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Physical fitness test performance probability with increasing age: suggestions for practical applications in military physical training

Probabilidade de desempenho no teste de aptidão física e o aumento da idade: sugestões de aplicações práticas no treinamento físico militar

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Abstract – This article analyzes the Physical Fitness Test (PFT) which is performed by the Brazilian Navy to check the physical parameters of its military members in order to present the performance of probabilities with increasing age. We analyzed 702 PFT data in this study, separated into three groups based on the age of those assessed by the PFT, as follows: young adults (YA, n=91, age range between 20-30 years), adults (A, n=243, age range between 30-40 years) and mature adults (MA, n=368, age range between 40-50 years old). PFT measurements were: Body Mass Index (BMI), 100 m freestyle swimming, 3,200 m running, 1 min sit-ups, Pull-up on the bar and Push-up test. The main results indicated significant differences between groups when compared Body mass (YA: 79.1±11.4kg and A: 82.1±14kg < MA: 84.1±12.3kg), BMI (YA: 25.4±2.9 < A: 26.4±4.3 < MA: 27.5±4),Pull-ups (YA: 10.8±4.6 freq./min < A: 10±3.6 freq./min < MA: 8.5±4.7 freq./min), 3,200 m running time (YA: 1282,1±172,4s < A: 1421±199.8s < MA: 1566.7±192.4s) and 100 m swimming time (YA: 760.0 ± 56.6s < A: 800.0 ± 118.2s < MA: 882.0 ± 113.7s) and the regression analysis demonstrated that 3,200 m running and pull-ups were the most affected variable of aging process ($p<0.05$). In summary, it is possible to carry out a practical application, considering aging process and the decline of the aerobic capacity and the upper limbs strength-power in Military Physical Training.

Key words: Age; Military science; Performance.

Resumo – *Este artigo analisou o Teste de Aptidão Física (PFT), realizado pela Marinha do Brasil para medir os parâmetros físicos de seus militares, a fim de apresentar as probabilidades de desempenho com o aumento da idade. Analisamos 702 dados de PFT, separados em três grupos com base na idade, como segue: adultos jovens (YA, n=91, faixa etária entre 20–30 anos), adultos (A, n=243, faixa etária entre 30–40 anos) e adultos de meia idade (MA, n=368, faixa etária entre 40–50 anos). As medidas da PFT foram: Índice de Massa Corporal (BMI), natação de 100m livre, 3.200m de corrida, 1min de abdominais, flexão na barra e flexão de braço. Os principais resultados indicaram diferenças significativas entre os grupos quando comparados a massa corporal (YA: 79,1±11,4kg e A: 82,1±14kg <MA: 84,1±12,3kg), IMC (IA: 25,4±2,9 <A: 26,4±4,3 <MA: 27,5±4,0), Pull-ups (YA: 10,8±4,6 freq./min <A: 10,0±3,6 freq./min <MA: 8,5±4,7 freq./min), 3.200 m de tempo de execução (YA: 1282,1±172,4s <A: 1421±199,8s <MA: 1566,7±192,4s) e 100m de natação (YA: 760,0 ± 56,6s < A: 800,0 ± 118,2s < MA: 882,0 ± 113,7s) e a análise de regressão demonstrou que 3.200m de corrida e flexões de braço foram a variável mais afetada do processo de envelhecimento ($p<0,05$). Em resumo, é possível realizar uma aplicação prática, considerando o processo de envelhecimento e o declínio da capacidade aeróbica e da força-força dos membros superiores no treinamento físico militar.*

Palavras-chave: *Idade; Ciência militar; Desempenho.*

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INTRODUCTION

The physical training of a military person should be guided by the objectives and activities which are proper to their assignment and specialty, meaning those tasks which derive from the mission in their respective unit, position and post[1-2]. Physical fitness is gained through the use of the various physical training facilities available in Military Physical Training (MPT) sessions, and of course through instructional and training activities such as marches, tactical instruction and campaign exercises[3]. Therefore, there is a great need to have the target of the MPT in accordance with physical fitness in order to maintain the daily activities of the military[2-4-5].

