



Level of physical activity, functional capacity and flexibility of soldiers entering the Brazilian Army

Nível de atividade física, capacidade funcional e flexibilidade de soldados ingressantes no Exército brasileiro

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ABSTRACT

This study aimed to evaluate the level of physical activity, functional capacity (FC), and flexibility of young adults before and ten months after joining a physical exercise program in the Brazilian Army. This was a prospective cohort study. The level of physical activity was assessed using the International Physical Activity Questionnaire (IPAQ), FC using the Cooper Test, and flexibility using the Wells bench. Sample (n = 198; 18±0.27 years) with a body mass index (BMI) of 23.23±3.84 kg/m². After ten months of admission to the Brazilian Army, there was a reduction in the prevalence of sedentary lifestyle (33 → 28%) and FC (2,982±243.61 → 3,117±192.87 m), without change in flexibility (27.31±7.39 → 27.52±7.40 cm). There was a large effect size on BMI, waist-hip ratio (WHR), and flexibility. In short, inclusion in a physical exercise program in the Brazilian Army increased FC and reduced the WHR of young recruits.

Keywords: Physical functional performance. Exercise. Flexibility. Military health.

RESUMO

Objetivou avaliar o nível de atividade física, capacidade funcional (CF) e a flexibilidade de adultos jovens antes e após dez meses de ingresso em um programa de exercícios físicos no Exército brasileiro. Trata-se de uma pesquisa de coorte prospectivo. O nível de atividade física foi avaliado pelo Questionário Internacional de Atividade Física (IPAQ), a CF, pelo Teste de Cooper, e a flexibilidade, pelo Banco de Wells. Amostra (n = 198; 18±0,27 anos) com índice de massa corporal (IMC) de 23,23±3,84 kg/m². Após dez meses de admissão no Exército, constatou-se redução na prevalência de sedentarismo (33 → 28%) e na CF (2.982±243,61 → 3.117±192,87 m), sem alteração da flexibilidade (27,31±7,39 → 27,52±7,40 cm). Houve grande tamanho de efeito no IMC, na relação cintura quadril (RCQ) e na flexibilidade. Conclui-se que a inserção em um programa de exercícios físicos no Exército brasileiro aumentou a CF e reduziu a RCQ dos jovens.

Palavras-chave: Desempenho físico funcional. Exercício físico. Flexibilidade. Saúde militar.



INTRODUCTION

The Army is one of Brazil's three armed forces and is externally responsible for defending the country in mainly terrestrial operations and, internally, for guaranteeing law, order, and constitutional powers. Among the armies in Latin America, it has one of the largest troops, which are called up annually¹, and prioritizes the physical preparation of its members through the implementation of standardized physical exercises^{2,3}.

The military routine differs from most homes of Brazilian adolescents. With technological advances, it is increasingly common for them to participate in intellectual activities (school assignments, reading, pre-university, and training courses), in addition to greater involvement with distractors such as computers and cell phones with internet access⁴. The modern lifestyle associated with technological advancement and urban growth has been the factor that most contributes to a sedentary lifestyle⁵.

The low level of physical activity in this life cycle causes adverse events, such as obesity⁵ and high blood pressure^{6,7}, in addition to postural problems (increasing the risk of musculoskeletal and joint injuries)⁷, low self-esteem, and other problems related to mental health⁸. These factors are associated with lower functional capacity (FC) and less flexibility. A study indicated that the physical fitness of young people has significantly declined, mainly as a result of a sedentary lifestyle and lack of physical activity in today's society⁷. This is reflected in the quality of the Armed Forces personnel, which increasingly receives young people who are under- or overweight, which reaches close to 25% of the military contingent⁸.

The recent change in the profile of Army members becomes worrying, as the physical conditioning of military personnel is essential for professional performance⁸. Therefore, the regular practice of physical exercises is of paramount importance both to improve health conditions and to raise physical performance standards. Since there are few studies on this young population⁵, the present study aimed to evaluate the level of physical activity, FC, and flexibility of young adults before and after ten months of participating in a physical exercise program in the Brazilian Army.

