Physical Fitness, Age and Nutritional Status of Military Personnel

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Abstract

Background: **Although there is a trend toward the decrease in levels of physical fitness, the intensity of this decrease due to the aging process and the nutritional status in adult male individuals is not well-known, especially in the Brazilian population.**

Objective: **To analyze the levels of physical fitness according to age and the nutritional status in adult male individuals.**

Methods: **Aerobic and muscular endurance tests as well as flexibility tests and nutritional status assessment were carried out in 1,011 male individuals. Analyses of correlation, covariance and prevalence ratio were performed through Poisson regression.**

Results: **The individuals presented a moderate performance at the physical fitness tests. A decrease in the levels of physical performance according to the aging process was verified, considering all age ranges analyzed. The analysis of covariance corrected by age showed differences ($p<0.001$) for all tests comparing normal individuals and those with overweight/obesity. The prevalence ratios showed a strong trend toward the decrease in the physical fitness from 18 to 54 years. Individuals aged 41 to 54 years presented prevalences of low VO_{2max} index that were 3.22-fold higher when compared to those aged 18 to 20 and 1.40-fold higher when compared to individuals aged 21 to 25 years. There was a decrease in the VO_{2max} scores in the 18 to 20 age range, when compared to the 41 to 54 age range, of 11.45% in the normal group and 20.91% in the group with overweight and obesity.**

Conclusion: **Age and the nutritional status have a strong influence on the decreased physical performance scores, mainly after 30 years of age. (Arq Bras Cardiol 2010; 94(4):412-417)**

Key words: **Physical fitness; age; nutritional status.**

Introduction

Adequate levels of physical fitness and physical activity have been shown to be protective factors against several diseases and to promote good quality of life[1-3].

In spite of that, there is a complex context that encompasses aspects of genetic constitution, age, sex, psychomotor maturity, social, cultural and ethnic differences of the demographic groups and populations that determine the physical performance of the individuals at each phase of life[4]. In general terms, a decrease in the levels of physical fitness and involvement with regular sports activities has been identified during the adult phase and insertion in the work market[5].

A classic study[6] showed that the low level of physical fitness is associated with higher levels of mortality, even after adjusted for age, smoking status, levels of cholesterol, arterial pressure, glycemia and family history of coronary disease. Investigations with Brazilian patients have demonstrated a high prevalence of low physical fitness, as well as lack of data regarding the adult population, with studies focusing mainly on the physical performance of adolescents and schoolchildren[7-9].

Age and the nutritional status can be indicated as the main factors for physical performance and the levels of physical fitness decrease with age, as well as in those individuals with overweight and obesity[9,10].

In spite of that, a more detailed assessment of how this process occurs and its velocity during the transition from adolescence to older age can reveal vital points of intervention, as well as collaborating to a better understanding of the different biological mechanisms related to human development. Therefore, the aim of this study was to describe and discuss the associations between age and body mass index (BMI) in the physical performance of adult military men.

Methods

A total of 1,011 male individuals from the Brazilian Air Force stationed at a base in southern Brazil were studied. All participants who presented physical and/or medical restrictions were excluded from the study. The individuals mean age was 28.32 ± 8.73 years, 95%CI (27.28-28.86 years) and had a mean body mass index (BMI) and height of 76.27

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± 11.48 kg, 95% CI (75.55 - 76.97 kg) and 174.16 ± 7.91 cm, 95%CI (173.67 - 174.65 cm), respectively.

The study was approved by the Human Research Ethics Committee of the institution, project protocol # 23081.002290/2007-53.

The Air Force Physical Fitness Tests[11,12] were considered for the analysis. The Flexitest was used to evaluate flexibility according to the Araujo procotol[13], considering the measurement of the joint range of motion of the shoulder, trunk and hip, in which five movements (extension with shoulder posterior adduction, posterior adduction with 180° of shoulder abduction with flexed elbows, trunk flexion and hip abduction) considering the final score the sum of the scores obtained for the movements.

