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Rate of perceived exertion and affectivity in body weight exercises in trained elderly people with cardiometabolic risk factors

Percepção subjetiva de esforço e afetividade em exercícios com peso corporal em idosos treinados e com fatores de risco cardiometabólico

Jeferson da Silva Hahn[1]
https ://orcid.org/0009-0004-6167-5084
Angelica Danielevicz[1]
https ://orcid.org/0000-0003-0432-1437
Mabel Diesel[1]
https ://orcid.org/0000-0003-0416-8102
Cíntia de La Rocha Freitas[1]
https ://orcid.org/0000-0001-8566-6298
Rodrigo Sudatti Delevatti[1]
https ://orcid.org/0000-0003-1827-7799

1 Universidade Federal de Santa Catarina. Florianópolis, SC. Brasil.

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Corresponding author
Angelica Danielevicz.
Universidade Federal de Santa Catarina – UFSC
Rua Eng. Agronômico Andrei Cristian Ferreira, s/n, 88040-900, Trindade, Florianópolis (SC), Brasil.
E-mail: angelica_danielevicz@hotmail.com

Abstract - One of the strategies to mitigate the deleterious effects of the aging process is body weight exercise. However, gaps remain regarding the appropriate progression and intensity, particularly in older adults with cardiometabolic risk factors. The aim of this study was to analyze the rate of perceived exertion (RPE) and affectivity associated with body weight exercise in older adults with cardiometabolic risk factors, considering different levels of complexity. This is a descriptive cross-sectional study. The RPE was assessed using the OMNI-Res scale, and affectivity was measured using the Hardy and Rejeski scale. Multi-joint exercises (squat, push up, pull up) were performed using only body weight and categorized into hypothetical intensities (easy, medium, and difficult) based on complexity adjustments. No significant difference in RPE was found for squat (p=0.261) and push up (p=0.063). However, a significant increase in RPE was observed for the pull up exercise (p=0.001) between the easy and difficult, as well as the medium and difficult complexities. No difference in affectivity was observed for the squat exercise (p=0.008). In the push up exercise, a significant difference in affectivity was found between the easy and difficult complexities (p=0.004), while in the pull up exercise, differences were observed between the easy and difficult, as well as the medium and difficult complexities (p=0.003). Modifying the complexity of squat and push up exercises in trained older adults with cardiometabolic risk factors did not result in differences in perceived intensity. However, performing pull up exercises using the TRX may be an interesting alternative for intensity progression.

Key words: Elderly; Exercise with body weight; Rate of Perceived Exertion.

Resumo - *Uma das estratégias para minimizar os efeitos deletérios do processo de envelhecimento é o exercício físico com peso corporal. Entretanto, há lacunas a respeito da progressão e intensidade adequadas, principalmente em idosos com fatores de risco cardiometabólico. Objetivou-se analisar a percepção subjetiva do esforço (PSE) e a afetividade associadas ao exercício realizado com peso corporal em idosos com fatores de risco cardiometabólico, em diferentes complexidades. Estudo transversal descritivo em que foram avaliadas a PSE, pela escala de OMNI-Res, e a afetividade, pela escala de Hardy e Rejeski. Exercícios multiarticulares (agachar, empurrar e puxar) foram realizados apenas com o peso corporal, e divididos em intensidades hipotéticas (fácil, médio e difícil) através da alteração da complexidade. Não houve diferença para a PSE nos exercícios de agachar (p = 0,261) e empurrar (p = 0,063). Houve um aumento na PSE para o exercício de puxar (p = 0,001) entre as complexidades fácil e difícil, bem como médio e difícil. Não houve diferença na afetividade para o exercício de agachar (p = 0,008). No exercício de empurrar, entre as complexidades fácil e difícil (p = 0,004), e no exercício de puxar, entre fácil e difícil assim como médio e difícil (p = 0,003), observou-se diferença na afetividade. Alterar a complexidade de exercício de agachar e empurrar, em idosos treinados e com fatores de risco cardiometabólico, não apresentou diferença na intensidade percebida, enquanto o exercício de puxar utilizando o TRX pode ser uma alternativa interessante para progressão de intensidade.*

Palavras-chave: *Idosos; Exercício com peso do corpo; Percepção Subjetiva do Esforço.*

INTRODUCTION

The regular practice of physical activity is a non-pharmacological strategy that minimizes the harmful effects of aging, and the inclusion of physical activity programs is a fundamental action to improve the physical-functional aspects of healthy elderly people or those with a clinical condition[1]. Among the recommendations for the elderly population with chronic conditions, multicomponent training involving muscle strengthening stands out[1,2], which should include squatting (Squat exercise), pulling (Pull Up on the TRX exercise) and pushing (Push Up exercise) patterns, approaching daily actions of the individual[3], aiming to gain mass and functional strength, which are directly related to the reduction in the number of falls and disability in the elderly population[4].

