens (67,62 ± 10,23) kg e mulheres (61,32 ± 10,18) kg; altura de homens (1,72 ± 0,08) cm e mulheres (1,62 ± 0,07) cm; índice de massa corporal (IMC) de homens (22,72 ± 2,96) kg/cm² e mulheres (23,20 ± 3,34) kg/cm²; e força preênsil de homens (38,36 ± 7,86) kg e mulheres (25,44 ± 5,24) kg. Conclusões: O baixo valor da força preênsil é um importante indicador de saúde, sendo um forte preditor independente de síndrome metabólica, ocorrendo tanto em mulheres como em homens, com as mulheres apresentando valores mais baixos de força preênsil em comparação aos homens.

Palavras-chave: Universitários; Dinamometria; Aptidão física; Nutrição.

INTRODUCTION

The university stage is marked by a series of changes in lifestyles, which can interfere with and affect both diet and physical condition, as well as the habitual behaviors that characterize a person's way of life, these behaviors being permanent over time. Among these behaviors, healthy and unhealthy practices are evident that interact with each other, contributing to a sedentary lifestyle (Lema et al., 2009).

Lifestyles are influenced by psychological, social, cultural and economic factors, which makes the university population a vulnerable group, prone to suffer from chronic non-communicable diseases. These effects are reflected in the physical condition related to health and, therefore, in the grip strength, which is an indicator of health and cardiovascular risk, measured by dynamometry (Vaara et al., 2012). Dynamometry is a low-cost, highly applicable, fast and easy-to-perform technique that allows the detection of loss of physiological muscle function and the assessment of normal nutritional status (Vaz et al., 1996). This technique allows the identification of the level of development and the degree of disability of the hand in childhood, and is also used to plan assessments and treatments (Klidjian et al., 1980). In addition, hand grip strength correlates with lean mass (Hanten et al., 1999), being a functional consequence of lower muscle mass and reduced muscle strength (Peolsson et al., 2001). Some research has identified that grip strength presents a curvilinear relationship with age (Chau et al., 1997). Generally, an increase in grip strength is observed with increasing age, reaching a peak between 25 and 39 years, followed by a gradual decrease with age (Mason et al., 2007). However, the purpose of this research was to evaluate the grip strength levels of Physical Education students in Bogotá, Colombia, in three universities that participated in the call, and to compare these reference values with those established in university students of different careers in Colombia for use as a diagnosis (Vivas-Díaz et al., 2016).

METHODS

This is a quantitative study, with a cross-sectional and descriptive scope, in which 334 healthy university students, aged between 18 and 32 years, students of the degree in physical education, recreation and sports, from the city of Bogotá, were evaluated. The call was made in three private universities during the months of February and March, with the purpose of evaluating body composition and grip strength. The students were invited to participate voluntarily, and subsequently signed the informed consent.

The sample consisted of 334 university students, of which 258 were men and 76 women. To measure body composition, the height of each participant was recorded with the SECA-217 stadiometer. Weight was measured with the Tanita scale, with a precision of 500 g. These variables allowed the calculation of the body mass index (BMI) in kg/cm^2.

Grip strength was assessed with the Takei Smedley III T-19 dynamometer, with a precision of 0.1 kg. Regarding the dynamometry procedure, the protocol proposed by Vivas-Díaz et al. (2016) was followed. Previously, the dynamometer was adjusted according to the size of each person's hand. Standing in a firm position, with the arm extended and parallel to the trunk, they were instructed to squeeze steadily for three seconds. During the measurement, the participants were instructed not to raise their hand, bend over, crouch down, or make movements that could change the original position. At the same

time, they were verbally encouraged in a uniform manner to apply their maximum force. The dynamometry was performed in duplicate on both hands, with a break of approximately three minutes between each attempt, and the highest value of each attempt was used. This study was designed in accordance with the ethical standards recognized in the Declaration of Helsinki of the World Medical Association (2013) and Resolution 008430 of 1993 of the Ministry of Health of the Republic of Colombia, which regulates clinical research in human beings. All participants were informed about the details of the study through informed consent.

Statistical analysis: The statistical analysis was carried out with the SPSS version 23.0 program. A descriptive analysis was performed with the mean values and standard deviation in the variables of age, grip strength, weight, height and body mass index. A normality analysis was performed with the Kolmogorov-Smirnov test, and the T-Student test was used to identify differences between men and women in variables with a p value < 0.05. The results were classified according to the strength percentiles in the study by Vivas-Díaz et al. (2016) and the body mass index (BMI), taking into account the age range and sex, obtaining the frequency of the percentile values in percentage.

RESULTS

The study included 334 university students, of whom 258 were men (22.21 ± 3.37) and 76 were women (23.21 ± 4.56). The characteristics of the sample are presented in Table 1. Women had a higher BMI value (23.20 ± 3.34) compared to men (22.72 ± 2.96). In the dynamometry, men showed higher values (38.36 ± 7.68) compared to women (25.44 ± 5.14), presenting significant differences.

Table 1.
Characteristics of anthropometric variables and grip strength of university students.

