ORIGINAL ARTICLE

Received: 08/06/2018
Accepted: 11/22/2018
Funding: none

Health-related physical fitness of military police officers in Paraiba, Brazil

Aptidão física relacionada à saúde de policiais militares da Paraíba

Adeilma Lima Lima-dos-Santos[1,2,3], Jarbas Rállison Domingos-Gomes[1,2,3], Ozineide Sousa Dantas Andrade[1], Maria do Socorro Cirilo-Sousa[2], Eduardo Domingos da Silva Freitas[3,4], Júlio Cesar Gomes Silva[2,3], Petrônio Jaques Galdino Izidorio[1], Rodrigo Ramalho Aniceto[1,2,3]

ABSTRACT | Background: An adequate relationship among health–related physical fitness (HRPF) components improve the professional performance of military police officers (MOPs). **Objective:** To investigate the correlation among HRPF components for Special Police Operations (BOPE) and Traffic Police (BPTRAN) Battalion MOPs. **Method:** The sample comprised 47 male MOPs aged 26 to 49 years old divided in two groups BOPE (N=25) and BPTRAN (n=22). The participants were subjected to a test battery—anthropometric measurements, sit–and–reach test, 1-minute sit–up test, elbow flexion test, and 20–meter shuttle run test—for evaluation of the HRPF morphological, cardiorespiratory and neuromuscular components. **Results:** Both groups exhibited moderate–to–strong correlation of waste circumference (WC), body mass index (BMI) and body fat percentage (BFP) with localized muscle resistance (LMR) (r=-0.589; r=-0.404; r=-0.637) and dynamic muscle strength (DMS) (r=0.592; r=-0.416; r=-0.651) (p<0.05). Significant positive and negative correlation was found between maximum oxygen consumption and WC, BMI, BFP and LMR (p<0.05) but not with flexibility for BOPE. **Conclusion:** There was strong correlation between the HRPF morphological, cardiorespiratory and neuromuscular components, except for flexibility among BOPE MPOs. The study findings allow inferring that HRPF is a global variable.

Keywords | kinanthropometry; physical fitness; burnout, professional; occupational health; police.

RESUMO | Introdução: Boas relações entre os componentes da aptidão física relacionada à saúde (AFRS) melhoram o desempenho da atividade ocupacional de policiais militares. **Objetivo:** Verificar a relação entre componentes da AFRS em policiais militares do Batalhão de Operações Policiais Especiais (BOPE) e do Batalhão de Policiamento de Trânsito (BPTRAN). **Método:** Participaram do estudo 47 policiais com idades entre 26 e 49 anos do sexo masculino fracionados em dois grupos: BOPE (n=25) e o BPTRAN (n=22). Foi realizada uma bateria de testes: medidas antropométricas, teste de sentar-e-alcançar no banco de Wells, teste de abdominal de 1 minuto, teste de flexão dos cotovelos e teste vai-e-vem de 20 metros, para avaliar os componentes morfológico, cardiorrespiratório e neuromuscular da AFRS. **Resultados:** Ambos os grupos obtiveram de moderada à forte correlação negativa significante em relação à circunferência de cintura (CC), índice de massa corpórea (IMC) e percentual de gordura (PG) com a resistência muscular localizada (RML) (r=-0,589; r=-0,404; r=-0,637) e a força muscular dinâmica (FD) (r=0,592; r=-0,416; r=-0,651) (p<0,05). Contudo, houve correlações positivas e negativas significantes entre o consumo máximo de oxigênio ($VO_{2\,máx}$) e as variáveis CC, IMC, PG e RML (p<0,05), exceto para flexibilidade no BOPE. **Conclusão:** Existe uma forte correlação entre os componentes morfológico, cardiorrespiratório e neuromuscular, exceto para a flexibilidade em PMs do BOPE. Tal fato permite afirmar que a AFRS é uma variável global.

Palavras-chave | cineantropometria; aptidão física; esgotamento profissional; saúde do trabalhador; polícia.

[1]Laboratory of Kinesiology and Biomechanics, Faculdades Integradas de Patos - Patos (PB), Brazil.

[2]Laboratory of Kineanthropometry and Human Performance, Universidade Federal da Paraíba - João Pessoa (PB), Brazil.

[3]Study and Research Group in Biomechanics and Psychophysiology of Exercise, Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Norte - Currais Novos (RN), Brazil.

[4]Department of Health and Exercise Science, University Oklahoma - Norman (OK), United States.