Training using only body weight as resistance, manipulating intensity through the complexity of exercises, has proven to be an interesting and low-cost alternative for practicing physical activity for the elderly population[5-7]. This modality stands out by overcoming barriers such as lack of equipment, physical space, time, or even a certain prejudice against traditional strength training, identified in studies as the main reasons that make it difficult for older people to adhere to physical training programs[4,8].

Among the benefits of body weight training in the elderly are the improvement of functional capacity, strength, power and the reduction of the effects of sarcopenia[9-12]. Despite this, it is still necessary to understand and quantify the intensity of performing these exercises, especially in individuals who have cardiometabolic risk factors, as the prevalence of one or more of these factors in the elderly is greater than 50%[13].

The rate of perceived exertion (RPE) by OMNI-Res[14] is a tool used to capture the perception mentioned during physical exercise, which can help in prescribing and controlling the intensity of effort produced specifically during strength training[15]. Another important tool is the perception of affectivity towards the exercise performed, using the Affectivity Scale[16], which is directly associated with the perceived exertion, as exercises performed at vigorous intensities can promote discomfort, promoting a possible negative affective response, which can contribute to the abandonment of physical exercise[17,18].

Identifying the intensity generated from the exercises and their progressions according to the different levels of complexity (universal or bilateral, greater or lesser amplitudes, etc.), can help the professional who seeks to understand whether the intensity perceived by the individual follows the intention of external load progression prescribed with the aim of increasing internal load. Therefore, the main objective of the present study was to analyze the intensity and affectivity associated with exercise performed with body weight in elderly people with cardiometabolic risk factors, at different complexities.

METHODS

Design

This is a descriptive, cross-sectional study in which the RPE and affectivity of elderly people with cardiometabolic risk factors were analyzed when performing body weight exercises at different levels of complexity.

Participants

The sample for this study was generated non-randomly and voluntarily, composed of trained elderly individuals of both sexes with cardiometabolic risk factors participating in the Cardiorespiratory Prevention and Rehabilitation Program (Programa de Prevenção e Reabilitação Cardiorrespiratória - PROCOR) at the Federal University of Santa Catarina. The following eligibility criteria were adopted: being a participant in the PROCOR program for at least three months, having medical authorization to practice physical exercise, having a cardiometabolic risk factor (type 2 diabetes and/or hypertension and/or dyslipidemia), and not having musculoskeletal limitations that would impair the performance of the exercises. The study was approved by the Human Research Ethics Committee of the Federal University of Santa Catarina (protocol number: 3,615,659), and all participants who agreed to participate signed the Free and Informed Consent Form.

Experimental procedures

Two meetings lasting 60-minutes were held. The first meeting aimed to clarify the stages and procedures of the research, filling out the informed consent form, anamnesis, carrying out the sitting and standing and elbow flexion tests to classify strength and resistance of the lower and upper limbs, respectively[19], and familiarization with the exercises and scales that would be used to evaluate RPE and affectivity. In the second meeting, three body weight exercises were performed with three different complexities each, with the main outcome being the monitoring of RPE and affectivity at the end of each exercise.

Measurements and outcomes

Subjective perception of exertion

The internal load of each exercise was measured using the OMNI-Res scale to evaluate the intensity after the exercises performed. For this measurement, each participant was asked, individually, how they perceived the intensity of the exercise performed, immediately after completing the exercise of that complexity. The OMNI-Res scale is a visual scale that contains alphanumeric information and figures, with numbers from 0 to 10 referring to intensity, with 0 = extremely easy; 2 = easy; 4 = reasonably easy; 6 = fairly heavy; 8 = heavy; 10 = extremely heavy[20].

Affectivity

The affective response to the exercises was collected using the Hardy and Rejeski[16] affective scale, after each exercise. For this measurement, it was asked, individually, what the affective response was to the exercise performed immediately after the execution was completed. The answer came from observing the affective scale, which consists of a visual scale containing alphanumeric information with numbers from -5 to +5 referring to the affectivity that the exercise generated, with -5 = very bad; -3 = bad; -1 = reasonably bad; 0 = neutral; +1 = reasonably good; +3 = good; +5 = very good[16].

Description of the exercises performed

Three exercises were selected, divided between upper limbs (pulling and pushing) and lower limbs (squatting). For progression, three different levels of complexity were selected, hypothetically corresponding to easy, medium and difficult. The order in which the exercises were performed was randomized in Excel Software and the exercises were performed over a period of 30 seconds, with a cadence of 1.5 seconds in the concentric phase and 1.5 seconds in the eccentric phase, controlled through a mobile application called Metronome Beats, totaling 10 repetitions. Immediately after performing each exercise at a respective intensity, outcomes were collected by following the subjects for a three-minute passive seated interval.