For the most part, older military personnel are usually those with higher ranks and occupying positions which do not require the same physical performance as lower ranking military personnel[6-7]. However, it is not yet known how increasing age impacts the physical fitness of the military; furthermore, this knowledge can show new parameters and suggestions for directing one's career plan according to the military's physical fitness, and even provide suggestions for the MPT which are capable of reducing the loss of skills and abilities, as well as injuries which may occur with increasing age[8].

Assuming that increasing military age may interfere with physical capabilities, this paper hypothesizes the existence of significant differences in physical fitness associated with the aging process in strength, muscle and cardiorespiratory endurance. Therefore, the aim of the study is to compare the PFT of active military personnel in three different age groups (20<30 years, 30<40 years and 40<50 years), to perform a regression analysis to verify the likelihood of loss of performance in the tests, and thus to provide practical application of these results to the specification of the MPT, according to the natural physical fitness losses with increasing age. We hypothesize that age will be an intervening factor in test performance.

METHOD

Study design

This is an observational epidemiological study, as it verifies the results of the PFT and part of the definition evaluating the distribution of military-related physical fitness factors, may help in modifying the MPT. We initially intend to acquire the public data of the PFT held by the military in 2017-2018. In a second phase, we intend to establish performance probabilities in PFT associated with increasing age. Finally, in the discussion we intend to make suggestions for practical applications in the MPT based on the changes which occur with increasing age in an attempt to maintain better performance in following the PFT's own indexes. To do so, the study took place with data from the Rio de Janeiro Marine Personnel Command, but these are publicly accessible within the Command. This study was submitted to and approved by the Local Committee of Eth-

ics in Research (protocol 051979/2017), following the rules of resolution 196/96 of the National Health Council and according with the WMA Declaration of Helsinki.

Sample

We used 702 PFT data in this study, separated into three groups based on the age of those assessed by the PFT, as follows: young adults (YA, n=91, age range between 20-30 years), adults (A, n=243, age range between 30-40 years) and mature adults (MA, n=368, age range between 40-50 years). The data used herein come from tests carried out at the Marine Personnel Command of the municipality of Rio de Janeiro between the years 2017-2018. All participants signed a consent form. Anonymity and confidentiality have been ensured by replacing the athletes' personal identification by a code. The military personnel responsible for the application of the tests, within the established norms, are designated through an Ordinance of the Commander of the Military Organization. All tests are performed on the command itself - the swimming and running tests are carried out in a 50m pool and 400m athletics track, respectively. The barbell and abdominal crunches were performed in an area attached to the unit's own weight training gym.

The inclusion criteria consisted of: a) complete military data which showed all results in each of the tests, b) ≥18 years, c) without cognitive changes that would prevent participation, d) without recent surgeries and, e) without injuries that would prevent the tests. The exclusion criteria consisted of: a) incomplete data, b) data from people who were unable to complete the assessment, c) mainly for health reasons, and duly attested by doctors.

Procedures and measures

After the consent of the sample and the Rio de Janeiro Marine Personnel Command, all military personnel evaluated participated in the MPT, which meant training offered twice a week with sessions of 90 minutes each, always on alternate days. Each MPT session comprised the following steps: i) Aerobic work at light intensity and gradual increase until reaching moderate intensity, usually performed in the form of running (45 minutes); ii) Cool down with a light walk (15 minutes); iii) Flexibility and stretching exercises (30 minutes). Under the guidance of another trainer, a third 60-minute weekly session is also held for MPT, dedicated to learning self-defense techniques in which the localized exercises are systematically worked during the military career[9].

Even with frequent participation in the MPT before beginning the evaluations, the test participants perform clinical examinations to check if the participants fulfill the inclusion and exclusion criteria. They subsequently perform anamnesis, anthropometric assessment and five assessments on different days in the same week, which are classified as: Swimming, Resistance (Fluctuation in the water), Running, Abdominal and Push-ups on the bar, as will be addressed in the PFT assessment.