DOI: 10.5327/Z1679443520180304

INTRODUCTION

Military police officers (MPOs) are a professional category with particular characteristics as they need to continuously cope with situations which cause physical and mental stress. The Military Police of the state of Paraiba, Brazil, includes a Traffic Police Battalion (Batalhão de Policiamento de Trânsito — BPTRAN) charged of policing traffic violations, and a Special Police Operation Battalion (Batalhão de Operações Policiais Especiais–BOPE) highly specialized and trained to deal with high–risk situations, such as kidnapping and interventions in prisons and dangerous places, for which reason they are considered as an elite corps[1].

The job of MPOs includes countless daily routine activities which demand considerable physical and mental effort. For this reason, this professional category is at high risk for development of stress and cardiovascular diseases, and consequently also burnout syndrome[2]. Given this scenario, adequate physical fitness is crucial for their daily professional performance and thus enable them contribute to improve the public safety. Several activities might be included in MPOs' training to improve and maintain their physical fitness[3] and reduce absenteeism[4].

Among the military, performance in the job is directly related to morphological, neuromuscular and cardiorespiratory aspects, which are the components of health–related physical fitness (HRPF). Poor physical fitness is seen as having negative impact on the ability to perform functional activities[5], and might interfere with the professional performance and health of MPOs, thus increasing their morbidity and mortality[6]. Training programs induce significant changes in HRPF components[7], while some studies conducted with police officers found inadequate levels of some such components[1]. It is worth observing that this population is exposed to several risk factors in common with the overall population, including physical inactivity, dyslipidemia, smoking, excess weight[8] and abdominal obesity[9].

Although previous studies analyzed HRPF among PMOs, they only performed comparison between subgroups[1,10-12] or focused on some of HRPF components[12-14]. On these grounds, the present study is fully justified, as we believe that a faithful picture of physical fitness aspects (morphological, cardiorespiratory and neuromuscular) directly related to the state of health of different military police subgroups will establish the relevance of exercise programs targeting this specific population to optimize the performance of their social service tasks, and thus contribute to improve the public safety. Therefore, the aim of the present study was to investigate the correlation between HRPF components for BOPE and BPTRAN PMOs in Paraiba, Brazil.

METHOD

SAMPLE

The present cross-sectional study was approved by the research ethics committee of Integrated Schools of Patos (Faculdades Integradas de Patos–FIP) ruling no. 205 / 2012, in compliance with the National Health Council Resolution no. 466 / 12. Before the onset of data collection, all the participants were informed about the study aims and procedures, and signed an informed consent form. The study was conducted in Patos, Paraiba, which according to the Brazilian Institute of Geography and Statistics (IBGE)[15] in 2017 had an area of 473,056 km^2, and in 2010 a population of 100,674 inhabitants and demographic density of 212.82 inhabitants / km^2.

Patos military police includes the third largest battalion in the state, to a total of 473 police officers, 33 allocated to the 6th BOPE company and 30 to the 4th BPTRAN company. The sample comprised 47 male MPOs aged 26 to 49 years old divided into groups BOPE (n=25) and BPTRAN (n=22) corresponding to 75.75% and 73.33% of each battalion.

We included MPOs effectively working, and categorized as physically active according to the short form of International Physical Activity Questionnaire (IPAQ)[16] according to which the minimum considered is 30 min / session of moderate–intensity physical activity 5 days / week (= 150 min / week), 20 min / session of vigorous–intensity physical activity 3 days / week (=60 min / week) or a combination of moderate– and vigorous–intensity physical activity.

Individuals taking any medication, dietary supplements, having consumed alcohol or smoked 48 hours before and

along the study, with musculoskeletal or cardiovascular disorders, or unable to complete the tests included in the study protocol were excluded.

DATA COLLECTION PROCEDURES

The participants visited the data collection site in the morning to undergo a HRPF test battery. After anthropometric measurement was performed, the participants were subjected to neuromuscular and cardiorespiratory tests, with 5-minute interval between them.

The following anthropometric measurements were collected to analyze the morphological component of HRPF: body mass (kg), height (m), waist circumference (WC, cm) and mean chest, abdominal and thigh skinfold thickness (mm). The body mass index (BMI, kg / m^2) was calculated by dividing the body mass by the height squared. Body fat percentage (BFP) was calculated according to Jackson and Pollock's protocol[17]. All the measurements were performed by a same experienced examiner following the recommendations by the *International Society for the Advancement of Kinanthropometry*[18].