METHOD

This was a quantitative prospective cohort study that evaluated, between February and December 2021, individuals who attended to fulfill the mandatory year of military service in barracks in the city of Santa Maria (state of Rio Grande do Sul). The recommendations of

Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)⁹ were followed. Santa Maria is located in the central region of Rio Grande do Sul, is the fifth largest city in the state, and has the second largest military contingent in Brazil, thus characterizing a strong military tradition¹. The study was approved by the Research Ethics Committee of the University of Santa Cruz do Sul (UNISC) (4691119), with the consent of the General Hospital de Santa Maria and the Chief of Staff of the Army. All participants signed the Informed Consent (IC).

Participants were young people between 18 and 20 years old in the mandatory year of military service, entering the operational, logistical, and support units of the Brazilian Army of Artillery, Infantry, Cavalry, Logistics, and Maintenance; 4th Logistics Battalion – 4th B Log (Logistics); 3rd Self-Propelled Field Artillery Group – Mallet Regiment (Artillery); 29th Armored Infantry Battalion – 29th BIB (Infantry); 1st Tank Regiment – 1st RCC (Cavalry); and the Regional Maintenance Park of the 3rd Military Region – Pq R Mnt/3 (Maintenance). Individuals who were unable to understand the objectives of the research and respond to the questions asked, who had pre-existing musculoskeletal injuries, and who had undergone spine, hip, knee, and ankle surgery were excluded.

Assessments were made for anthropometric and sociodemographic characteristics, self-rated current health status, covering information on the difficulty of performing physical activity, regular medication intake, cigarette consumption, intake of alcohol or other additives, presence or absence of diseases, as well as level of physical activity, FC and flexibility before joining the Brazilian Army and ten months after joining.

PHYSICAL EXERCISE PROTOCOL

The physical exercise protocol to which those entering military service were subjected involved group exercise training five times a week and lasting 1h30min. After a 15-minute warm-up, through static and dynamic exercises, training to increase functional capacity was carried out, including running for 30 minutes. Subsequently, strengthening exercises were performed, such as push-ups, sit-ups, and pull-ups, for 30 minutes. The completion of the protocol included stretching the major muscle chains for 15 minutes².

ANTHROPOMETRIC DATA

Body mass was measured using a digital scale (Seca[®]) with a capacity of up to 200 kg and accurate to 0.50 g. Height was measured using a stadiometer attached to the scale, positioned at 90° to the ground, and accurate to 0.5 cm. Body mass index (BMI) was obtained as the ratio of body mass to height squared, with $\leq 18.5 \text{ kg/m}^2$ considered underweight, between 18.5 and 24.9 kg/m^2 (healthy weight), between 25 and 29.9 kg/m^2 (overweight or above-desired weight), and $\geq 30 \text{ kg/m}^2$ (obesity)¹⁰.

Waist circumference (WC) was measured from the midpoint between the lowest rib and the iliac crest, and hip circumference (HC) was measured at the largest circumference around the buttocks. Measurements were taken using an inelastic anthropometric tape (Seca[®]) ranging from 0 to 200 cm. The waist-to-hip ratio (WHR) was obtained by the ratio of WC to HC. The diagnosis of central obesity occurs when the WHR is 0.85 for women or 0.90 for men. It is worth mentioning that when higher than the aforementioned values for either sex, it indicates a risk of developing cardiovascular diseases¹⁰.

SELF-RATED HEALTH

The self-rated health status was adapted from the diagnostic form used by the Gerontology Laboratory (LAGER) of the State University of Santa Catarina (UDESC). This is a questionnaire used to obtain information about an individual's perceived and self-rated health. It is designed to offer an overview from the person's own perspective, in which alcohol and cigarette consumption habits, current health status, and frequency of physical activity are investigated¹¹.

