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Artigo original

Strength profile of lower and upper limbs of young people and adults from Grande Vitória, ES

Perfil de força de membros inferiores e superiores de jovens e adultos da grande Vitória, ES

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ABSTRACT

Introduction: Aging contributes to loss of functional mobility and quality of life, and, consequently, health complications and diseases incidence. **Objective:** The purpose of this study was to evaluate the strength levels of men (M) and women (W) for lower (LL) and upper (UL) limbs in different age groups to map the normative references of these profiles. **Methods:** 270 individuals, adults, and non-athletes, aged between 20 and 59 years old and residing in the metropolitan region of Vitória/ES, participated in the research. Separated into groups having 160 (M) and 110 (W), in the age groups between 20 to 29 years (A), 30 to 39 years (B), 40 to 49 years (C), and 50 to 59 years (D). Body composition assessment: body mass, height, perimeters, bone diameters, and skinfolds, using Sanny equipment and the fat percentage determination using physical assessment software, Jackson and Pollock protocol (7 skinfolds). Maximum isometric strength levels were assessed using a computerized digital dynamometer. **Results:** The assessed population shows a trend towards strength loss with age, especially from the 30-39 age group for men and women. Despite not being statistically significant, the data make the loss of strength evident. Notably, low levels can also be highlighted, following the references for functional health classification. **Conclusion:** The assessed population shows a tendency towards loss of strength with age, in addition to pointing out low levels of strength, according to the references for functional health classification.

Keywords: strength; aging; longevity; computerized digital dynamometry.

RESUMO

Introdução: O envelhecimento contribui para a chance de perda na mobilidade funcional e qualidade de vida e, por consequência, complicações na saúde e incidência de doenças. **Objetivo:** A proposta deste estudo foi avaliar os níveis de força de homens (H) e mulheres (M), para membros inferiores (MI) e superiores (MS), em diferentes faixas etárias, com objetivo de mapear os referenciais normativos desses perfis. **Métodos:** Participaram da pesquisa 270 indivíduos, adultos e não atletas, com idades entre 20 e 59 anos e residentes na região metropolitana de Vitória/ES. Separados em grupos tendo 160 (H) e 110 (M), nas faixas etárias entre 20 a 29 anos (A), 30 a 39 anos (B), 40 a 49 anos (C) e 50 a 59 anos (D). Avaliação de composição corporal: massa corporal, altura, perímetros, diâmetros ósseos e dobras cutâneas, por equipamentos de marca *Sanny* e determinação do percentual de gordura por software de avaliação física, protocolo de Jackson e Pollock (7 dobras). Os níveis de força máxima isométrica foram avaliados por um dinamômetro digital computadorizado. **Resultados:** A população avaliada demonstra tendência de perda de força com o passar da idade, destacadamente a partir do grupo 30-39 para homens e mulheres, apesar de não serem estatisticamente significantes os dados deixam evidente a perda de força. **Conclusão:** A população avaliada demonstra tendência para perda de força com o passar da idade, além de apontar baixos níveis de força, conforme as referências para classificação de saúde funcional.

Palavras-chave: força; envelhecimento; longevidade; dinamometria digital computadorizada.

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Introduction

The city of Vitória is the capital of the state of Espírito Santo, located in the Southeast of Brazil. According to a survey by the Brazilian Institute of Geography and Statistics (IBGE), until 2021, it had a population of approximately 365,855 inhabitants, thus being classified as the metropolitan region of the state. According to the publication of the SAÚDE program in Veja magazine, Vitória was in 3rd place in the ranking of the survey "Brazilian Cities Friendly to Physical Activity", carried out by researchers from PUC-PR [1]. On the other hand, IBGE publications in 2019 point out that 40.3% of the population over 18 years of age is considered insufficiently active [2]. Subsequently, data from the Ministry of Health (MS) in 2021 warns that, in Brazil, 48.3% of the population residing in the capitals do not perform any type of physical activity [3]. In particular, people aged 55 and over. Also, in 2021, research results from Fiocruz in partnership with UFMG and Unicamp show that 62% of Brazilians stopped carrying out activities during the Covid pandemic, increasing the percentage of sedentary people [4]. Sedentary behavior contributes to the detraining of biomotor skills, increasing the chance of health complications, as well as contributing to the development of diseases, loss of functional mobility, and quality of life [5]. This fatality can contribute to a high level of overload in public health systems [6].