The neuromuscular component was assessed based on variables flexibility (FLEX) — measured by means of the sit–and–reach test on the due box[19]; localized muscle resistance (LMR) — measured with the 1-minute sit–up test[20]; and dynamic muscle strength (DMS) — assessed based on the elbow flexion test[20]. Evaluation of the cardiorespiratory component was based on the 20–meter shuttle run test, and the maximum rate of oxygen consumption ($VO_{2\ max}$, mL/kg/min) was calculated with the Léger equation[21]. For being a broad-scoped reserach project, the descriptive data of HRPF were reported in a previous publication with a different focus[1].

STATISTICAL ANALYSIS

The normality and homogeneity of the data were verified by means of the Kolmogorov–Smirnov and Levene's tests, respectively. The independent sample t–test was used for comparisons between groups. The relationship between HRPF variables (WC, BMI, BFP, FLEX, LMR, DMS and VO_{2max}) in each group was tested with Pearson's correlation. The correlation coefficient values were categorized following Hopkins et al as[22]: trivial (r<0.1), weak (0,1<r<0.3), moderate (0.3<r<0.5), strong (0.5<r<0.7), very strong (0.7<r<0.9) or almost perfect (r>0.9). All the data are expressed as mean and standard deviation; the significance level was set to p=0.05. Statistical analysis was performed with package SPSS[å] 20 (IBM, Chicago, IL, USA).

RESULTS

The results did not evidence significant difference between the groups relative to variables age (BOPE: 37.0±6.7; BPTRAN: 38.7±8.1 years old; p=0.515) or length in the job (BOPE: 15.2±7.2; BPTRAN: 16.2±9.4 years; p=0.898). The sample was manly composed of soldiers (n=20; 42.6%). Most participants had completed secondary school (n=29; 61.7%). More than half of the sample was categorized as economic class B1 or B2, while none as A1. No participant smoked, but 29 (61.7%) reported to consume alcohol.

For the full sample (Table 1) WC, BMI, BFP, LMR, DMS and VO_{2max} exhibited positive or negative relationship with all the other variables, except for FLEX and BMI (r=-0.054). On analysis per group (Tables 2 and 3), several significant correlations were found among HRPF components. For BOPE, WC, BMI and BFP exhibited moderate–to–strong significant (p<0.05) negative correlation with LMR (r=-0.472; r=-0.453; r=-0.607) and DMS FD (r=-0.489; r=-0.425; r=-0.756). None of these variables exhibited significant (p>0.05) correlation with FLEX. VO_{2max} exhibited significant correlation with WC, BMI, BFP, LMR and DMS, but not with FLEX (p<0.05).

For BPTRAN, WC, BMI and BFP exhibited moderate–to–strong significant negative correlation with DMS (r=-0.673; r=-0.480; r=-0.541) and LMR (r=-0.696; r=-0.458; r=-0.627) (p<0.05). Only WC exhibited correlation with FLEX (p<0.05). VO_{2max} exhibited significant correlation with WC, BMI, BFP, LMR and FLEX, but not with DMS (p<0.05).

DISCUSSION

In the present study we analyzed correlations among HRPF components for BOPE and BPTRAN MPOs.

Table 1. Correlation between physical fitness components for military police officers, Paraiba, 2012 (n=47).

Variables	WC (cm)	BMI (kg/m²)	BFP (%)	FLEX (cm)	DMS (repetitions)	LMR (repetitions)	VO_{2max} (mL/kg/min)
WC (cm)							
BMI (kg/m²)	0.841**						
BFP (%)	0.731**	0.592**					
FLEX (cm)	-0.301*	-0.054	-0.406**				
DMS (repetitions)	-0.592**	-0.416**	-0.651**	0.356*			
LMR (repetitions)	-0.589**	-0.404**	-0.637**	0.331*	0.672**		
VO_{2max} (mL/kg/min)	-0.664**	-0.551**	-0.648**	0.342*	0.487**	0.665**	

WC: waist circumference; BMI: body mass index; BFP: body fat percentage; FLEX: flexibility; DMS: dynamic muscle strength; MLR: localized muscle resistance; $VO_{2máx}$: maximum oxygen consumption; *p<0.05; **p<0.01.

Table 2. Correlation between health-related physical fitness components for Special Police Operation Battalion military police officers, Paraiba, 2012 (n=25).