PHYSICAL ACTIVITY LEVEL

The International Physical Activity Questionnaire (IPAQ) is an instrument with good reproducibility to assess the prevalence of physical activity in the world population¹². The short version consists of eight questions and involves the analysis of various levels of intensity of physical activity, classifying young individuals as active or inactive. According to the World Health Organization (WHO), young individuals must perform at least 300 minutes of moderate and vigorous physical activity per week to be classified as physically active. Activities that moderately increase respiratory and heart rate – light pedaling, swimming, dancing, light

aerobic exercise, playing recreational volleyball, etc. – are considered moderate. In turn, those that highly increase respiratory and heart rate – running, aerobic gymnastics, soccer, quick pedaling, basketball, heavy domestic work at home, in the yard or the garden, and carrying heavy weights – are classified as vigorous¹⁰.

FLEXIBILITY

The flexibility of the hamstring muscles was measured using the Sit and Reach Test using the Wells Bench, following the Canadian standardization for physical fitness assessment tests of the Canadian Standardized Test of Fitness. To this end, a box measuring 35 cm in height and width and 40 cm in length was used, with a standard ruler at the top extending 15 cm beyond the support surface of the feet¹³.

The individual remained in a sitting position with bare feet and tried to touch their feet to the box, keeping their knees extended. With shoulders flexed, elbows extended and hands overlapping, he flexed his torso, trying to reach the maximum point of the scale with his hands. Three attempts were made, and only the highest mark achieved was considered¹³. Flexibility is classified according to age and gender. In the present study, the sample consisted of male individuals aged 18 to 20 years, flexibility was considered “excellent” when the reach was more than 39 cm; “good” (from 34 to 39 cm); “regular” (between 29 and 33 cm); “poor” (between 24 and 28 cm); and “very poor” (below 23 cm).

FUNCTIONAL CAPACITY (FC)

FC was assessed using the Cooper Test, in which the individual ran or walked without interruption for 12 minutes on a running track, maintaining an ideal pace of activity. The distance covered was recorded in meters¹⁴.

STATISTICAL ANALYSIS

Data were descriptively analyzed using the Statistical Package for the Social Science (SPSS) software and expressed as mean and standard deviation. Data normality was assessed using the Shapiro-Wilk test, and comparison between groups using the paired Student’s t-test. The significance level adopted was $p \leq 0.05$. Friedman’s analysis of variance (ANOVA) was applied to obtain Z scores to calculate Cohen’s r effect size measures for each comparison with

the classification “non-significant” (when $r < 0.19$), “small difference” ($r \geq 0.20$ to 0.49), “medium difference” ($r \geq 0.5$ to 0.79), “large difference” ($r \geq 0.8$ to 1.29) and “very large difference” ($r < 1.30$)¹⁵.

RESULTS

The sample consisted of 198 male individuals with a mean age of 18 ± 0.27 years. Regarding anthropometric characteristics, a difference in BMI ($p < 0.001$) and body mass ($p < 0.001$) was found between the times before and after joining the Brazilian Army, as well as between HC ($p < 0.001$) and WHR ($p = 0.032$). There was an increase in the distance covered in the Cooper Test between these two moments ($p < 0.001$) and also in the level of physical activity ($p < 0.001$) (Table 1).

Table 1. Anthropometric characteristics, functional capacity, and level of physical activity between the moments before and ten months after entering military service (n = 198)