Physical Fitness Test (PFT) assessment

The PFT assessment is a way of demonstrating the need and effectiveness of these tests in the troops, as it is a way of measuring the personal capacity of each one, thus being a more accurate assessment form carried out in the CGCFN-15-ostensive, regarding the rules on military physical training and physical evaluation tests in the Brazilian navy[10]:

- Anthropometric: The body mass index (BMI) was measured using a electronic scale (model EB 9015®, Bioland, Brasil) and a portable stadiometer with precision in millimeters (ES2030®, Sanny, Brazil).
- Swimming Protocol: 100 m freestyle test in the shortest possible time – performed in a 50 m pool.
- Running: running takes place on an official athletics track, and any previously defined flat course can be used. The distance to be covered for the military Marines is 3,200 meters, Officers up to 49 years of age and Students of the Naval College must reach the 2,400 m mark.
- Sit-ups: The sit-ups are performed on the floor in the supine position, with the legs bent, the knees together, arms crossed over the chest, with the help of a companion giving support on the feet and knees. Sit-ups are counted between the touch of the back on the ground and the touch of the forearms on the thighs, for one minute.
- Pull-ups on the bar: In an attempt at maximum frequencies without interruptions, the push-ups on the bar can be performed with the palms facing forward (pronation) or backward (supination), being chosen by the evaluated participant. They can use any means to reach the bar, however, the impulse should not be used to count the first flexion. After the order to start, the soldier must perform a flexion of the arms on the bar until his chin completely overcomes the bar (with the head in the natural position, without hyperextension of the neck), and immediately lowering the trunk until their elbows are completely extended (respecting individual joint limitations), when 1 repetition will be counted.
- Push-up test: The push-up test is done at a maximum frequency count for one minute. The participant is in the prone position, and should perform elbow extension and flexion with their palms resting on the floor at shoulder width. For counting, the participant's body cannot touch the ground during the movement, only establishing contact with the palms and the toes. The lower limbs should be joined. Each elbow extension should be complete and the flexion should occur up to a maximum measure of approximation of the candidate's trunk to 5cm from the ground

Statistical analysis

The descriptive data of the PFT variables and comparisons between the groups were made using the Statistical Package for Social Sciences 20.0 (SPSS). Means and standard deviations were calculated for descriptive statistics, all parametric, according to the Kolmogorov-Smirnov normal-

ity test. Comparisons of the variables contained were performed using a One-way ANOVA in order to verify the differences between groups. A Bonferroni post hoc test was performed when a significant difference was found by analysis of variance. Furthermore, a regression analysis was used to confirm the effects of age on the PFT. The statistical power was calculated by eta squared (ES), and the significance level was set at 5% ($p < 0.05$) for all tests and analyzes.

RESULTS

The results of the descriptive, the analysis of variance and the respective values of the differences for the post-hoc when there was significance can be observed in Table 1.

Table 1. Descriptive analysis and inferences of the PFT, separated by age group.

Variables	Group	Result	F	p-value	ES	*Bonferroni* (p-value)		
						≠1	≠2	≠3
Body mass (kg)	YA	79.1±11.4	3.98	.019	.016			.022
	A	82.1±14.0						
	MA	84.1±12.3				.022		
	Total	82.8±12.9						
Height (m)	YA	1.8±0.1	2.74	.065	.011			
	A	1.8±0.1						
	MA	1.7±0.1						
	Total	1.8±0.1						
BMI (Kg/m^2)	YA	25.4±2.9	8.15	≤.001	.031			.010
	A	26.4±4.3						.006
	MA	27.5±4.0				.010	.006	
	Total	26.9±4.0						
Sit-ups (freq./min)	YA	52.5±20.5	1.26	.284	.005			
	A	52.2±15.1						
	MA	50.3±11.2						
	Total	51.3±14.0						
Pull-ups (max)	YA	10.8±4.6	10.53	.000	.040			≤.001
	A	10.0±3.6						≤.001
	MA	8.5±4.7				≤.001	≤.001	
	Total	9.3±4.4						
Push-ups (freq./min)	YA	0.0±0.0	.36	.694	.001			
	A	0.2±2.4						
	MA	0.1±1.2						
	Total	0.1±1.7						
3,200 m running (sec.)	YA	760.0 ± 56.6	65.30	≤.001	.206		≤.001	≤.001
	A	800.0 ± 118.2				≤.001		≤.001
	MA	882.0 ± 113.7				≤.001	≤.001	
	Total	814.0 ± 96.2						
100 m swimming (sec.)	YA	140.1±45.6	35.11	≤.001	.123			≤.001
	A	149.7±37.9						≤.001
	MA	180.8±50.0				≤.001	≤.001	
	Total	164.9±48.5						