Lower limbs

Squat (easy): The individual started the movement standing, with their back to a chair, which was leaning against the wall for safety reasons. The arms remained crossed in front of the chest, so that they were not used as assistance during the movement. Then, the knees and hips must be flexed with the aim of sitting on the chair. After sitting on the chair, the individual returned to the starting position.

Squat (medium): The movement is the same as the easy level, however during the movement the individual only touched the chair and returned to the starting position.

Squat (difficult): The individual started the movement with one leg in front of the other, both hip-width apart and with knees extended, then flexed both knees, taking the knee behind towards the ground. By bringing the knee closer to the ground, the individual returned to the starting position.

Upper limbs

Push Up (easy and medium): In a vertical position supported on both feet and with arms extended in front in contact with the wall, the individual flexed their elbows, bringing the body closer to the wall and then returned to the starting position. To define the intensity, the individual used their own feet to measure the distance from the wall, placing their feet one in front of the other, with two "feet" for easy and three "feet" for medium.

Push Up (difficult): Lying in the prone position, the individual placed their hands and knees on the ground, keeping their elbows extended, so that the body was partially suspended by both contacts, then flexed their elbows to approximately 90º and returned to starting position.

Pull Up on the TRX (easy, medium and difficult): Standing, facing the TRX fixed to a door, the individual held the TRX handles with a neutral grip and extended the elbows, moving the body away from the door. Then, he flexed his elbows to return to the starting position. To define the intensity, the individual used their own feet to measure the distance from the door, placing their feet one in front of the other, with three "feet" for easy, two "feet" for medium and one "foot" for difficult.

Data analysis

Data analysis was performed using SPSS Software, version 21.0. The normality and homogeneity of the data were verified using the Shapiro-Wilk and

Levene tests, respectively. Parametric values were described using mean and standard deviation and non-parametric values were described using median and interquartile range. Comparison of data between levels (easy vs medium vs difficult) in each exercise was performed by one-way Analysis of Variance (ANOVA), with Bonferroni post-hoc, for parametric data, and by the Friedman test, for non-parametric data. The significance level adopted was 5%.

RESULTS

The research participants were 14 trained elderly people, most with hypertension and dyslipidemia (Table 1).

Regarding RPE, there was no significant difference between the complexities adopted in the Push Up ($p = 0.063$) and Squat ($p = 0.261$) exercises. For the Pull Up ($p = 0.001$), a significant difference was found between the easy and difficult ($p = 0.001$) and medium and difficult ($p = 0.040$) complexity levels (Table 2).

For affectivity values, although the first analysis showed significance (p=0.008), post-hoc tests did not show significant differences between the complexities adopted in the Squat; however, there was a significant difference in the Push Up between the easy and difficult complexity, and in the Pull Up between the easy and difficult and medium and difficult complexities (Table 3).

Table 1. Sample characterization (n = 14).

Sociodemographic and characterization data	
Age (years old)	66.93 ± 4.18
Sex (Woman/Man)	8/6
Body Mass (Kg)	73.47 ± 16.68
Height (m)	1.62 ± 0.12
BMI (kg/m2)	27.63 ± 4.13
Sit-to-Stand test (reps)	16.50 ± 2.65
Elbow flexion test (reps)	20.86 ± 3.55
Cardiometabolic risk factors	*n/ %*
Hypertension	10 (71.42%)
Dyslipidemia	9 (64.28%)
Diabetes Mellitus	5 (35.71%)
Coronary Artery Disease	6 (42.85%)

Note. m: meters; kg: kilograms; kg/m^2: kilogram per square meter; reps:repetitions; Continuous data are presented as mean and standard deviation; Categorical data are presented in absolute and relative frequency (n sample).

Table 2. Subjective perception of effort between different complexities of exercises, performed with body weight.

Exercise	Easy	Medium	Difficult	*p*-value
Squat	2.38 ± 1.56	2.85 ± 1.57	3.46 ± 1.81	0.261
Push up	2.36 ± 1.78	2.93 ± 1.69	4.00 ± 1.96	0.063
Pull up	1.71 ± 1.07a	2.86 ± 1.92 a	4.43 ± 1.70b	0.001

Note. Values expressed in U.A.; Values described by mean and standard deviation. α: 0.05; Different letters indicate significant difference.

Table 3. Affectivity between different complexities of exercises performed with body weight.