Variables	Before	After	p-value	Cohen's effect size	
	mean (SD)			R	Classification
Age (years)	18.00 ± 0.27				
Height (cm)	1.75 ± 0.07				
Body mass (kg)	71.69 ± 14.23	73.52 ± 12.20	0.001	1.370	Very large
BMI (kg/m ²)	23.23 ± 3.84	23.98 ± 3.32	0.001	2.077	Very large
WC (cm)	77.10 ± 10.37	77.59 ± 7.47	0.280	0.531	Moderate
HC (cm)	93.97 ± 8.82	90.85 ± 8.04	0.001	1.977	Very large
WHR	0.82 ± 0.04	0.81 ± 0.05	0.032	1.553	Very large
Flexibility (cm)	27.31 ± 7.39	27.52 ± 7.40	0.772	0.289	Small
Cooper test distance (m)	2.982 ± 243.60	3.117 ± 192.80	0.001	6.087	Very large
	Before	After	p-value*		
	n(%)				
BMI (kg/m²)					
Healthy	111 (56.10)	123 (62.10)	0.220		
Obese	16 (8.10)	12 (6.10)	0.432		
Overweight	36 (18.30)	48 (24.20)	0.140		
Underweight	35 (17.50)	15 (7.60)	0.002		
WHR					
Very high	3 (1.50)	0 (0.00)	---		
High	17 (8.60)	9 (4.50)	0.104		
Low	129 (65.20)	142 (71.70)	0.159		
Moderate	49 (24.70)	47 (23.70)	0.814		
IPAQ					
Active	132 (66.67)	141 (71.21)	0.001		
Inactive	66 (33.33)	57 (28.79)	----		

BMI = body mass index; WC = waist circumference; HC = hip circumference; WHR = waist-hip ratio; IPAQ = International Physical Activity Questionnaire. Data expressed as mean and standard deviation (SD) for continuous variables or absolute frequency. Paired Student's t-test. Values in bold indicate significant differences between initial and final scores ($p \leq 0.05$).

Source: Prepared by the authors (2023).

When analyzing the indicators of the current self-rated health status, a difference was evident between the moments before and ten months after the Brazilian Army in the perception of health status ($p = 0.026$), the reduction of the difficulty in performing physical activity ($p < 0.001$), regular medication intake ($p < 0.041$), cigarette consumption ($p < 0.001$) and alcohol intake ($p < 0.001$) (Table 2).

Table 2. Health habits of the sample evaluated before and after joining the Brazilian Army

	Before	After	p-value*
	n (%)		
What is your current health status?			
Excellent/good	147 (74.24)	165 (83.33)	0.026
Regular	43 (21.71)	29 (14.64)	0.068
Poor/poor bad	8 (4.05)	4 (2.03)	0.241
Does your current health condition make it difficult to practice physical activity/exercise?			
Yes	73 (36.86)	21 (10.60)	0.001
No	125 (63.14)	177 (89.40)	0.001
Do you take medication regularly?			
Yes	12 (6.06)	3 (1.52)	0.041
No	186 (93.94)	194 (97.98)	0.017
Did not answer	0	1 (0.51)	---
Do you smoke?			
Yes	39 (19.70)	14 (7.07)	0.001
No	157 (79.29)	18 (91.42)	0.001
Did not answer	2 (1.01)	3 (1.51)	---
Do you consume alcohol?			
Yes	162 (81.82)	119 (60.10)	0.001
No	32 (16.16)	71 (35.86)	0.001
Did not answer	4 (2.02)	8 (4.04)	0.241

Values in bold indicate significant statistical differences between initial and final scores ($p \leq 0.05$). Paired Student's t-test.

Source: Prepared by the authors (2023).

DISCUSSION

The present study analyzed the FC and flexibility of young adults before and ten months after starting to participate in a standardized physical exercise program in the Brazilian Army. An increase in FC was evidenced through the distance covered in the Cooper Test and a decrease in WHR; there was no change in the participants' flexibility. The admission age of the individuals assessed was 18 years old, and the majority of the Armed Forces personnel (around $\frac{3}{4}$) are made up of military personnel entering their initial military service who have completed 18 years of age and reached the age of adulthood¹⁶.

Regarding the anthropometric variables examined here, after joining the physical exercise program, there was a significant increase in body mass and BMI and a reduction in WHR. Of the recruits analyzed, 56.10% were classified as eutrophic, 17.50% were

underweight, 18.30% overweight, and 8.10% were obese. These findings were similar to those of Campos et al.¹⁷, who analyzed the morphofunctional profile of recruits entering a military organization of the Brazilian Air Force (FAB) and identified that, at the beginning of their mandatory military service, 75.54% were classified as eutrophic, 9.35% were underweight and 15.1% were overweight.