Note. YA = young adults, A = adults and MA = mature adults. F = ANOVA result. ES = effect size.

Significant differences were observed between the age groups for the running, pull-ups, swimming, body mass and BMI variables, particularly when group 3 was compared to groups 1 and 2. Next, a linear regression model was used to observe the impact of each variable associated with increasing age.

Table 2. Regression analysis performed to determine the interaction between PFT results and aging process.

Model	NSC		SC	t	p-value	95% CI for Exp. (B)	
	B	S.E.	Exp. (B)			Lower	Upper
(Constant)	31.824	10.028		3.174	.002	12.122	51.525
Body Mass	-.035	.051	-.070	-.688	.492	-.134	.065
Height	-6.711	5.908	-.069	-1.136	.257	-18.318	4.897
BMI	.144	.139	.091	1.030	.303	-.130	.417
Sit-ups	-.002	.024	-.003	-.063	.950	-.049	.046
Pull-ups	-.159	.076	-.110	-2.093	.037	-.309	-.010
Push-ups	-.192	.147	-.051	-1.309	.191	-.481	.096
3,200 m running	.012	.001	.390	7.987	≤.001	.009	.014
100 m swimming	.017	.006	.131	2.786	.006	.005	.030

Note. NSC = Non-standardized coefficient; SC = Standardized coefficient; B = regression coefficient; SE = Standard error; Exp. (B) = exponentiation of B; CI = confidence interval.

The regression model shows that the physical fitness tests which suffer the greatest impact from age are the bar, running and the ability to swim. Therefore, it is possible to perceive the need for certain changes, since age-related physical conditioning has a certain variation in physical capacity.

DISCUSSION

The present study showed the existence of a significant difference in physical fitness associated with the aging process in strength (barbell), muscle endurance (swimming) and cardiorespiratory (running). In turn, significant differences were observed between the group of 20 to 30 years old and the group between 40 and 50 years old. There were no differences between soldiers aged between 20 and 40 years, and the regression model shows that the physical fitness tests that suffer the greatest impact from age are the bar, running and the ability to swim. In a previous study, the authors indicated that ~45% of the investigated military reported not practicing any physical activity in their free time[9]. Among the reasons which make it difficult for the officers to engage in physical activities in their free time are: family commitments, working hours, lack of equipment, unsafe environment, lack of company, housework and lack of financial resources[3-6-7-9]. It is assumed that MPT is a way to standardize the military's physical conditioning, in which the technical aspects of physical conditioning that people have undergone can be noted.

Different types of training methods are conducted in order to improve

the soldiers in their activities, always trying to respect the biological individualities of each of the participants. However, the present result indicates that the MPT does not guarantee equivalent maintenance between groups with increasing age, especially when observing military personnel between 40 and 50 years old, and particularly in aerobic condition. Araújo et al.[9] showed maximum VO_2 evolution with MPT from 44.9±5.3 to 53.1±3.6 ml/kg/min^{-1} in 54 weeks. Similar results were observed by[8] after 12 weeks (35.2±8.3ml/kg/min^{-1} to 49.8±7.4 ml/kg/min^{-1}).

Matos et al.[11] indicate that good physical fitness is essential for the military's readiness and provides better conditions for their daily routine. Thus, the physical condition of the military is a determining factor for maintaining their health, bringing efficiency to their professional performance and functionality in combat. Decision-making in the face of unforeseen circumstances and the security of one's life in many situations directly or indirectly depend on the physical and moral qualities acquired in the MPT. Improvement in physical fitness contributes to a significant increase in the readiness of the military for combat. Physically fit individuals are more resistant to disease and recover more quickly from injuries compared to people who are not physically fit[1-8-9]. In addition, it is important to note that physically fit individuals have high levels of self-confidence and motivation. In other words, well-prepared military personnel are better able to withstand the extreme stress of combat[11].