Variables	WC (cm)	BMI (kg/m²)	BFP (%)	FLEX (cm)	DMS (repetitions)	LMR (repetitions)	VO_{2max} (mL/kg/min)
WC (cm)							
BMI (kg/m²)	0.898**						
BFP (%)	0.623**	0.539**					
FLEX (cm)	-0.102	-0.002	-0.374				
DMS (repetitions)	-0.489*	-0.425*	-0.756**	0.411*			
LMR (repetitions)	-0.472*	-0.453*	-0.607**	0.339	0.619**		
VO_{2max} (mL/kg/min)	-0.607**	-0.553**	-0.672**	0.162	0.553**	0.745**	

WC: waist circumference; BMI: body mass index; BFP: body fat percentage; FLEX: flexibility; DMS: dynamic muscle strength; MLR: localized muscle resistance; $VO_{2máx}$: maximum oxygen consumption; *p<0.05; **p<0.01.

Table 3. Correlation between health-related physical fitness components for Traffic Police Battalion military police officers, Paraiba, 2012 (n=22).

Variables	WC (cm)	BMI (kg/m²)	BFP (%)	FLEX (cm)	DMS (repetitions)	LMR (repetitions)	VO_{2max} (mL/kg/min)
WC (cm)							
BMI (kg/m²)	0.830**						
BFP (%)	0.839**	0.739**					
FLEX (cm)	-0.448*	-0.194	-0.359				
DMS (repetitions)	-0.673**	-0.480*	-0.541**	0.250			
LMR (repetitions)	-0.696**	-0.458*	-0.627**	0.226	0.688**		
VO_{2max} (mL/kg/min)	-0.737**	-0.637**	-0.597**	0.429*	0.398	0.562**	

WC: waist circumference; BMI: body mass index; BFP: body fat percentage; FLEX: flexibility; DMS: dynamic muscle strength; MLR: localized muscle resistance; $VO_{2máx}$: maximum oxygen consumption; *p<0.05; **p<0.01

The main findings point to strong correlation between the HRPF morphological, neuromuscular and cardiorespiratory components in each group and also for the full sample. These results reinforce the relevance of physical activity, as it is able to modulate the HRPF components, and determine positive changes in the quality of life, health, and work–related tasks of individuals. For this reason, assessing the correlation among physical fitness components among MPOs is even more relevant, as their job includes countless situations which put high physical and mental demands. Therefore, the HRPF components should exhibit adequate levels in this population of workers.

In the present study, the HRPF morphological component exhibited strong negative correlation with the cardiorespiratory component in each group and also on joint analysis. These findings corroborate the results of other studies which indicate strong association between these two HRPF componentes among military personnel[13]. A possible explanation is that MPOs must mandatorily exercise regularly, while as a rule training consists in walking or running, usually at 60% of the maximum heart rate or 50% of the maximum oxygen consumption, which increases the cardiorespiratory capacity[16]. Mikkola et al.[23] reported that among conscripts entering military service sport training decreased the body mass, WC and fat mass concomitantly to improvements on the Cooper test, resulting in strong negative correlation between the morphological and cardiorespiratory components of HRPF.

Negative moderate–to–strong correlation was found between the morphological and neuromuscular HRPF components in each group and also on joint analysis (r=-0.592; r=-0.416; r=-0.651; r=-0.589; r=-0.404; r=-0.637). These findings agree with those of the study by Slemenda et al.[24] which evidenced lower muscle strength among the individuals with higher body fat. To be sure, muscle strength is positively correlated with the cross-section of muscles. Therefore, the higher the latter, the more energy should be expended to meet the demands put on muscles, while the resting metabolic rate concomitantly increases, all of which results in the reduction of the body fat[25]. We should observe that FLEX did not exhibit relationship to any morphological variable for group BOPE, but for group BPTRAN only. This finding might be accounted for by the dispersion of the data, as found in the study by Domingos-Gomes et al.[1], in which 44% and 83% of BOPE MPOs exhibited FLEX and BFP above the mean values, respectively, while among BPTRAN MPOs FLEX was below the mean for 54.5% of the sample and BFP above the mean for 81.8%.

Positive correlation was found between the HRPF neuromuscular and cardiorespiratory components for each group and on joint analysis. These results agree with those reported by Cadore et al.[26] and Brentano et al.[27]. Although these studies were conducted with different populations, their findings reinforce the idea that the cardiorespiratory component increases in parallel to the neuromuscular component. This fact might be accounted for by physiological adaptations induced by training, such as increased capillary supply, myoglobin content, mitochondrial function, and oxidative enzyme activity[26]. We should emphasize that all the participants were physically active, i.e. all of them performed physical activity regularly, which might have influenced the results of correlation analysis.