Variables	Female (76)	Male (258)	Total	p
Age (years)	23,21 ± 4,56	22,21 ± 3,37	22,43 ± 3,62	0,067
Weight (kg)	61,32 ± 10,18*	67,62 ± 10,23*	66,18 ± 10,54	0,034*
Height (cm)	1,62 ± 0,07*	1,72 ± 0,08*	1,70 ± 0,08	0,036*
BMI (kg/cm2)	23,10 ± 3,34	22,72 ± 2,96	22,83 ± 3,05	0,078
HGS right (kg)	25,44 ± 5,14*	38,36 ± 7,68*	35,48 ± 8,98	0,021*
HGS left (kg)	25,04 ± 5,27*	36,71 ± 7,59 *	34,05 ± 8,64	0,013*

*HGS hand grip strength, significant difference between groups p <0.05**

Table 2 presents the body mass index (BMI) values in university students according to the WHO classification. In women, 2.63% are underweight, 15.79% are overweight, 3.95% are obese, and 77.63% have an adequate weight. In men, 7.75% are underweight, 13.17% are overweight, 1.95% are obese, and 77.13% have an adequate weight.

Table 2.
Body Mass Index classification of university students according to WHO values.

Variables	Female (76)	N (%)	Male (258)	N (%)
Underweight	17,27 ± 1,54	2 (2,63)	17,47 ± 0,82	(7,75)
Normal	22,17 ±1,78	59 (77,63)	22,31 ± 1,66	(77,13)
Overweight	26,50 ± 1,34	12 (15,79)	26,76 ± 1,33	(13,17)
Obese	34,24 ± 1,33	3 (3,95)	32,47 ± 1,93	(1,95)

Table 3 shows the grip strength values in university students according to the percentiles established for university students in Bogotá, Colombia (Vivas-Díaz et al., 2016), adjusted for age and sex. In women, 43.42% have inadequate values, while 56.58% have adequate grip strength values. In men, 42.63% have inadequate values, and 57.37% have adequate values.

Table 3.

Characteristics of anthropometric variables and grip strength of university students.

Strength Percentiles	Female (76)	N (%)	Male (258)	N (%)
P3	18,58 ± 2,95	5 (6,58)	24,75 ± 3,77	23 (8,91)
P10	29,12 ± 4,22	9 (11,84)	28,24 ± 6,68	25 (9,69)
P25	34,12 ± 4,38	19 (25,00)	33,36 ± 5,22	62 (24,03)
P50	35,69 ± 7,10	19 (25,00)	34,69 ± 7,41	69 (26,74)
P75	38,02 ± 8,76	12 (15,79)	41,54 ± 6,56	43 (16,67)
P90	42,60 ± 7,73	8 (10,53)	42,21 ± 8,23	25 (9,69)
P97	53,25 ± 3,12	4 (5,26)	52,04 ± 3,87	11 (4,67)

Mean values, standard deviation, percentage and classification according to Colombia's percentile values.

DISCUSSION

In the present cross-sectional study, it was found that 43.42% of women had inadequate grip strength values, while 42.63% of men had low values within the appropriate percentiles. These results are related to the risk of developing future cardiovascular diseases and metabolic syndrome. Regarding body mass index (BMI), 19.74% of women and 15.10% of men had inadequate values, which represent risk factors that may contribute to the development of future diseases.

Some studies have described that nutritional factors, the level of physical activity and a low level of physical fitness may contribute to low grip strength and a high BMI. These factors have been linked to cardiovascular diseases in adults (Brodney et al., 2001). Likewise, another study showed that aerobic capacity, strength and adiposity are the main indicators of physical condition and health in young people (Rosa-Guillamón, 2019).

Several researchers, in prospective studies, have shown that muscle strength is inversely associated with all-cause mortality. Muscle strength has also been found to be inversely related to the prevalence of metabolic syndrome, independently of aerobic capacity and other fitness variables. In addition, the combined association of muscle strength and aerobic capacity with the risk of suffering from metabolic syndrome and other risk factors has been shown in men and women between 18 and 75 years of age (Ruiz et al., 2008).

In this sense, low levels of muscle strength are associated with higher levels of adiposity, higher metabolic risk and lower respiratory capacity. As a predictor of physical condition, grip strength has been used as a marker of nutritional status. Low levels of grip strength in young adults have been shown to be predictors of functional limitation and disability, and have been associated with all-cause cardiovascular mortality (Artero et al., 2011). Additionally, it is important to mention that among young university students there are certain barriers to the systematic practice of physical activity, such as academic workload (Calestine et al., 2017), lack of time and social commitments (Henao & Arévalo, 2016).

In this sense, the importance of a physically active life in the university population is becoming more relevant today (Guzmán-Muñoz et al., 2024).

One of the main limitations of the present study is the sample size. Although there are differences in the size of the groups, the evidence suggests that men have greater grip strength. For this reason, it is recommended to use the same sample size between genders in future studies.

CONCLUSION

This study provides evidence on the status of university students in physical education academic programs in Bogotá, Colombia, according to percentile values. It affirms the importance of generating strategies to implement muscle strengthening programs, since the sample showed a low value of muscle strength, accompanied by an alteration in the BMI, variables that could impact the future development of cardiovascular diseases, as premature causes of mortality, and constitute a risk factor in the lowest values.

Therefore, low grip strength constitutes an emerging risk factor. In the present study, 43.42% of women and 42.63% of men presented inadequate grip strength values, which is a nutritional indicator and a predictor of physical condition.

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