Regarding anthropometric data, only the groups between 20 and 30 years versus 40 and 50 years were different from each other, with young adults presenting results similar to a previous study on the effect of mental training on PFT, which indicated 74±12kg, 1.8±0.1 for soldiers with mental training and 77±13kg and 1.8± 0.1cm for soldiers without mental training[12]. It is believed that the increase in body mass in group 3 may have influenced oxygen consumption during tests that required cardiovascular resistance, such as running and swimming[6]. Thus, it was necessary to have professionals in the area of physical education with the help of doctors monitoring in case of any type of accident in the accomplishment of these activities in the present study, in addition to the team which was assigned to the effectiveness of that physical conditioning analysis program[13-14]. In the 12-minute running tests presented by a previous study[12] in people with mental training versus without mental training, the authors found 3160±178m versus 3160±178m, and there were no differences between groups. These findings support the result of the group of young adults in the present study.

Running training takes place consistently in MPT programs at least 2 times a week. The indices to be achieved are maximum times to cover the distances, which correspond to a percentage of the estimated VO_{2max} of the Weltman et al.[15] protocol (3,200 m), and which are equivalent to a graduation from 50-100 points. The indices foreseen for 50 points when extrapolated mean the military member fail in the PFT[10]. This race test of the Physical Evaluation Test (PFT) is attributed to the male and female

soldiers, and the indices required to join in Brazilian Navy (PFT-i) must be parameters to be overcome by regularly practicing physical activity throughout their career[8-10]. For example, swimming in the MPT Program should take place at least twice a week, on non-consecutive days, in each of which the military member must swim at least 500m. This helped in the results obtained from the data of the present study. However, the assessments of the present abdominal PFT showed a lower result than the previously published average result of 72.1±9.7 rpm, no significant differences were observed in the push-up test on the ground, with 37.0±4.0 repetitions for the experimental group versus 37.0±3.9 repetitions, and on the fixed bar with mental training 9.7±2.6 versus 10.1±2.9 repetitions[12].

A limitation of the present study was not using the data of all military personnel, because some military personnel were unable to perform flexion on the bar and only flexed on the ground due to duly proven health restrictions. It is important to highlight that the objective of MPT is to improve the physical conditioning of the soldiers in the platoon, so that a good contribution can be made to maintain the health of everyone regardless of age. Thus, the whole test must be tested for the good of all so that they can provide a good interaction between all military members, and for them to be effective in military activities without causing losses to the activity. It is important to note that the linear regression of the present study reveals the need for one of the physical fitness tests to be scaled according to age, especially the bar, running and the ability to swim. Another suggestion made with the present findings is to carry out more localized and specific training to increase the strength conditioning, especially related to body mass, as well as cardiorespiratory capacity, since two of the tests depend on this physical condition if harmed by increasing age in the military.

CONCLUSION

The present study showed that the increase in a military member's age may interfere with physical abilities, and so the present work hypothesizes the existence of a significant difference in physical fitness associated with the aging process in strength, muscle and cardiorespiratory resistance. Therefore, there was a difference in the PFT results of active military personnel in three different age groups (20<30 years, 30<40 years and 40<50 years). The linear regression of the present study reveals the need for one of the physical fitness tests to be scaled according to age, especially the bar, running and the ability to swim. Physical performance in all the evaluated tests varied between ages, but with generally good results. the results in the present study suggest modifying the MPT to compensate for the greatest losses, as shown by the differences between military personnel 20<30 years versus 40<50 years. In summary, it is necessary that more studies be carried out in the future regarding additional physical activities in the MPT. Thus, different types of training methods and the MPT analysis itself can also be analyzed, thereby contributing to the better development of several studies.