The main biomotor capacity affected by detraining is strength, and its decline is responsible for a series of factors that compromise movement production and aid adaptations of other conditioning capacities [7,8]. One of the factors, and indeed inevitable, that can cause the decline in strength levels is aging [9]. In this process, a set of structural, functional, and physiological alterations occur that generate a loss in adaptability [10]. These changes are significant in the neuromuscular system, tending towards muscle atrophy, and can lead to limitations that expose older adults to the risk of pathological processes such as sarcopenia [11-13].

Therefore, the purpose of this study was to evaluate the strength levels of men (M) and women (W), for lower (LL) and upper (UL) limbs, in different age groups through computerized digital dynamometry to map the normative references of these profiles.

Methods

Study design

The project was approved by the Research Ethics Committee of the University of Vila Velha CAAE 78770017.0.0000.5064 in 2017.

Sample eligibility criteria

The non-probabilistic, purposeful, careful sampling was composed of 270 individuals, adults and non-athletes, 160 (M) and 110 (W), all living in the metropolitan region of Vitória, aged between 20 and 59 years, divided into age groups: 20 to 29 years (A), 30 to 39 years (B), 40 to 49 years (C), and 50 to 59 years (D). The sample calculation was based on a confidence level of 95% and a margin of error of 6% for a population of approximately 500,000 inhabitants. Inclusion criteria were: adults and non-athletes, while exclusion criteria were: inability to produce force due to injury or injury sequelae, as well as recent post-surgical patients (≤12 months).

Data collection

Body composition

Data collection took place on the same day as the strength assessments, and the data referring to the body composition assessment were: body mass, height, perimeters, bone diameters, and skinfolds. For this purpose, Sanny® equipment was used, namely: a stadiometer, measuring tape, caliper, and adipometer, in addition to a Tanita® scale. To determine the fat percentage, the protocol by Jackson and Pollock (1978) 7 folds [14] and the physical evaluation software Avaesportes were selected.

Strength assessment

All subjects underwent a 10-minute warm-up on a Moviment® stationary bicycle, with a rotation from 50 to 60 rpm and load adjustment to produce approximately 80-100 watts.

Maximum isometric strength levels were evaluated by a computerized digital dynamometer (Power DIN, CEFISE®, Nova Odessa, São Paulo, Brazil) fixed to a solid 1.80m bar; this bar fixed to a pole with height adjustment and balancing counterweight (fig 1). Data referring to peak force in kgf and N, average force in kgf and N, as well as the peak force expression time in milliseconds, were found from the readings of the load cells and the 02-channel signal acquisition system (interface), N2000 PRO CEFISE®. For measuring the strength expression in the lower limbs, the subjects were submitted to the position of the Half Back Squat exercise (half squat), performing strength only in the concentric phase, and for the upper limbs, with the Benchpress exercise position, also with the application of force only in the concentric phase. All collections were carried out between 2018 and 2021, and the time between strength measurements was 10 minutes to eliminate potential fatigue that could generate false negatives.

Figure 1 - Equipment for Digital Dynamometry, Half Squat, and Benchpress exercises

Statistical analysis

Descriptive analysis of the results, mean and standard deviation, and ANOVA for independent samples was performed to determine whether there were statistical differences between the different age groups of the two subgroups; in addition, the Tukey post-hoc test was performed for multiple comparisons.

Results

The tables below present the mean values and standard deviation of all measurements collected in their respective age groups and genders.