The arm muscular endurance (AMB) was used to evaluate the arm and shoulder girdle resistance and the trunk flexion test (modified abdominal test) was used to evaluate the endurance of the abdominal trunk muscular endurance (TME), according to the protocols of Johnson and Nelson[14]. The 12-minute run test aimed at measuring the cardiorespiratory resistance and followed the recommendations by Cooper[15] and Johnson and Nelson[14], with the maximal oxygen consumption (VO_{2max}) being estimated through the following equation: VO_{2max} = (distance walked/miles - 0.3138)/0.0278).

The following ranges were adopted for the age variable, in years: 18 to 20, 21 to 25, 26 to 30, 31 to 35, 36 to 40 and 41 to 54. For the BMI, we considered a normal nutritional status when BMI was up to 24.99 and overweight/obesity when BMI was > 25. For the analysis of prevalence ratios, the scores below the mean general performance of the group for each physical test were considered as low level of physical fitness.

Descriptive statistical analyses were carried out considering means, standard deviations, confidence intervals and low physical fitness prevalences. The normality of the data was confirmed by the Kolmogorov-Smirnov test. To verify possible associations among the variables, Pearson's correlation tests were applied for continuous variables and Spearman's correlations tests were used for interval-like variables. The criteria used by Malina[16] were used for the analysis of the correlations, which describe a low correlation for a value < 0.30, a moderate correlation for values between 0.30 and 0.60 and high correlation for values > 0.60. The analysis of covariance (ANCOVA) was used to verify possible differences between physical performance means at different nutritional status, adjusted by age. Poisson regression analysis was used to estimate the prevalence ratios considering the low physical fitness as the dependent variable, as the outcomes present high prevalence values[17]. The level of statistical significance was set at 5% for all analyses.

Results

The mean BMI of the sample was 25.08 $kg.m^2$ with a standard deviation of 3.38 $kg.m^2$. Table 1 shows the results of the correlations between the performance at the physical fitness tests and age and BMI, which showed moderate correlations at all variables and higher ones when considering age. Figure 1 shows the performance at the tests according to the established age ranges and it is possible to observe a linear decrease in the performance scores with age. The decrease in VO_{2max} from the first to the last age range was 20.96%.

When stratified according to the nutritional status, the percentage of decrease considering the mean VO_{2max} performance between the first and the last age range was 11.45% in the normal group, increasing to 20.91% in the overweight/obesity group. Regarding flexibility, the decrease was 24.23% in the general group and similar in the normal (22.71%) and the overweight/obesity group (20.96%). At the TME assessment these values were 38.33% in the general group; 37.02% in the normal group; and 38.56% in the overweight/obesity group. At the RMB assessment, the decrease was 47.98% in the general group and, when considering the nutritional status, 44.19% for the normal group and 47.02% in the overweight/obesity group.

Table 2 shows the differences in performance according to the nutritional status which, considering the adjustment by age, showed significant differences for all physical capacities that were investigated.

The prevalence ratios presented in Table 3 show a strong trend toward the decrease in physical fitness for older ages and for overweight and obesity. Considering the nutritional status, the highest prevalence ratio was observed for the evaluation of cardiorespiratory resistance and the obese individuals presented prevalences of low physical fitness that were 1.41-fold higher when compared with the individuals with normal nutritional status. Although a strong trend toward the decrease in physical fitness was observed with age, flexibility was the physical quality that presented less evident prevalences of low physical fitness when compared with other physical capacities that were investigated. The prevalence ratios showed a similar behavior when the performance at the arm and trunk muscular endurance tests was analyzed. The prevalences of low physical

Table 1 - **Means, standard deviations and correlations (r) of the physical fitness test performance with age and BMI**

Variables	Means (SD)	Age		BMI	
		r	p*	r	p†
Flexibility (score)	12.49 (2.62)	-0.446	<0.001	-0.361	<0.001
TME (repetitions)	40.76 (10.30)	-0.555	<0.001	-0.231	<0.001
AME (repetitions)	25.87 (12.15)	-0.434	<0.001	-0.283	<0.001
VO_{2max} ($ml.kg^{-1}.min^{-1}$)	44.24 (7.20)	-0.434	<0.001	-0.381	<0.001

AME - arm muscular endurance; TME - trunk muscular endurance. (*) Pearson's correlation test probability; (†) probability of the test for Spearman's correlation.