The results of the present study contribute to the understanding of the relationship between the HRPF morphological, neuromuscular and cardiorespiratory components, and show that regular physical activity promotes mechanisms with direct influence on these components. Our results further reinforce the relevance of structured and organized exercise programs supervised by physical education professionals as a part of routine activities at military institutions. The reason is that in addition of its crucial role in the prevention of diseases and maintenance of health, exercise might influence the performance of MPOs at work.

CONCLUSION

The results of the present study evidenced strong correlation between the HRPF morphological, cardiorespiratory and neuromuscular components, except for FLEX, on separate analysis of BOPE. Therefore, we might conclude that HRPF is a global variable, and that its components are strongly interrelated in the case of MPOs.

ACKNOWLEDGMENTS

The authors thank Laboratory of Kinanthropometry, FIP, for lending their equipment; Banco do Brasil Athletic Association, Patos, for providing room for data collection; and to BOPE and BPTRAN commandants and MPOs who participated in the present study.

REFERENCES

1. Domingos-Gomes JR, Oliota-Ribeiro LS, Silva JS, Melo AC, Albuquerque Neto SL, Cirilo-Sousa MS, et al. Comparação da aptidão física relacionada à saúde e sua associação com o tempo de serviço entre policiais militares de operações especiais e de trânsito. J Phys Education. 2016;27(1):27-43. http://doi.org/10.4025/jphyseduc.v27i1.2743
2. De la Fuente Solana EI, Extremera RA, Pecino CV, Cañadas de la Fuente GR. Prevalence and risk factors of burnout syndrome among Spanish officers. Psicothema. 2013;25(4):488-93. https://doi.org/10.7334/psicothema2013.81
3. Gibala MJ, Gagnon PJ, Nindl BC. Military Applicability of Interval Training for Health and Performance. J Strength Cond Res. 2015;29(Suppl. 11):S40-5. https://doi.org/10.1519/JSC.0000000000001119
4. Bravo DS, Barbosa PMK, Calamita Z. Absenteísmo e envelhecimento no contexto ocupacional do Policial Militar. Rev Bras Med Trab. 2016;14(2):134-42. https://doi.org/10.5327/Z1679-443520161915
5. Glaner MF. Nível de atividade física e aptidão física relacionada à saúde em rapazes rurais e urbanos. Rev Paul Educ Fís. 2002;16(1):76-85.
6. Moraes LFR, Pereira LZ, Lopes HEG, Rocha DB, Ferreira SAA. Estresse e qualidade de vida no trabalho na polícia militar do estado de Minas Gerais. Minas Gerais: EnANPAD, 2001.
7. Maziero RSB, Bozza R, Barbosa Filho VC, Piola TS, Campos W. Correlação do índice de massa corporal com as demais variáveis da aptidão física relacionada à saúde em escolares do sexo masculino de Curitiba-PR, Brasil. UNOPAR Cient Ciênc Biol Saúde. 2015;7(1):9-12. http://dx.doi.org/10.17921/2447-8938.2015v17n1p9-12
8. Barbosa RO, Silva EF. Prevalência de fatores de risco cardiovascular em policiais militares. Rev Bras Cardiol. 2013;26(1):45-53.
9. Braga Filho RT, D'Oliveira Junior A. The prevalence of metabolic syndrome among soldiers of the military police of Bahia state, Brazil. Am J Mens Health. 2014;8(4):310-5. https://doi.org/10.1177/1557988313510928
10. Silva JMD. Segurança Pública Ativa: Avaliação do VO2MAX dos ciclo-patrulheiros do 2º Batalhão de Polícia Militar do Estado da Paraíba (BPM-PB) [undergraduate course final essay]. Campina Grande: Universidade Estadual da Paraíba; 2013.
11. Nogueira EC, Porto LGG, Nogueira RM, Martins WR, Fonseca RM, Lunardi CC, et al. Body composition is strongly associated with cardiorespiratory fitness in a large Brazilian military firefighter cohort: the Brazilian firefighters study. J Strength Cond Res. 2016;30(1):33-8. https://doi.org/10.1519/JSC.0000000000001039
12. Knihs DA, Moura BM, Reis LF. Perfil antropométrico de bombeiros militares: comparação entre os grupos de trabalho operacional e administrativo. Rev Bras Med Trab. 2018;16(1):19-25. https://doi.org/10.5327/Z1679443520180122
13. Araújo Junior AT, Medeiros RDJ, Oliveira LS, Ferreira LA, Sousa MSC. Comparação do consumo máximo de oxigênio ($VO_{2\,máx}$) de militares que trabalham em rádio patrulha e guarda de presídio. Fitness Performan J. 2009;8(2):90-5. https://doi.org/10.3900/fpj.8.2.90.p
14. Delgado C, Fernandes Filho JF, Barbosa FP, Oliveira HB. Utilização do esfigmomanômetro na avaliação da força dos músculos extensores e flexores da articulação do joelho em militares. Rev Bras Med Esporte. 2004;10(5):362-6.
15. Instituto Brasileiro de Geografia e Estatística. Censo Cidades [Internet]. Instituto Brasileiro de Geografia e Estatística; 2017 [cited 11 Dec 2017]. Available at: https://cidades.ibge.gov.br/brasil/pb/patos/panorama
16. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, et al. American College of Sports Medicine position stand. Quantity and quality of exercise for Developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. Med Sci Sports Exerc. 2011;43(7):1334-59. https://doi.org/10.1249/MSS.0b013e318213fefb
17. Jackson AS, Pollock, ML. Generalized equations for predicting body density of men. Br J Nutr. 1978;40(3):497-504.
18. International Society for the Advancement of Kinanthropometry. International standards for anthropometric assessment. Australia: National Library of Australia; 2001.
19. Bertolla F, Baroni BF, Leal Junior ECP, Oltramari JD. Efeito de um programa de treinamento utilizando o método *Pilates*® na flexibilidade de atletas juvenis de futsal. Rev Bras Med Esporte. 2007;13(4):222-6. http://dx.doi.org/10.1590/S1517-86922007000400002
20. American College of Sports Medicine. Diretrizes do ACSM para os testes de esforço e sua prescrição. 9ª ed. Rio de Janeiro: Guanabara Koogan; 2014.
21. Léger LA, Mercier D, Gadoury C, Lambert J. The multistage 20 metre shuttle run test for aerobic fitness. J Sports Sci. 1988;6(2):93-101. https://doi.org/10.1080/02640418808729800
22. Hopkins WG, Marshall SW, Batterham AM, Hanin J. Progressive statistics for studies in sports medicine and exercise science. Med Sci Sports Exerc. 2009;41(1):3-13. https://doi.org/10.1249/MSS.0b013e31818cb278
23. Mikkola I, Keinänen-Kiukaanniemi S, Jokelainen J, Peitso A, Härkönen P, Timonen M, et al. Aerobic performance and body composition changes during military service. Scand J Prim Health Care. 2012;30(2):95-100. https://doi.org/10.3109/02813432.2012.649631