Table I - Mean and standard deviation of data from the men

Age Group (amount)	Weight (kg)	Height (cm)	BMI (kg/m²)	Fat %	LL strength (kgf)	UL strength (kgf)
A (31)	81±16	177±0.06	26±5.28	19±7.59	99±45	68±23
B (83)	87±13	176±0.06	28±4.25	22±6.97	113±44	77±26
C (38)	89±14	179±0.06	27±4.60	23±6.19	102±45	69±33
D (08)	74±26	157±0.57	23±8.38	21±8.07	94±37	63±21

20 to 29 years old (A), 30 to 39 years old (B), 40 to 49 years old (C), and 50 to 59 years old (D)

Table II - Mean and standard deviation of data from the women

Age Group (amount)	Weight (kg)	Height (cm)	BMI (kg/m²)	Fat %	LL strength (kgf)	UL strength (kgf)
A (19)	64±11.12	161±0.06	24±4.32	28±6.82	74±31.25	33±22.10
B (56)	63±11.14	163±0.04	23±3.93	27±7.12	76±38.67	37±21.95
C (27)	66±11.39	162±0.06	25±3.98	28±4.91	74±35.94	31±13.59
D (08)	66±14.48	161±0.03	25±5.46	29±7.47	52±14.79	31±7.15

20 to 29 years old (A), 30 to 39 years old (B), 40 to 49 years old (C), and 50 to 59 years old (D)

The graphs below present comparative data on the evolution of the strengths of the evaluated men and women.

Figure 2 - Evolution of strength by age group – lower limbs – female and male

Figure 3 - Evolution of strength by age group – upper limbs – female and male

Results of statistical analysis

No statistically significant differences were found between the age groups of the two subgroups when analyzing ANOVA for independent samples and in the post-hoc Tukey test for multiple comparisons. However, for the women group in the benchpress exercise, Bartlett's test, there was a statistically significant difference (**), p-value= 0.0094.