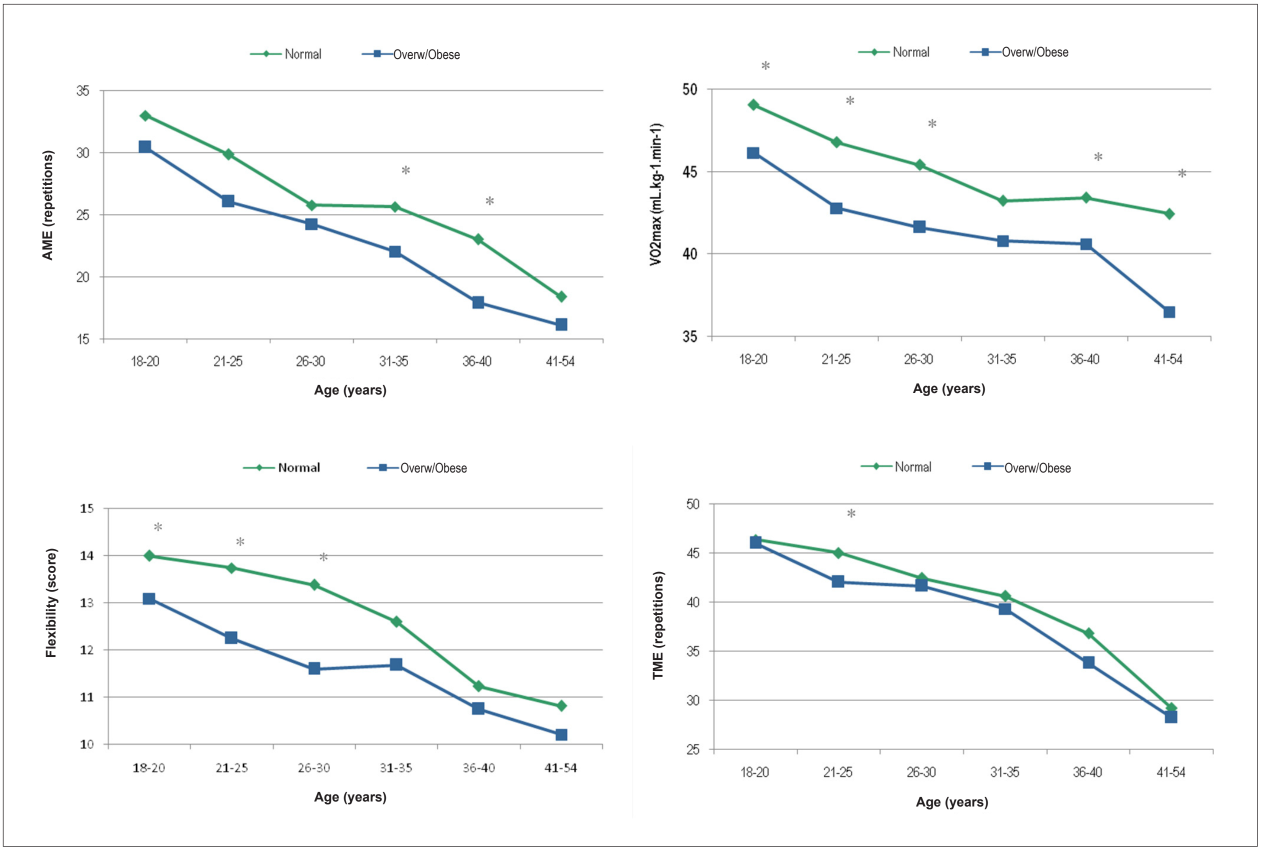

*Figure 1 - Distribution of performance frequencies according to age ranges and the nutritional status. * Student's t test probability.*