24. Slemenda C, Heilman DK, Brandt KD, Katz BP, Mazzuca SA, Braunstein EM, et al. Reduced quadriceps strength relative to body weight: a risk factor for knee osteoarthritis in women? Arthritis Rheum. 1998;41(11):1951-9. https://doi.org/10.1002/1529-0131(199811)41:11%3C1951::AID-ART9%3E3.0.CO;2-9
25. Mcardle WD, Katch K. Fisiologia do Exercício. Energia, Nutrição e Desempenho Humano. 9th ed. Rio de Janeiro: Guanabara Koogan; 2016.
26. Cadore EL, Pinto RS, Alberton CL, Pinto SS, Lhullier FLR, Tartaruga MP, et al. Neuromuscular economy, strength, and endurance in healthy elderly men. J Strength Cond Res. 2011;25(4):997-03. https://doi.org/10.1519/JSC.0b013e3181d650ba
27. Brentano MA, Cadore EL, Da Silva EM, Ambrosini AB, Coertjens M, Petkowicz R, et al. Physiological adaptations to strength and circuit training in postmenopausal women with bone loss. J Strength Cond Res. 2008;22(6):1816-25. https://doi.org/10.1519/JSC.0b013e31817ae3f1

Correspondence address: Rodrigo Ramalho Aniceto – Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Norte – Rua Manoel Lopes Filho, 773, Valfredo Galvão – CEP: 59380-000 – Currais Novos (RN), Brazil – E-mail: rodrigo-afa@hotmail.com