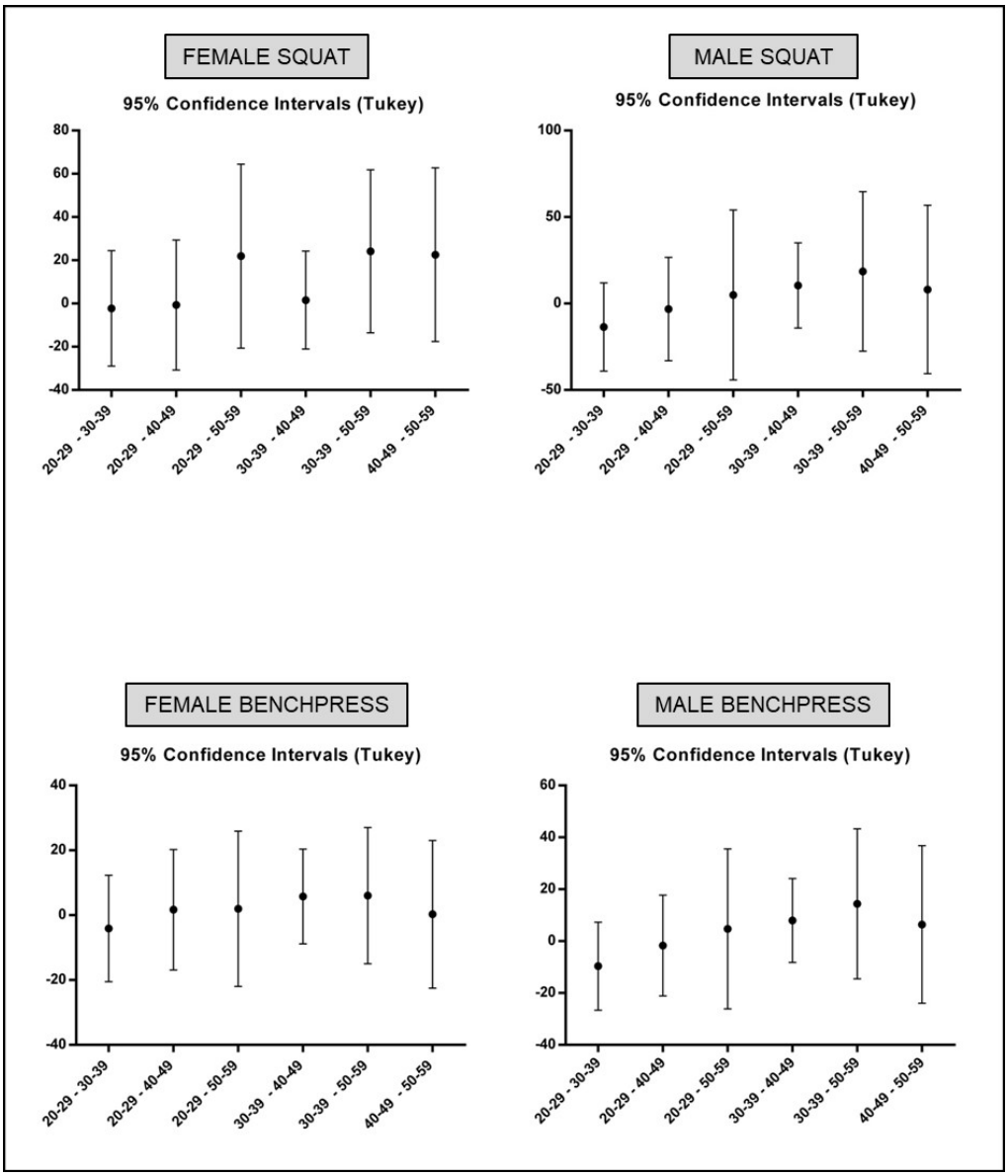

Figure 4 – Tukey post-hoc test for multiple comparisons

Discussion

The assessed population demonstrates a tendency towards loss of strength with age, especially from the 30-39 age group for men and women; despite not being statistically significant, the data make the loss of strength evident. Notably, low levels can also be highlighted following the references for functional health classification. Following references from Kraemer and Fleck [16], strength, in general, is an essential

biomotor capacity for maintaining health concerning physiological functioning and functional capacity. Relatively, the ability to apply force in values referring to 1x kgf/body weight for UL and 1.5x kgf/body weight for LL are classified as healthy levels [17]. Observing the LL and UL averages about the body weight, all the evaluated ones present lower values when compared to the data of this aforementioned reference.

Corroborating the findings of this study, we can emphasize data from the literature that point to aging as a set of structural and functional changes that are unfavorable to the body, which generate loss of adaptability [18]. These changes mean the loss of muscle fibers, loss of muscle strength and functionality, and are also significant in the neuromuscular system, tending to muscle atrophy [10].

According to Queiroga [20], research using handgrip strength to verify the effects of aging on strength and resistance indices also revealed a negative correlation with the evolution of age. Other studies [21] indicate the possibility of postponing the worsening of this decline through physical activities practice. In the comparison between genders, the main divergence in the absolute strength value seems to be due to anthropometric measures. The literature presents results in different scenarios, indicating lower values of muscle strength in women related to differences in body size and muscle mass, and they exhibit approximately two-thirds of the absolute strength of men [22,23]. Furthermore, when it comes to the production of hormones, very different results are found between men and women, directly influencing the total production of muscle strength [24-26]. Considering the BMI and %BF values, we urge you to cite studies carried out with older adults of both genders as a sample, which indicates that there is no proven significant correlation between these measurements and muscle strength performance [27-30].

In a practical way, the research suggests that programs aimed at maintaining or gaining strength are necessary from a specific age group onwards, both for men and women. As a limitation of the study, it is worth highlighting the comparison of strength levels of sedentary and active individuals in structured training with an emphasis on maintaining or gaining strength.

Conclusion

The assessed population shows a tendency towards loss of strength with age, in addition to pointing out low levels of strength, according to the references, for the classification of functional health. These findings suggest the real need for evaluations and strength training programs for the general population, especially for older adults, intending to minimize the risks of diseases and improve quality of life, autonomy, and functional mobility.

Conflict of interest
There are no conflicts of interest.

Financing source
The study was carried out without funding sources.

Authors' contribution
Conception and design of the research: Affonso HO; Data collection: Neto AB, Affonso HO, Souza MB; **Data analysis and interpretation:** Affonso HO; **Statistical analysis:** Affonso HO; **Manuscript writing:** Affonso HO, Souza MB; **Critical review of the manuscript for important intellectual content:** Affonso HO.

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