Table 2 - Analysis of covariance of the physical fitness variables according to the nutritional status adjusted by age

Variables	Normal	Overw./Obese	ANCOVA	
			F	p
Flexibility (points)	13.27 (2.52)	11.58 (2.45)	157.36	<0.001
TME (repetitions)	28.49 (13.33)	22.78 (9.74)	227.48	<0.001
AME (repetitions)	42.92 (9.35)	38.25 (10.80)	125.09	<0.001
VO_{2max} (ml.kg^{-1}.min^{-1})	46.46 (6.68)	41.50 (6.88)	149.28	<0.001

AME - arm muscular endurance; TME - trunk muscular endurance.

fitness were higher considering the age, in comparison with the nutritional status.

Discussion

The present study analyzed the results of the assessment of the physical performance of 1,011 men aged 18 to 54 years and the association of this performance with age and nutritional status. The mean BMI was slightly higher than the one observed in a study[9] carried out with military personnel from 36 different garrisons of the Brazilian Army, as well as in the study[18] that assessed 121 military individuals from the Brazilian Army from a military garrison at Porto Alegre, state of Rio Grande do Sul, Brazil.

In the present study, age showed stronger correlations than BMI results (Table 1), although both factors had a strong effect on the physical fitness tests, in accordance with associations identified in a longitudinal study with Finnish military personnel[5]. In addition to the associations with age, it has been verified that the indicators of the nutritional status worsen as the individuals rise in their careers[19].

High prevalences of overweight and obesity in adult men have been identified[20-22] and are directly associated with the aging process, mainly at the age range of 27 to 37 years. National investigations[21] identified that approximately 8% of the Brazilian adult men are obese, with this prevalence being higher in the south and southeast regions of the country.

Table 3 - Prevalences and prevalence ratios for low physical fitness according to age and BMI

Variables	n	%	PR (IC95%)	p-value*
		Flexibility		
Age				<0.001
18	89	34.90	1.00	
21	89	39.04	1.12 (0.88-1.41)	
26	94	55.29	1.58 (1.28-1.96)	
31	67	59.82	1.71 (1.37-2.15)	
36	89	79.46	2.28 (1.88-2.76)	
41	114	87.02	2.49 (2.08-2.99)	
BMI				<0.001
Non-obese	149	41.70	1.00	
Overw./Obese	226	67.89	1.63 (1.45-1.83)	
		AME		
Age				<0.001
18	68	26.67	1.00	
21	113	49.78	1.87 (1.47-2.38)	
26	104	61.18	2.29 (1.81-2.91)	
31	72	64.86	2.43 (1.90-3.11)	
36	85	75.89	2.85 (2.26-3.58)	
41	120	92.31	3.46 (2.81-4.27)	
BMI				<0.001
Non-obese	253	46.77	1.00	
Overw./Obese	308	66.67	1.42 (1.28-1.59)	
		TME		
Age				<0.001
18	62	24.41	1.00	
21	69	30.26	1.24 (0.92-1.66)	
26	79	46.20	1.89 (1.44-2.48)	
31	58	51.79	2.12 (1.60-2.81)	
36	81	72.32	2.96 (2.32-3.78)	
41	116	88.55	3.63 (2.90-4.54)	
BMI				<0.001
Non-obese	210	38.82	1.00	
Overw./Obese	254	54.62	1.41 (1.23-1.61)	
		$VO_{2máx}$		
Age				<0.001
18	63	25.20	1.00	
21	80	35.40	1.40 (1.06-1.85)	
26	85	52.47	2.08 (1.61-2.70)	
31	64	60.95	2.42 (1.86-3.15)	
36	66	63.46	2.52 (1.94-3.26)	
41	86	81.13	3.22 (2.55-4.06)	
BMI				<0.001
Non-obese	167	31.87	1.00	
Overw./Obese	276	64.64	2.03 (1.75-2.34)	

(*) non-adjusted p value (Chi-square p value).