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Ethical approval

Ethical approval was obtained from the Institutional Ethics Board - Universidade Federal do Rio de Janeiro (051979/2017) was written in accordance with the standards established by the Declaration of Helsinki.

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conception and design of the experiment: FJM, JVDL, EAAM, DIVP, MAFS, CJB, BM. Realization of the experiments: FJM, JVDL, EAAM, DIVP, MAFS, CJB, BM. Data analysis: FJM, JVDL, EAAM, DIVP, MAFS, CJB, BM. Contribution with reagents/research materials/analysis tools: FJM, JVDL, EAAM, DIVP, MAFS, CJB, BM. Article Writing: FJM, JVDL, EAAM, DIVP, MAFS, CJB, BM. All authors read and approved the final version of the manuscript.

REFERENCES

1. Vanderburgh PM. Occupational relevance and body mass bias in military physical fitness tests. Med Sci Sports Exerc 2008;40(8):1538-45.
2. Martins ACV, Melo SIL. Study of the functinal characteristics and of the boot use by military policeman and its influence in the performance in the activity of patrol. Rev Bras Cineantropom Desempenho Hum 2005;7(1):50-8.
3. Taylor MK, Markham AE, Reis JP, Padilla GA, Potterat EG, Drummond SP, et al. Physical fitness influences stress reactions to extreme military training. Military Med 2008;173(8):738-42.
4. Harman EA, Gutekunst DJ, Frykman PN, Nindl BC, Alemany JA, Mello RP, et al. Effects of two different eight-week training programs on military physical performance. J Strength Cond Res 2008;22(2):524-34.
5. Heinrich KM, Spencer V, Fehl N, Carlos Poston WS. Mission essential fitness: comparison of functional circuit training to traditional Army physical training for active duty military. Military Med 2012;177(10):1125-30.
6. Webber BJ, Ruiz SA, Talcott GW, Little MA, Tate DF. Weight Gain of Service Members After Basic Military Training. Am J Prev Med 2020;58(1):117-21.
7. Pihlainen K, Vaara J, Ojanen T, Santtila M, Vasankari T, Tokola K, et al. Effects of Baseline Fitness and BMI Levels on Changes in Physical Fitness During Military Service. J Sci Med Sport 2020;23:1-5.
8. Campos LCB, Campos FAD, Bezerra TAR, Pellegrinotti ÍL. Effects of 12 Weeks of Physical Training on Body Composition and Physical Fitness in Military Recruits. Int J Exerc Sci 2017;10(4):560-7.
9. Araújo LGMd, Sanches M, Turi BC, Monteiro HL. Physical fitness and injuries: 54 weeks of physical training among military police officers. Rev Bras Med Esporte 2017;23(2):98-102.
10. Monteiro ÁAD. CGCFN-15. Normas sobre treinamento físico militar e testes de avaliação física na marinha do brasil, marinha do brasil comando-geral do corpo de fuzileiros navais. Rio de Janeiro: Marinha do Brasil; 2009. 118 p.

11. Matos DG, Silva Salgueiro R, Mazini Filho ML, Rodrigues BM, Aidar FJ, de Lima JRP. Profile evolution of the aerobic conditioning and the strength in military police. Rev Atenção Saúde 2011;8(25):14-20.
12. Brito RP, Silva GJJ, Navarro AC. A influência do mental training na performance de militares do exército brasileiro durante o teste de avaliação física (TAF). Rev Bras Prescr Fisiol Exerc 2008;2(11):475-83.
13. Kaufman KR, Brodine S, Shaffer R. Military training-related injuries: surveillance, research, and prevention. Am J Prev Med 2000;18(3):54-63.
14. Lisman P, O'CONNOR FG, Deuster PA, Knapik JJ. Functional movement screen and aerobic fitness predict injuries in military training. Med Sci Sports Exerc 2013;45(4):636-43.
15. Weltman A, Snead D, Seip R, Schurrer R, Levine S, Rutt R, et al. Prediction of lactate threshold and fixed blood lactate concentrations from 3200-m running performance in male runners. Int J Sports Med 1987;8(06):401-6.

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