Exercise	Easy	Medium	Difficult	*p*-value
Squat	4 (3.0 – 5.0)	5 (3.0 – 5.0)	3 (3.0 – 3.0)	0.008
Push up	5 (3.0 – 5.0)a	3 (3.0– 5.0)ab	3 (3.0 – 3.0)b	0.004
Pull up	3 (3.0 – 5.0)a	4 (3.0 – 5.0)a	3 (3.0 – 3.0)b	0.003

Note. Values expressed in AU; Values described by median and interquartile range. α: 0.05; Different letters indicate significant difference.

DISCUSSION

The results showed that, although we did not find a significant difference in RPE for the Squat and Push Up exercises at their different complexities, there was a significant difference in the Pull Up exercise between the easy and difficult and medium and difficult complexities, as reported by RPE. Regarding affectivity, it can be observed that there was no significant difference between the complexities of the squat exercise. In the Push Up exercise, even with similar RPE values, there was a significant difference between the easy and difficult complexities, and for the Pull Up exercise, between the easy and difficult, and medium and difficult complexities.

One factor that may have influenced the similarity between the different complexities of Squat and Push Up is the fact that the elderly individuals evaluated in the present study are already part of a physical exercise program, in which they already train with an overload greater than body weight for exercises similar to those evaluated here. However, the difference found in the Pull Up exercise between the easy and difficult and medium and difficult complexities showed that the TRX implement appears to increase the external load (body weight) as we modify the body position to a more horizontal one. These results demonstrate that changing the angulations in the TRX can be a good strategy for load progression in the Pull Up, performed with body weight in trained elderly people with cardiometabolic risk factors. However, it is necessary to look for an alternative to the complexities between easy and medium to have a concise progression. In this sense, we suggest the use of the perception of effort itself, the outcome of this study, as a tool for controlling intensity in exercises primarily prescribed based on body weight.

Regarding affectivity, the significant differences in the Push Up between easy and difficult complexities, and the Pull Up between easy and difficult, and medium and difficult complexities, corroborate studies that demonstrate that greater intensities generate lower affectivity values[17,18]. Although the Push Up did not obtain significant differences between the easy and difficult complexities for RPE, we can observe an increase between these complexities, which could explain the difference observed in affectivity, requiring further studies to confirm this hypothesis.

A recent study[21] demonstrated a significant improvement in the functional capacity of elderly people in squatting exercises regardless of the complexity of the exercise performed, whether deep or partial. Another study[22] showed an improvement in the ability to generate force in knee extensors and ankle plantar flexors in a body weight training program, but it was reported that the improvement in strength was influenced by the ability to generate force before participating in the exercise program, that is, those individuals with a lower capacity to generate force obtained a greater gain in these values, which leads us to believe that for trained individuals, as in this study, the suggested complexities of body weight exercises may not generate significant gains in strength, making it necessary to search for other progression options that generate greater adaptation. However, these exercises suggested in the research can be used for another objective, such as: the variability of exercises for the same muscle group for training carried out with your own body weight.

The use of the TRX implement seems to be a good option to generate higher RPE values in certain complexities of the Pull Up, in addition to generating

benefits to delay the deleterious effects of aging as demonstrated in the literature[23]. However, it is important to highlight that higher intensities can generate less affection for the exercise, so using lower complexities with the aim of reducing the perception of effort can be an interesting strategy to avoid the risk of giving up on physical exercise due to negative affect.

As a limitation of this study, we can mention the small sample size and the lack of another marker of internal charge, such as blood lactate and/or electromyography (EMG) signal. The strengths of this work include the randomization of exercises and intensities during collection, the use of an internal load marker such as RPE, which is important for controlling the intensity of the exercises performed, and also the use of body weight exercises, widely used today and must be prescribed appropriately and safely, in addition to noting the need for high-cost or difficult-to-access equipment, encouraging control of variables in different training scenarios with clinical populations.

CONCLUSION

It is concluded that for the population of trained elderly people, with cardiometabolic risk factors, changing the complexity of Squat and Push Up, as proposed in the present study, does not seem to be a good strategy for increasing intensity aiming at the progression of exercise training. As for the Pull Up, performed with the TRX implement, changing the complexity, as proposed here, can generate greater intensities, being a possibility of increasing the load for the progression of strength training with body weight in trained elderly people with cardiometabolic risk factors.

COMPLIANCE WITH ETHICAL STANDARDS

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Ethical approval

Ethical approval was obtained from the Human Research Ethics Committee of the Federal University of Santa Catarina (protocol number: 3,615,659) and the protocol was written in accordance with the standards established by the Helsinki Declaration.

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conception and design of the experiment: RSD, JSH, AD. Experiment execution: JSH, AD, MD, CDLRF. Data analysis: RSD, JSH, CDLRF.

Contribution with reagents/research materials/analysis tools: RSD, CDLRF. Article writing: JSH, AD, MD, CDLRF, RSD. All authors read and approved the final version of the manuscript.

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