Em relação às variáveis antropométricas examinadas no presente estudo, constatou-se que, após o ingresso no programa de exercícios físicos, houve aumento significativo de massa corporal e do IMC, assim como redução da RCQ. Dos recrutas analisados, 56,10% foram classificados como eutróficos, entretanto 17,50% apresentaram baixo peso, 18,30% (sobrepeso) e 8,10% (obesidade). Tais achados foram semelhantes aos de Campos et al.¹⁷, que analisaram o perfil morfofuncional de recrutas ingressantes em uma organização militar da Força Aérea Brasileira (FAB) e identificaram que, no início do cumprimento do serviço militar obrigatório, 75,54% foram classificados como eutróficos, 9,35% apresentaram baixo peso e 15,1%, excesso de peso.

Muniz and Bastos¹⁸ investigated the prevalence of obesity and its implications for aerospace medicine in 28,745 military personnel from 174 FAB military organizations – which corresponds to 41.68% of all personnel – and found that 53.3% had a healthy weight, 1.2% were underweight, and 45.5% were overweight or obese. Such evidence is in line with the results of the present study, in which 30.10% of the military personnel evaluated were overweight or obese.

When investigating the level of physical fitness and body adiposity in military police officers, Santos et al.¹⁹ concluded that 60.8% of the sample were classified as overweight, showing higher values than those found herein. However, it is worth highlighting that in this study, the average age of the individuals evaluated was lower than in Santos et al., which can determine differences in metabolism and eating habits in different age groups¹⁸.

WHR is an indicator of overall health status and the risk of developing obesity¹⁰. In the present investigation, after admission to the Brazilian Army, there was a reduction in this variable, probably due to the participation in a standardized and regular physical exercise routine, which generated caloric burn secondary to the increase in energy expenditure^{8,20}. Another factor that reduces WHR is the improvement of metabolism, as regular physical activity can accelerate basal metabolism, such as the daily practice of cardiovascular exercises in the Brazilian Army, such as running^{21,22}.

Regarding the level of physical activity, 66% of the individuals evaluated were active, performing more than 300 minutes of moderate or vigorous physical activity per week. This

percentage was higher than that found in adolescents from Australia (13.7%), the United States (34.7%), and Spain (48.8%), similar to those from Finland (50.5%) and lower than those from China (56%). In Brazil, the proportion of adolescents who practice physical activities following current recommendations is 50%²².

Given the social and economic changes seen in recent decades, the inactive lifestyle has become a worldwide phenomenon, resulting from technological advances, accelerated urbanization, increased work demands, and the availability of modern amenities²³. The consequences of this model are alarming and associated with an increased prevalence of chronic diseases, such as obesity, type 2 diabetes, heart disease, and systemic arterial hypertension²¹⁻²³. Furthermore, mental health problems (stress, anxiety, and depression) are also related to a sedentary lifestyle²². The inactive lifestyle is a social challenge that requires comprehensive actions – for example, promoting awareness and creating adequate infrastructure and environments conducive to the development of physical activities – and such initiatives are carried out by the Brazilian Army to mitigate the negative effects of a sedentary lifestyle and cultivate a healthier and more active society.

In the present study, health perception and willingness to perform physical activity, assessed by a self-reported questionnaire, revealed that participation in a daily physical exercise program improved the participants' health conditions. Research developed by Brito and Rocha²⁴ concluded that regular physical exercise is associated with the release of endorphins, neurotransmitters responsible for the feeling of pleasure and well-being, in addition to providing increased resistance.