A more marked decrease in performance (Figure 1) was identified soon after 30 years of age and, in some cases, performance stability was observed between 20 and 30 years of age. The third decade of life is indicated[23] as a period of stabilization in lung function that tends to decrease gradually. This decrease follows an age-related pattern; however, the decrease between 40 and 50 years of age tends to be associated with factors such as increase in body weight, instead of being associated with actual tissue alterations. Regarding the physical fitness variables[19], a decrease of approximately 10 to 15% in aerobic power is estimated for each decade of life as individuals approach their 3rd decade. However, it seems that the loss can be as little as 5% to 7% per decade in highly trained individuals[24].

The studied Brazilian sample showed a decrease in VO_{2max} that was slightly higher than the one in the Finnish study[5], when similar age intervals were compared. The absolute values presented by the Brazilian military personnel at the analysis of the VO_{2max} were classified as presenting a good level[15]. Nevertheless, a study with a similar sample[10] identified low cardiorespiratory fitness among the studied military personnel. The cardiorespiratory fitness[9] is considered a protective factor against health risks attributed to obesity and reflects the need for a more active lifestyle, in the sense of preventing and controlling chronic-degenerative diseases and metabolic syndromes.

Analyses of the decrease in the percentage of fitness considering the nutritional status for a similar population were not found in the literature. In the studied individuals, the VO_{2max} decrease from the first to the last age range was 11.45% in the normal group and 20.91% in the overweight/obesity group, which shows a strong influence of the nutritional status in the long term. Although cross-sectional data cannot reveal a cause-effect association, these results are in agreement with those by Santilla et al[5] in a longitudinal follow-up of a similar sample. In spite of this important percentage difference according to the nutritional status for the $VO2_{max}$, the decrease in the performance scores was more significant in the assessments of localized muscular resistance, reaching a decrease of more than 40% at the age ranges of 18 to 20 and 41 to 54 years.

Similar results were presented in the literature[9], identifying that, even after adjusted for age, the individuals with higher waist circumferences presented lower cardiorespiratory fitness.

The results of the correlations (Table 1) and the analysis of covariance (Table 2), which showed the differences in performance according to the nutritional status corrected by age, indicated the need for nutritional interventions at all age ranges and have confirmed the results of an epidemiological study[25] that showed that sedentary young individuals have a higher chance of becoming sedentary adults. Additionally, the lack of alternatives for the practice of physical exercises by adults, especially after their insertion in the work market, is pointed out as one of the causes for the low physical fitness[26]. The prevalence ratios (Table 3) confirmed the strong trend toward the decrease in physical fitness among the elderly and also for individuals with overweight and obesity. Nonetheless, this analysis identified a higher relevance of the nutritional status for low levels of cardiorespiratory resistance, when compared to other physical capacities.

The behavior of the results of the flexibility assessment is in agreement with the norms[27] proposed in relation to age. In spite of that, the flexibility showed to be the physical quality that is least influenced by age, according to the calculated prevalence ratios (Table 3).

The indexes in the localized muscular strength assessment for the trunk flexion test are between the 25th and the 50th percentiles[28]; at the arm flexion test, they showed indexes at the 55th percentile[14], which imply in a moderate to poor performance. However similar values have been verified in samples of military athletes[29].

A non-linear decrease in localized muscle resistance in both arm flexions and abdominal exercises at the adult phase has been previously reported[19] and decreases in muscular strength[30] have been reported from the third and fourth decades of life, with a decrease of 8 to 15% per decade, which demonstrates the need for establishing strategies to promote functional health, especially at the adult phase, when there is a higher rate of insertion in the work market.

Conclusion

Age and nutritional status have a strong influence on the decreased scores of physical performance. A more marked decrease was observed after 30 years of age. The decrease in the physical performance considering the age ranges was higher in the overweight and obesity group, especially regarding the localized muscle strength performance. It is necessary to adopt measures aimed at improving physical fitness, as well as controlling overweight and obesity at all age ranges, due to the possible negative effects, at mid and long term, on several health outcomes.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any post-graduation program.

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