Different mechanisms can explain the relationship between the level of physical activity and health perception, such as an increase in the feeling of well-being and self-esteem and improved self-image, which leads to greater satisfaction with health. Furthermore, physically active young people have a lower risk of developing metabolic syndrome, excess body weight, dyslipidemia, and elevated blood sugar levels compared to those who are less active. There is evidence that physical activity positively influences health perception regardless of other risk factors. Added to this is the fact that overweight adolescents were three times more likely to perceive their health negatively than those without excess weight^{7,8,22,25}.

The present study did not show any difference in flexibility between before and after joining a standardized physical training program in the Brazilian Army. The indices obtained were considered low for the gender and age of the sample (34-39 cm), according to the classification of Wells and Dillon²⁶. This differs from the study described by Etchepare et al.²⁷, who evaluated the flexibility of 16 military men and athletes between 22 and 42 years old and

showed an average flexibility of 37.51 cm. Importantly, values below expectations for the population between 18 and 19 years old may indicate a relationship with a higher incidence of low back pain and localized fatigue, affecting the physical performance and performance of work activities of these individuals²⁰.

The present study indicated a significant increase in the distance covered in 12 minutes in the Cooper Test, and the better performance after starting to participate in the Army's physical exercise program can be attributed to regular and consistent training, providing an increase in cardiovascular and muscular conditioning. These results corroborate El Hage and Reis Filho²⁸, who investigated the physical performance and anthropometric profile of students on the Military Police soldier course in Cuiabá (state of Mato Grosse) before and 12 weeks after physical training. After this period of systematized and guided training, there was an improvement in physical performance, as well as in the anthropometric profile of those evaluated.

The work of Silva et al.²⁹ indicated that the level of physical fitness of young Brazilians has declined significantly, mainly caused by a sedentary lifestyle and lack of physical activity. Campos¹⁷ found that around 25% of FAB recruits enter with a sedentary lifestyle, which can cause harm to the quality of the force and the results of their physical and functional assessment tests¹⁷.

Although military personnel are historically recognized for their good performance in physical tests, this has not been confirmed in recent years²⁷⁻²⁹. There is evidence that members of the Armed Forces are showing a decline in their aerobic performance, associated with a gain in body fat, an increase in abdominal circumference, WHR, and the sedentary lifestyle index, especially among those aged 18-19 and 27-37 years old²⁹. The change in the anthropometric profile of members is the result, among other factors, of the change in the behavioral profile of today's society, which has become more obese and sedentary. When considering the population that enters military service, this implies a reduction in their performance once the physical conditioning of these individuals is essential for professional performance³⁰.

Regular physical exercise has been identified as a determining factor in promoting the health of individuals and has the potential to prevent some risk conditions for the development of diseases. When practiced regularly, at least since adolescence, physical exercise provides physical and psychological benefits considered to be predictors of health conditions in adult life^{29,30}. Therefore, the Army plays a fundamental role in promoting health, as it encourages physical exercise, offers supervised training, provides adequate sports facilities, or develops

initiatives to raise awareness of the importance of exercise among its members, generating results that can extend to adult life².

The present study has limitations, such as not using an accelerometer to measure physical activity. This would allow capturing the movement of body acceleration in the mediolateral, vertical, and anteroposterior axes and measuring the time and intensity of the activity performed. The impossibility of blinding participants was also a limitation, as they may have generated responses that met the research objectives. Nevertheless, the short version of the IPAQ is an instrument with high reproducibility and proved suitable for the present cohort study. The results obtained allow us to expand knowledge and direct future approaches in the area of physical activity and health promotion for Brazilian military personnel.

CONCLUSION

Participation in a standardized physical exercise program in the Brazilian Army in a cohort of soldiers followed up for ten months provided an increase in FC and a decrease in WHR. There was no change in the flexibility of young enlisted personnel. Such data contribute to a more accurate update of the profile of individuals admitted to the Army, as well as the effects of a physical exercise program on FC and flexibility, as there is a lack of data in the literature on such findings. Strategies should be created to help young people maintain a healthy lifestyle after completing mandatory military service.

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